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The Influence of Factor Marketization on the Development of Green Economy

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Abstract

In the process of China's economic development, the traditional economic model characterized by "high input, high pollution and high energy consumption" can no longer meet the needs of sustainable economic development. In the presence of factor market distortion, green total factor productivity is bound to be significantly affected. In recent years, with the improvement of people's requirements for the quality of life, the development of green economy has become the focus of high-quality development strategy, and the attention of social development to green efficiency has made the green development strategy an inevitable requirement. Based on the large spatial differences in China and the regional differences in the influencing factors of economic development, this paper selects the relevant data of 30 provinces and cities in China from 2008 to 2017 based on the spatial panel data of our country, incorporating the explained variables, explanatory variables, control variables, and categorical variables into the constructed spatial dynamic panel model, The spatial autocorrelation is tested by calculating the adjacent spatial weight matrix and calculating the Moran index. At the same time, the spatial dynamic panel model is selected based on the fixed effect. The empirical research results of the display variables are described. Through the analysis of the empirical results, the following conclusions are obtained: first, the factors marketization and the level of green economy development in China are positively correlated, with high spatial dependence; second, different control variables will have different effects on the development of green economy, the same factor will also have different degrees of impact on the development of urban green economy in different spaces; third, the improvement of factor marketization will have the most positive impact on the level of green economy development in the eastern region, and the dependence of foreign trade will have a certain degree of negative impact; Fourth, industrial optimization and upgrading in the central and western regions will promote the development of green economy in this province and adjacent regions. Therefore, this paper suggests: rationally allocating market factor resources, strengthening the process of urbanization in central and western regions and optimizing the industrial structure of central and western regions; appropriately reducing government regulation at the macro level; reducing the dependence of foreign trade and cultivating enterprises' ability of innovation and development.

Keywords

Green economy; Factor marketization; Green total factor productivity; Spatial Dobin model.

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1. INTRODUCTION

After 40 years of reform and opening up, China's economic development has made remarkable achievements, but in the process, the problems of excessive investment, resource constraints and environmental pollution caused by the miracle of economic development in exchange for high investment have brought great pressure to the high quality development of the economy. According to the data, high input, high pollution and high energy consumption are the three characteristics of China's traditional economic development. The development of economy under this model will inevitably bring distortion of resource allocation in factor market, and eventually reduce total factor productivity and affect the development of green economy. With more attention and attention to the green growth strategy, it has become the key requirement of high quality economic development to carry out the concept of green economy into the traditional economic growth model.

Therefore, in order to guide the rationalization of the allocation of factor market resources, improve the overall green factor productivity, and eliminate the influence of factor distortion on the development of green economy, this paper focuses on the impact of factor marketization on the development of green economy. Because of the vast land area and the uneven degree of regional economic development, the factors restricting the development of green economy between provinces will be affected by spatial factors. Based on this, we select factor index, divide input into green input, capital input and energy input, use super-efficiency SBM model full of non-expected output to calculate green total factor productivity, and control a series of factors, such as urbanization level, foreign trade dependence degree, government restriction, etc. On the basis of understanding, understanding and comparative analysis of relevant data, a spatial Dobin model is established for empirical test. Based on literature reading and data collection, this paper makes a statistical analysis of the green total factor productivity (ETFP) panel data of 30 provinces and cities in China from 2008 to 2017 and measures the relevant indicators. In order to explore the role of factor marketization on the development of green economy.

Under the background of the new normal state of China's economy, the correlation analysis of factor marketization and green economy through the relevant indexes such as green total factor productivity and factor market development degree index can provide new ideas for the study of how to solve the resource and environment problems faced by economic development, improve the quality of green economy development and stick to the road of sustainable development, and explore the equilibrium point of factor marketization and green economy development. By collecting and analyzing the spatial panel data of provinces and cities, we can get the correlation degree between the green economy development of a province and the independent variables of the green economy development and the adjacent provinces, The conclusion has important theoretical and practical significance for enterprise micro-strategy customization and government macro-mechanism regulation. At the same time, because of the vast land area and the large difference of provincial space, it is necessary to explore the influence of factor marketization on the development level of green economy from the perspective of spatial panel data. From this point of view, the following research will analyze the similarities and differences of factor marketization and other control variable factors in different spaces from a new perspective, and provide guidance suggestions for policy direction and enterprise industrial structure adjustment.

2. LITERATURE REVIEW

Factor market refers to the commonly referred to factor of production market. The scope of the whole factor includes labor force, capital, energy, technology and so on. The market plays an absolute role in the allocation of resources, GDP is expected output, and environmental

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pollution is non-expected output. With the green growth strategy put forward, speeding up the improvement of ecological environment and regional coordinated development has been the inevitable requirement of high quality economic development, and the rationality of factor market allocation is particularly important, which has been studied by many scholars at home and abroad.

At first, the related research on total factor productivity remained under the influence of traditional capital, labor and other factors. During the process of measuring TFP, the research of calculation has experienced a continuous and perfect development process. Solo proposed Solo residual method in 1957 [1] After that Aigner a stochastic frontier production function is proposed on the basis of Solow residual value [2];" Data Envelopment Analysis "was first introduced in A.Charns and W.W.cooper 1978(DEA)[3]Malmquist Productivity Index was proposed in 1982, which combines the idea of scaling factor and applies it to the study of productivity. However, the publication of the "Limits of Growth" report has exposed the consequences caused by the shortage of resources and the insufficient carrying capacity of the environment to people's vision, and the development of green sustainability has gradually attracted wide attention.

At present, there are many researches on factor marketization, green economy development level and green total factor productivity. Many experts and scholars put forward their own views through unremitting efforts and data calculation and analysis. Some scholars believe that factor marketization will affect the efficiency of factor utilization, thus affecting the development of green economy. Sun Yannan and Yang Mingyan studied the source of regional gap and convergence club by measuring the green total factor productivity of China's interprovincial, and considered that the difference of technological efficiency change is the main source of the regional gap of green total factor productivity growth in China at present[4]One of the major reasons for Lin's impact on energy efficiency is the distortion of the elements, and on this basis, three paths of influence are clarified. Xie Xianjun, based on the SYS-CMM estimation method, empirically analyzes that factor marketization will affect the green TFP through the intermediary effect channel of technological progress and efficiency improvement, and the distortion of factor market will bring obvious inhibition to it [5] There is also a view that the marketization of elements will have an impact on environmental governance, which in turn will affect the development of the green economy. By combing the influence mechanism of factor market distortion on the environment, Zhanhua found that the factor market distortion in China has a very significant negative impact on environmental pollution, and the unreasonable allocation of factor market will increase the negative effect on the improvement of environmental quality [6] Li Yingjie explores the relationship between factor marketization and urban air quality from the perspective of spatial correlation, and thinks that the distortion of factor market will worsen urban air quality, and there is a significant direct effect in it. Therefore, it is necessary to promote the reform of factor marketization in China to improve environmental quality and accelerate the development of green economy and urbanization [7] From the perspective of the spatial effects of green economy development, some scholars, such as Ren Yi and Liu Chuanzhe, have considered that fiscal decentralization has a positive spatial effect on the green economy of the region and a negative spatial spillover effect on the green economy of neighboring regions through the sample analysis of panel data from 30 provinces in China from 2009 to 2018 [8] From the point of view of spatial measurement, Fan Qiao and Guo Aijun analyzed the deficiency of traditional Solo residual value and improved the calculation process of total factor productivity by using spatial measurement method [9].

