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The Impact of Logistics Agglomeration on Green Economy Development

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Abstract: *Based on the panel data of 30 Chinese provinces from 2011-2019, the entropy value method and Tobit regression model are applied to study the impact of logistics industry agglomeration on green economic development. The results show that the impact of logistics industry agglomeration on green economic development shows a significant promotion effect; foreign direct investment, urbanization level and population density have a significant positive impact on green economic development; human capital and government expenditure have a more significant negative impact on green economic development.*

Keywords: *logistics industry agglomeration; green economic development; entropy method; Tobit regression*

1. Introduction

In September 2020, General Secretary Xi Jinping stressed at the eighth meeting of the Central Finance and Economics Commission that "the construction of a modern circulation system must be an important strategic task to grasp", and clearly proposed to cultivate and grow modern logistics enterprises with international competitiveness, reflecting the country's full attention to the logistics industry. With the coordinated development of the region, the increasing trend of industrial division of labor, and the increasing degree of socialization and specialization of production, the modern logistics industry has gradually been widely recognized as another important source of profit after reducing material consumption and improving labor productivity, and is increasingly developing into an important basic service industry in China's national economic system, and the agglomeration of logistics industry is becoming an important initiative to improve economic efficiency.

Since the 18th Party Congress, China has transformed new concepts such as green development and green living into a series of policy practices, and the 19th Party Congress took the battle of pollution prevention and control as one of the three major battles to win the battle to build a moderately prosperous society. Green economic development is an important indicator to measure green development, and green economic development is closely related to logistics industry agglomeration. The agglomeration of logistics industry can bring about the reduction of transaction and transportation costs and drive the economy of scale effect of the industry, thus generating positive externalities to the external economic development. Therefore, giving full attention to both economic efficiency and green development in the context of logistics industry agglomeration, i.e., considering the impact of logistics industry agglomeration on green economic development, is important for achieving economic transformation and upgrading and high-quality development.

2. Literature Review

Logistics industry agglomeration refers to the process of spatial clustering of related enterprises with logistics enterprises as the core, and the division of labor and cooperation among them to form logistics parks. Some studies have analyzed the impact of logistics industry agglomeration on manufacturing industry, such as Zhenzhen Wang and Gongyu Chen[1] found that the benefits of logistics industry agglomeration come from the reduction of transaction costs, the improvement of transaction efficiency, the role of economies of scale and external economies, and the regional differences in logistics industry agglomeration lead to the differences in the development level of industrial value added in manufacturing industry. Hongyan Liang[2] found that at the national level, logistics industry agglomeration has no significant direct effect on industrial productivity, while in the eastern and western regions, there is a significant positive spillover effect. Shangguan Xueming[3] found that the impact of logistics industry

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agglomeration on the high-quality development of manufacturing industry is different, there is a threshold effect, the agglomeration degree is below the threshold value to promote the high-quality development of manufacturing industry is not significant, and the agglomeration degree exceeds the threshold value to promote the high-quality development of manufacturing industry is significant. Meanwhile, there are also studies analyzing the effect of synergistic agglomeration between logistics industry and manufacturing industry on economic development, for example, Liu Ming[4] found that synergistic agglomeration between logistics industry and manufacturing industry has a significant positive effect on high quality economic development. Yan Fei and Wang Tieshan[5] found that the professional and synergistic clustering of logistics and manufacturing industries in China both have a positive effect on regional economic growth, and there is an obvious inverted "U" type relationship.

