

The Correlation Analysis of Education Level and Regional Economic Growth Quality in Guangdong Province

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ABSTRACT

Under the background of China's slowing economic development trend, Guangdong Provincial Government took the lead in putting forward the innovation-driven development strategy. The level of educational efficiency is closely related to the quality of regional economic growth. This paper examined the relationship between educational efficiency level and economic growth quality in Guangdong Province. Though the Entropy and Grey correlation analysis of between educational efficiency level index and economic growth quality index from 2004 to 2019, the conclusion is drawn that a significantly impact of education level on economic growth in Guangdong. The results suggested the importance of education, particularly for the impact on economic growth.

Keywords: Education level; The quality of economy growth; Data envelopment analysis; Grey correlation

1. INTRODUCTION

Under the background of China's slowing economic development trend, Guangdong Provincial Government took the lead in putting forward the innovation-driven development strategy. Improving and optimizing the input-output efficiency of the education system is an indispensable strategic policy for improving the overall level of regional education and cultivating high-quality talents to drive the high-quality development of regional economy. In order to find the relationship between educational level and economic growth, this paper examined the regional education level in Guangdong province, and finds out the problems of redundant input and insufficient output in educational input and output, so as to improve the efficiency of educational resource allocation and coordinate the common development of economy.

2. LITERATURE REVIEW

The selection of indicators is based on China's national conditions, combined with the principle of comprehensiveness, simplicity and feasibility. For education indicators, (OECD) Based on the development of The Times and the status quo of education development, four complete educational index systems, including output index, input index, opportunity index and process index, have been gradually formed. Xue-min zhang, Xin chen (2019) since the founding of the Chinese education

standards, evaluation methods and the trend of evolution characteristics, clarify the connotation of the evaluation standard, basic methods and indicators. To measure the index of economic quality, the academic circle takes the broad view as a more comprehensive interpretation.[1] Bianhua Li (2004) believes that the index system to measure the quality of economic development should include eight aspects: economic stability, scientific and technological progress, environmental protection, competitiveness, people's livelihood, economic stability, economic efficiency and economic structure.[2] Xiaojing Chao (2010) believes that four dimensions are adopted to measure the quality of economic growth: economic growth structure, economic growth stability, welfare change and achievement distribution, resource utilization and ecological environment cost. Therefore, this paper selects four levels of economic quality to measure.[3] The index evaluation table is shown in Table 1 and Table 2

3. RESEARCH METHODS

3.1. Principal component analysis and applicability

In the process of multi-index evaluation and decision making, there is often a large amount of index information, and there is correlation among indexes, which affects the accuracy and effectiveness of index evaluation. Principal component analysis uses mathematical transformation to

form a new linear combination of variables and principal components, and selects the principal components with large variation information to analyze the educational level. The applicability of the principal components was tested by the sample adequacy and sphericity of KMO.

3.2. DEA data envelopment analysis

Shanmai Wang(1995) believes that educational efficiency, as a kind of production or economic activity, is transplanted from the perspective of economics, and its efficiency covers educational investment, utilization of educational resources, internal benefits of educational investment and other aspects.[4] Xing Chen and Xuemin Zhang(2019) further put forward the data envelopment analysis (DEA) as the standard research method for studying educational efficiency.[5] Data Envelopment Analysis (DEA) model has become the most commonly used model to evaluate efficiency. It is a method based on relative efficiency theory and using mathematical programming theory to evaluate the efficiency of decision making units with various inputs and outputs. This paper also adopts this method, choosing input and output as the guide to carry out the analysis.

$$\left\{ \begin{array}{l} \min \left[\theta - \varepsilon \left(\sum_{r=1}^t s_r^+ + \sum_{i=1}^m s_i^- \right) \right] \\ \sum_{j=1}^n \lambda_j x_{ij} + s_i^- = \theta x_{ij} \\ \sum_{j=1}^n \lambda_j y_{rj} - s_r^+ = y_{rj} \quad (j = 1, 2, \dots, n) \\ \lambda_j \geq 0 \\ s_i^- \geq 0 \\ s_r^+ \geq 0 \end{array} \right.$$

s_i^-, s_r^+ is the relaxation variable, respectively represent input redundancy and output deficiency; ε is the Archimedes infinitesimally small, $\varepsilon = 10^{-6}$; θ is the valid value of the decision unit which is the relative efficiency of inputs relative to outputs.

