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Relationship between Regional Economic Development and Ecological Environment Based on Spatial Data Mining

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Abstract

In order to understand the relationship between economy and environment under the point-axis development model, spatial data mining methods and spatial analysis software were used to analyze the spatial distribution of GDP in the Heilongjiang Province industrial corridor in 2018. In addition, the spatial correlation of GDP levels is analyzed. The results show that GDP of each county in this period is positively correlated in spatial correlation, and the correlation coefficient is small. The spatial distribution of GDP shows the spatial clustering among similar values. The spatial distribution of GDP and ecological environmental factors shows a significant positive correlation, indicating that the economic development activities of industrial corridor have a greater impact on the ecological environment. Through the analysis of the correlation between GDP and population quantity of each county in Harbin, it is found that the spatial influence of GDP on population is also positively correlated. The correlation between the GDP of the county of Harbin and the number of graduates of ordinary high schools was further analyzed. It was found that the two were negatively correlated. The current state of education cannot meet the needs of economic development very well. Therefore, the Heilongjiang Province industrial corridor shows that labor-intensive and resource-intensive companies are suitable for low-knowledge labor concentration. The law of technology-intensive enterprises, capital-intensive enterprises and high-tech labor-intensive correlations indicates that the Heilongjiang Province industrial corridor is still in a higher stage of industrialization.

Keywords: Heilongjiang Province industrial corridor, point axis development, ecological environment, spatial data mining

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INTRODUCTION

With the vigorous development of social economy, the development of regional economy is developing rapidly. At the same time, the environmental problems brought by economic development are particularly prominent. Under this great environmental challenge, human beings begin to look for ways and means to coordinate the relationship between regional development and ecological environment. The economic model of point-axis development came into being. Then, combined with the characteristics of China's development and economic layout, in 1984, the theory of point-axis development was initially formed. The model of economic belt is put forward for territorial development and regional economic development. This provides a scientific basis for the layout of industrial productivity (Wiengarten et al. 2017).

The theory of point axis development basically conforms to the objective law of productivity space motion. First of all, it makes up for the deficiency of the planar block progressive mode of gradient process through the development of the key axis and the form of gradual diffusion, and gives full play to the advantages of the main body. This method is conducive to transforming the regional dual structure and promoting the development of rural economy around the town, so as to better coordinate the economic development between the city and the region and between regions. Secondly, through the combination of the two elements of "point" and "axis", the spatial structure appears a pattern from point to axis and from axis to plane. A three-dimensional structure and grid situation is presented, which has great advantages for the horizontal flow of information and the horizontal connection of economy. In addition, it will help to maximize the optimal allocation of resources, avoid the irrational flow of resources, eliminate regional market barriers, and promote the formation of a unified national market (Beltramomartin et al. 2018).

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The Heilongjiang Province industrial corridor is located in the southwest of Heilongjiang Province. The corridor takes Harbin as the leader and Daqing and Qiqihar as the regional backbone. Harbin, Daqing, Qiqihar, Anda, Zhaodong, etc. were connected. While promoting the development of regional economy, Heilongjiang Province gives play to the special economic advantages of the region. While promoting the regional economy, the problems of water shortage, shrinking wetlands, soil erosion and other ecological environment deterioration have emerged. Taking Heilongjiang Province industrial corridor as an example, the distribution of GDP, the relationship between GDP and environment, and the relationship between GDP and population were analyzed in order to understand the relationship between economy and environment under the point-axis development model.

LITERATURE REVIEW

The research of spatial data mining is later than the research of general relational databases and transactional databases. However, it has attracted wide interest in recent years. At present, research and application of geospatial data mining and knowledge discovery have been carried out at home and abroad.