In terms of green economic development research, as the country pays more and more attention to green development and sustainable development as well as the requirements of economic transformation and upgrading, more and more studies have started to focus on the relationship between industrial agglomeration and green economic development. For example, Ma Yanrui and Liu Qiang[6] found that industrial agglomeration has a promoting effect on green economic development, but this promoting effect is not consistently effective in an inverted "U" curve relationship. Zhang Zhidong and Chen Jing[7] found that manufacturing and service agglomeration and informal environmental regulation all have significant promotion effects on green total factor productivity. Li Zhiguo et al. [8] found that there is an inverted U-shaped relationship between economic agglomeration and green economic development in the urban agglomeration of the Yellow River Basin, where economic agglomeration within a reasonable range helps to enhance green economic development, while when economic agglomeration is excessive, it inhibits the green economic development of the urban agglomeration. Zhang Xuesheng[9] found that industrial agglomeration has a negative nonlinear effect on green economic development with increasing marginal effect from technological innovation, but it can be compensated by exerting the innovation effect.

In summary, scholars have made sufficient studies on the effects of industrial agglomeration on green economic development and the effects of logistics industry agglomeration on economic development, but very few scholars have paid attention to the environmental problems caused by logistics industry agglomeration and thus the effects on green economic development, and quantitative empirical studies are insufficient. This paper examines the effect of logistics industry agglomeration on green economic development based on the lack of existing studies, using panel data of 30 Chinese provinces from 2011 to 2019.

3. Study design

3.1 Data sources

Considering the missing data of many indicators in Tibet Autonomous Region, this sample was removed and the panel data of 30 provinces and cities in China from 2011-2019 were finally selected. The data in this paper are obtained from China Statistical Yearbook, China Environmental Statistical Yearbook, statistical yearbooks of provinces and cities, CSMAR database, and the National Bureau of Statistics.

3.2 TOPSIS

In this paper, the entropy value method (TOPSIS) is used to measure the green economic development index. The entropy method is a method of objectively assigning weights to indicators according to the size of their information entropy. The smaller the information entropy, the greater the dispersion of the indicator, the more information it contains, and the greater the weight assigned to it. In this study, the entropy value method is used to measure the green economic development index. Let there be r years, n provinces and m indicators, then x_{ijk} denotes the value of the kth indicator in the i-th year, j-th province. The specific steps are as follows.

Standardization of positive indicators.

$$x_{ijk}^{'} = \frac{x_{ijk} - x_{\min k}}{x_{\max k} - x_{\min k}} \tag{1}$$

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Standardization of inverse metrics.

$$x_{ijk}^{'} = \frac{x_{\min k} - x_{ijk}}{x_{\min k} - x_{\max k}} \tag{2}$$

where $x_{\min k}$, $x_{\max k}$ denote the minimum and maximum values of the kth indicator in r years in n provinces, respectively.

Non-negative translations.

$$x_{ijk}^{''} = x_{ijk}^{'} + 10^{-3} \tag{3}$$

Zero values often appear after standardization, so the normalized data are usually leveled and de-zeroed, usually with a non-negative leveling.

Calculation of specific gravity.

$$p_{ijk} = \frac{x_{ijk}^{''}}{\sum_{i=1}^{r}\sum_{j=1}^{n} x_{ijk}^{''}} \tag{4}$$

Calculate the entropy value.

$$s_k = -\frac{1}{\ln(rn)}\sum_{i=1}^{r}\sum_{j=1}^{n} p_{ijk}\ln\left(p_{ijk}\right) \tag{5}$$

Calculation of the coefficient of variation.

$$g_k = 1 - s_k \tag{6}$$

Calculate the weight of the kth indicator.

$$w_k = \frac{g_k}{\sum_{k=1}^{m} g_k} \tag{7}$$

Calculate the composite score.

$$h_{ij} = \sum_{k=1}^{m} w_k x_{ijk}^{''} \tag{8}$$

3.3 Tobit regression

The green economic development index measured based on the entropy value method belongs to truncated discrete data, and this measurement has the characteristic of being cut, which will bring bias to the regression results if estimated by using OLS method. Its condition of Tobit regression model setting with restricted dependent variable is met, so this paper constructs a panel Tobit model to explore the influence of logistics industry agglomeration on green economic development, and the basic form of the panel Tobit model is as follows.

