

An Empirical Study on the Relationship between Educational Funds and Economic Growth

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ABSTRACT

In the paper, the annual data from 1996 to 2018 are selected, based on VAR model, and the empirical measurement methods such as ADF unit root test, Johansen cointegration test, AR root test, Granger causality test, impulse response function analysis and variance decomposition are used to qualitatively and quantitatively analyze the relationship between education expenditure and economic growth. It is found that education investment is one of the main forces of economic growth, but the contribution of capital investment to economic growth is more obvious than that of education investment. Based on the research conclusions, this paper puts forward the optimization of education investment structure, and the attraction of social non-governmental forces to invest in education, in order to provide a feasible reference direction for promoting national economic growth.

Keywords: *Investment in education funds, economic growth, VAR model*

1. INTRODUCTION

The economic growth and development is very important for a country, and it is one of the main goals of a country's macro-economy. With the rapid economic development, education has become one of the main factors of economic growth. Education is the largest basic project and the foundation of a country's development, and the development of a country and education cannot be separated. The premise task of education development is to invest in education funds, continuously increase the investment in education funds and personnel compensation, so as to improve labor productivity and promote the growth of national economy.

As one of the major educational countries in the world, China needs to seriously solve the problem of how to do a good job in education. On the one hand, the country has a large population, huge total resources but insufficient per capita, so there is still much room for economic growth. On the other hand, it is necessary to increase investment in education so that more people can receive education. Therefore, the relationship between the investment of education funds and economic growth has gradually

become a research hotspot in academic circles. In recent years, the scholars have studied the influencing factors of economic growth from different angles and the relationship between education investment and economic growth. However, few scholars have considered the social factors of education into the scope of endogenous factors that affect economic development, and more regard the social factors of education as exogenous variables of economic growth. Moreover, different econometric methods are adopted, and the research conclusions are different. Therefore, on the basis of relevant scholars' findings, this paper deeply studies the relationship between education investment and economic development, and empirically analyzes the relationship between education investment and economic growth by using VAR model and the data from 1996 to 2018, in order to have a deeper understanding of the relationship between education investment and economic development, quantitatively understand the strong support of education for economic growth, and explore the strategies to promote the positive interaction between education investment and economic growth, so as to provide feasible reference suggestions for promoting national economic development.

2. LITERATURE REVIEW

2.1. Literature Review at Home and Abroad

Foreign scholars are interested in the research on the role of education investment, especially the role of education in economic development is a hot issue in this research field, and a large number of literatures have been produced. Most studies use theoretical and empirical analysis models to study the role of education investment, but scholars hold different views on the relationship between education investment and economic growth. Some scholars believe that education investment has a significant contribution to economic growth. For example, Schultz T.W. (1961) found that the contribution rate of American education to its national economic growth reached about 33%, and considered that the improvement of national knowledge quality is the source of national economic growth^[1]. Lawrence J. Lau(1993) thinks that every year of schooling per capita in Brazil can increase the total output of Brazilian national economy by about 20%^[2]. Gyimah-Brempon, Paddison and Mitiku(2006) used dynamic panel estimation to study that all levels of education have a significant positive impact on the growth of per capita income in Africa^[3]. Govindaraju, Rao and Anwar(2011) empirically analyzed the real GDP caused by Granger's total government expenditure in Malaysia by using binary model and multivariate model^[4]. However, other scholars think that the promotion effect of education investment on economic growth is not significant. Benhabib and Spiegel(1992), who studied under the classical economic model, concluded that the effect of education investment on economic growth is not significant^[5]. Young(1995), who studied the contribution of education investment in the framework of total factor productivity, thought that the most important contribution to economic growth came from the increase of capital accumulation and labor investment, while the increase of total factor productivity was not obvious^[6]. Pritchett(1996) found that it was futile to use human capital to explain the differences of economic growth by comparing the economic differences of some countries^[7]. Although the role of education investment in economic growth is controversial in foreign academic circles, most scholars believe that a country's economic growth can not be separated from the accumulation of knowledge and technological progress.