In 2016, Woodhouse studied the relationship between social capital and economic development in two small towns in Australia from 2014 to 2015. The results show that if the level of social capital is higher, the level of economic development is higher. The level of social capital is low, and the level of economic development of the town is low (Woodhouse 2016). In 2018, Mactaggart et al. used WEKA machine learning and data mining system methods to study the impact of education investment and research and development investment on economic welfare. The results show that participation in high-level education and research and development has a high impact on economic welfare. In addition, research and development indicators can be used as an important driver to evaluate economic welfare (Mactaggart et al. 2018). Traynor used time series to study the relationship between economic development and traffic fatalities. The interaction between highway usage, personal average income, and mortality is considered. The results show that the number of vehicles per kilometer is inversely related to mortality, and the number of vehicles per kilometer is directly related to mortality. State and federal government policy makers should consider the impact of resource allocation (Traynor 2018), Wiebe and Branas (2016) proposed the overall theoretical framework of regional ecological environment spatial data mining based on GIS and RS. Based on the comprehensive analysis of the main characteristics of the ecological environment data, the establishment method of the ecological environment database is proposed. Multi-factor quantitative ecological sensitivity comprehensive evaluation and ecological function zoning were completed. Mao(2018) analyzed the impact of the global financial crisis on infrastructure. By comparing the traffic volumes of several typical countries, the relationship between economic data and population, transportation, and social economic indicators is explored. The definition of the various stages in the process of transport and economic development is further proposed. Shirani et al. (2018), used data mining methods such as model trees and linear regression to study the report of the Statistical Institute of Romania during the period of 2016-2017. In addition to the typical way of investigating the pattern of GDP, the evolution of GDP in Romania and the influence of the pattern are discussed through wage levels and the contribution of employers to different sectors of the economy.

METHODS

Theory of Coordinated Development of Regional Development and Environment

In recent years, with the continuous development of economic construction, regional development activities have been increasing. Many countries have carried out a series of major development activities in specific regions and periods. These development zones are generally referred to as development zones, such as economic and technological development zones, high-tech industrial development zones, and tourist resorts. The impact of these projects on the regional environment has additive and cumulative effects (Luo and Shen 2016). The development of human regions is essentially a process of breaking the original ecological balance of the region and transforming it into a new ecological environment. Regional development is one of the most powerful effects of human economic activities on the ecological environment. The direction of regional development is very clear, which is the transformation of the original ecological environment system of the region. In the process of regional development, human beings use the materials and energy provided by the local ecological environment to transform the original ecological system into another ecological environmental system according to human needs. For example, the original ecosystems such as forests, grasslands, and marshes are transformed into artificial ecosystems such as plantations, grasslands, swamps, agriculture, or cities. Artificial ecosystems can better meet the needs of human socio-economic development. For example, agro-ecosystems provide more stable conditions for human beings, and urban ecosystems provide convenience for human industrial and commercial development. However, in the process of development, due to the loss of natural resources and the occupation of ecological environment capacity, the original ecosystem is destroyed, which constitutes the ecological environment cost of regional development (Wan et al. 2017).

Point Axis System Theory

Formation of point axis system theory

Polish economists Salamba and Marx first proposed the theory of point axis development, which is widely used in regional planning. In 1984, a theoretical model of the point-axis system was proposed. In the continuous research and supplement, the formation process of the point-axis spatial structure, the structure and type of the development axis, the point-axis progressive diffusion, the point-axis accumulation area and the formation of the point-axis spatial structure system are elaborated. A complete system has basically been formed.

The connotation of point axis system theory

Point - axis development is progressively diffused. At some point, point-axis theory is at the heart of central geography. Within the scope of this region, the existing linear infrastructure (modern transportation, communication, power supply, water supply, gas supply, etc.) between several regions with strong conditions and between cities is determined to be the key development point (urban area, industrial area, development center) on the axis. The linear infrastructure forms clusters in space, thus forming the development axis, which enables the industrial and population clusters of the line and the city to develop along the axis (Hong et al. 2016) Point-axis development theory holds that the spatial movement and diffusion of economy have an impact on regional economy through the point. Then, through the driving of the shaft, the focus of regional development is to achieve small-pitch jump transfer (He et al. 2017).

The regional development has reached a certain stage and the regional economic strength has been continuously enhanced. Many of the original growth poles increase in density over a certain spatial range. With the improvement of traffic conditions, industrial correlation and the spatial interaction between points and points, the development axis gradually extends to underdeveloped areas, including development areas far from the central axis of the development zone and remote areas. With the development center point as the low-level development center, the point is gradually transferred to the line, and the point-axis development system is composed to realize the better configuration of resources.