At present, the research related to the development of green economy based on factor marketization has been paid more and more attention, but there are still few research results, the summary of the influencing factors on the level of green economy development is not comprehensive enough, and the geographical and spatial differences between provinces in our

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country are not taken into account. At present, because the method of spatial econometric analysis is gradually entering the mainstream analysis system, this method can make the accounting results obtained by the traditional production function model setting and estimation more accurate by merging the explained variables, explanatory variables and random disturbance terms into the traditional non-spatial model. The innovation of this paper is to combine factor marketization, total green factor productivity and spatial panel data, to further study the influence of factor marketization and related factors on green economy from the perspective of total sample and sub-sample, and to analyze the influence factors of foreign trade dependence, urbanization level, government regulation and industrial structure.

3. THE EFFECT MECHANISM OF FACTOR MARKETIZATION ON GREEN ECONOMY DEVELOPMENT

To a certain extent, the degree of marketization of a country can characterize the market vitality of the economy, and the higher the degree of marketization, the more reasonable allocation of the country's economic resources can be reflected. At the same time, the rapid improvement of China's regional green development level is promoted by the improvement of marketization. The objective of the market-oriented reform is to make the market mechanism play a decisive role in the allocation and price formation of factors of production, promote the free flow of capital, labor and innovative elements, optimize the adjustment of industrial structure, and improve economic efficiency [10].

The following will be through the construction of theoretical models to explore the economic efficiency of the promotion of factors market-oriented reform of the theoretical mechanism. Assuming that there are only two production sectors in the economy, adding technological progress factors to the traditional two-factor production function, there are:

$$Y_i = F(A_i, K_i, L_i, T_i) = A_i K_i^a L_i^b T_i^c, i = 1, 2$$

K_i L_i T_i Y_i a b c Among them, the input of capital, labor and innovation elements i by the department is the output elasticity of the three elements, and the value is (0/1).

Taking capital as an example, we analyze the mechanism of promoting economic development through rational allocation of capital elements in the process of marketization, and assume that the total capital of the two departments is fixed, that is:

$$K_1 + K_2 = K$$

K r_{ki} At the beginning of the period, when the elements can not flow freely, there are barriers between departments, and the return rate of capital elements in the two departments is different. Let's assume >. r_{k1} r_{k2} r_{k1} r_{k2}

The initial total output is:, capital productivity is:. $Y = Y_1 + Y_2 = \dfrac{(K_1 r_{k1} + K_2 r_{k2})}{\alpha}$ $PK = \dfrac{Y}{K}$

Now the capital factor can be market-oriented reform, that is, capital as a factor of production can flow freely between sectors, assuming that capital flows through time t, capital elements flow between sectors △K, and after the flow of capital into the two sectors, K_1^t K_2^t

$$K_1^t = K_1 + \Delta K, \quad K_2^t = K_2 - \Delta K$$

Then the total output after the capital factor marketization reform is:

$$Y^t = Y_1^t + Y_2^t = Y + \frac{\Delta K (r_{k1} - r_{k2})}{\alpha}$$

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The capital productivity is: $PK^t = PK + \frac{\Delta K(r_{k1} - r_{k2})}{\alpha K}$

r_{k1} r_{k2} Y^t Y PK^t PK >, due to >. Therefore, promoting the rational allocation of resources through the reform of factor marketization can reduce the waste of resources and promote the development of green economy.

Factor marketization makes our country's resources more reasonable allocation and promotes the adjustment and upgrading of our country's industrial structure. The green economy development in China's middle, east and west regions is influenced by factor marketization, and the incentive effect in the eastern region is the most significant. However, the eastern part of China depends too much on foreign trade, which to some extent inhibits the development of green economy.

4. MEASUREMENT AND ANALYSIS OF FACTOR MARKETIZATION AND GREEN ECONOMY DEVELOPMENT

4.1. Marketability of Elements

Factor market development index (Factor) is used as the data basis to analyze factor marketization and green economy development. The data is from the 2008-2017" China market process index report ". The change of factor market development degree index reflects the trend of green economy development, which is closely related.

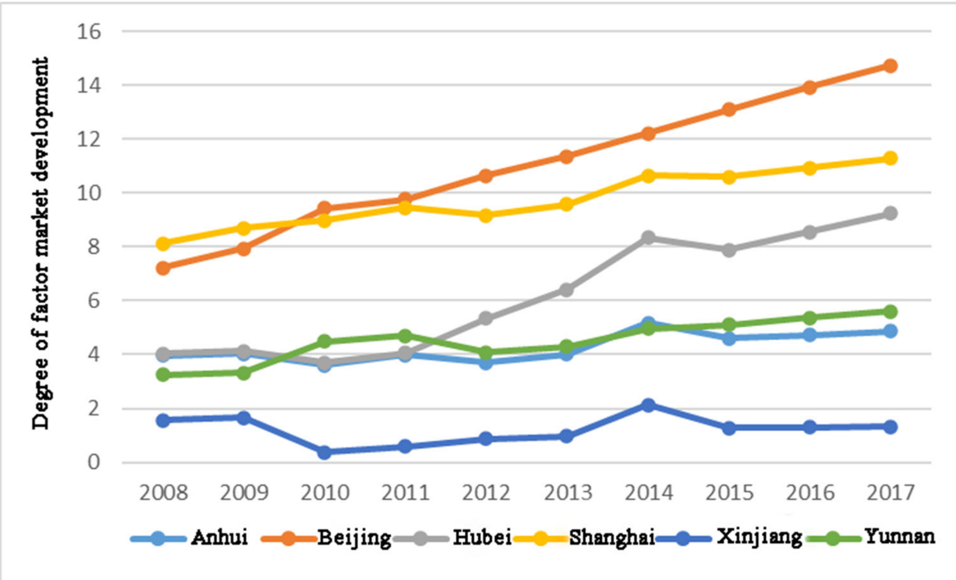

Figure 1. Shows the trend of factor market development index in the region

This paper selects six of the 30 provinces (municipalities directly under the Central Government) with geographical representation (municipalities directly under the Central Government). Shanghai and Beijing represent the eastern region, Anhui and Hubei provinces represent the central region, Yunnan Province in the southwest of China and Xinjiang Uygur Autonomous region in the northwest of China.