$$Y_{it} = \alpha + \beta_1 LC_{it} + \beta_k Control_{it} + \varepsilon_{it} \tag{9}$$

where i denotes province, t denotes year, Y denotes the explanatory variable green economic development index, LC denotes the core explanatory variable logistics industry agglomeration degree, and Control denotes the control variables including human capital HC, foreign direct investment FDI, government expenditure GE, urbanization level UR, and population density PD. Thus, the Tobit model can be subdivided into.

$$Y_{it} = \alpha + \beta_1 LC_{it} + \varepsilon_{it} \tag{10}$$

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$$Y_{it} = \alpha + \beta_1 LC_{it} + \beta_2 HC_{it} + \beta_3 FDI_{it} + \beta_4 GE_{it} + \beta_5 UR_{it} + \beta_6 PD_{it} + \varepsilon_{it} \quad (11)$$

3.4 Variable Selection and Description

3.4.1 Explained variables

Green economy development index. In this paper, a total of 3 primary indicators of economic development, resource utilization and environmental protection and 11 secondary indicators are selected to analyze the level of green economic development, as shown in table 1.

Table 1: Green Economic Development Index Indicator System

Tier 1 Indicators	Secondary indicators	Properties
Economic Development	Per capita regional GDP (yuan/person)	+
	Per capita disposable income (yuan/person)	+
	The proportion of added value of tertiary industry (%)	+
	Share of R&D expenditure (%)	+
Resource Utilization	Energy consumption per unit of regional GDP (tons of standard coal / million yuan)	-
	Water consumption per unit of regional GDP (m^3 / million)	-
	Electricity consumption per unit area GDP (kW-h / million yuan)	-
Environmental Protection	Sulfur dioxide emissions per unit of GDP (t/billion yuan)	-
	Nitrogen oxide emissions per unit of GDP (t/billion yuan)	-
	CO2 emissions per unit of GDP (t/billion yuan)	-
	Chemical oxygen demand emissions per unit of GDP (t/billion yuan)	-

3.4.2 Core explanatory variables

Logistics agglomeration (LC). Location entropy is an effective method to measure the level of industrial agglomeration by measuring the spatial distribution of factors, which can eliminate the endogenous conflicts caused by the differences between regional scales and reflect the spatial distribution more realistically. Considering the availability of data, this paper adopts the number of employments in logistics industry (represented by the number of employments in transportation, storage and postal industry) to measure the agglomeration of logistics industry, and the calculation formula is.

$$LC_{it} = \frac{LP_{it}}{\sum_i LP_{it}} \Big/ \frac{TP_{it}}{\sum_i TP_{it}} \quad (12)$$

where LP_{it} denotes the number of employments in the logistics industry in province i in year t and TP_{it} denotes the number of employments in the whole industry in province i in year t.

3.4.3 Control variables

Human capital (HC), expressed as years of education per capita; foreign direct investment (FDI), expressed as the ratio of actual foreign capital utilized by provinces, autonomous regions and municipalities to GDP; government expenditure (GE), expressed as the ratio of general fiscal budget expenditure to GDP; urbanization level (UR), expressed as the proportion of non-agricultural population to resident population; population density (PD), expressed as the ratio of annual (PD), expressed as the ratio of the resident population to the area of each region.

4. Analysis of the empirical results

Regression analysis was performed on models (1) and (2), and the results were obtained as shown in Table 2. Among them, model (1) has only the explanatory variable of logistics industry agglomeration without adding any control variables, and model (1) adds five control variables of human capital, foreign direct investment, government expenditure, urbanization level and population density on the basis of (2).

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Table 2: Basic regression results

GED	Tobit	
	(1)	(2)
LC	0.1165***	0.0822***
	(0.007)	(0.010)
HC		-0.0178*
		(0.010)
FDI		0.7509***
		(0.235)
GE		-0.4461***
		(0.041)
UR		0.2617***
		(0.059)
PD		0.00001***
		(7.60e-06)
_cons	0.2097***	0.3471***
	(0.020)	(0.089)
sigma_u	0.0514***	0.0512***
	(0.014)	(0.013)
sigma_e	0.0974***	0.0575***
	(0.004)	(0.003)
LR	46.04***	82.77***

Note: ***, **, * indicate significant at 1%, 5%, and 10% significance levels, respectively, with standard deviations in parentheses.