The application of point axis system theory

The point axis development mode is a specific application of the point axis system theory. The point-axis model believes that resource elements are always concentrated first in a few cities or enterprises with better location conditions. The process of forming "points" (i.e., growth poles) is also the process of polarization. Growth factors are freely circulated between points with comparative advantages depending on various types of traffic routes and even power supply lines, which form an axis. Once the axis is formed, it has a stronger polarization effect on various factors such as population and industry. The flow of people and logistics in the area radiated by the point axis has increased rapidly, and production and transportation costs have decreased. The location conditions and investment environment have been further improved, which has given birth to new economic growth points. When the point axis passes through, a point axis system is formed. Compared with the growth pole development model, the point-axis development model not only focuses on point driving and radiation, but also focuses on the aggregation and diffusion effects of the shaft in regional development. After the development axis is continuously enriched, it will eventually become a development zone (Zhong and Gross 2017).

Spatial Data Mining

The meaning and characteristics of spatial data mining

Spatial data mining (SDM) or spatial knowledge discovery (SKDD) is the discovery of potentially valuable features and patterns implicit in spatial databases. The content of spatial data mining is much richer than general data mining. Due to the huge difference between spatial data and ordinary data, there are considerable differences between spatial data and other types of data in mining methods. The complex characteristics of spatial data determine that spatial data mining has the following characteristics (Jr et al. 2018):

First, spatial data has spatial autocorrelation, and everything is related to other things. However, the correlation between adjacent things is much greater than the distance between things that are far away. Therefore, when performing spatial data mining, the influence of the spatial object itself and the non-spatial properties of its neighboring objects is considered. Traditional data mining methods usually assume that data samples are independently distributed, which is not true in spatial data.

Second, there are many spatial data mining methods, and most of them are more complicated and difficult. Some algorithms are only applicable to specific areas.

Third, spatial data mining is a decision support process based on spatial data. It has technical difficulties such as dynamic data changes, noise, data incompleteness, information redundancy, data sparseness and large data volume.

Fourth, there are many types of knowledge and various ways of expression. The understanding and evaluation of knowledge depends on the degree of human cognition of the objective world.

The main method of spatial data mining

According to the characteristics of spatial database, there are many methods of spatial data mining and knowledge discovery. The spatial data mining methods involved in this paper mainly include spatial analysis methods, statistical analysis methods, and spatial association rules mining methods.

In addition to the above methods, the commonly used methods for spatial data mining include Rough set method, cloud theory, image analysis and pattern recognition, clustering method, exploratory data analysis, genetic algorithm, fuzzy set theory, artificial neural network, decision tree, etc. (Wang and Eick 2018).

Spatial Autocorrelation

In practical applications, in order to discover certain types of knowledge, different methods need to be used for different data, and these methods are sometimes used in combination. With the help of Geoda095i software, the spatial correlation between the economic development of Heilongjiang Province industrial corridor and environmental factors and population distribution was analyzed. The role of regional point axis development in the economic development of Heilongjiang Province industrial corridor is more intuitively illustrated. This provides a basis for the more scientific and sustainable development of the regional economy and a reference for guiding the more stable growth of the regional economy.

A binary symmetric spatial weight matrix W is usually defined to express the neighborhood of spatial regions at several locations (Munsie and Gyngell 2018). Its form is as follows:

$$W = \begin{bmatrix} w_{11} & w_{12} & \Lambda & w_{1n} \\ w_{21} & w_{22} & \Lambda & w_{2n} \\ \Lambda & \Lambda & \Lambda & \Lambda \\ w_{n1} & w_{n2} & \Lambda & w_{nn} \end{bmatrix} \quad (1)$$

In the formula, n represents the number of spatial units, and W_{ij} represents the neighbor relationship of the regions i and j. A weight matrix based on spatial adjacency is established in 28 cities and counties in the Heilongjiang Province industrial corridor area. The adjacency here means having a common boundary, and the rules are as follows:

$$w_{ij} = \begin{cases} 1 \ when\ the\ areas\ j\ and\ i\ are\ connected \\ 0\ others \end{cases} \quad (2)$$

The Moran index reflects the degree of similarity of spatially adjacent or spatially adjacent unit attribute values. If it is an observation of a position (region), the global Moran index of the variable is calculated by the following formula (Luo et al. 2017):

$$I = \frac{n\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(x_i - \overline{x})(x_j - \overline{x})}{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}\sum_{i=1}^{n}(x_i - \overline{x})^2} = \frac{\sum_{i=1}^{n}\sum_{j\neq 1}^{n} w_{ij}(x_i - \overline{x})(x_j - \overline{x})}{S^2\sum_{i=1}^{n}\sum_{j\neq 1}^{n} w_{ij}} \quad (3)$$

$$S^2 = \frac{1}{n}\sum_{j}(x_i - \overline{x})^2 \quad (4)$$

$$\overline{x} = \frac{1}{n}\sum_{i=1}^{n} x_i \quad (5)$$

In the formula: I is the Moran index; x_i is the observation of the region i; w_{ij} is the spatial weight matrix;

The Moran index I is generally between [-1, 1]. If the value is less than 0, it indicates a negative correlation. If the value is equal to 0, it means irrelevant. If the value is greater than 0, it indicates a positive correlation.