We can see that in 2008-2017, China's overall factor market development index is gradually rising, overall steady development. However, the western region of the Middle East has great differences, the development degree of factor market in the eastern region is better than that in the central and western regions, while the development degree of factor market in the western region is the most weak overall. Xinjiang Uygur Autonomous region is showing a downward trend. This shows that the development of green economy in China also has great regional differences, the development situation of green economy in the central and eastern regions is better than that in the western region as a whole, and the development of green economy in China is still in a state of spatial imbalance.

4.2. Green Economy Development

Green total factor productivity is used as the proxy variable of green economy development in this paper. The index of measurement is green total factor productivity (ETFP), which is different from factor productivity. Green total factor productivity is the comprehensive productivity of production units (enterprises) as all elements in the system. Total factor productivity is actually productivity, its improvement is equivalent to industrial structure upgrading and productivity development. Growth accounting and econometric methods are often used in academic circles to estimate total factor productivity. The parameter method and the non-parametric method together constitute the econometric method. The parameter method involves the analysis of the input and output of a large number of kinds of elements. The calculation is large and the requirements for obtaining data are more stringent, but the non-parametric does not have these drawbacks.

And in the nonparametric method, Data Envelopment Analysis (Data Envelopment Analysis,) Analysis DEA) is often used by academia, Therefore, this method is used as the calculation model. This method does not need to set the production function and select the factor parameters, It is only necessary to calculate the green total factor productivity according to the relevant data of input and output. It needs to be emphasized, For the calculation DEA green total factor productivity in the provinces using standard measurement methods, Multiple evaluation modules (DMU) are often rated as valid. There are some defects in the traditional efficiency measurement method, For example, When there are multiple decision units on the efficiency front, The data can not be further distinguished, In this case, The calculated range of efficiency values is [0, 1]. And so to make up for the general data envelopment analysis (DEA), This paper selects the SMB model of "super efficiency" DEA model, Green total factor productivity (TFP) of 30 provinces (cities) in China from 2007 to 2016 was calculated SBM using the super efficiency model containing non-expected output. Assuming a constant (CRS) scale reward, Calculate the ML (green total factor productivity index) index.

Tone (2003) definition considers the SBM efficiency measure model of non-expected output, which can consider the relationship between input, output and pollution, and solve the relaxation problem in efficiency evaluation properly [12] i.e. for a particular DMU0(x) Annex0y, Ig0y, Ib0), the following linear programming models are SBM models that take into account non-expected outputs:

$$min\rho^* = \frac{1-\frac{1}{n}\sum_{i=1}^{n}\frac{s_i^-}{x_{i0}}}{1+\frac{1}{u+v}\left(\sum_{j=1}^{u}\frac{s_j^g}{y_{j0}^g}+\sum_{j=1}^{v}\frac{s_j^b}{y_{j0}^b}\right)}$$

$$x_0 = X\lambda + s^-, y_0^g = Y^g\lambda - s^g, y_0^b = Y^b\lambda + s^b, \lambda, s^g, s^b, s^- \geq 0$$

While in the actual operation of the S BM model, the data of labor input, capital input, energy input, environmental pollution index, gross domestic product (G DP) in various regions of our country have also been involved over the years. The data are from China Statistical Yearbook, China Energy Statistics Yearbook, provincial statistical yearbooks (bulletins) and so on.

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Table 1. DEA measures of green total factor productivity

Inputs		Capital inputs (K)	The fixed capital stock is used to measure the capital input in the production process of each district, and the sustainable inventory method is used to calculate the provincial and municipal investment sequence data with the constant price of 2005
		Labour inputs (L)	Total employed population
		Energy inputs (E)	Total electricity consumption by region
Output	Expected output	GDP	By using the regional GDP of each province as the desired output, the GDP of each region was reduced based on 2005
	Non-expected output	Integrated Environmental Pollution Index	The comprehensive index of environmental pollution is calculated by the entropy method.

Table 2. Capital capacity of converted provinces (in billion yuan)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Beijing	37545	38508	40179	41984	44555	47415	50340	53361	57626	61672
Tianjin	37470	39076	41786	45401	49850	54984	60426	64560	67997	70731
Hebei	83977	85646	88208	92706	98057	103930	110055	116151	123018	128488
Shanxi Province	35876	37383	39668	42625	45594	49186	52581	55802	58286	58597
Inner Mongolia	55965	58130	61164	65121	70434	77374	82029	86839	90002	90615
Liaoning	99814	99414	100870	103793	107775	112700	117614	117807	115272	113071
Jilin Province	56083	57017	59025	61133	63826	66739	69930	73648	76361	78216
Heilongjiang	36553	38162	39767	41930	44938	48844	52496	56225	59185	62028
Shanghai	54194	55639	56637	57549	58606	60115	61822	64533	68595	72413
Jiangsu Province	144185	147884	153856	161442	170361	179494	188460	198689	210497	222698
Zhejiang Province	93691	95266	98079	101371	105172	110028	115122	121286	129294	136511
Anhui Province	42902	43805	45592	48160	51398	55267	59625	64232	69642	74803
Fujian Province	56014	57206	58966	61734	65333	69883	75207	81260	88083	95312
Jiangxi Province	32035	33208	34728	36696	38892	41283	43530	46541	50499	54212
Shandong Province	141415	146141	152823	160782	170125	180719	192415	205146	217245	227470
Henan Province	104354	107817	113213	119918	128440	138670	150028	161905	174655	184965
Hubei Province	53690	55229	57857	61854	66598	72277	78809	85947	93930	101957
Hunan	54807	56232	59102	62864	67439	72820	78858	84216	90191	95388
Guangdong	114054	117608	123206	129876	138067	147927	159170	170809	184959	200684
Guangxi	35599	37834	41919	46991	52265	56262	60406	65010	70016	71332
Hainan	7411	7616	8032	8596	9516	10617	11883	12840	13878	14976
Chongqing	36150	36395	37287	38918	40796	42965	45645	48811	52777	56644
Sichuan	65796	67073	69479	72902	77205	81967	87054	92337	98454	104581
Guizhou Province	16891	17306	18076	19233	21069	23661	26652	30331	34714	39214
Yunnan	26168	27226	29785	33257	37500	42513	48433	54949	61980	69081
Shaanxi Province	45692	46613	48797	51627	55345	59482	63990	68079	72601	77433
Gansu Province	17335	17433	17832	18562	19567	20927	22567	24403	26557	27094
Qinghai	5832	6057	6485	7091	8072	9386	11014	12837	14714	16534
Ningxia	8586	8945	9513	10073	10832	11746	13225	15102	17028	18648
Xinjiang	22276	22661	23641	24971	27538	31157	35631	40223	44290	49503

4.2.1 input variables

(1) Capital inputs (k)

Based on previous studies, we use the concept of fixed capital stock to measure capital investment in the production process in various regions. The calculation of fixed capital stock is based on perpetual inventory method, and 2005 is selected as constant price. Using perpetual inventory method to obtain the actual investment data sequence of our provinces.

