The Grey Correlation Analysis of the Coordinated Development of Education and Economy -Taking Shaanxi of China as an example

[1,]Hui Wang , [2,]Lijie Nie

[1,] *School of Economic & Management, Northwest University, 710127, Shaanxi Xi'an,*
[2,]*School of Management, XI'AN Jiaotong University, 710049, Shaanxi Xi'an , China*

ABSTRACT: The coordinated development of education and economy is the objective requirement of the economic and social development. Based on the present situation of education and economic development in Shaanxi Province, this paper used the grey system theory, and took the statistical data of education and economy in Shaanxi Province as an empirical calculus, and analysed the relationship between education and economic development in Shaanxi province. The analysis results show that the correlation coefficient of education and economic development indicators in Shaanxi is 0.5202, which has a positive correlation and a strong correlation on the whole. This shows that education investment in Shaanxi is insufficient and cannot fully promote the development of the economy.
.
KEY WORDS: Education; Economy; Coordinated development ;Grey correlation

I. INTRODUCTION

In the process of economic integration in the world at an unprecedented speed, "knowledge is power" and "knowledge is wealth", "knowledge is development" has been endowed with new meaning of era. The competition between countries is in essence the competition of comprehensive national strength based on economy and science and technology. The natural resource is becoming scarcer and technology is changing rapidly under the condition of competition of comprehensive national strength more and more prominently in talent, intellectual resources development and utilization. The development of education is the ability to transform after all, namely science and education to productivity.

Education is the production department of knowledge and human capital, which is in the basic position in the comprehensive national strength and is the source of power for economic development. The fundamental purpose of the existence and development of educational undertakings is to serve the social and economic development through the training of talents and scientific research. To achieve this goal, the key is to make education compatible with the requirements of economic and social development, that is, education cannot lag behind economic development, nor can it exceed the requirements of economic development and the total load capacity of fiscal expenditure. The development of education can effectively promote economic growth. The quality and effect of economic growth fundamentally restrict the input of education and influence the development of education. The synchronous development of educational undertakings and regional economy is a necessary way for the development of modern society. Therefore, the coordinated development of education and economy is the objective requirement of the economic and social development. To strengthen the study of education itself, we explored the association between education and economy and its influence on the economy and the contribution in our current economic development, improve the GDP, enhance the comprehensive national strength, the construction of socialist modernization situation, has far-reaching significance.

Shaanxi province of China is located in the northwest of China, the birthplace of Chinese civilization with a long historysince ancient times. It is a historical and cultural gravity. In the development of education, it has been known for a large province of higher education, higher education institutions a total of more than 102, the number of students reached 750 thousand, the number of students in the University and high school in the country to hold a three column for a long period of time. It has preliminarily formed the higher education system of coexistence and development of public colleges and private colleges and universities. By the end of 2016, compulsory education has been popularized in Shaanxi Province, and the popularization of high school education has been greatly promoted. Xi'an is also the city with the largest number of higher education. On average, One-sixth people have received undergraduate education. However, the economic development of Shaanxi province is relatively lagging, the economic and social development is in the middle level of the country and still belongs to the less developed provinces. The development of the economy and society has a

weak dependence on talents, and the lack of investment in financial education funds has restricted the development level of education. The mode of talent training and the quality of education cannot fully meet the requirements of its economic construction and social development. However, in order to improve the level and quality of education in Shaanxi province and improve the contribution rate of education to the economic society, it is urgent to study the contribution of education to economic and social development and explore the way of coordinated development of education and economic society.

II. REVIEW
A. Qualitative analysis of the study of the relationship between education and economy

Human capital theory: Theodore. W. Schultz (1963), in the book "the economic value of education", first put forward that human capital as an input element of production plays an important role in economic activities and contributes more to economic growth. Education is the main channel for the formation of human capital, and the increase of educational investment has the role of stimulating economic growth. Arthur Lewis, the representative of development economics, believes that education is both a consumer and an investment project. As an investment, education contributes directly to the promotion of production.

Screening theory: Berg (1970) pointed out that education was used as a means to distinguish individual abilities in the "education and vocational training robbers". After Berg, a series of arguments were put forward by scholars such as arrow, Spence and Stig Leif, which challenged the theory of human capital, and attributed the function of education to the function of screening. Finally, the "screening theory" was formed. The core point is that education plays an important role in identifying students' abilities and talents. Education level is an effective signal to reflect individual's ability or future productivity.

Theory of labor market division: Paiao (1971) proposed the labor market division theory, that the economic benefits to the individual, it is not how much to improve cognitive skills, but that it is one of the important factors that determine a person in the main labor market or the secondary labor market work.