The local indicators of spatial association (LISA) meet the following two conditions: The first is the LISA of each regional unit. This is an indicator to describe the degree of spatial clustering among the regional units with significant similar values around the regional units. The second is that the sum of all regional units LISA is proportional to the global spatial connection indicator.

LISA includes a local Moran index and a local Geary index. The local Moran index is introduced and discussed below. The local Moran index is defined as (Moran et al. 2016):

Table 1. Key construction enterprises of Heilongjiang Province industrial corridor

Industrial zone name	Planned area (square kilometers)	Key development company
Harbin Industrial Zone	251.68	Green food, modern medicine, automobile, aerospace, electromechanical industry, airport logistics and finishing, trade with Russia, etc.
Daqing Industrial Zone	155.63	Petrochemical, natural gas chemical, textile industry, glass, rubber, petroleum processing
Qiqihar Industrial Zone	111.87	Equipment industry, organic agricultural production materials, metallurgical manufacturing and new energy-saving and environmentally-friendly building materials industry and deep processing of coal chemical industry

$$I_i = \frac{(x_i - \overline{x})}{S^2} \sum_j w_{ij}(x_j - \overline{x}) \quad (6)$$

Moran scatter plots are often used to study local spatial instability. The four quadrants of the Moran scatter plot correspond to the four types of local spatial associations between the regional unit and its neighbors: The first quadrant represents the spatial relation form in which the regional units with high observed values are surrounded by the same high-value region. The second quadrant represents the spatially connected form of the low-observation regional unit surrounded by the high-valued region. The third quadrant represents a spatially connected form of low-observation regional units surrounded by low-value regions. The fourth quadrant represents the spatial association of high-observation regional units surrounded by low-value regions (Sinaiko et al. 2016)

Compared with local Moran index, its important advantage is that it can further distinguish the spatial relation forms among high value and high value, low value and low value, high value and low value, low value and high value between regional units and their neighbors. Combining Moran scatter diagram with LISA significance level, Moran significance level diagram can be obtained. The figure shows significant LISA region and identifies response regions corresponding to different quadrants in the Moran scatter diagram (Lechner et al. 2017).

EXPERIMENTS

In 2018, the total area of the Heilongjiang Province corridor was 21,180 square kilometers, accounting for 4.67% of the total area of the province. The total population is 8.03 million, accounting for 21.04% of the total population of the province. The total production value is 260 billion-yuan, accounting for 49% of the province. The per capita GDP is 32,379 yuan. The GDP of Harbin, Daqing and Qiqihar were 286.8 billion yuan, 222 billion yuan and 66.6 billion yuan respectively. The per capita GDP is 29,012 yuan, 80,655 yuan and 12,272 yuan respectively. This shows that the economic development level of Harbin and Daqing is much higher than that of Qiqihar. The industrial structure of the three cities is generally characterized by heavy chemicals. Harbin's tertiary industry is the most developed. In 2018, the added value was 151 billion yuan, which accounted for 49.7% of the city's GDP. The added value of the primary industry is 40 billion yuan, and the added value of the tertiary industry is 108.6 billion yuan. They accounted for 14.7% and 38.3% of the city's total GDP, respectively. The added value of the first, second and third industries in Qiqihar City was 14.6 billion yuan, 22.7 billion yuan and 29.3 billion yuan. They account for 24.1%, 33.9% and 43.1% of the city's total GDP, respectively.

