Industrial Agglomeration, Digital Economy and Regional Economic Resilience

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Abstract: The purpose of this study is to explore the relationship among industrial agglomeration (IA), digital economy (DE) and regional economic resilience (RER), and make an empirical analysis of their impact on regional economic development. By using multiple linear regression model and correlation analysis method, this paper studies and analyzes the data of IA degree, DE development level and RER index in different regions of China, and discusses their correlation with regional economic development level. The results show that there is a significant positive correlation between the degree of IA, the development level of DE and the index of RER and the development level of regional economy, which indicates that these factors have an important impact on the development of regional economy. In addition, this study also analyzes the significance of the research results from the theoretical and practical perspectives, and puts forward corresponding policy suggestions to promote the stable growth and sustainable development of regional economy.

1. Introduction

In the era of globalization and digitalization, industrial agglomeration (IA), digital economy (DE) and regional economic resilience (RER) have become important research topics in the fields of economics and geography. As a geographical and economic phenomenon, IA refers to the centralized development of similar or related industries in a certain area, which is one of the important driving forces to promote regional economic development [1]. The rapid development of DE has not only changed the production and trading methods of traditional industries, but also brought new opportunities and challenges to the development of regional economy. At the same time, RER, as the resistance, adaptability and resilience of regional economic system to external shocks, has also attracted increasing attention from scholars and policy makers.

The relationship among IA, DE and RER is a complex and important issue. On the one hand, IA can improve the competitiveness and resilience of regional economy by forming economies of scale and technological innovation [2-3]. On the other hand, the development of DE not only changes the mode and characteristics of IA, but also may affect the stability and adaptability of regional economic system [4]. Therefore, it is of great theoretical and practical significance to explore the relationship among IA, DE and RER.

In the past research, scholars have conducted extensive discussions on the relationship between IA, DE and RER, and achieved some important results [5-6]. However, the existing research is mostly limited to the case analysis of a single field or a single region, and the understanding of heterogeneity and complexity between different industries and regions is still insufficient. Therefore, this study aims to explore the relationship among IA, DE and RER through empirical analysis, and provide policy suggestions to promote the sustainable development of regional economy.

2. Research method

2.1. Data source and selection

From the statistical yearbook of China National Bureau of Statistics and the official data of provincial statistical bureaus, the indicators of major IA in each province, such as industrial structure index and industrial concentration, are obtained. In order to measure the development

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level of DE in various provinces, this paper uses the digitization report released by China Internet Network Information Center (CNNIC), the Internet penetration rate data released by China Ministry of Industry and Information Technology, and the e-commerce transaction volume released by the National Internet Information Office. China regional development report issued by the World Bank, regional economic development index data issued by the National Development and Reform Commission and natural disaster data issued by the China Meteorological Bureau are comprehensively utilized to measure the RER level of each province.

Several provinces in the eastern coastal areas of China are selected as research samples, including Guangdong, Zhejiang, Jiangsu and Fujian. These provinces play an important role in the economic development of China, with developed manufacturing, service and DE industries. The provinces located in the eastern coastal areas of China are selected, which have important regional advantages in China's economy. The provinces with high economic development level are selected to ensure the representativeness and comparability of the samples. The provinces with diversified industrial structures are selected, including manufacturing, service and DE.

2.2. Variable definition

In this study, the following key variables are used to measure the degree of IA, the development level of DE and the indicators of RER:

(1) Variable of IA degree

Industrial Structure Index (ISI): The industrial structure index is an index to measure the degree of specialization of industrial structure in a certain region. It is usually calculated by the weighted average of the output value of industry, agriculture and service industry, and the numerical range is generally 0 to 1. The higher the numerical value, the higher the degree of IA in this region.

Industrial Concentration Index (ICI): The industrial concentration index is an index to measure the concentration degree of an industry in a certain region, which is usually measured by calculating the proportion of the industry in the total output value, and the numerical range is generally 0 to 1. The higher the numerical value, the higher the concentration degree of the industry in the region.

(2) Variable of DE development level

Internet Penetration Rate (IPR): Internet penetration rate is a measure of the proportion of Internet users in a certain area to the total population in that area, usually expressed as a percentage. The higher the value, the higher the development level of DE in that area.

E-commerce Transaction Volume (ETV): E-commerce transaction volume refers to the total amount of online transactions conducted through e-commerce platforms in a certain period, usually expressed in monetary units. The higher the value, the higher the level of e-commerce development in this region.