Theory of socialization of Education: The theory of socialization of education is put forward by Bowers and J. Ti (1976). It emphasizes the function of capitalist production relations in educational reproduction and denies the analysis of the theory of human capital on the development of productivity promoted by education. It is more important to emphasize the socialized role of education than it is to improve the role of cognitive skills.

Quantitative calculation of the relationship between education and economy: Schultz (1961) pioneered the investment incremental analysis method. It concluded that the 1929-1957 years' increase in American education accounted for 33% of the total growth of the US national income in the same period. Dennison (1962) adopted the growth factor analysis method to analyze the contribution of education to the growth of national income by calculating the ratio of education to total labor input and considering the role of generalized intellectual investment in economic growth. The results of the calculation show that the contribution of education to the growth of national income in the United States was 37% in 1929-1948 years. Dennison's approach is a step further than Schultz's approach to factor analysis. Mankiw etc. (1992) regression with the Solow model, human capital for the cross regional economic growth effect. Grabowski (2004) uses the time series of specific countries to study whether there is a causal relationship between education and economic growth. It is found that primary education has a great impact on economic growth.

Research on the harmonious development relationship between education and economy: Caihong Sun (2003) applied principal component analysis (PCA) to analyze the data in 2001 and concluded that the correlation between regional education and economic coordinated development is not high. Yong Lin (2003) carries out an empirical study on the harmonious relationship between education and economic growth in China. The empirical research on the relationship between the coordinated development of education and economic growth has three closely related aspects: a) The coordinated development of education is closely related to economic growth; The total and quality of the development of higher education is closely related to the total value of the second industry and the number of employees in the second industry. The "Pujiu" coverage of the third industry and third industry gross and employment ratio is closely related. At the same time, he thought that only when we achieve the goal of coordinated development of education,
moderate speed of education development, balanced development of education at all levels, and gradual improvement of education level of all the people, can we finally achieve the coordinated development of

education and economy. Yandong Jia et al. (2006) analyzed the coordination of education and economic development in the eastern, middle and western regions through the panel data of 1996-2003 years, and the results showed that the 3 regions were different. First, the development of the economy leads to the increasing investment in education. Secondly, the increase of educational input leads to the improvement of educational level. Finally, the increase in the level of education has promoted the further growth of the economy. Zuobin Jiang (2006) pointed out that the coordinated development of education and economic society needs to solve two problems in the "on" the coordinated development of provincial education, one is the development of education to better serve economic and social development, the two is the economic and social development to provide effective support for the development of education. Lijie Nie et al. (2008) used the human capital spillover model to calculate the output of human capital in the whole country and Shaanxi province. The conclusion is that the output elasticity of human capital in Shaanxi is lower than the national average level. The development of Shaanxi's economy is not consistent with the current situation of the National Education Province. Shengyong Mao (2009) uses factor analysis to calculate and sort the level of economic development and the development level of higher education in 31 provinces and regions.

The results show that the degree of coordination between the development of higher education and the level of regional economic development in China is not high. Especially in some provinces, the degree of deviation between the two is very large, which is very unfavorable for the sustainable development of local economy, society and education. Especially, the higher level of higher education in Shaanxi is ranked eighth, but the level of economic development is only twentieth. Done a lot of research scholars at home and abroad in the coordinated development of education and economy, the research content is broad, but various studies in the conclusions reached a basic consensus: a) education has positive effect on economic growth, but this effect is influenced by other factors; b) the coordination level of the development of education and economy in China is not high.

III. GRAY CORRELATION ANALYSIS

The basic idea of grey correlation analysis is to judge whether the connection is close according to the similarity of the geometric shape of the sequence curve. The closer the curve is, the greater the grey correlation between the corresponding sequences, and vice versa. Gray correlation analysis method is calculated between the characteristic variables of system data and related factors of variable data sequence of grey correlation, establish grey correlation matrix analysis, the principle of advantage, obtain the order of various factors, determined the main influencing factors. Grey relational analysis method proposed by the grey system theory avoids the limitations of large sample and typical probability distribution, such as regression analysis, such as regression analysis. It can find out their relevance through random data processing and find out the main contradiction and find out the main characteristics and main factors.

Construction of grey relational model for coordinated development of education and economic society: From the history of the development of education and economy, it is clear that the development of education can effectively promote economic growth. The quality and effect of economic growth fundamentally restricts the input of education and affects the development of education. Educational development and economic growth are a unified system of interaction. In this system, the development of education and economic growth affect and interact with each other. The relationship between education and economic growth not only depends on the complexity of educational and economic phenomena of the complexity, but also depends on the measure of education benefits of multi factors, the theory is not complete, for reference in institutional differences, quantitative calculation model in the assumption of unreasonable and defect data. The relationship between educational development and economic growth has information incompleteness and diversity of norms. From the information to the result, there are many to many grey maps, and the basic characteristics of the grey system such as the relationship between education and economic growth is uncertain.