In China, the research on the relationship between education input and economic growth was much later than that of foreign countries. In 1980s and 1990s, scholars made a preliminary study on the relationship between education and economic development, and considered that education investment has a positive effect on economic growth, such as Yining Li (1984)^[8]. Since the 21st century, many scholars have been attracted to study this issue. For example, Yong Lin (2002) built two index systems of education development and economic

growth, and analyzed the relationship between education and economic growth at that time by using the linear data relationship theory^[8]. Ye Liu and Chengjian Huang (2009) analyzed that education expenditure has a significant contribution rate to economic growth^[9]. Xiaowen Liu (2013) pointed out that education investment in Shandong Province has a certain role in promoting economic growth, but the role is small^[11]. Xiaobin Guan (2014) verified that the higher education investment has been continuously promoted in the regional economy, but the benefits gradually weakened after three years^[12]. Changshan Mei (2018) used Cobb-Douglas function to analyze the mutual promotion between financial education investment and economic growth^[13]. Yujun Liu (2020) concluded that the investment in education funds has a significant role in promoting economic development, and this effect is the most significant in the eastern region and the weakest in the central region^[14].

2.2. Brief Summary of Literature

Up to now, scholars have deeply discussed the relationship between education investment and economic development. Although generally speaking, education and economic development promote each other, education investment has a significant role in promoting economic growth, and economic development has a great contribution to education. However, most scholars study education investment as an exogenous variable of economic development, using simple descriptive statistics, less empirical analysis based on measurement and statistical methods, outdated data, short time span, weak persuasiveness and inconsistent research conclusions. Therefore, in order to solve these problems, this paper selects the 22 years' data from 1996 to 2018, based on the VAR model, regards education investment as an endogenous variable of economic development, and uses the methods of unit root test, Johansen cointegration test, Granger causality test, impulse response function analysis and so on to make empirical analysis, in order to reduce errors and explain the relationship between education investment and economic growth more quantitatively.

3. MODELS AND DATA

3.1. Empirical Model

The vector autoregressive model (VAR model) examines the dynamic interaction between multiple variables, and constructs the regression model by taking each endogenous variable in the system as a function of the lag term of all variables. The general form is as follows.

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \dots + A_p Y_{t-p} + B_0 X_t + \dots + B_r X_{t-r} + \varepsilon_t \quad \square t=1,2, \dots, n \square$$

Among them, Y_t is the vector of k endogenous

variables lagging behind to order P , X_{t-i} ($i=0,1,\dots,r$) is the vector of d -dimensional exogenous variables or the vector of lagging exogenous variables, p and r are the lagging orders of endogenous variables and exogenous variables respectively, A_p and B are the coefficient matrix to be estimated, and ε_t is the vector random disturbance term with independent and identical distribution.

In order to analyze the relationship between education investment and economic growth, this paper introduces the VAR model of four variables: GDP, total investment in education, capital investment and labor investment.

3.2. Index Selection

According to international practice, the most important variable to explain economic growth is GDP index, so this paper takes GDP as the explained variable to measure the evolution trend of China's economic growth, and the data comes from China Statistical Yearbook, which is expressed by Y in this paper. The effective measure of education investment is the total investment of education funds. The data comes from China Education Statistical Yearbook in different years, which is represented by E in this paper. Capital investment is measured by the total fixed assets investment index of the whole society. The data comes from the National Bureau of Statistics, which is expressed by K in this paper. Labor input is measured by the total number of workers in the whole society. The data comes from China Labor Statistics Yearbook in different years, which is expressed by L in this paper.

This paper selects the data from 1996 to 2018. Considering the influence of statistical caliber on the data,

the gross domestic product (GDP) is calculated at the constant price of 1996. The total investment in education funds and the total investment in fixed assets of the whole society are converted into the constant price of 1996 according to the comprehensive price index every year. At the same time, considering the possible heteroscedasticity influence of the original variables, the data indicators are digitized, and the processed data are recorded as $\ln Y$, $\ln E$, $\ln K$ and $\ln L$ respectively.

