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Measurement and Driving Factors of Green Total Factor Productivity in Huaihe Ecological Economic Belt based on Industry Perspective

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Abstract

In this paper, panel data of 25 prefecture-level cities in the Huaihe Ecological Economic Belt from 2008 to 2018 were taken as samples. Firstly, SBM-ML model was used to measure green total factor productivity, technical efficiency and technological progress of the whole, industry, agriculture and tourism of the Huaihe Ecological Economic Belt. The overall green total factor productivity and technological progress index of Huaihe Ecological Economic Belt increased, while the technical efficiency deteriorated. Industrial green total factor productivity and technological progress index increased, while technical efficiency deteriorated. Agricultural green total factor productivity and technological progress index increased, while technical efficiency deteriorated. The index of green total factor productivity and technical efficiency of tourism industry deteriorates, and the index of technological progress increases.

Keywords

Huaihe River Ecological Economic Belt; Green Total Factor Productivity; Divisions.

1. Research Background

In 2018, the State Council approved the huaihe river ecological economic zone development planning, planning a clear area of huaihe river ecological economic zone, including hubei, henan, anhui, shandong and jiangsu province 5,25 cities and 4 counties, and puts forward the huaihe river ecological economic zone to adhere to high quality development, explore new model construction of huaihe river basin ecological civilization. The fifth Plenary Session of the 19th Central Committee also made it clear that we should adhere to the five development concepts, promote green development and achieve new results in economic development. As one of the regions with the greatest development potential, the Huaihe River Ecological economic Belt has made a series of achievements in the ecological construction of various cities under the promotion of the policy, but there are still problems in the Huaihe River Basin, such as lagging economic development and large industrial pollutant discharge, and the pollution situation is grim. Therefore, this paper selects green total factor productivity, which can both measure economic development and reflect green development, to investigate the growth level of green total factor productivity in 25 prefecture-level cities by industry and region, in order to provide policy suggestions for the green development of Huaihe Ecological Economic Belt.

Existing on the research of the development of the ecological economic zone of the huaihe river green is less, zhi-an ren (2019) based on the three stages such as DEA model to measure the ecological efficiency of 25 cities of huaihe river ecological economic zone, the study found that the huaihe river ecological economic zone green economic efficiency level there is a certain difference between the cities, including eastern linkage of hai river lake ecological efficiency is the most optimistic, However, the ecological efficiency of cities in the inland rising areas of central and western China is at a low level, and the level of ecological efficiency of cities is very different. With further research, zhi-an ren (2020), such as by building green development level

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evaluation system, using entropy and TOPSIS model to comprehensive measure of municipal green development level, analysis the ecological economic zone of the huaihe river green development level of the overall rise, municipal green development level exist obvious regional difference, presents the characteristics of east west high low, There is obvious spatial differentiation phenomenon; From the point of view of global spatial autocorrelation, the green development of Huaihe Ecological Economic Belt has the characteristics of significant spatial agglomeration. From the analysis of obstacle degree, the quality of economic growth, scientific and technological innovation ability, and the development of social undertakings have become the common problems restricting the green development level of Huaihe Ecological economic belt. Shen Xiaomei and to min (2020) under the collaborative vision capacity coupling coordination model from the economic, social and ecological three level of the huaihe river green high quality development level measure of ecological economic zone, analysis the ecological economic zone of the huaihe river regional green high quality development level and its economic, social and ecological three subsystems are in obvious upward trend in the development level; In terms of regional balance, there are significant differences in green and high-quality development levels among the three regions of the Huaihe Ecological Economic Belt, showing a declining trend in the east, the north, and the central and western regions. Existing literature to measure the ecological economic zone green development level of the huaihe river, and analyzed the regional differences, but less from the point of view of regional divisions and points analysis of huaihe river ecological economic zone green total factor productivity growth, this article from the two aspects measure green total factor productivity of the huaihe river ecological economic zone, And the driving factors of green total factor productivity are analyzed.