Therefore, citing the improvement of the calculation of grey relational space and grey relational grade by Youhua Chen, Anhui University, we can establish the grey correlation model based on the average thinking calculation, which is the coordinated development of education and economy. If X is a sequence set, if it has the following properties, the numerical comparability, the quantity comparability and the non negative factor, it is called the set of grey relational sequences.

$$X = \begin{cases} x \mid i \in N, N = \{0,1,2,......m\}, m \geq 2, x_i = \left(x_i(1), x_i(2), x_i(3),......, x_i(n)\right), \\ x_i(k) \in X, k \in K, K = \{1,2,......,n\}, n \geq 3 \end{cases}$$

$\gamma(x_0(k), x_i(k))$ is the grey correlation coefficient of X_i to X_0 at k point, for short, $\gamma(x_0, x_i)$ is the grey correlation of Xi to X0 . In the light of the relationship between education and economic and social development, there are following empirical models. There are natural sequences X (t) and Y (t), that is:

$$X_i(t_k) = \{X_i(t_1), X_i(t_2),......, X_i(t_n)\}$$
$$Y_j(t_k) = \{Y_j(t_1), Y_j(t_2),......, Y_j(t_n)\}$$
$$i, j, t=\{1, 2, \ldots N\}.$$

The correlation coefficient of the X (t) and Y (t) two sequences at the t moment is γ_{ij} (t):

$$\gamma_{ij} = \frac{1}{1+\left|\dfrac{\Delta x(t)}{\partial_{x_i}} - \dfrac{\Delta y(t)}{\partial_{y_j}}\right|}$$

$$t \in T$$

$$\Delta x(t) = x(t+1) - x(t)$$
$$\Delta y(t) = y(t+1) - y(t)$$

$\partial_{xi}, \partial_{yi}$ are standard deviations for x_i and y_i.

B. Index and data selection

Index selection basis: Based on the achievements of scholars both at home and abroad, combined with the status and basic characteristics of education in Shaanxi Province, and considering the availability of data, the following twenty indicators of education and economic development are selected and detailed in Table 1.

Data selection: This data is mainly derived from the statistical yearbook of national economic and social development in Shaanxi province. Based on the characteristics of educational investment, the lag time of economic benefits of education investment is noticed when selecting data. According to the analysis of experts, it is estimated that the lag period is three to four years. The educational indicators were selected to select 2009-2013 years' relevant data, and the economic indicators were selected for four years and 2013-2017 years. The specific indicators and data were shown in table 1.

Table 1 Indicators for education and economic development

Variable	Educational development indicators	Variable	Economic development indicators
$x_1(t)$	Proportion of educational investment in fixed assets investment (%)	$y_1(t)$	Total GDP (billion yuan)
$x_2(t)$	Growth rate of educational funds within per capita budget	$y_2(t)$	Per capita GDP (yuan)
$x_3(t)$	The proportion of educational funds in per capita budget to GDP per capita	$y_3(t)$	GDP growth rate (%) over the previous year
$x_4(t)$	Annual growth rate of higher education students	$y_4(t)$	The rate of increase in the first industry (%)
$x_5(t)$	Annual growth rate of graduate students	$y_5(t)$	Increase in the second industry (%)
$x_6(t)$	Annual growth rate of students in high school education	$y_6(t)$	Increase in the third industry (%)
$x_7(t)$	Primary school age population enrolment	$y_7(t)$	Growth rate of fixed assets investment (%)

x₈(t)	Number of graduate students in every ten thousand people (people)	y₈(t)	Consumer price index
x₉(t)	The number of college students per 10000 people (people)	y₉(t)	Third industry / total GDP (%)
x₁₀(t)	Primary school enrolment rate	y₁₀(t)	Annual per capita disposable income growth rate per capita of urban residents(%)

According to the empirical analysis model of the coordinated development of education and economy, the time series of T=1, T=2, T=3, T=4 and T=5 are set up. The grey relational degree of economic development indicators for educational development indicators is calculated by the above formula, as shown in table 2.