4. EMPIRICAL ANALYSIS

4.1. Unit Root Test and Determination of Optimal Lag Order

Firstly, the stationarity of the model is tested. In this paper, Eviews7.0 is used to test the unit root of the logarithmic data of Y , E , K and L and the first-order difference and second-order difference of their logarithm. At the confidence level of 0.05, the results are shown in Table 1. The test values of $ddl\ln Y$, $ddl\ln E$, $ddl\ln K$ and $ddl\ln L$ are less than the critical value and the probability p value is less than 0.05, respectively. If there is no unit root in the sequence, it is a stationary sequence. Therefore, the second-order differences of $\ln Y$, $\ln E$, $\ln K$ and $\ln L$ may have cointegration relationship, which is the premise of cointegration test. In this paper, the selection of the optimal lag order is determined according to the minimum information value criterion of AIC, SC and HQ. As can be seen from Table 2, more than half of the criteria select the lag order of 4, so the lag order of this VAR model can be defined as 4.

Table 1. ADF unit root test results

variable	ADF inspection value	Critical value (significance level 5%)	Test result
$ddl\ln Y$	-6.036805	-3.02997	stable
$ddl\ln E$	-6.413263	-3.02997	stable
$ddl\ln K$	-4.505364	-3.02997	stable
$ddl\ln L$	-4.878074	-3.052169	stable

Table 2. Test results of optimal lag order

Lag	LogL	LR	FPE	AIC	SC	HQ
0	284.6682	NA	5.37e-20	-33.01979	-32.82374	-33.00030
1	309.7173	35.36342*	1.99e-20	-34.08439	-33.10414	-33.98695
2	337.0568	25.73126	7.87e-21	-35.41844	-33.65399	-35.24305
3	371.2020	16.06836	4.02e-21*	-37.55318	-35.00453	-37.29984
4	2553.929	0.000000	NA	-292.4623*	-289.1294*	-292.1310*

4.2. Johansen Cointegration Relationship

In this paper, Johansen cointegration test method is used to test the cointegration relationship of the above four variables by trace statistics and maximum eigenvalue statistics test, respectively. The results are

shown in Table 3. When the significance level is 5%, trace statistics show that there are four cointegration relationships, and the maximum eigenvalue test shows that there are three cointegration relationships, which shows that education funds. There is a cointegration relationship among investment, fixed assets investment, labor input and economic growth.

Table 3. Johansen cointegration test results

null hypothesis	Trace statistic test result			Maximum eigenvalue test result		
	eigenvalue	Trace statistics	P value	eigenvalue	Maximum eigenvalue	P value
0	0.91062	99.86978	0.0000	0.91062	45.88226	0.0001
Up to 1	0.836136	53.98752	0.0000	0.836136	34.36566	0.0004
Up to 2	0.467662	19.62186	0.0113	0.467662	11.97905	0.1114
Up to 3	0.331189	7.642813	0.0057	0.331189	7.642813	0.0057

4.3. Granger Causality Test

From the above-mentioned co-integration test results, we can see that there is a long-term and stable co-integration relationship among investment in education

funds, investment in fixed assets, investment in labor force and economic growth, but whether this co-integration relationship constitutes a causal relationship needs further verification. Granger causality test results are shown in Table 4.

Table 4. Granger causality test results

	null hypothesis	Chi-sq statistics	P value	Refuse/not refuse null hypothesis
LnY equation	LnE is not Granger cause of LnY	4.868035	0.0877	refuse
	LnK is not Granger cause of LnY	6.731551	0.0345	refuse
	L is not Granger cause of LnY	0.478257	0.7873	Do not refuse
	E, LnK and LnL are not the cause of LnY at the same time	9.431266	0.1507	Do not refuse
LnE equation	Y is not Granger cause of LnE.	6.920398	0.0314	refuse
	LnK is not Granger cause of LnE	9.327518	0.0094	refuse
	L is not Granger cause of LnE	2.383366	0.3037	Do not refuse
	Y, LnK and LnL are not the cause of LnE at the same time.	18.13126	0.0059	refuse
LnK equation	LnY is not Granger cause of LnK	12.34176	0.0021	refuse
	LnE is not Granger cause of LnK	7.633271	0.022	refuse
	L is not Granger cause of LnK	2.904726	0.234	Do not refuse
	Y, LnE and LnL are not the cause of LnK at the same time.	18.36123	0.0054	refuse
LnL equation	Y is not Granger cause of LnL.	2.574896	0.276	Do not refuse
	LnE is not Granger cause of LnL	3.164888	0.2055	Do not refuse
	LnK is not Granger cause of LnL	6.329234	0.0422	refuse
	Y, LnE and LnK are not the cause of LnL at the same time.	8.102892	0.2307	Do not refuse