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In this paper, according to Zhang Jun et al .(2004), the capital stock of each provincial administrative region is estimated, and the selected samples are estimated as follows:

$$K_{it} = (1-\delta_{it})\ K_{i,t-1} + KF_{it}$$

The K is the material capital stock of the i province in the t year, and the economic depreciation rate of the i province in the first year. In fact, there is no consensus on how to select economic depreciation rate. This paper decides to be consistent with the existing literature and set it at 9.6.

(2) Labour input (L): This paper uses the total number of employed persons in various regions and towns of China officially published by the National Bureau of Statistics as the data index to express the labor input in the production of enterprises.

(3) Energy input (E): in enterprise production, the main source of non-expected output is energy consumption, while power consumption is the most important energy consumption in most enterprises.

4.2.2 output variables

(1) In this paper, the annual gross national product (GDP) at constant prices in each province is selected as the expected output, and the base period is 200, which is reduced by the GDP of each region.

As for the fixed asset investment KFit, it is also necessary to reduce the statistical data collected (i.e. fixed assets at the current year's price), so as to obtain the new fixed assets calculated at the constant price of the base period, as follows:

$$KF_{it} = \frac{INV_{it}}{\prod_{s=t_0+1}^{i}\left(\frac{KFI_{is}}{100}\right)}$$

Of these, the new capital in the capital stock of the i province in the t year is called the INVitThe KFIis is the fixed asset price investment index of the i province in the s year (last year =100).

(2) Using the entropy weight method, the pollution quantity of water, air and solid waste in the provinces over the years is regarded as the environmental quality parameters, which are weighted to construct the comprehensive index of environmental pollution used to characterize the non-expected output.

(3) The pollution assessment index is the environmental pollution index, which is summed up by a variety of environmental quality parameters. It is an abstract and generalized value, which can comprehensively represent the degree of environmental pollution or show the environmental quality grade. The formula of the comprehensive index of environmental pollution selected in this paper is the following formula:

$$\min \rho = \frac{1-\frac{1}{m}\sum_{i=1}^{m} s_i^- / x_{ik}}{1+\frac{1}{s}\sum_{i=1}^{m} s_r^+ / y_{kr}}$$

$$s.t. \sum_{j\in T}^{n} x_{ij}\lambda_j + s_i^- = x_{ik}$$

$$\sum_{j\in T}^{n} y_{rj}\lambda_j - s_r^- = y_{rk}$$

$$\lambda, s^-, s^+ \geq 0$$

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$$i = 1, 2, \ldots, m; r = 1, 2, \ldots, q; j \in T, i \notin V$$

According to the above index data, with the help of linear programming method, the MAXDEX software is used to calculate the scale compensation. From 2009 to 2017, the green total factor productivity index of provinces and cities in China can be obtained, which is called the M L index in the following articles. For the calculation of ML index, this paper refers to the method adopted by Qiu Bin et al .(2008) in this paper. Because the M L index reflects not the green total factor productivity itself, but the growth rate of green total factor productivity. Therefore, this paper assumes that the green total factor productivity (2008) is 1, and then multiplies the calculated M L index to obtain the green total factor productivity of all provinces (municipalities directly under the Central Government) from 2009 to 2017.

Table 3. 2009-2017 Green Total Factor Productivity in 30 Provinces (Cities) of China

	2009	2010	2011	2012	2013	2014	2015	2016	2017
Anhui Province	1.0560	1.1230	1.3243	1.3306	1.3724	1.3579	1.4747	1.4399	1.4994
Beijing	1.0193	1.0409	1.0204	1.0388	1.0595	1.1128	1.1041	1.1135	1.1297
Fujian Province	1.0763	1.1344	1.3754	1.4795	1.6181	1.5386	1.9287	1.9616	1.9363
Gansu Province	1.0614	1.0864	1.1518	1.7227	3.5166	1.7921	3.5774	3.8042	3.4919
Guangdong	1.0296	1.0521	1.0939	1.0855	1.1234	1.0560	1.1449	1.1251	1.1477
Guangxi	1.0067	1.0403	1.4259	1.5760	1.8792	1.5232	2.6881	1.8217	1.9101
Guizhou Province	1.0312	1.1002	1.1433	1.1244	1.0897	1.1869	1.0917	1.3885	1.0936
Hainan	1.0296	1.1031	0.9634	0.9215	0.9746	1.0351	0.9709	0.9195	0.9303
Hebei	1.1194	1.3347	1.4277	1.5150	1.5817	1.6372	1.8376	1.8556	2.0354
Henan Province	1.0970	1.1963	1.2801	1.3014	1.4903	1.4554	1.7704	2.2746	2.2100
Heilongjiang	1.0382	1.0647	1.0423	1.0897	1.1193	1.0060	1.1274	1.1210	0.9834
Hubei Province	1.0781	1.1309	0.9917	1.3144	1.4160	1.3425	1.7694	1.8024	1.8177
Hunan	1.0647	1.1444	1.4325	2.0508	2.1072	2.0324	2.1170	2.3269	2.3739
Jilin Province	1.0741	1.2946	1.4011	1.5807	1.6763	1.6616	1.6233	3.6364	2.2073
Jiangsu Province	1.1221	1.2122	1.5790	1.6334	1.6934	1.6846	1.7786	1.7555	1.7019
Jiangxi Province	1.0347	1.0666	1.0580	1.2445	1.3246	1.1051	1.1312	0.9956	1.4993
Liaoning	1.1020	1.2176	1.2890	1.1933	1.2533	1.2400	1.3734	1.4780	2.2554
Inner Mongolia	1.1485	1.1380	1.2107	1.1104	1.2266	1.0890	1.2198	1.2177	1.1850
Ningxia	1.0424	1.0999	1.1040	1.1626	1.1971	1.2042	1.2197	1.2324	1.2344
Qinghai	1.0736	0.9785	2.6018	2.7111	2.7504	2.4144	2.9280	1.0883	2.7580
Shandong Province	1.1092	1.2048	1.3387	1.3691	1.4101	1.3819	1.4182	1.4062	1.4609
Shanxi Province	1.0952	1.1367	1.2019	1.2076	1.4236	1.4777	1.5895	1.6555	1.5957
Shaanxi Province	1.1406	1.1943	1.2505	1.3888	1.6815	1.6934	1.9574	2.5011	2.4489
Shanghai	1.0306	1.0641	1.1053	1.1393	1.1682	1.1207	1.1522	1.1807	1.2104
Sichuan	1.0839	1.1008	1.1198	1.1503	0.7173	1.0040	1.4117	1.3506	1.0650
Tianjin	1.0455	1.0488	1.1638	1.2739	1.3894	1.8277	1.8726	1.9246	1.9899
Xinjiang	0.8859	0.9837	0.8386	0.7561	0.7103	0.5624	0.6778	0.8307	0.7208
Yunnan	0.9529	1.0409	0.8023	0.8084	0.7738	0.8465	0.9264	1.2127	1.0781
Zhejiang Province	1.0755	1.1950	1.6493	1.7035	1.7749	1.8011	1.8750	1.8898	1.9391
Chongqing	1.0412	1.0632	1.1252	1.2258	1.1639	1.1838	1.2371	1.3884	1.5005