2. Model Selection and Index Selection

(1) Model selection

This paper adopts SBM directional distance function and ML index to measure green total factor productivity. The expression of SBM model is as follows:

$$\rho^* = \min \frac{1 - \frac{1}{M}\sum_{m=1}^{M}\frac{s_m^x}{x_m^k}}{1 + \frac{1}{N+I}\left(\sum_{n=1}^{N}\frac{s_n^y}{y_n^k} + \sum_{i=1}^{I}\frac{s_i^u}{u_i^k}\right)}$$

$$s.t.\begin{cases} x_m^k = \sum_{k=1}^{K} r_k x_m^k + s_m^x \\ y_n^k = \sum_{k=1}^{K} r_k y_n^k - s_n^y \\ u_i^k = \sum_{k=1}^{K} r_k x_i^k + s_i^u \end{cases}$$

$$s_m^x \geq 0,\ s_n^y \geq 0,\ s_i^u \geq 0,\ r_k \geq 0,\ i = 1,2,\cdots k$$

The ML productivity index expression based on SBM directional distance function is:

$$ML = \left(\frac{D^t(x^{t+1},y^{t+1},u^{t+1})}{D^t(x^t,y^t,u^t)} \times \frac{D^{t+1}(x^{t+1},y^{t+1},u^{t+1})}{D^{t+1}(x^t,y^t,u^t)}\right)^{\frac{1}{2}} = TC \times EC$$

(2) Index selection

This section will study the growth of green total factor productivity in huaihe Ecological Economic Belt from four industries, including the whole region, agriculture, industry and tourism, and analyze the evolution trend of green total factor productivity in all industries.

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From the regional point of view, ecological economic zone of the huaihe river green total factor productivity growth state, indicate that ecological economic belt on the whole, the green development of the huaihe river, among them, the agricultural and industrial green total factor productivity are positive, play a role in the development area of the green, tourism presents the negative growth, the inhibition.

The whole region. Measuring green total factor productivity of Huaihe Ecological Economic Belt includes expected output, non-expected output and input indexes. In this paper, regional GDP is selected as the desired output. The undesired output was represented by the comprehensive pollution index, and the comprehensive index including agricultural carbon emissions, industrial sulfur dioxide emissions, industrial wastewater emissions and tourism wastewater emissions was calculated by the entropy method. Input includes three input indexes of labor, capital and energy. Labor input is represented by the number of employment at the end of the year, capital input is measured by the amount of fixed assets investment in the study of Lu Liwen et al. (2017), and energy input is measured by the total amount of electricity consumption in the whole society in the study of Wang Wei and Sun Fang (2018).

Agriculture. Measuring agricultural green total factor productivity includes expected output, unexpected output and input indicators. The total output value of agriculture, forestry, animal husbandry and fishery was selected as the expected output. Non-expected output refers to the research results of Li Bo et al. (2011) and is expressed as agricultural carbon emissions. Total carbon emissions can be measured by multiplying the number of carbon emission sources of agricultural fertilizer application, total sown area of crops and effective irrigated area by their respective emission coefficients. , where C represents the total amount of agricultural carbon emission, represents the emissions of various carbon emission sources, represents the number of various carbon sources, and represents the emission coefficient of various carbon sources; Reference cheng-jun ji and agricultural input Xia Huaiming (2020) research methods include labor, land, machinery, chemical fertilizer and irrigation area of five indicators, labor input in animal husbandry fishery workers, land input area with total sown area of crops, the mechanical input in agricultural machinery total power, fertilizer input in agricultural find, Irrigation input is represented by effective irrigated area.

Industry. Measuring industrial green total factor productivity includes expected output, unexpected output and input indicators. Considering intermediate inputs, this paper chooses industrial gross output value rather than industrial added value to measure industrial expected output. Typical pollutants and main objects of environmental pollution control in China include chemical oxygen demand (COD) and sulfur dioxide emissions in wastewater. Therefore, industrial wastewater emissions and sulfur dioxide emissions are selected as undesired outputs in this paper based on the research method of Friday 7 (2019). Input includes labor, capital and energy: Labor input due to the limitation of the prefecture level statistics, including mining, manufacturing and electricity gas and water production and supply industry to measure industrial workers labor input and capital input in each prefecture level of fixed assets investment as a proxy variable, energy into study reference fu-cai lu (2021) to choose the prefecture level measured industrial electricity consumption.

Tourism. Measuring green total factor productivity of tourism industry includes expected output, unexpected output and input indexes. In this paper, the total income of tourism is selected as the expected output. Non-expected output refers to the study of Liu Jia and Zhang Junfei (2017). The sewage discharge of tourism industry is expressed, and the proportion of total tourism revenue in gross regional product is adopted to separate the total sewage discharge as tourism sewage discharge. Including labor, capital and energy input three indicators, due to the lack of data part of the prefecture level employment in tourism, this article labor input reference Gong Yan and Guo Zhengrong (2014) research methods of the third industry employment, said capital investment in the tertiary industry of fixed assets investment,

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energy input measured by tourism consumption, The proportion of tourism total income to regional GDP is used to separate the total electricity consumption as tourism electricity consumption.