From Table 4, it can be seen that the refusal to invest in education is not the Granger cause of GDP, which

shows that China's investment in education has a significant role in promoting economic growth, because education activities can shorten the necessary labor time of social production and achieve greater economic benefits. Rejecting the whole society's investment in fixed assets is not the Granger cause of GDP, which shows that capital investment can significantly promote economic growth, because increasing investment in social infrastructure is conducive to reducing market transaction costs and management costs, and accelerating trade development, thus promoting economic growth. Unable to refuse labor input is not the Granger cause of GDP, which shows that at a significant level of 5%, the promotion of labor input to economic growth in the whole society is not significant, because the proportion of labor in GDP is too low and the growth rate of labor is slow, which shows that compared with other influencing factors, the promotion effect of labor input to economic growth is not obvious. Rejecting GDP is not Granger's reason for investment in education, which shows that economic growth can significantly promote the level of investment in education, because the rapid development of economy provides modern material equipment for the development of education and increases the opportunities for people to receive education, and at the same time, educational methods are constantly improved, thus promoting the development of education. Rejecting the fixed assets of the whole society is not the Granger reason for the investment in education funds, which shows that capital investment can promote the investment in education. Unable to refuse labor force is not Granger's reason for the investment in education funds, which shows that under the significance level of 5%, the promotion effect of the whole society's manpower investment on education investment is not significant.

After analyzing the results of Granger causality test mentioned above, we can see that attaching importance to developing education has a high contribution rate to the economic growth of a country, but the promotion of labor input to economic growth is not direct, and whether human capital can play a decisive role in economic growth is still controversial in academic circles. Some scholars believe that the sustained economic growth must be based on the gradual accumulation of knowledge, while others believe that it is futile for human capital to explain the differences of economic growth in some countries.

4.4. Impulse Response Function Analysis

The impulse response function is used to analyze the

impact response between education funding and economic growth. The impulse response function reflects the degree of impact of an endogenous variable on other endogenous variables, as shown in Figure 2, in which the abscissa indicates the number of periods of impact, and the ordinate indicates the dynamic relationship between the intensity and duration of mutual impact effects of GDP, investment in education funds, investment in fixed assets of the whole society and investment in labor force of the whole society.

(1) The response of GDP to the change of investment in education, as can be seen from the first line and the first of Figure 1, the economic growth in the early stage decreased with the investment in education, and with the passage of time, the investment in education has promoted the economic growth, and the impact of investment in education on economic growth reached the maximum in the fifth period, and the promotion of investment in education on economic growth tended to be stable in the ninth period. In the 1990s, China began to vigorously develop education, increased the investment in education, expanded the enrollment scale, and relatively increased the proportion of national income used for developing education. Moreover, due to the lag and continuity of educational achievements, the economic growth slowed down to a certain extent. With the development of education becoming mature, the knowledge quality of society is enhanced, which in turn promotes economic growth.

(2) The response of GDP to the changes of fixed assets investment and labor investment of the whole society. From the first figure in the second of Figure 1, we can see that the economic growth in the early stage decreased with the investment of capital. With the passage of time, the investment of capital has promoted the economic growth, showing positive fluctuations, and the promotion of capital investment on economic growth tends to be stable in the seventh period. In the 1990s, China accelerated the construction and investment of infrastructure, which slowed down the economic growth to a certain extent. When there is a certain stock of infrastructure, it can reduce the market transaction cost and management cost, and accelerate the development of trade, thus promoting economic growth. From the fourth figure in the third of Figure 1, it can be seen that the fluctuation range of economic growth with the input of labor force is very small, because the input of labor force accounts for a small proportion of GDP, and the promotion effect on economic growth is relatively insignificant.