ISSN: 2472-3703 DOI: 10.6911/WSRJ.202106_7(6).0054

5. RESEARCH DESIGN AND DATA DESCRIPTION

5.1. Sample Selection and Data Sources

In order to explore the impact of factor marketization on the development of green economy in China, this paper selects the relevant data of 30 provinces (cities)(excluding Tibet) in China from 2008 to 2017. The data mainly come from the provincial statistical yearbooks such as Anhui Statistical Yearbook, National Bureau of Statistics, China Economic and Social big data research platform and other data platforms. For the treatment of missing values in some provinces, the following two methods are mainly adopted :(1) taking the average value of the provincial calendar year data and replacing it with the average value of the calendar year ;(2) using the provincial data with the same economic situation in the same year to replace it [13].

5.2. Variable Determination and Model Building

5.2.1Variable definition and description

The green total factor productivity (ETFP) is taken as the explained variable and the factor market development degree (Factor) as the explanatory variable to study the influence of factor marketization on the development of green economy in China, and some control variables are set up, including foreign trade dependence (Open), urbanization level (UR), government regulation (ENV) and industrial structure.

Table 4. Definition and description of variables

Type of variable	Agent variables	Variable symbol	Method and description of variable value
Interpretative variables	Green total factor productivity	ETFP	DEA Malmquist index estimates
Explanatory variables	Index of factor market development	Factor	From China Market Process Index Report
Control variables	Dependence on Foreign Trade	Open	Gross import/export trade/ GDP
	Level of urbanization	UR	Urban/total population
	Government Regulation	ENV	Investment in pollution control/ GDP
	Industrial structure	Struc	III. Output/ GDP of tertiary industry

5.2.2 Model Setting

The general spatial panel model is:

$$ETFP_{i,t} = \gamma ETFP_{i,t-1} + \rho W \times ETFP_{i,t} + \beta Factor_{i,t} + d_i X_t \delta + \mu_i + \phi_t + \varepsilon_{i,t}$$

$$\varepsilon_{i,t} = \varphi m_i \varepsilon_{i,t} + \nu_{i,t}$$

$d_i X_t \delta$ The upper formula represents the spatial lag of the explanatory variable, the i line of the corresponding spatial weight is the time effect, and the i line of the spatial weight of the random disturbance term, the I, j represents the i province domain and the t year respectively, and the X is the control variable. d_i ϕ_t m_i μ and φ are individual time-saving virtual variables, ε is a random error term, W the above model of spatial weight matrix can generate the main 4 models: first, when =0, For the "spatial Doberman model "(SDM); Second, when =0 and =0, For the "spatial autoregressive model "(SAR); Third, when =0 and =0, For the "spatial

ISSN: 2472-3703 DOI: 10.6911/WSRJ.202106_7(6).0054

autocorrelation model "(SAC); The fourth is the spatial error model =0(SEM). φ φ δ γ δ $\gamma = \rho = 0$ δ

According to the following series of tests of data and related literature, the spatial Doberman model (SDM) is selected. The model is:

$$ETFP = \gamma WETFP + X\beta + WX\delta + \varepsilon$$

6. EMPIRICAL RESULTS AND ANALYSIS

6.1. Spatial Autocorrelation Test

6.1.1 Calculation of Spatial Weight Matrix

we need to measure the spatial distance between 30 provinces in china before carrying out the spatial measurement analysis. the commonly used spatial weight matrices are adjacency matrix, inverse distance matrix, economic feature matrix, etc. in this paper, we choose adjacency spatial weight matrix.

The geographical distance j provincial i and provinces is dij, defining spatial weights:

$$w_{ij} = \begin{cases} 1, \text{if} d_{ij} < d \\ 0, \text{if} d_{ij} \geq d \end{cases}$$

Where the d is a given distance critical value in advance, a matrix of 30×30 can be obtained, as follows:

$$W = \begin{pmatrix} 0 & 0 & 0 & 0 & \text{B} & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & \text{B} & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \text{B} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \text{B} & 0 & 0 & 0 & 1 \\ \text{C} & \text{C} & \text{C} & \text{C} & \text{B} & \text{C} & \text{C} & \text{C} & \text{C} \\ 0 & 1 & 0 & 0 & \text{B} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \text{B} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \text{B} & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 & \text{B} & 0 & 0 & 0 & 0 \end{pmatrix}$$

6.1.2 Moran's I Calculation

In determining the use of spatial measurement methods, it is also necessary to consider whether there is spatial dependence of data, so it is necessary to test spatial autocorrelation. The indices of spatial autocorrelation in general measures are Moran I, Geary's C and Getis-Ord index G. Moran's index This paper studies Moran index I (Moran's I) in detail to test spatial correlation.

The formula is:

$$I = \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{S^2 \sum_{i=1}^{n} \sum_{j=1}^{n} wi_j}$$

$S^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n}$ Among them is sample variance, wij $\sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij}$ For the above calculated spatial weight matrix, for the sum of spatial weights. Taking into account the subsequent use of spatial measurement methods, the need willMoran's I standardization, at this time, the specific formula is: $\sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij} = n$

ISSN: 2472-3703 DOI: 10.6911/WSRJ.202106_7(6).0054

$$I = \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

If the value range of the Moran's I is [-1], if greater than 0 means positive correlation, the low value is adjacent to the low value, the high value is adjacent to the high value, and if less than 0 means negative correlation, the high value is adjacent to the low value. If the Moran's I is close to 0, the spatial distribution is random. If the observed value and its spatial lag are transformed into a scatter plot, the Moran scatter plot is formed, and the slope of the regression line is the Moran index I.. The the following two graphs are green total factor productivity moran scatter plot and factor-market moran scatter plot. the four quadrants in the graph correspond to high-high aggregation region, high-low aggregation region, low-low aggregation region and low-high aggregation region, respectively.

