Dependence Analysis of Education and Regional Economic Development: A Case Study of Dezhou City

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Abstract. China's economic construction changes from the development speed requirements to the quality optimization period, the status of the national economic construction has put forward new goal planning for the economic construction of Dezhou city - to optimize the economic construction structure. The country is strong when the young are strong, and the country is good when the young are excellent. This paper analyzes the relationship between Dezhou's education level construction structure and regional economic development cooperation, and provides new ideas for optimizing Dezhou's economic construction structure by optimizing the education level construction. Based on the education structure data and economic structure data of Dezhou City from 2013 to 2023, this paper analyzes the correlation degree of education structure and economic structure, and probes into the dependence analysis of economic construction relying on the development construction function of education construction structure. The analysis results show that the coverage of middle school education and college students is highly consistent with the GDP development of Dezhou. The deepening of middle school education and local college education as the direction of education deepening may contribute to the economic construction of Dezhou. The analysis theory can provide reference for Dezhou's economic construction and education investment planning, and provide research basis for the subsequent development planning of Dezhou.

Keywords: economy, educational structure, correlation degree, dependence analysis.

1 Introduction

With the rapid development of China's economy, education, as an important factor supporting economic development, has attracted increasing attention for its coordination with regional economy. Dezhou City of Shandong Province, as an important engine of economic development in the northwest of Shandong Province, is also one of the important agricultural and industrial bases in the country. At the same time, Dezhou's transportation and location advantages also provide strong support for economic development.

Under the background of innovation-driven development strategy, regional coordinated development strategy, green development and open economy, Dezhou will continue to increase its efforts in industrial structure adjustment and transformation and upgrading to promote sustainable and healthy economic development. Science and education revitalize the region, education development is closely combined with regional economic development, so that education can better serve the development of regional economy, and at the same time adjust educational policies according to the development of regional economy, so as to realize the

coordinated development of education and economy is the direction of social development. The analysis of the coordination between education level and regional economic development is of great practical significance. This paper aims to deeply explore the inner relationship between Dezhou's education level and regional economic development, and help Dezhou's economic development and science, education and education to advance together.

In order to quantitatively express the relationship between qualitative analysis, theoretical education level construction and regional economic development.[1,2] Pearson's correlation coefficient theory was introduced to accurately express the coordination between education level construction and regional economic development, and the selected research elements of education level in Dezhou from 2013 to 2023 were calculated: education level of higher education, secondary education, vocational education, regional economic development and economic development level: The Pearson correlation coefficient of primary industry, secondary industry and tertiary industry explains the driving influence of education level and economic structure.

By using the Douglas production function calculation, we simulate the driving model of the effect of education level on regional economic structure in recent 10 years, and explain the synergistic characteristics of the development of education level on regional economic construction in the dimension of time and space. The grayscale prediction of education structure in 2023 proves the feasibility value of the research method.

The research method can assist Dezhou's economic construction investment planning and educational structure level planning decision-making, and provide ideas for relevant departments to investigate education development.

2 Analysis of education status quo in Dezhou City

In recent years, education in Dezhou City has made remarkable progress. The education system at all levels, such as higher education, vocational education and basic education, has been greatly improved. The number and scale of higher education institutions continue to expand, providing the necessary talent support for local economic development. At the same time, the development of vocational education is also close to market demand, providing technical skills for the transformation and upgrading of local industries. The popularization and promotion of basic education has laid a foundation for the improvement of local residents' quality.

3 Dezhou City economic development status analysis

The economic development of Dezhou City is in good condition, and the main industries include manufacturing, agriculture and service industry. Among them, the manufacturing industry is the economic pillar of Dezhou, especially the development momentum of high-end manufacturing industry is strong. In terms of agriculture, the process of agricultural modernization in Dezhou City has been accelerating, and the efficiency of agricultural production has been improved. In terms of service industry, Dezhou's service industry has developed rapidly, especially the emerging service formats such as logistics and e-commerce have a good momentum of development.

4 The coordination analysis of education level and regional economic development

4.1 Data Sources

The research data encompasses educational hierarchy structure data and economic development data. The economic development basic data from 2013 to 2023 for Dazhou City includes GDP, the GDP of the primary industry, the GDP of the secondary industry, and the GDP of the tertiary industry. The educational structure analysis basic data set comprises the number of students in higher education institutions, vocational education institutions, middle schools (high schools and junior high schools), primary schools, kindergartens, as well as special education school student numbers for each year from 2013 to 2023. These research datasets are sourced from the official website of Dazhou Statistical Bureau.