(3) Measure results

This paper takes 25 prefecture-level cities in the Huaihe River Ecological Economic Belt as the research object and measures the green total factor productivity of the Huaihe River ecological Economic Belt by industry. Table 1 shows the average annual growth rate of green total factor productivity and decomposition items by industry in each prefecture-level city from 2008 to 2018.

Table 1. Average Annual Growth rate of GTFP and decomposition items by industry in prefecture-level cities from 2008 to 2018

	The whole area			agricultural			industrial			The tourism industry		
	GTFP	EC	TC	GTFP	EC	TC	GTFP	EC	TC	GTFP	EC	TC
2007-2008	1.055	1.022	1.032	1.123	0.995	1.129	1.074	0.993	1.081	1.045	0.999	1.045
2008-2009	0.989	1.001	0.988	1.057	1.011	1.045	1.045	0.986	1.060	0.984	1.002	0.982
2009-2010	1.015	1.008	1.006	1.071	0.990	1.082	1.052	0.983	1.070	0.994	0.977	1.017
2010-2011	1.058	0.975	1.084	1.080	1.007	1.073	1.012	1.006	1.006	1.002	0.999	1.003
2011-2012	1.006	0.982	1.024	1.053	1.000	1.053	1.042	0.972	1.072	0.946	0.977	0.969
2012-2013	0.993	0.997	0.996	1.117	1.014	1.102	1.022	1.016	1.006	0.941	1.010	0.931
2013-2014	0.992	1.012	0.980	1.035	0.990	1.046	1.059	1.027	1.032	1.033	0.992	1.041
2014-2015	0.967	0.982	0.985	1.040	0.984	1.057	0.980	0.895	1.095	0.972	0.986	0.986
2015-2016	1.025	0.989	1.036	1.051	0.982	1.070	1.110	1.005	1.104	1.006	0.992	1.014
2016-2017	1.068	0.989	1.080	1.012	0.998	1.014	1.092	1.023	1.068	1.022	0.980	1.043
2017-2018	1.000	0.993	1.005	1.063	0.989	1.075	1.101	1.032	1.067	1.013	1.003	1.011
mean	1.015	0.995	1.019	1.063	0.996	1.067	1.053	0.994	1.060	0.996	0.992	1.003

To sum up, the overall green TFP and technological progress of the Ecological economy of the Huaihe River show an increasing state with an average annual growth rate of 1.5% and 1.9% respectively, while the technological efficiency shows a deteriorating state with an average annual growth rate of -0.5%. Agricultural green TFP and technological progress increased with an average annual growth rate of 6.3% and 6.7% respectively, while technical efficiency deteriorated with an average annual growth rate of -0.4%. Industrial green TFP and technological progress were increasing with an average annual growth rate of 5.3% and 6.0% respectively, while technical efficiency was deteriorating with an average annual growth rate of -0.6%. Green TFP and technical efficiency of tourism industry are deteriorating, with an annual growth rate of -0.4% and -0.8% respectively. Technological progress is increasing, with an annual growth rate of 0.3%.

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3. Empirical Results

In this section, we will analysis from the perspective of industry ecological economic zone of the huaihe river green total factor productivity driven factors, considering the characteristics of various industries, urbanization level, the degree of marketization, Internet penetration, foreign investment, tourism industrial structure, financial support level, the level of economic growth and environmental regulation review 8 aspects such as the green driving factors of total factor productivity.

(I) Model setting

The Tobit model has been widely used since it was proposed. This model mainly investigates the regression of the explained variables with limitations, and the estimation results of the Tobit model cannot explain the magnitude of the influence between dependent variables and independent variables, but can only indicate the influence direction of the influencing factors. The form of the Tobit model is as follows:

$$\begin{cases} y_i^* = \beta X_i + \mu_i \\ y_i = y_i^*, \quad y_i^* > 0 \\ y_i = 0, \quad y_i^* \le 0 \end{cases}$$

Where, is the latent variable, is the observed dependent variable, is the independent variable vector, is the coefficient vector, and the error terms are independent and subject to normal distribution. This section considers that green total factor productivity index (GTFP) by industry is mainly affected by the following factors:

(1) Urbanization level (PS) : Urbanization level accelerates population flow to cities and towns, which may have a negative effect on agricultural green total factor productivity. It is expressed by the proportion of urban population in the total population.