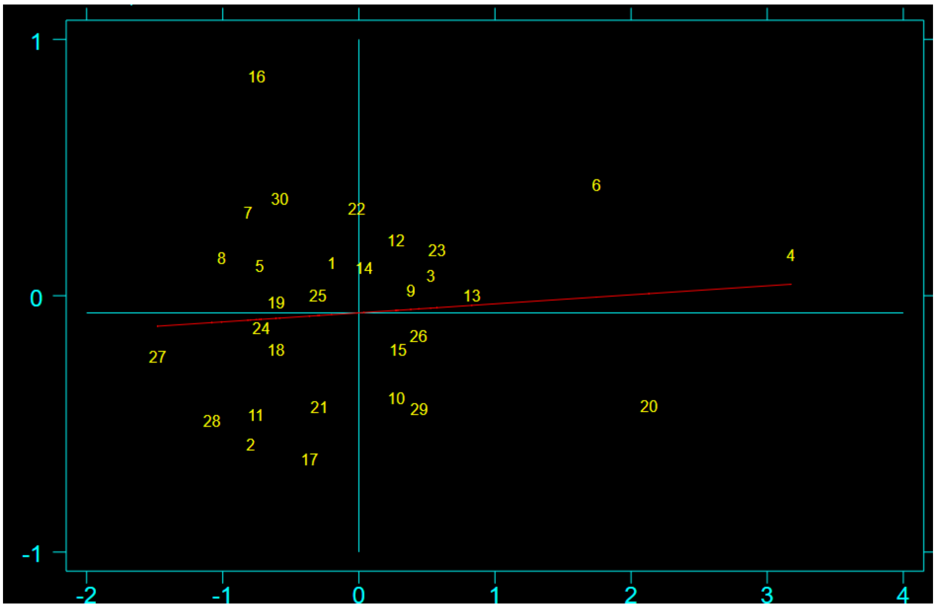

Figure 2. Moran scatter plot of green TFP

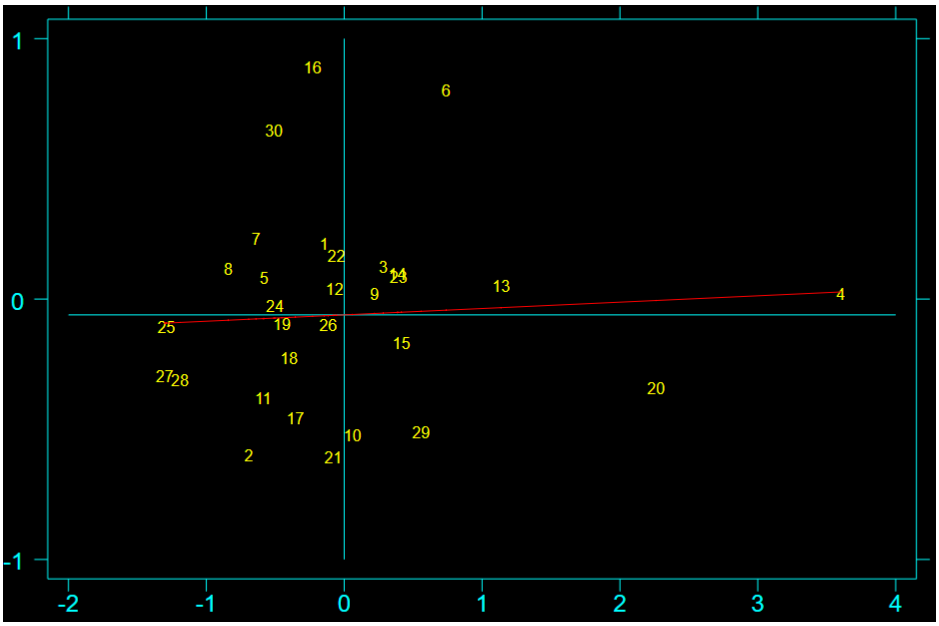

Figure 3. Moran scatter plot of elements marketization

ISSN: 2472-3703 DOI: 10.6911/WSRJ.202106_7(6).0054

Figure 3 shows the Moran Index I. of Green Total Factor Productivity and Factor marketization 2009-2017 Although the Moran index of green total factor productivity and factor marketization I show certain fluctuation and are all greater than 0, it shows that there is a positive correlation between factor marketization and green total factor productivity in China. We also know that the spatial differences between factor marketization and green total factor productivity are not random, they show strong spatial dependence, and from the scattered plot, the scattered points are mostly concentrated in one or three quadrants. It has obvious characteristics of H-H aggregation and L-L aggregation, which all show that geospatial factors affect the effect of factor marketization on green total factor productivity to some extent [14].

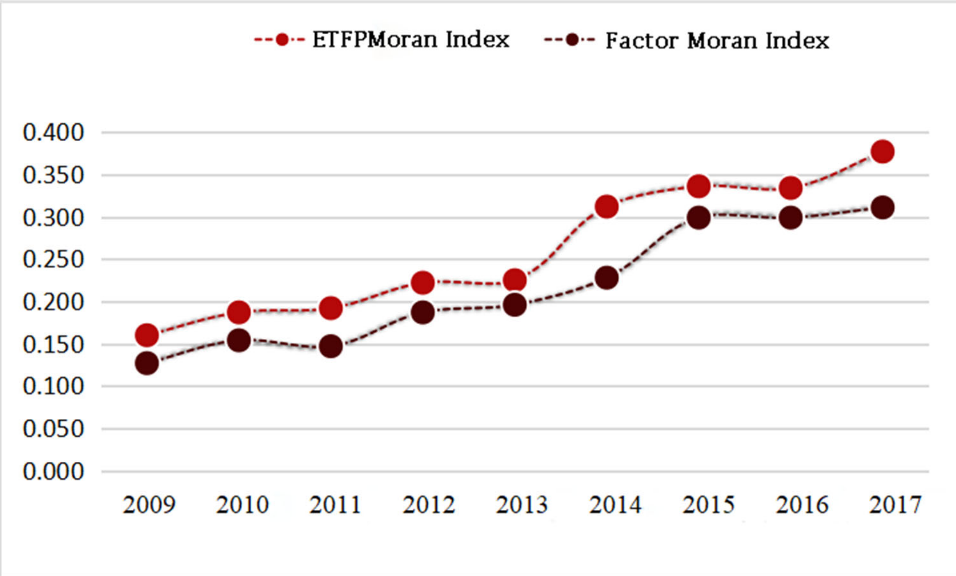

Figure 4. Moran Index of Green Total Factor Productivity and Factor Marketability 2009-2017

6.2. Selection of a Spatial Dynamic Panel Model

6.2.1 decide whether to choose fixed effect or random effect

The Hausman test (Hausman) is carried out on the panel data before setting the model. First, the fixed effect estimation (FE) and the random effect estimation (RE) are carried out. The p value is 0.0000. Therefore, the original hypothesis is rejected and the fixed effect model should be used instead of the random effect model.