4.2 Pearson Correlation Analysis

Pearson correlation is utilized to assess attribute association using Pearson's correlation coefficient which ranges between -1 and 1. A value greater than 0 closer to 1 indicates a positive correlation suggesting a higher degree of association between analyzed educational levels and regional economic development with mutual promotion driving form; while a value less than 0 closer to -1 signifies negative correlation indicating a higher degree of association but with mutual hindrance driving form; values closer to 0 indicate lower correlation coefficients signifying lesser impact on regional economic development by analyzed educational levels.

The formula for calculating Pearson's correlation coefficient is:

$$r = \frac{\sum(x-\overline{x})(y-\overline{y})}{\sqrt{\sum(x-\overline{x})^2\sum(y-\overline{y})^2}} \tag{1}$$

Where r represents Pearson's correlation coefficient, x and y represent two analyzed attribute values, $\overline{x}$ and $\overline{y}$ denote average attribute values.

Using SPSS for computing analysis attributes' Pearson correlations reveals strong dependency between Dazhou City's economic construction and regional higher education student numbers, vocational education student numbers as well as middle school (secondary education) student numbers along with special education student numbers. Further detailed analysis shows that vocational education has a stronger relationship with secondary education compared to special education concerning their impact on regional economic construction. Qualitative analysis reflects that students' sources at different educational levels in Dazhou City show relatively smaller proportions from within or outside city areas for higher educations whereas similar proportions exist for vocational educations & secondary educations among local & non-local sources respectively.

Based on importance level according to correlations strength , less significant analytical attribute indicators are excluded while important descriptors closely related to economic construction are extracted . This allows simulation modeling over past decade exploring influence intensity regarding both educational & economical aspects.

Table 1: Summary of Pearson Correlation Coefficients Between Educational Attributes And Economic Attributes

	1	2	3	4	5	6	7	8	9	10	11	12
1	1	.951**	.911**	.918**	0.605	.940**	.971**	-0.527	.899**	.798*	0.313	0.411
2	.951**	1	.880**	.925**	0.532	.896**	.911**	-0.697	.847**	.782*	0.366	0.399
3	.911**	.880**	1	.990**	0.49	.982**	.983**	-0.329	.988**	.943**	0.66	.746*
4	.918**	.925**	.990**	1	0.461	.968**	0.12	-0.445	.970**	.940**	0.65	0.706
5	0.605	0.532	0.49	0.461	1	0.639	-0.337	-0.107	0.531	0.332	-0.08	0.13
6	.940**	.896**	.982**	.968**	0.639	1	0.033	-0.322	.976**	.886**	0.546	0.664
7	-0.264	-0.216	0.154	0.12	-0.337	0.033	1	0.449	0.165	0.323	.806*	.760*
8	-0.527	-0.697	-0.329	-0.445	-0.107	-0.322	0.449	1	-0.293	-0.298	0.057	0.169
9	.899**	.847**	.988**	.970**	0.531	.976**	0.165	-0.293	1	.952**	0.645	.751*
10	.798*	.782*	.943**	.940**	0.332	.886**	0.323	-0.298	.952**	1	.776*	.819*
11	0.313	0.366	0.66	0.65	-0.08	0.546	.806*	0.057	0.645	.776*	1	.959**
12	0.411	0.399	.746*	0.706	0.13	0.664	.760*	0.169	.751*	.819*	.959**	1

** At 0.01 level (double-tailed), the correlation was significant; * At level 0.05 (two-tailed), the correlation was significant.

In order to simplify the form of the table, the analysis attribute indicators are codenamed, and the corresponding situation is as follows: 1GDP (billion yuan); 2. Primary industry (100 million yuan); 3. Secondary industry (100 million yuan); 4. Tertiary industry (100 million yuan); 5 Population (10,000); 6. College students (10,000); 7 Vocational school students (10,000); 8 Primary school students (10,000); 9 Middle school students (10,000); 10 special education students (10,000); 11 Kindergarten students (10,000); 12 Total population with education (10,000).

4.3 Regression simulation analysis

The Douglas production function [3,4] is a form of production function proposed by the American mathematician Charles Cobb and the economist Paul Dauglas in 1928:

$$Y = AK^{\alpha}L^{\beta} \tag{2}$$

The parameter Y represents output, K represents capital input, and L represents labor input. α and β represent the output elasticity of capital and labor, and meet $0 \leq \alpha \leq 1, 0 \leq \beta \leq 1$. α+β greater than 1, equal to 1, less than 1, respectively, represents increasing, constant and decreasing returns to scale; A is the efficiency factor, which, in a broad sense, reflects the level of technological progress. Up to now, production function theory has not been limited to the field of economic production, and domestic and foreign scholars have conducted research and verification of production function. Douglas production function theory has been gradually applied to the research of economic output development, agricultural production development and Marine industry construction [5], airport volume forecasting and airport development benefits [6], railway and road transportation development scale forecasting [7] and education structure construction and development [8].