Response to Cholesky One S.D. Innovations ?2 S.E.

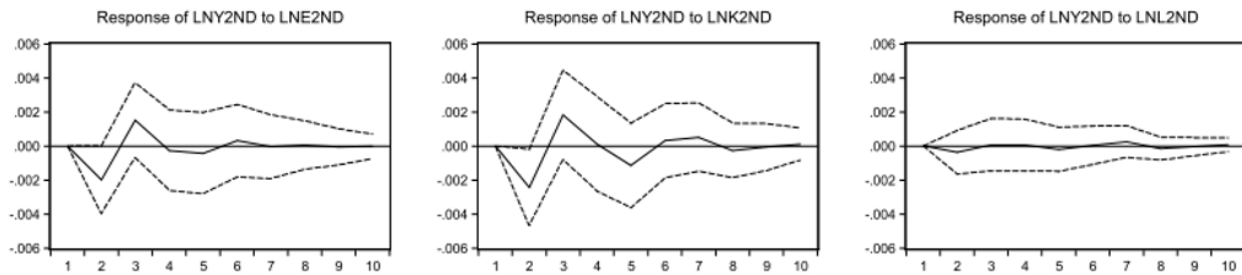


Figure 1 Analysis results of impulse response function (logarithm unitless)

4.5. Variance Decomposition

Based on the analysis of impulse response function between the level of education expenditure and economic growth, in order to further understand the mutual contribution between them, the variance decomposition is used to dynamically study the changing relationship between them. As the aforementioned analysis shows,, capital investment has the greatest impact on economic growth, and the explanatory power is around 33%. Secondly, education investment has a great influence on economic growth, and the explanatory ability is around 20%. Labor input has little influence on economic growth. As the aforementioned analysis shows, the proportion of labor input to GDP is too small, so the influence on it is not significant. Economic growth has the greatest impact on education investment, and the explanatory power is around 27%. Secondly, capital investment has a great influence on education investment, and the explanatory ability is around 24%. It can be analyzed that economic growth is influenced by many factors, and the promotion effect of education investment on economic growth is very significant. Meanwhile, to a large extent, economic growth contributes a lot to education investment, and the contribution is very significant.

5. CONCLUSIONS

Based on the data from 1996 to 2018, this paper sorts out the related data of total investment in education, total investment in fixed assets of the whole society, total investment in labor force and GDP and constructs the VAR model. By using ADF unit root test, Johansen cointegration test, Granger causality test, impulse response function analysis, variance decomposition and other measurement methods, this paper empirically analyzes the dynamic relationship among various variables, and draws the following conclusions:

Firstly, after the second-order difference, the time series of education investment and economic growth has reached a steady state, and using Johansen cointegration test method, it is verified that there is a long-term cointegration relationship among education investment, fixed assets investment, labor input and economic growth

at a significant level of 5%.

Secondly, according to the Granger causality test results, it can be seen that the investment in education funds has a significant Granger impact on economic growth, and there is a bidirectional Granger causality between them. It shows that education investment will promote economic growth, and in turn, economic growth is also beneficial to education investment.

Thirdly, from the results of impulse response function analysis, it can be seen that the promotion of capital investment to economic growth is more obvious than that of education investment.

Fourthly, according to the result of variance decomposition, among the three variables of education input, capital input and labor input, the variance of economic growth forecast is mainly caused by the variable of capital input, followed by education input.

6. RECOMMENDATIONS

Firstly, attach importance to education and give priority to education. Through the empirical analysis results of this paper, we can see that education has injected the power source for economic development and is an important force for sustainable economic development. Investment in education can promote the quality of human capital, promote technological progress, and then transform China's economic growth from relying on the population's quantity advantage to the quality advantage. Priority should be given to ensuring the housing and salary of teaching and administrative staff, and at the same time, the popularization and equality of compulsory education should be guaranteed to solve the problem of continuing education for children from difficult families.