3.3. Entropy analysis

Wei Shan(2003) established the quality evaluation system of economic growth from the four aspects of stability, coordination, continuity and potential of economic growth, and used entropy evaluation theory to discuss the quality of economic growth in China from 1995 to 2000.[6] Min Wei and Shuhao Li (2018) constructed the measurement system of high-quality economic development level, and used entropy weight method to measure the difference of regional economic quality development level.[7] In the measurement, the lower the information entropy is, the more orderly the system is, and the higher the information entropy is, the greater the uncertainty of its variables is, and the greater the amount of information needs to be examined.

By the J item entropy: $e_j = -k \sum_{i=1}^m p_{ij} \ln p_{ij}$

Comprehensive economic efficiency coefficient :

$$v_i = \sum_{j=1}^n a_j p_{ij} ,$$

a_j is the weight of definition $a_j = \frac{1-e_j}{\sum_{j=1}^n 1-e_j}$, p_{ij} is the index specific gravity.

3.4. Grey correlation analysis

Sue-fung Wang, xue-zhen Zhao (2010) argue that education in the economy there are many factors influence each other, showing the characteristics of the "gray" relationship, and by using grey correlation analysis to the relationship between education and economic development level in China for empirical research, confirmed that the strong correlation between education and economic development, education input and output has an obvious role in promoting the economic development of.[8] Grey correlation degree is used in gray mathematics to study the influence of complex factors that interrelate and interact with each other, to determine the factors that affect the essence of things, and to clarify the gray relationship among various influencing factors.

The grey correlation degree formula of parent sequence and sub-sequence is:

$$r_{ij}^* = \frac{1}{n} \sum_{j=1}^n r_{ij}(t)$$

Among then, when $P=0.5, r_{ij}^* > 0.6$, achieved best result

4. RESEARCH DESIGN AND CONSTRUCTION OF INDEX SYSTEM

Firstly, it starts from the construction of evaluation index of education level and economic growth quality, based on the construction logic, method and standard of literature evaluation index system. Statistical indexes with different dimensions and different aspects of the evaluated indexes are transformed into dimensionless relative evaluation values. This paper firstly uses principal component analysis (PAC) to transform the original index of educational input-output level into the main component, so as to ensure the objective reflection of the realistic relationship among the sample indexes. The BCC model with variable return to scale is used to evaluate the efficiency of education level from 2004 to 2019. The DEA projection analysis is carried out to correct the problems of input redundancy and output deficiency in education efficiency level. In the comprehensive evaluation of economic quality, the entropy method is used to reflect the utility of economic growth quality index information. Finally, the correlation between the educational level index and the quality of economic growth in Guangdong Province is discussed through the grey correlation.

Table 1. Evaluation index of educational level.

Level indicators	Secondary indicators	The index name	Nature
Educational input index	Human input	NO primary school teachers	positive
		NO secondary school teachers	positive

	Material input	NO High School Teachers	positive	
		NO full-time teachers in colleges	positive	
		Primary school number	positive	
		Junior high school number	positive	
		NO high school	positive	
		NO Institutions of Higher Learning	positive	
		To educate the total fixed assets of the whole society	positive	
	Financial investment	The government allocated funds for education	positive	
		Local public finance expenditure on education	positive	
		Average public finance education expenses per student	positive	
		Public Finance Education expenditure budget	positive	
	Educational output indicator	Basic Education	NO aged 6 and over who have not attended school	negative
			Illiterate population aged 15 and over	negative
			Secondary school population aged 6 and above	positive
Higher Education		NO undergraduate and junior college graduates	positive	
		NO postgraduate graduates	positive	
		NO patents granted	positive	
		NO research projects	positive	

The data of education level evaluation index and economic increment evaluation index in the study are from 2004-2019 Guangdong Statistical Yearbook, Guangdong Statistical Yearbook of Education Statistics and China Statistical Yearbook.