Table 2 Grey correlation degree of the economic development index $y_1(t) \sim y_{10}(t)$ for educational development indicators $x_1(t) \sim x_{10}(t)$

rᵢⱼ	y₁(t)	y₂(t)	y₃(t)	y₄(t)	y₅(t)	y₆(t)	y₇(t)	y₈(t)	y₉(t)	y₁₀(t)
x₁(t)	0. 696*	0. 499	0. 440	0. 484	0. 474	0. 467	0. 743*	0. 833*	0. 836*	0. 585
x₂(t)	0. 697*	0. 373	0. 499	0. 471	0. 470	0. 466	0. 730*	0. 814*	0. 850*	0. 599
x₃(t)	0. 424	0. 430	0. 450	0. 513	0. 533	0. 458	0. 565	0. 627	0. 580	0. 587
x₄(t)	0. 401	0. 547	0. 506	0. 434	0. 399	*0. 306*	0. 526	0. 419	0. 400	0. 368
x₅(t)	0. 474	0. 493	0. 424	0. 366	0. 503	0. 458	0. 510	0. 508	0. 477	0. 524
x₆(t)	0. 565	*0. 319*	0. 448	0. 578	0. 457	0. 673	0. 569	0. 714*	0. 744*	0. 762*
x₇(t)	0. 452	*0. 289*	0. 414	0. 436	0. 436	0. 413	0. 510	0. 534	0. 630	0. 564
x₈(t)	0. 620	0. 473	0. 548	0. 581	0. 425	0. 468	0. 807*	0. 607	0. 599	0. 526
x₉(t)	0. 360	0. 434	0. 617	0. 545	0. 573	0. 384	0. 390	0. 398	0. 377	0. 357
x₁₀(t)	0. 468	0. 553	0. 400	0. 460	0. 527	0. 396	0. 664*	0. 624	0. 595	0. 503
AVR	0. 516	0. 441	0. 475	0. 487	0. 480	0. 449	0. 601	0. 608	0. 609	0. 537

According to the correlation strength coefficient, $0 < \gamma < 0.35$ is weak association, $0.35 < \gamma < 0.65$ is the middle Association, $0.65 < \gamma < 1$ is strong correlation degree. The correlation between education and economic development is shown in tables 3, 4 and 5.

Table 3 Strong correlation for the indicators of development of education for

Economic development indicators	Strong correlation
y₁(t)	x₁(t) x₂(t)
y₂(t)	
y₃(t)	
y₄(t)	
y₅(t)	
y₆(t)	
y₇(t)	x₁(t) x₂(t) x₈(t) x₁₀(t)
y₈(t)	x₁(t) x₂(t) x₆(t)
y₉(t)	x₁(t) x₂(t) x₆(t)
y₁₀(t)	x₆(t)

Table 4 Relevance of economic development indicators to the indicators of education development

Economic development indicators	Relevance
$y_1(t)$	$x_3(t)$ $x_4(t)$ $x_5(t)$ $x_6(t)$ $x_7(t)$ $x_8(t)$ $x_9(t)$ $x_{10}(t)$
$y_2(t)$	$x_1(t)$ $x_2(t)$ $x_3(t)$ $x_4(t)$ $x_5(t)$ $x_8(t)$ $x_9(t)$ $x_{10}(t)$
$y_3(t)$	$x_1(t)$ $x_2(t)$ $x_3(t)$ $x_4(t)$ $x_5(t)$ $x_6(t)$ $x_7(t)$ $x_8(t)$ $x_9(t)$ $x_{10}(t)$
$y_4(t)$	$x_1(t)$ $x_2(t)$ $x_3(t)$ $x_4(t)$ $x_5(t)$ $x_6(t)$ $x_7(t)$ $x_8(t)$ $x_9(t)$ $x_{10}(t)$
$y_5(t)$	$x_1(t)$ $x_2(t)$ $x_3(t)$ $x_4(t)$ $x_5(t)$ $x_6(t)$ $x_7(t)$ $x_8(t)$ $x_9(t)$ $x_{10}(t)$
$y_6(t)$	$x_1(t)$ $x_2(t)$ $x_3(t)$ $x_5(t)$ $x_6(t)$ $x_7(t)$ $x_8(t)$ $x_9(t)$ $x_{10}(t)$
$y_7(t)$	$x_3(t)$ $x_4(t)$ $x_5(t)$ $x_6(t)$ $x_7(t)$ $x_9(t)$
$y_8(t)$	$x_3(t)$ $x_4(t)$ $x_5(t)$ $x_7(t)$ $x_8(t)$ $x_9(t)$ $x_{10}(t)$
$y_9(t)$	$x_3(t)$ $x_4(t)$ $x_5(t)$ $x_7(t)$ $x_8(t)$ $x_9(t)$ $x_{10}(t)$
$y_{10}(t)$	$x_1(t)$ $x_2(t)$ $x_3(t)$ $x_4(t)$ $x_5(t)$ $x_7(t)$ $x_8(t)$ $x_9(t)$ $x_{10}(t)$