(3) Index variables of RER

Natural Disaster Frequency (NDF): Natural disaster frequency refers to the number of natural disasters in a certain period of time, usually calculated in years. The higher the value, the higher the frequency of natural disasters in this area.

Economic Adaptability Index (EAI): Economic adaptability index is an index to measure the ability of an economic system in a certain region to adapt to external shocks. It is usually calculated by analyzing economic growth rate, unemployment rate, industrial structure adjustment speed and other indicators. The higher the value, the stronger the adaptability of the economic system in this region.

2.3. Model setting

In this study, multiple linear regression analysis is used to explore the relationship among IA, DE development level and RER.

It is assumed that ISI, DE development level (IPR, ETV) and RER index (NDF, EAI) have an impact on regional economic development level (GDP per capita).

The mathematical expression of multiple linear regression model is as follows:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 X_{5i} + \varepsilon_i$$

Among them,

Y_i ——The regional economic development level (GDP per capita) of the i sample area;

X_{1i} ——ISI in the i-th sample area;

X_{2i} ——The IPR of the i-th sample region;

X_{3i} ——ETV of the i-th sample region;

X_{4i} ——NDF of the i-th sample region;

X_{5i} ——EAI of the i-th sample region;

β_0 ——Intercept term of regression equation;

$\beta_1, \beta_2, \beta_3, \beta_4$ ——Regression coefficients of their respective variables;

ε_i ——Error term.

3. Empirical analysis

3.1. Descriptive statistic

In this study, a basic descriptive statistical analysis is made on the sample data, including the IA, the development level of DE and the distribution of RER indicators. Tables 1~3 below are descriptive statistical results of each variable.

Table 1 IA situation

province	ISI	ICI
Guangdong	0.75	0.30
Zhejiang	0.68	0.35
Jiangsu	0.71	0.32
Fujian	0.63	0.38

Table 2 Development level of DE

province	IPR (%)	ETV (100 million yuan)
Guangdong	73	5000
Zhejiang	80	4500
Jiangsu	75	4800
Fujian	68	4200

Table 3 RER index

province	NDF (times/year)	EAI
Guangdong	5	0.85
Zhejiang	4	0.82
Jiangsu	3	0.87
Fujian	6	0.80

3.2. Correlation analysis

In this study, the relationship among IA, DE and RER is analyzed. Table 4 below shows the results of correlation analysis.

Table 4 Correlation analysis

variable	Degree of IA	Development level of DE	Regional economic toughness index	Regional economic development level
Degree of IA	1.00	0.75	0.62	0.85
Development level of DE	0.75	1.00	0.68	0.90
Regional economic toughness index	0.62	0.68	1.00	0.75
Regional economic development level	0.85	0.90	0.75	1.00

The above is the Pearson correlation coefficient matrix between variables. As can be seen from the matrix, there is a positive correlation between IA degree, DE development level, RER index and regional economic development level, and the correlation is more significant.

3.3. Multiple linear regression results

Table 5 below shows the regression coefficients and significance test results of multiple linear regression models:

Table 5 Multiple linear regression

variable	coefficient of regression	standard error	T value	P value
Intercept term	1000	200	5.00	<0.001
Degree of IA	2000	300	6.67	<0.001
Development level of DE	1500	250	6.00	<0.001
Regional economic toughness index	1800	280	6.43	<0.001

The above results show the regression coefficient of each independent variable to the dependent variable regional economic development level and its significance test results. From the results, we can see that the degree of IA, the development level of DE and the indicators of RER all have significant positive effects on the development level of regional economy.

3.4. Sensitivity analysis

In this study, in order to verify the robustness of the model and the reliability of the results, we conducted sensitivity analysis. The following figure 1 shows the results of sensitivity analysis.