DISCUSSION

Industrial structure analysis of industrial corridor of Heilongjiang Province

The sustainable development of the economy depends on whether the spatial layout of the industrial structure is reasonable. When the concentration of industrial structure is high, the gap in economic output between industries will be large, and the development of various industries in the region will be extremely uneven. The concentration index can well describe the concentration degree of geographical elements or the specialization degree of economic elements, and it can also reflect the concentration degree of certain economic activities in space and analyze the concentration degree and its changes of the spatial layout of industrial structure in a certain period. Its calculation formula: $J = (A - R)/(M - R)$. Among them, J: centralization index; A: the total cumulative percentage of the three major industries; M: cumulative percentage of the assumed three major industries when they are concentrated; R: the cumulative percentage of the assumed three major industries when they are all evenly distributed. The value of the centralization index J is between 0 and 1. When the concentration index J is larger, the degree of centralization of the industrial distribution is high. And the smaller the J, the more balanced the industrial distribution. $J = 1$ indicates that

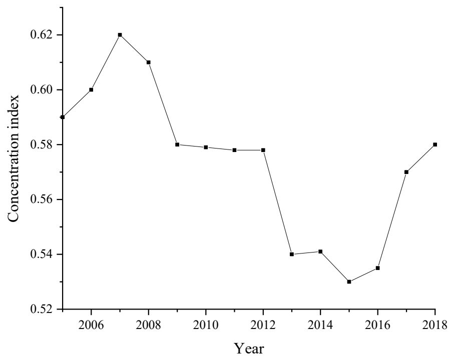

Fig. 1. Concentration of industrial structure

the industry is completely concentrated, and $J = 0$ indicates that the industry is evenly distributed. The industrial structure concentration index is calculated. **Fig. 1** shows the trend of industrial structure concentration index. It can be concluded that the concentration of the spatial layout of the industrial structure of the industrial corridor of Heilongjiang Province has been at a above-average level. It can be concluded from the figure that after 2005, the highest point was in 2007, indicating that the industrial space was the most concentrated in 2007; from 2008 to 2015, the overall trend of industrial structure concentration was declining, which indicated that the spatial layout of industrial structure of the industrial corridor of Heilongjiang Province had become more and more reasonable; however, after 2015, the concentration index began to rise again, and the spatial layout of the industrial structure developed in the direction of centralization again.

Correlation analysis between structural characteristics and ecological environment effects of industrial corridor industry of Heilongjiang Province

SPSS statistical software is used to analyze the correlation between the advanced degree, concentration degree, rationality degree and ecological environment index of industrial structure of the industrial corridor of Heilongjiang Province from 2005 to 2018, and the results are shown in **Table 1**. It can be concluded that the correlation coefficients of advanced degree, concentration degree and rationality degree of industrial structure reach 0.98 and 0.76 respectively, showing a highly significant positive correlation, indicating that the transfer of industrial structure and the concentration of regional industrial structure are developing simultaneously. The economic development brought about by the transfer of industrial structure will lead to the irrational industrial structure, which also indicates that the current industrial structure transfer of the industrial corridor of Heilongjiang Province doesn't match the ideal rational industrial structure and needs to be adjusted; the rationality and concentration of the industrial structure are also significantly and positively correlated, indicating that the more concentrated the industrial structure of the industrial corridor of Heilongjiang Province, the lower the rationality of its industrial structure. At the same time, the ecological environment effect of industrial structure is significantly negatively correlated with its industrial structure characteristics, indicating that with the improvement of industrial structure level and the acceleration of industrial transfer in the current period, the current ecological environment will be improved and pollution will be reduced. In 2005-2018, according to the indication of the correlation coefficient, the more concentrated the current industrial structure distribution and the more reasonable the industrial structure, the less pollution to the ecological environment. Correlation between industrial structure characteristics and ecological environment index.

Regression analysis of ecological environment and economic development of Heilongjiang Province

Data of per capita GDP, waste water discharge, industrial waste gas discharge and solid waste production from 2005 to 2018 in the industrial corridor of Heilongjiang Province were selected. The level of economic development (the standard development level of per capita GDP) was taken as the explanatory variable X, and the degree of environmental damage was used as the explanatory variable Y. It was assumed that the degree of environmental damage was determined by three factors: wastewater, waste gas and waste. The analytic hierarchy process (AHP) of SPSS software was used to determine the influence weights of waste water, waste gas and waste on the degree of environmental damage. The results showed that the relative importance of wastewater, waste gas and waste to environmental damage was: $W_1=0.444$, $W_2=0.333$, and $W_3=0.223$. Then the degree of damage Y was calculated.