Table 2. Economic growth quality evaluation table

Level indicators	Secondary indicators	Nature
Economic structure	Proportion of secondary and tertiary industries in GDP	positive
	Urbanization rate	positive
	Year-end balance of deposits and loans of financial institutions /GDP	positive
	Investment consumption ratio	positive
	Total imports and exports /GDP	positive
Economic benefit	The unemployment rate	negative
	Rate of inflation	negative
	Output per unit of energy consumption	positive
	Labor productivity of the whole society	positive
Economic potential	Ratio of RD expenditure to GDP	positive
	Technology market turnover	positive
	The proportion of science and technology appropriations in the government	positive
Economic welfare	Per capita hospital bed	positive
	Engel coefficient	positive
	Urban green area	positive

	Per capita disposable income of rural residents	positive
	Per capita disposable income of urban residents	positive

5. RESULTS AND DISCUSSION

Table 3. DEA analysis results

Y	Comprehensive efficiency	Pure technical efficiency	The scale efficiency	Scale reward
2004	1.000	1.000	1.000	-
2005	1.000	1.000	1.000	-
2006	0.940	1.000	0.940	drs
2007	0.869	0.877	0.990	drs
2008	0.859	0.869	0.989	drs
2009	0.816	0.830	0.982	drs
2010	0.742	0.805	0.921	drs
2011	0.780	0.813	0.960	drs
2012	0.921	0.972	0.948	irs
2013	0.781	0.819	0.953	drs
2014	0.751	0.800	0.939	drs
2015	0.685	1.000	0.685	drs
2016	0.694	0.808	0.859	drs
2017	0.764	0.851	0.897	drs
2018	0.905	0.928	0.976	drs
2019	1.000	1.000	1.000	-
The mean	0.844	0.898	0.940	

In 2004, 2005 and 2019, DEA is effective. The comprehensive efficiency reflects the overall resource allocation of the education level in Guangdong Province from 2004 to 2019, with an average value of 0.844, indicating that the overall education level in Guangdong Province is relatively high from 2004 to 2019. The pure technical efficiency reflects the educational management level and educational system level of Guangdong province, and the mean value of pure technical efficiency is 0.898. The educational management level and educational system level of Guangdong province are relatively high. Scale efficiency reflects the existing scale of education of Guangdong province and the gap between the optimal scale, scale efficiency mean value is 0.94, shows the whole higher education scale level of Guangdong province, comparing the scale efficiency and pure technical efficiency, can be found that the overall scale efficiency higher than that of pure technical efficiency, suggests that the education level of Guangdong province is mainly composed of scale efficiency. In addition, education management needs to be further optimized and improved so as to play a positive role in regional economic growth more effectively.

Table 4. Input redundancy and output deficiency analysis

	Comprehensive efficiency	Human input	Material input	Financial Investment	Basic Education	Higher Education
Mean	0.844	15.58%	39.39%	21.21%	0.00%	1.07%

From the perspective of input redundancy rate, the average redundancy rates of human input, material input and financial input are 15.58%, 39.39% and 21.21% respectively,

indicating that the existing educational input in Guangdong Province has a certain degree of redundancy rate. In terms of the output deficit rate, the output deficit rate of higher education is 0.00%, and that of basic education is 1.07%. On the whole, the educational level of Guangdong Province is mainly affected by the redundant educational input, and it is necessary to further strengthen the effective use of educational input resources