Secondly, continue to increase investment in education. Overall, China's investment in education is increasing year by year, but compared with developed countries, there is still a big gap. Paying attention to education and narrowing the gap in the total amount can appropriately attract private investment. Considering the international competition pattern that China will face in

the future, we can further increase the proportion of education investment in GDP to 5%-6% by learning from the experience of "catching up" countries such as the United States and Japan, and with the private investment in education, the proportion of education investment in China to GDP will reach about 7% [15].

Thirdly, continue to optimize the investment structure of education. Demand-oriented optimization of educational investment structure, encouraging all sectors of society to invest in the field of education. Appropriately learn from the experience of OECD countries and other countries, attract non-governmental forces, promote the integration of production and education, and develop talent education to meet the needs of society, so as to promote the economic growth of the whole society.

The fourth is to improve the transformation mechanism of educational achievements. Meaningful education should be done, so that the educational achievements can be fully transformed into various forms that are beneficial to society. We should strengthen and improve the patent system, legislate to protect the patent rights of individuals or teams, encourage individuals or institutions to invest in education and training expenses, and encourage legal use of patents, so as to form a good atmosphere of respecting, protecting and using intellectual property rights in the whole society.

Fifthly, vigorously cultivate innovative and research-oriented talents. One of the main ways to deal with international competition is innovation. In today's situation, only innovation can promote economic development to the maximum extent, and the premise of innovation is to have high-quality educational resources. Strengthen students' logical thinking, critical thinking and exploratory thinking, cultivate innovative talents, promote technological progress, promote economic development and enhance comprehensive national strength.

REFERENCES

- [1] Schutz T W. Investment in Human Capital [J]. *Economic Joimzal*, 1961, 82(326):787.
- [2] Lawrence. J. Lau, Dean T. Jamnison, Shu-Cheng Lin, Steven Riv-kin. Education and Economic Growth Some Cross-Sectional Evidence from Brazil [J]. *Journal of Developert Economics*. 1993.
- [3] Gyimah-Brempong, K., Paddison, O., Mitiku, W. Higher education and economic growth in Africa [J]. *The Journal of Development Studies*. 2006, 42(3):509-529.
- [4] Govindaraju, V.G.R.C., Rao, R, Anwar, S. Economic growth and government spending in Malaysia: a re-examination of Wagner and Keynesian views [J]. *Economic Change and Restructuring*. 2011, 44(3):203-219.
- [5] Benhabib, Spiegel. The Role of Human Capital in economic Development: Evidence form Aggregate Cross-Country Regional U.S. Data [J]. *Working Papers*, 1992, 66(1):139-40.
- [6] Young A the Tyranny of numbers: Confronting the statistical realities of the East Asia growth experience. *The Quarterly Journal of Economics*, 1995 110: 641-680.
- [7] Pritchett: "Human capital and economic development, *Journal of Development Economics*, VOI.79, P.26-72.
- [8] Yining Li. On the basis of reasonable proportion of education funds in national income [J]. *Chinese Social Sciences*, 1984(04):109-122.
- [9] Yong Lin. Research on the relationship between coordinated development of education and economic growth under the guidance of public investment [D]. Chongqing University, 2002.
- [10] Ye Liu, Chengjian Huang. An empirical study on the contribution rate of education expenditure to economic growth in China-based on the analysis of temporal and spatial differences of provincial panel data [J]. *Education and Economy*, 2009(04):47-51.
- [11] Xiaowen Liu. Empirical study on the relationship between education investment and economic growth [D]. China University of Political Science and Law, 2013.
- [12] Xiaobin Guan. Research on the coordination relationship between higher education investment and economic development in Beijing [J]. *Education Journal of Renmin University of China*, 2014(04):117-127.
- [13] Changshan Mei. Empirical analysis of the contribution of financial education investment to economic growth-based on the data from 1978 to 2016 [J]. *Times Finance*, 2018(21):235+247.
- [14] Yujun Liu, Chengwu Wang, Weiping Ying. Study on the regional differences of the impact of education funds on economic development [J]. *statistics and decision*, 2020, 36(02):121-124.
- [15] Tingting Yang. Research on Education Investment and China's Economic Development [D]. Graduate School of Chinese Academy of Social Sciences, 2020.