Table 2. Correlation between industrial structure characteristics and ecological environment index

Correlation coefficient	Advanced degree	Concentration ratio	Reasonable degree	Ecological environment index
Advanced degree	1	0.98**	0.76**	-0.89**
Concentration ratio		1		-0.88**
Reasonable degree			1	-0.92**
Ecological environment index				1

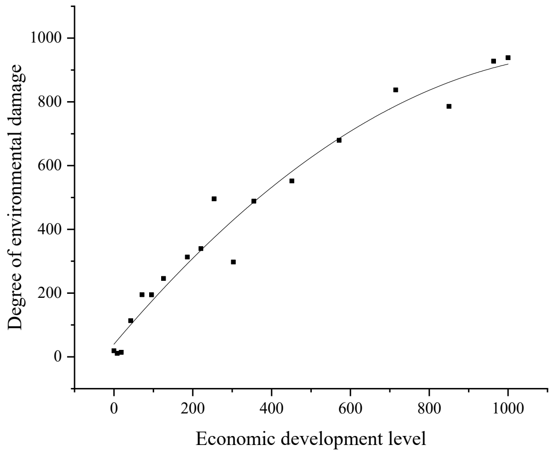

Fig. 2. Environmental curve fit diagram of Heilongjiang Province

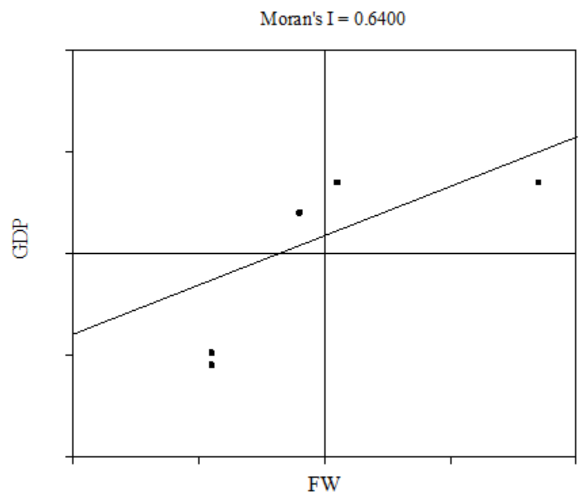

Fig. 3. Correlation between GDP and industrial solid waste emissions

With x as the X-axis variable and Y as the Y-axis variable, SPSS software was used to fit the x and Y data obtained by regression analysis, and the optimal quadratic curve was selected to obtain such a model: $Y = 39.542154 + 1.465177x - 0.000586x^2$. The model's decision coefficient R^2 is 0.96498, the standard error is 58.86008, and the value of the F-test statistic is 235.21021. The t-test statistics of parameter estimation of variables x and x^2 are 9.168 and –3.633, respectively, and the critical point of t-distribution is 2.131 when the degree of freedom was 15 and the confidence interval is 95%, so all model parameters pass the t-test.

The above model selected wastewater, waste gas and waste as the criteria for describing the degree of environmental damage, but the environmental change didn't only include these three types, so it couldn't fully reflect the relationship between the economy and the environment. Even so, the analysis in the figure showed that the economic development model of Heilongjiang Province was at the expense of environmental damage.

Correlation Analysis of GDP and Population of Heilongjiang Province

Population is an important factor in the social situation of a region. The size of the population, the structure of the population, and the distribution of the population and the quality of the population play an important role in the economic development and social customs of a region. Population is an essential factor for economic growth and economic development, but excessive population growth has a huge negative impact on the economy.

In order to understand whether the spatial distribution structure of the population in the Heilongjiang Province industrial corridor region directly affects the distribution of GDP, the correlation between the spatial distribution of GDP in the counties of Heilongjiang Province and the spatial distribution of the population of each county was established. The population attribute data and the GDP attribute data are selected as two variables of the spatial correlation analysis, the correlation parameters are set, and the correlation analysis is performed. Moran's $I = 0.1223$, it can be seen that the GDP of the counties of Heilongjiang Province is positively correlated with the population of each county. The spatial correlation between GDP and population distribution is relatively strong. The reason for this is mainly because Heilongjiang Province industrial corridor has consistently adhered to the goal of consolidating and strengthening the primary industry, transforming and upgrading the secondary industry and accelerating the development of the tertiary industry. An industrial pattern has gradually taken shape with agriculture as the foundation, high-tech industries as the forerunner, equipment manufacturing and raw material industries as the support, and the service industry developing rapidly and comprehensively.