Table 5. Entropy weight method

Y	Economic structure	Economic benefit	Economic potential	Economic welfare	Comprehensive score of economic growth quality
2004	0.0085	0.0022	0.0006	0.0073	0.0186
2005	0.0073	0.0049	0.0009	0.0077	0.0208
2006	0.0110	0.0059	0.0020	0.0078	0.0267
2007	0.0127	0.0064	0.0034	0.0068	0.0293
2008	0.0155	0.0052	0.0054	0.0130	0.0391
2009	0.0163	0.0122	0.0072	0.0138	0.0495
2010	0.0147	0.0093	0.0087	0.0162	0.0489
2011	0.0161	0.0087	0.0108	0.0198	0.0554
2012	0.0160	0.0115	0.0141	0.0231	0.0646
2013	0.0173	0.0138	0.0178	0.0236	0.0724
2014	0.0155	0.0149	0.0164	0.0244	0.0712
2015	0.0178	0.0148	0.0187	0.0262	0.0774
2016	0.0198	0.0149	0.0214	0.0291	0.0853
2017	0.0215	0.0169	0.0249	0.0314	0.0946
2018	0.0240	0.0189	0.0334	0.0356	0.1118
2019	0.0262	0.0202	0.0487	0.0391	0.1342

The comprehensive score of the quality of economic growth has increased from 0.186 in 2004 to 0.1342 in 2019, showing an overall upward trend.

Table 6. Grey correlation between education level and economic growth quality

Y	Education - Economic Structure	Education - Economic benefits	Education - Economic potential	Education - Economic welfare	Education - Economic quality
2004	0.635	0.533	0.495	0.578	0.561
2005	0.607	0.603	0.500	0.585	0.571
2006	0.729	0.660	0.537	0.610	0.625
2007	0.832	0.717	0.587	0.622	0.673
2008	0.967	0.675	0.638	0.758	0.750
2009	0.992	0.928	0.711	0.810	0.882
2010	1.000	0.972	0.811	0.952	0.940
2011	0.965	0.899	0.873	0.978	0.991
2012	0.932	0.960	0.914	0.983	0.974
2013	0.910	0.804	0.807	0.840	0.842
2014	0.968	0.732	0.845	0.794	0.832
2015	0.810	0.701	0.715	0.709	0.733
2016	0.748	0.699	0.642	0.652	0.681
2017	0.739	0.661	0.589	0.641	0.653
2018	0.746	0.656	0.482	0.627	0.614
2019	0.734	0.656	0.342	0.605	0.540
Mean	0.832	0.741	0.655	0.734	0.741

The average correlation degree between education level and economic growth quality is 0.741 > 0.5. From the four aspects of education level and economic growth quality, the correlation degree of economic structure, economic benefit, economic potential and economic welfare is 0.832, 0.741, 0.655 and 0.734, respectively. Among them, the correlation degree of economic structure is the highest and that of economic potential is the lowest.

Therefore, the overall results are as follows:

1. The overall education of Guangdong Province has reached a high level in resource allocation, education management and education scale, but there is some redundancy in educational input resources, and the output of higher education is maximized, while the output of basic education is still insufficient to a certain extent.
2. The overall quality of regional economic growth in Guangdong Province presents an upward trend in economic structure, economic benefit, economic potential and economic welfare, among which the economic welfare has the greatest impact on the quality of economic growth
3. The grey correlation between the education level and the comprehensive index of economic growth quality in Guangdong province is 0.741, which indicates that the education level in Guangdong province has a great impact on the quality of economic growth.

6. CONCLUSION

In recent years, the construction of colleges and universities in Guangdong province has expanded greatly, so Guangdong province should improve the effective use of resources in the construction of colleges and universities. The pure technical efficiency is lower than the scale efficiency, and the educational level of Guangdong Province is driven by the scale efficiency, so the educational management and system level need to be further improved. Education of Guangdong province level correlation degree is low, the economic potential for higher education to further maintain the existing standard output, technological transformation to the economic and productivity on strengthen the cooperation of colleges and universities, scientific research institutions and private enterprise, integrate the capital resource advantage, promote education on economic potential of the excitation effect, pay attention to the quality of education training to achieve the basis education maximize output.

ACKNOWLEDGMENT

Funded by Program for Research Development of Beijing Normal University at Zhuhai, and Lixue Project of International Business Faculty, (Project No. 201754021, 201754024, 201850005, 201920001, and 201942).

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