Table 5 The weak association of economic development indicators to educational development indicators

Economic development indicators	Weak association
$y_1(t)$	
$y_2(t)$	$x_6(t)$ $x_7(t)$
$y_3(t)$	
$y_4(t)$	
$y_5(t)$	
$y_6(t)$	$x_4(t)$
$y_7(t)$	
$y_8(t)$	
$y_9(t)$	
$y_{10}(t)$	

IV. CONCLUSION

According to the preceding formula, we can also calculate the 2009-2017 year's correlation index of economic and social development in Shaanxi Province, which has a positive correlation with the correlation coefficient R=0. 5202 of educational development indicators. Among all the indicators of educational development and economic development, the ratio of the number of three strong, medium and weak association intensity to 100 times, respectively, is 13%, 84% and 3%. In the strong association of education development indicators, fixed asset investment in education investment proportion (x_1 (t)), per capita budgetary education expenditure growth rate (x_2 (t)), high school education in the annual growth rate (x_6 (t)) the maximum number of times respectively accounted for all a number of factors related to the sum of the 13 of the 30. 8%, 30. 8% and 23. 1%. That is, the proportion of education investment in fixed assets investment, the growth rate of per capita budgetary education funds and the annual growth rate of high school education students are three main factors that affect the economic development of Shaanxi province.

V. SUGGESTIONS

The above analysis results show that education investment, per capita education expenditure and graduate student number per million are important and controllable factors that restrict economic development.
a) Shaanxi should diversify our educational resources and increase our government's investment in higher education and set up a higher education system as soon as possible, including government investment, multi-channel financing, diversification of school running subjects and joint development of public and private sectors.

b) It should make full use of high quality resources of higher education in Shaanxi province to develop postgraduate education. The high and new technology talents are trained by postgraduate education, while many colleges and universities in Shaanxi province have high-quality higher education teachers, all indicators are higher than the national level, and they have a teaching team to train postgraduate education. Therefore, Shaanxi province should adapt to the needs of western development and Shaanxi's economic and social development, vigorously develop postgraduate education, and cultivate high-tech talents for Shaanxi and western economic development.

c) It should increase the transformation of scientific research results in Colleges and Universities. Higher education in Shaanxi province has been among the best in the country, but the level of economic development is far behind other provinces and cities, mainly because Shaanxi has not made full use of the existing science and technology advantages to promote local economic development. The region should rely on the existing educational advantages to transform the existing scientific research achievements into practical productive forces.

REFERENCE

[1]   T. W. Schultz, human capital investment, 1990.
[2]   Berg education and professional training thieves, 1970.
[3]   Paiao, internal labor market and human resource policy, 1971.
[4]   Bowers, McGinty, school education, American capitalism, 1976.
[5]   Robert. M. Solow economic growth factor analysis [M]. Beijing: The Commercial Press, 2003.
[6]   Sharmistha Self Richard Grabowski, does education at all levels cause growth: India, a case study, Economics of Education Review, 2004.
[7]   N. Gregory Mankiw, David N. Weil, A Contribution to the Empirics of Economic Growth, The Quarterly Journal of Economics, 1992.
[8]   C. H. Sun, An empirical analysis of the coordinated development of regional education and economy, Journal of Industrial and Commercial University of Chongqing, 2003.
[9]   Y. Lin, The relationship between the coordinated development of education and economic growth in China and the empirical analysis, the research on education development, 2003.
[10]   Y. D. Jia, H. X. Zhang, Empirical research on the relationship between regional sex education and economic coordinated development, financial science 2006.
[11]   L. J. Nie, H.B. Zhou, X. Mu, Research on the influence of government education investment on economic growth, Journal of Shanxi University of Finance and Economics, 2008.
[12]   S. Y. Mao, Regional coordination of China's higher education and economic development, statistical study, 2009.
[13]   H.Y. Chen, T.Wu, Y.S. Xu, Improvement of correlation space and grey correlation degree calculation, Journal of Anhui University The Science Edition, 1999.
[14]   Shaanxi Statistical Yearbook (2009~2017), Shaanxi Statistics Bureau, [M]. China Statistics Press.

Hui Wang Ph. D. in Business Management, School of economics & management, Northwest University in China. The research direction is knowledge management and technological innovation. She has participated in a number of enterprise projects and published high-quality papers both in home and abroad journals.

Lijie Nie Associate professor of School of management, XI'AN Jiaotong University in China. Her main research direction is financial management.