Table 5. Hausman test results

	(b)	(B)	(b-B)	sqrt (diag (V_b-V_B))
	FE	RE	Difference	S.E.
Factor	0.0086	01.025	-05.016	0.0095
Open	0.0170	-09.235	0.2529	06.041
UR	4.9336	1.5101	3.4235	0.6189
ENV	-57.4749	-60.1895	2.7146	9.8179
Struc	08.841	0.8571	-0.0153	08.3631
cons _	-1.6805	0.1889	-1.8694	08.275
chi2(7)=(b-B)'[(V_b-V_B)^(-1)](b-B)51.42				
Prob>chi2=0.0000(V_b-V_B is not positive definite)				

ISSN: 2472-3703 DOI: 10.6911/WSRJ.202106_7(6).0054

6.2.2 Screening and testing of model effects

(1) To test the significance of individual effects

To test the significance of individual effect, the OLS mixed model is used to regression to obtain the regression results as shown in Table 6. The results of F test show that the fixed effect model is superior to the OLS mixed model.

Table 6. OLS Mixed regression results

	Coef.	Std.Err.	z	P>|z|	[95 Conf.Interval]][95 per cent	
Factor	0.0086	0.0215	0.40	0.689	-08.033	0.0510
Open	0.0170	01.081	0.21	0.834	-0.1425	0.1766
UR	4.9336	0.8031	6.14	0.000	3.3523	6.5150
ENV	-57.4749	24.9254	-2.31	0.022	-106.5520	-8.3978
Struc	08.841	0.6486	1.30	0.195	-03.435	2.1188
cons _	-1.6805	0.3508	-4.79	0.000	-2.3712	-0.9897
F test that all u_i=0: F(29,265)F test that all u_i=12.54 Prob F(29,265)F test that all u_i=F F test that all u_i=0.0000						

(2) Test the significance of time effect

To test the significance of the time effect, the LM statistics were selected to test, the P value was 0.0000, and the original hypothesis was rejected.

Table 7. LM Statistical tests

	VAR	Sd=sqrt (VAR)
ETFP	0.2500	0.5000
e	0.1079	0.3284
u	0.1031	0.3212
chibar2(01)=183.62		
Prob>chibar2=0.0000		

Lesage believe that the spatial Dobin model (SDM) can study the global spatial spillover effect and has good practical significance. Combined with the above analysis, the author uses the spatial Dobin model to estimate the results on the basis of the fixed effect.

6.3. Empirical Results Analysis

6.3.1 Descriptive presentation of variables

Table 8 shows descriptive statistical results. The gap between the maximum and minimum values of the main variables green total factor productivity and factor marketization is large, which indicates that the gap between factor marketization and green economy development level between Chinese provinces is large.

6.3.2 full sample empirical results

Le Sage and Pace (2009) [15] It has been suggested that when the coefficient of spatial lag term coefficient of explained variables is not 00:00, there may be systematic deviation in studying spatial spillover effect. Li Yanjun (2018) [16] It is suggested that the spatial effect should be decomposed. This paper studies the effect of factor marketization on green total factor productivity from three aspects: direct, indirect and total effect. Direct effect refers to the

ISSN: 2472-3703 DOI: 10.6911/WSRJ.202106_7(6).0054

influence of factor marketization on green total factor productivity in this area, and indirect effect refers to the influence of factor marketization on green total factor productivity according to the adjacent geographical matrix of each province in China.

Table 8. Descriptive statistics

Variable		Mean	Std.Dev.	Min	Max	Observations
	overal	1.3541	0.5000	0.5624	3.8042	N=300
ETFP	between		0.3213	04.7966	2.2204	n=30
	within		06.3871	07.133	3.2750	T=10
	overal	5.3338	2.4089	.37000	14.7536	N=300
Factor	between		2.0532	1.2055	11.0395	n=30
	within		1.3092	1.5143	9.4786	T=10
	overal	0.3427	0.4567	09.016	3.1058	N=300
Open	between		0.3800	0.0490	1.4253	n=30
	within		0.2617	-0.2284	2.2495	T=10
	overal	0.5472	01.132	02.291	01.896	N=300
UR	between		0.1287	0.3742	0.8875	n=30
	within		02.037	0.4625	02.633	T=10
	overal	0.0014	0.0012	01.000	.00010	N=300
ENV	between		0.0009	0.0003	08.004	n=30
	within		08.000	-06.001	0.0065	T=10
	overal	00.431	06.093	02.286	06.805	N=300
Struc	between		.08030	0.3421	06.7663	n=30
	within		0.04558	0.3054	03.558	T=10

Considering the different effects of variable data calculation and data difference in different regions, all variables are logarithmic. From the empirical results of table 9, we can see that the coefficients of direct and indirect effects of lnFactor are 0.0830 and 0.2420, respectively, and are significant at the level of 10% and 1%, indicating that factor marketization will have a positive effect on green total factor productivity. And has the positive spatial spillover. For external dependence, both direct and indirect effects are negative and not significant, but the total effect is significantly negative at 5% level. The industrial structure is easy to spread in adjacent areas, which provides some support for the development of green economy, but in terms of direct effect, the effect of industrial structure is not significant. It shows that the impact of industrial structure on the development of green economy is mainly concentrated in adjacent areas. The direct and indirect effects of government regulation are significantly negative at the level of 1% and 5% respectively, which indicates that government regulation has a certain inhibitory effect on the development of green economy in this region and adjacent areas. The direct effect of urbanization level is significantly positive at the level of 5%, and the indirect effect is not obvious, which indicates that the promotion effect of urbanization level on the development of green economy is limited to the region.