(2) Degree of marketization (MAR). High degree of marketization and active economic performance may promote the growth of agricultural GTFP, which can be measured by the proportion of local financial general budget expenditure in GDP.

(3) Internet penetration rate (IU). The higher the Internet penetration rate, the more likely it is to promote the industrial GTFP, which is expressed by the proportion of the year-end mobile phone users in the year-end total population.

(4) Scale of foreign investment (FDI). Foreign investment can bring capital and advanced technology, which may promote industrial GTFP. It is measured by the proportion of FDI in GDP.

(5) Financial support level (FS). The higher the level of financial support, the greater the effect on tourism GTFP may be, which can be measured by the proportion of RMB loans from financial institutions in GDP

(6) Tourism industry structure (LIS) : the optimization of tourism industry structure may promote tourism GTFP, which is expressed by the proportion of the number of foreign tourists in the number of domestic tourists.

(7) Economic growth level (REGDP). The higher the level of economic growth, the more attention will be paid to environmental governance, which may have a positive effect on GTFP, expressed by regional per capita GDP;

(8) Environmental regulation level (ER). The higher the environmental regulation level is, the more attention is paid to environmental protection, which may have a positive effect on GTFP. The comprehensive index of environmental regulation is constructed from the perspective of pollution discharge, and the pollutant indicators include wastewater discharge, sulfur dioxide discharge and smoke and dust discharge.

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In order to explore the impact of green TFP in the Huaihe Ecological Economic Belt, this paper constructed the following Tobit model:

$$GTFP_{i,t} = \alpha_0 + \alpha_1 PS_{i,t} + \alpha_2 MAR_{i,t} + \alpha_3 IU_{i,t} + \alpha_4 FDI_{i,t} + \alpha_5 FS_{i,t} + \alpha_6 LIS_{i,t} + \alpha_7 REGDP_{i,t} + \alpha_8 ER_{i,t} + \varepsilon_{i,t}$$

Among them, GTFP represents the explained variable green total factor productivity, PS represents urbanization level, MAR represents marketization degree, IU represents Internet penetration rate, FDI represents foreign investment scale, FS represents financial support level, LIS represents tourism industry structure, REGDP represents economic growth level, ER represents environmental regulation level, Represents 25 cities of Huaihe River ecological economic Belt, t represents year, and represents random disturbance term. The above data came from China Urban Statistical Yearbook, EPS global Statistical database and local urban Statistical yearbook, and some missing data were supplemented by interpolation method.

(2) Empirical results

This section studies the driving factors of green TFP from agriculture, industry and service industries, as shown in Table 2.

Table 2. Regression results of green TFP influencing factors by industry

variable	agriculturalGTFP	industrialGTFP	The tourism industryGTFP
PS	-0.031 (-0.49)		
MAR	0.213** (2.02)		
GIS		-0.129 (-1.30)	
FDI		-0.798*** (-3.44)	
FS			-0.140*** (-2.87)
LIS			10.247** (2.54)
REGDP	0.016*** (3.13)	0.001 (0.12)	-0.006 (-1.45)
ER	-0.001 (-0.99)	0.003*** (3.43)	0.002*** (4.18)
_cons	0.943*** (13.85)	1.125*** (11.40)	1.123*** (16.94)

The overall regression of the model is significant. From the perspective of agriculture, the degree of marketization has a significant positive effect on agricultural green total factor productivity in Huaihe Ecological Economic Belt, passing the significance test of 5%. The higher the degree of marketization, the more conducive to the growth of agricultural green total factor productivity. Economic growth level has a significant positive effect on agricultural green total factor productivity in Huaihe Ecological Economic Belt, passing the 1% significance test. The higher the economic growth level is, the more conducive to the growth of agricultural green total factor productivity. From the perspective of industry, the scale of foreign investment has a significant negative effect on the industrial green total factor productivity of Huaihe Ecological Economic Belt, which passes the 1% significance test. The larger the scale of foreign investment,

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the more unfavorable the growth of industrial green total factor productivity. The level of environmental regulation has a significant negative effect on the industrial green total factor productivity in huaihe Ecological Economic Belt, which passes the 1% significance test. The higher the level of environmental regulation is, the more conducive to the growth of industrial green total factor productivity. From the perspective of tourism, the level of financial support has a significant negative effect on the green total factor productivity of tourism in the Huaihe Ecological Economic Belt, which passes the 1% significance test. The higher the level of financial support is, the more unfavorable the growth of green total factor productivity of tourism. The structure of tourism industry has a significant positive effect on the green total factor productivity of tourism industry in huaihe Ecological Economic Belt, which passes the significance test of 5%. The optimization of tourism industry structure significantly promotes the green total factor productivity of tourism industry. The level of environmental regulation has a significant positive effect on the green total factor productivity of tourism industry in huaihe Ecological Economic Belt, passing the 1% significance test. The higher the level of environmental regulation is, the more conducive to the growth of green total factor productivity of tourism industry.