The scientific and cultural quality of the population plays a key role in promoting economic development. The UNESCO study shows that labor productivity is positively correlated with the educational level of the workforce. Compared with illiterate, elementary school graduates can increase productivity by 43%, junior high school graduates can increase productivity by 108%, and college graduates can increase productivity by 300%.

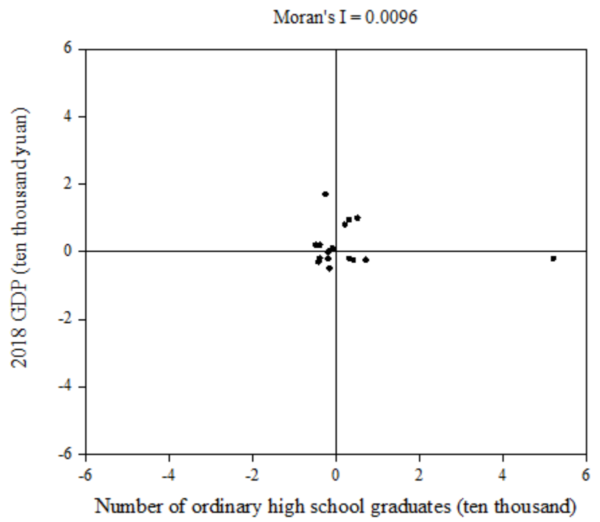

Fig. 4. The distribution of the correlation between GDP and the number of ordinary secondary school graduates

The correlation between the GDP of Heilongjiang Province and the number of graduates in ordinary secondary schools was established (**Fig. 4**). Moran's $I = -0.0096$, It can be seen that the GDP attribute data is negatively correlated with the attribute data of ordinary middle school graduates, and the spatial correlation between GDP and the number of ordinary middle school graduates is weak. Therefore, in areas with strong economic strength, the quality of the population is relatively poor. In the Heilongjiang Province industrial corridor, except for the number of graduates from Harbin Ordinary Middle School, which is 76,788, the highest is in other regions. This phenomenon occurs mainly because of the low level of knowledge, and productivity may be low. However, due to the low level of knowledge specialization, the cost of knowledge integration (transaction cost) is inevitably lower, and the net output of the regional production system is still greater than zero or even higher than the social evaluation productivity level. On the other hand, in high-tech regions, although specialization and division of labor in the process of knowledge specialization lead to higher transaction costs (knowledge integration costs), their productivity is higher. This leads to net output greater than zero, or even higher than the average level of social growth. Therefore, the Heilongjiang Province industrial corridor shows that labor-intensive and resource-intensive companies are suitable for low-knowledge labor concentration. The law of technology-intensive enterprises, capital-intensive enterprises and labor-intensive high-tech levels was discovered. This also shows that the Heilongjiang Province industrial corridor is still in the early stages of industrialization.

CONCLUSIONS

With the rapid development of the regional economy, Heilongjiang Province proposed a strategic decision to build the Heilongjiang Province industrial corridor to alleviate the contradiction between accelerating development and insufficient construction land. According to the GDP data of cities and counties in the Heilongjiang Province area in 2018, spatial statistical analysis was carried out. It is concluded that the GDP of each city and county in the period is positively correlated in spatial correlation, and the correlation coefficient is small. The spatial distribution of GDP is not completely random. Instead, it shows spatial clustering between spatial similarities. The correlation between the GDP of the Heilongjiang Province industrial corridor and the emissions of wastewater, waste gas and solid waste was analyzed. The values of Moran's I are 0.6769, 0.7792, and 0.6400, respectively. It shows that GDP and ecological environment factors show a significant positive correlation in spatial distribution. The economic development activities of industrial corridors have a great impact on the ecological environment. The ecological environment of the Heilongjiang Province industrial corridor is fragile. Therefore, it is necessary to pay attention to the protection of the surrounding environment during the development process. Further, the spatial distribution of GDP in Heilongjiang Province counties is related to the spatial distribution of the population of each county. The correlation between the GDP of Heilongjiang Province and the number of graduates of ordinary high schools was established. Studies have shown that GDP is positively correlated with the spatial impact of the population, but the correlation is not significant. The GDP attribute data is negatively correlated with the number of ordinary secondary school graduates. This shows that the continuous expansion of the population and the low quality of the population have led to the inconsistency of the population and economic development needs of the Heilongjiang Province industrial corridor. The coordination and sustainable development of economy, resources and environment of Heilongjiang Province industrial corridor are affected and constrained.

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