ISSN: 2472-3703 DOI: 10.6911/WSRJ.202106_7(6).0054

Table 9. Full sample empirical results

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Main	Wx	LR_Direct	LR_Indirect	LR_Total
lnFactor	0.0690	0.2720***	0.0830*	0.2420***	0.1590**
	(0.0541)	(0.0827)	(0.0583)	(0.0709)	(0.0668)
lnOpen	-0.0027	-0.0686	-0.0012	-0.0548	-0.0559**
	(0.0473)	(0.0546)	(0.0484)	(0.0511)	(0.0258)
lnUR	0.829**	0.7450	0.8330**	0.3940	1.2270***
	(0.3510)	(0.4930)	(0.3610)	(0.4200)	(0.2150)
lnENV	-0.0671***	0.0732**	-0.0721***	-0.0758**	-0.0037
	(0.0228)	(0.0371)	(0.0236)	(0.0316)	(0.0270)
lnStruc	-0.1430	0.4270*	-0.1700	0.388**	0.2180
	(0.1630)	(0.2200)	(0.1650)	(0.1880)	(0.1560)
Observations	300	300	300	300	300
Number of id	30	30	30	30	30
rho	0.2530***		sigma2_e	0.0266***	
	(0.0839)			(0.0022)	

Note: The t values in brackets, *** p<0.01, ** p<0.05, and * p<0.1, indicate significance at 1%, 5%, and 10% levels

6.3.3 sample empirical results

Considering the unbalanced development of factors such as marketization of elements, level of green economy development and level of urbanization in various regions of China, the samples are divided into three sub-samples in the east, central and western regions, and the results are obtained as shown in Table 10.

It can be seen from the regression results that, whether direct or indirect, the marketization of elements in the three regions has an incentive effect on the development of green economy, and the eastern region has the greatest incentive effect. In addition to the degree of foreign trade dependence in the eastern region has a certain inhibitory effect on the development of green economy, the effects of other regions are basically consistent with the results of total sample regression. In terms of urbanization level, the role of the three regions is limited to the development of green economy in the region, and the effect of urbanization level in the central and western regions is greater than that in the east. The direct and indirect effects of government regulation on the three regions are negative, which is consistent with the results of the total sample. According to the industrial structure, the industrial structure of the three regions can promote the development of green economy in the adjacent areas, the effect of the eastern region on the province is not obvious, and the optimization of the industrial structure in the central and western regions is conducive to the development of the green economy of the province.

ISSN: 2472-3703 DOI: 10.6911/WSRJ.202106_7(6).0054

Table 10. Sample empirical results for subregions

Explanatory variables	Eastern Region		Central region		Western Region	
	Direct effects	Indirect effects	Direct effects	Indirect effects	Direct effects	Indirect effects
lnFactor	0.1240**	0.3240***	0.0972*	0.2670**	0.6230*	0.1880*
	(0.0435)	(0.0807)	(0.0424)	(0.7080)	(0.0513)	(0.0503)
lnOpen	-0.0121*	-0.0882	-0.0052	-0.0664	-0.0024	-0.00684
	(0.0322)	(0.0211)	(0.0024)	(0.0202)	(0.0201)	(0.0563)
lnUR	0.724**	0.312	0.872**	0.386	0.867**	0.378
	(0.0316)	(0.420)	(0.3620)	(0.4340)	(0.3610)	(0.4324)
lnENV	-0.0722***	-0.756*	-0.716***	-0.758**	-0.0721***	-0.0746**
	(0.0236)	(0.0264)	(0.0226)	(0.0316)	(0.0236)	(0.0318)
lnStruc	-0.1730	0.3680**	0.1680*	0.3224*	0.1760**	0.2880*
	(0.1650)	(0.1880)	(0.1602)	(0.1588)	(0.1652)	(0.1422)
R2	0.040	0.052	0.038	0.046	0.041	0.048
Observations	300	300	300	300	300	300

Note: The t values in brackets, *** p<0.01, ** p<0.05, and * p<0.1, indicate significance at 1%, 5%, and 10% levels.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1. Main Conclusions

(1) The development level of factor marketization and green economy in China has the characteristics of large spatial difference and strong spatial dependence among provinces, and there is a positive correlation between the two. By calculating the adjacent spatial weight matrix and calculating the Moran index, the Moran scatter plot of green total factor productivity and the Moran scatter plot of factor marketization are obtained. The higher the green economy development level of the city. Because of the large span of land area in China, the economic environment, cultural background, urbanization process and foreign trade degree of each province are different, so the geospatial factor has become one of the factors that affect the marketization of the elements to a certain extent.

(2) From the national scope, the degree of foreign trade dependence, the degree of government regulation, the level of urbanization, the industrial structure and other factors within and between provinces will also have different degrees of influence on the green development level of the region and adjacent areas. By using fixed effect model and spatial Dobin model to construct and analyze spatial dynamic panel model ,30 provinces and cities in China from 2008 to 2017 were selected as samples to construct spatial dynamic panel lag model and error model.

(3) The improvement of marketization of elements has an incentive effect on the development of green economy, And the influence on the eastern region is the most obvious. Coefficient of direct effect and indirect effect lnFactor from full sample of spatial effect is 0.0830 and 0.2420, and significant at the levels of 10% and 1%; Study by spatial sampling, InFactor direct and indirect effects were 0.1240 and 0.3240 in the east, 0.0972,0.2670 in the middle, in the west is 0.6230,0.1880, respectively. So, you know, Whether it's East, Central, West or China's overall space, The improvement of factor marketization will play a positive role in the development of green economy, But the impact on the east is more pronounced than in the Midwest.

ISSN: 2472-3703 DOI: 10.6911/WSRJ.202106_7(6).0054

(4) Industrial optimization and upgrading in the central and western regions will promote the development of green economy in this province and adjacent regions. Industrial optimization is mainly manifested in the proportion of tertiary industry in the total GDP. From the data obtained from empirical analysis, it can be seen that industrial optimization and upgrading will mainly have a positive impact on the level of green economy development in adjacent areas.

(5) Eastern region foreign trade dependence degree is too high will produce certain degree of inhibition to the green economy development. The degree of dependence on foreign trade reflects the national import and export ratio, and the degree of dependence on foreign trade has little effect on the development of green economy. Generally speaking, it will exceed the national average degree of foreign trade dependence, too high will have a certain degree of inhibition on the development of green economy in the eastern region.

7.2. Key Recommendations

(1) Implementing government responsibility, reducing government regulation properly, improving the level of factor marketization and strengthening the supervision and management of factor resource allocation.

(2) Strengthen the level of industrial structure optimization in the central and western regions, promote the construction of urban and rural integration, formulate relevant macro policies, and promote the level of urbanization.

(3) At the same time, the eastern part should not rely too much on foreign trade, regulate the ratio of import and export reasonably, and allocate the essential resources reasonably.

(4) Enterprises need to take a variety of measures to optimize the structure of enterprises, at the same time moderately expand the scale of enterprise production, cultivate enterprise innovation ability, encourage enterprises to develop independently, reasonably reduce the dependence on foreign trade, and reduce the degree of excessive capital accumulation.

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