According to the correlation analysis results, SPSS was used to regression fit the economic construction of Dezhou City by combining the data of higher education, middle school education and special education from 2013 to 2023, and the regression fitting model that the

economic construction and development of Dezhou City depend on the regional education structure was obtained:

$$GDP = 0.65G^{0.734}Z^{0.91}z^{0.899}T^{0.798} \tag{3}$$

Among them, GDP is the gross National product of Dezhou City in the year of analysis (unit: 100 million yuan); G is the number of college students in Dezhou City (unit: 10,000); Z is the number of students in vocational schools in Dezhou City (unit: 10,000); z is the number of middle school students (unit: 10,000); T is the number of students in special education schools in Dezhou City (unit: 10,000). The goodness of regression fit calculated by the regression equation in SPSS is 0.879, indicating significant regression reliability. The economic construction of Dezhou City has a strong dependence on higher education, higher vocational education, middle school education and special education school education, which has a large proportion of local students.

As an important factor supporting economic development, the coordination between education and economic development is very important. The education system of Dezhou City has better coordination with economic development at all levels. Higher education provides the necessary talent support for local economic development and promotes the high-end development of industry. The development of vocational education is close to the market demand and provides a large number of technical talents for local industries. The popularization and promotion of basic education has laid the foundation for the improvement of local residents' quality and provided the necessary human resources guarantee for economic development.

Taking secondary vocational education as an example, this paper discusses the secondary indicators related to education levels, uses the secondary indicators of the development level of secondary vocational education, and uses the combination empowerment method to estimate the comprehensive scores of the primary indicators of the development level of secondary vocational education as C_{i1}, C_{i2}, C_{i3} and C_{i4}.[9-11] The calculation formula is as follows:

$$C_{i1} = \sum_{j=1}^{12} w_j \times Y_{ij} , C_{i2} = \sum_{j=13}^{7} w_j \times Y_{ij} \tag{4}$$

$$C_{i3} = \sum_{j=19}^{6} w_j \times Y_{ij} , C_{i4} = \sum_{j=36}^{6} w_j \times Y_{ij} \tag{5}$$

Secondly, according to the comprehensive score of the first-level index of the development level of secondary vocational education, the comprehensive evaluation score C_i measured by the combination empowerment method is calculated using the following formula:

$$C_i = \sum_{j=1}^{4} w_j \times Y_{ij} \tag{6}$$

Spatial autocorrelation model

(1) Global autocorrelation

Moran's | index was used to calculate the degree of global spatial autocorrelation, and the spatial dependence and agglomeration model of the development level of secondary vocational education was analyzed. The global Moran's | index formula is as follows:

$$I = \frac{n \sum_{i=1}^{n} \sum_{i \neq j}^{n} w_{ij}(v_i - \bar{v})(v_j - \bar{v})}{\sum_{i=1}^{n} \sum_{j \neq i}^{n} W_{ij} \sum_{i=1}^{n}(x_i - \bar{x})^2} \tag{7}$$

(2) Local spatial autocorrelation

The local Moran's I index assesses the degree of autocorrelation in local regions and reveals the spatial heterogeneity of the data. The Getis-Ord Gi* index was used to distinguish the

distribution of hot and cold spots on the local spatial region (i) of the development level of secondary vocational education. The calculation formula is as follows:

$$G_i = \frac{\sum_{j=1}^{n} w_{ij} v_j}{\sum_{j=1}^{n} v_j} \tag{8}$$

According to the coupling degree analysis, the index of correlation degree analysis in Table 1 is screened.

5 Conclusion

The economic construction of Dezhou City has a strong dependence on the regional educational hierarchy planning, among which the higher vocational education, middle school education and special education are more closely related to the regional economic construction under the influence of the student source ratio. This provides new ideas for planning economic construction development, education investment intensity, and the proportion of education funds in different hierarchical structures. The regression model has a high regression simulation excellence of 0.879, and the reliability of analyzing ideas to assist the relevant decision-making of government departments is obtained.

On the whole, there is a good coordination between education level and regional economic development in Dezhou. However, in order to better promote the coordinated development of economy and education, further efforts are still needed. For example, increase the investment in education and improve the quality of education; Optimize the educational structure to better adapt to and lead economic development; Strengthen the integration of industry and education, and enhance the ability of education to serve economic development. Through the implementation of these measures, we can further promote the coordination of education level and regional economic development in Dezhou City, and realize the benign interactive development of economy and education.

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