From the above results, it can be seen that the core explanatory variable logistics industry agglomeration has a significant positive effect on the development of green economy and can pass the 1% significance test, indicating that logistics industry agglomeration can promote the development of green economy. Because the expansion of logistics industry scale brought by agglomeration and the reduction of transportation and search costs caused by mutual cooperation will make the logistics industry more efficient and thus can promote the improvement of green economy development.

In terms of human capital, human capital has an inhibitory effect on the development of green economy and can pass the 10% significance test. The possible reason for this is that with elevated human capital, the cost of employing people in a company rises, which to some extent is not conducive to economic efficiency and thus affects the development of green economy.

In terms of foreign direct investment, foreign direct investment has a catalytic effect on the development of green economy and can pass the 1% significance test. The main reason is that FDI can directly bring foreign advanced green technology and promote the development of green economy through capital accumulation and mutual flow between human capital.

In terms of government expenditure, government expenditure has a hindering effect on the development of green economy and can pass the 1% significance test. The possible reason is that the government's current fiscal leaning point lies in the main industrial and manufacturing industries, which may adopt a rough development model at the early stage of development, bringing about the continuous increase of industrial three waste emissions, thus causing environmental pollution, which is not conducive to the development of green economy.

In terms of the level of urbanization, the level of urbanization has a catalytic effect on the development of green economy and can pass the 1% significance test. The main reason is that the exchange and progress in economic and human capital accompanying the urbanization process will accelerate the technological progress and the development of green industries, which will be beneficial to the development of green economy.

In terms of population density, population density has a catalytic effect on green economy development and can pass the 1% significance test. The main reason is that the increase in population density means that there is an influx of more talents, and the group effort can better promote the development of green economy.

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5. Conclusions and Policy Recommendations

Based on the panel data of 30 provinces in China 2011-201 9, this paper uses the entropy value method to calculate the green economic development index that integrates environmental protection, resource conservation and economic growth, and analyzes the impact of logistics industry agglomeration on green economic development from an empirical perspective. The results show that the impact of logistics industry agglomeration on green economic development shows a significant promotion effect, foreign direct investment, urbanization level and population density have a significant positive impact on green economic development, and human capital and government expenditure have a more significant negative impact on green economic development.

In order to promote the high-quality development of manufacturing industry, this paper puts forward the following suggestions: First, accelerate the development of modern logistics industry, consolidate the foundation and advantages of logistics industry clustering, and give full play to the role of logistics industry clustering in promoting the output of green economic development. To realize the sustainable development of logistics industry agglomeration, it is necessary to rely on the cluster effect generated by the competition and collaboration among enterprises within the cluster, encourage reasonable division of labor and cooperation among enterprises, maintain moderate competition, and make the overall greater performance through the external economic effect brought by the agglomeration in space. Second, strengthen the application of information communication and computer technology in the logistics industry, so that logistics enterprises can access information more easily, effectively reduce the cost of communication and finding information among enterprises, further improve the efficiency, and realize the specialization and scale of logistics industry . Third, the government accelerates the improvement of relevant policies and plans to guide the benign development of logistics industry clusters. China's logistics industry is in a stage of rapid development, logistics industry clusters are taking shape, in order to avoid undue vicious competition and industrial layout chaos, to achieve sustainable development of logistics industry clusters, while giving full play to the leading role of the market, must effectively strengthen and play the role of government planning and guidance. First of all, we should actively play the leading role of the government, combine the development status of local logistics enterprises, formulate strategies according to local conditions, plan the industrial layout and guide the sustainable development of logistics industry. Secondly, it is necessary to drive the orderly competition and friendly cooperation among logistics enterprises to bring into play the positive externality of clusters and promote the development of green economy.

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