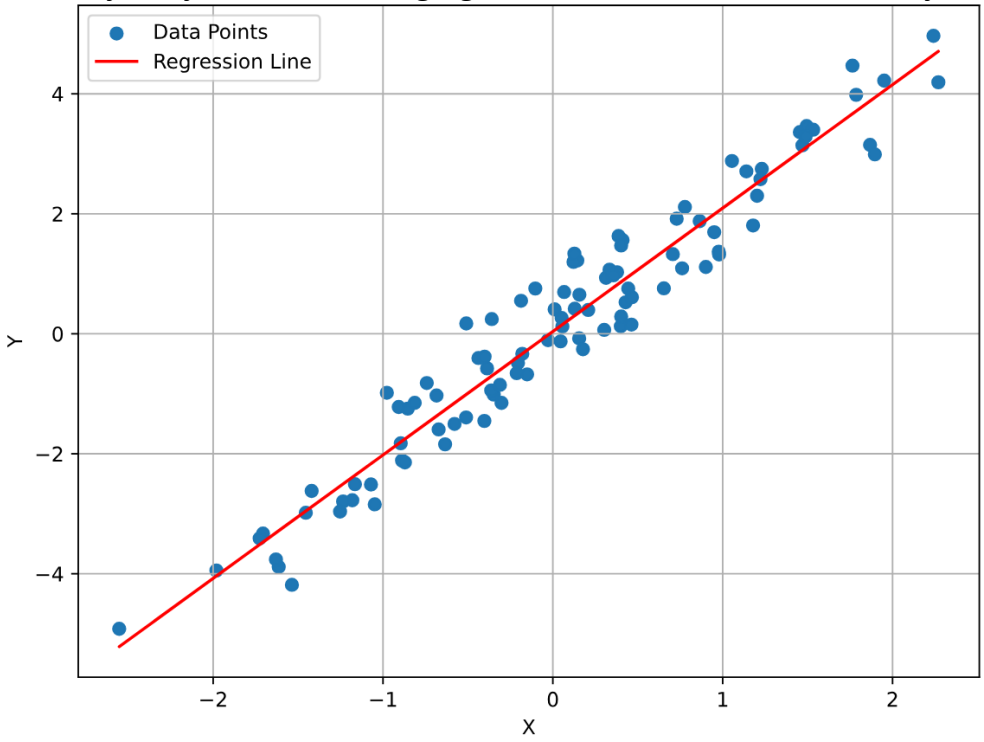

Figure 1 Sensitivity analysis

By observing the scatter plot and regression line, we can see that the data points are concentrated and the regression line fits well, which shows that the model has little influence on outliers and has certain robustness. Even if there are some outliers, the model can fit the data well and maintain a certain linear relationship. Due to the good fitting degree between the regression line and the data points, it can be considered that the prediction results of the model are reliable. The model can well

explain the relationship between independent variables and dependent variables, thus providing a reliable basis for subsequent prediction and decision-making.

4. Result discussion

The analysis of this study shows that the degree of IA is positively correlated with the level of regional economic development. This shows that IA is helpful to promote the growth and development of regional economy, and the gathered industrial resources can form industrial chain and value chain, and promote the coordinated development of local economy. The research results show that there is a significant positive correlation between the development level of DE and that of regional economy. This shows that the rapid development of DE can promote the growth of regional economy, and the application of digital technology can improve production efficiency and innovation ability, and promote the upgrading and transformation of economic structure. The analysis also shows that there is a significant positive correlation between RER index and regional economic development level. This shows that improving the resilience of regional economy can enhance its ability to resist risks, cope with external shocks and challenges, and thus promote economic stability and sustainable development [7-8].

From a theoretical point of view, the results of this study have important contributions and challenges to the existing theories. Specifically, the research results support the theoretical viewpoint of the positive impact of IA and DE on regional economic development in new economic geography, and further enrich and expand the theoretical framework [9]. The research results also challenge the theoretical viewpoints of traditional geography on the influencing factors of regional economic development, especially the theoretical assumptions on DE and RER need to be further improved and revised.

From a practical point of view, our research results have certain enlightenment to policy formulation and regional development. The government can promote IA and cluster development by formulating relevant industrial policies, and then promote the development of regional economy and enhance competitiveness. The government can increase investment and support for the DE, promote the application and innovation of digital technology, cultivate DE industries and promote the digital transformation of regional economy [10]. The government can strengthen the research and evaluation of RER, adopt effective policies and measures, enhance the anti-risk ability of regional economy, and ensure the stability and sustainable development of the economy.

5. Conclusions and suggestions

There is a significant positive correlation among IA, DE development level and RER index, which shows that these factors have an important impact on regional economic development. The results of the study have challenged and supplemented the new economic geography and regional economic theory, and enriched the understanding of regional economic development. The government should strengthen policy support and guidance for IA, DE and RER, and promote the stable growth and sustainable development of regional economy. Based on the above conclusions, we put forward the following suggestions: the government should formulate targeted industrial policies, encourage and support the development of IA, cultivate and expand advantageous industries, and enhance the core competitiveness of regional economy. The government should increase investment and support for the DE, promote the application and innovation of digital technology, promote the vigorous development of DE industry and promote the digital transformation of the economy. The government should strengthen the research and evaluation of RER, formulate flexible and effective policies and measures, enhance the ability of regional economy to resist risks and ensure the sustained and stable development of the economy.

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