4. Research Conclusions and Policy Recommendations

In this paper, panel data of 25 prefecture-level cities in the Huaihe Ecological Economic Belt from 2008 to 2018 were taken as samples. Firstly, sbM-ML model was used to measure green total factor productivity, technical efficiency and technological progress of the whole, industry, agriculture and tourism of the Huaihe Ecological Economic Belt. The overall green total factor productivity and technological progress index of Huaihe Ecological Economic Belt increased, while the technical efficiency deteriorated. Industrial green total factor productivity and technological progress index increased, while technical efficiency deteriorated. Agricultural green total factor productivity and technological progress index increased, while technical efficiency deteriorated. The index of green total factor productivity and technical efficiency of tourism industry deteriorates, and the index of technological progress increases.

Based on the regional perspective of the huaihe river ecological economic belt green total factor productivity measurement and its space-time evolution study found that the huaihe river ecological economic zone as a whole ecological economic zone green total factor productivity experienced up and down again rising trend, from 2008 to 2011, the east sea river linkage area ecological economic zone lake green total factor productivity growth is higher, The second is huaihai Economic Zone in the north and inland rising area in the central and western regions, with the growth rate of "higher in the east and lower in the west". From 2011 to 2014, green total factor productivity of the three regional ecological economic belts all declined to a certain extent, and the decline of huaihai Economic Zone in the north was the largest, which was actually the inland rising area in the central and western regions and the linkage area of rivers and lakes in the east. From 2014 to 2018, green total factor productivity (GTFP) of the three regional eco-economic belts showed growth. The eastern Sea-river-Lake linkage zone showed a high growth rate, followed by the northern Huaihai Economic Zone and the central and western inland rising zone, with a "high growth rate in the east and low growth rate in the west".

From the perspective of industry, the driving factors of green total factor productivity in Huaihe Ecological Economic Belt were studied. It was found that marketization level and economic growth level had a significant positive effect on agricultural green total factor productivity. The scale of foreign investment has a significant negative effect on green total factor productivity, and the level of environmental regulation has a significant positive effect on green total factor productivity. The level of financial support has a significant negative effect on green total factor productivity of tourism industry, while the structure of tourism industry and the level of

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environmental regulation have a significant positive effect on green total factor productivity of tourism industry.

References

[1] Lu Liwen, Song Deyong, Huang Can. Urban green total factor productivity measurement in the Yangtze River Economic Belt: A case study of 108 cities in the Yangtze River Economic Belt [J]. Urban Problems, 2017(01):61-67.

[2] Wang Wei, Sun Fangcheng. Journal of southwest university for nationalities (humanities and social sciences edition), 2018,39(01):129-137.

[3] Li Bo, Zhang Junbiao, Li Haipeng. China population, resources and environment,2011,21(08):80-86. (in Chinese).

[4] Ji Chengjun, Xia Huaiming. Regional difference and convergence analysis of agricultural green total factor productivity in China [J]. Chinese journal of agricultural resources and regional planning, 2020, 41(12):136-143.

[5] Chen S Y. Green industrial revolution in China: An explanation from the perspective of environmental total factor productivity (1980-2008). Economic research journal,2010,45(11):21-34+5.

[6] Zhou Z Q. Research on green total factor productivity growth and its driving force in Yangtze River Delta [J]. Economics and management,2019,33(01):36-42.

[7] Lu Fucai, Liu Linying, XU Yuanbin. Research on the impact of Internet development on industrial green total factor productivity [J]. Jiangxi Social Sciences, 201,41(01):39-50+254-255.

[8] Liu Jia, ZHANG Junfei. Change and convergence of green total factor productivity in tourism industry: An empirical study based on the coastal area of China [J]. Resources development and market, 2017, 33 (07):867-872.

[9] Gong Yan, GUO Zhengrong. Research on the development efficiency and Countermeasures of Jiangsu tourism industry: Based on super-efficiency DEA and Malmquist Index analysis [J]. East China economic management, 2014,28(04):7-12+17.

[10] hu g h, qin s y. comparative study on total factor energy efficiency in brics countries: based on dea-tobit model. Resources science, 2012,34 (03): 533-540.