

Effect Analysis of the Contributions of Financial Investment in Education and Human Capital to Local Economic Growth

--Empirical tests based on data from Sichuan Province

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Abstract—This thesis conducts empirical tests for the contributions made by financial investment in education as well as human capital to the local economic growth in Sichuan Province according to the relevant statistics of Sichuan Province from 1997 to 2011. The results show that compared to the relatively less influence from financial investment in education, human capital exerts a obviously positive effect on the economic growth in Sichuan Province. And its effect on economy is lasting and continuous with a contribution rate on economic growth as high as 35% to 40%. Regarding the adjustments of factors of growth in the economic development and the overall urban-rural comprehensive reform pilot trial, this conclusion provides reference and instruction for the Sichuan provincial government.

Keywords- financial investment in education, human capital, economic growth

I. INTRODUCTION OF THE QUESTION

According to the growth theory of neoclassical economics, human capital is essential to economic growth. Many scholars have studied before how human capital contributes to economic growth. Lucas (1988) introduced human capital in modeling and revised the technical progress equation of Uzawa, then came up with an endogenous growth model with the external effect of human capital as its core. Meanwhile, a lot of efforts have been made by many scholars in the field of empirical research. However, there is also an obvious and close correlation between regional economic growth and human capital as well as financial investment in education. After examining studies both home and abroad, we can find that a great number of scholars put education investment and human capital into consideration when studying regional economic growth and obtain many profound conclusions. For instance, Leandro Prados de la Escosura (2010) examined the data of Spain, and believed that though human capital could increase labor productivity, its effect was poor; while Barro(2001)、Glewwe & Hanan (2004) and Sorensen (1993) found that human capital had an obvious positive influence on economic growth. There has been lots of researches home, for example, Yu Lingyun (2008) went through the discrepancy between education investment ratio

and local economic growth and concluded that the investment from government and non-government in China had short-term effect on human capital accumulation and economic growth. Chen Hao (2011) tended to believe human capital was significant to our national economic growth but the mechanism of action was not strong enough. Besides, there were remarkable differences among various regions as to the effect human capital exerted on economic growth point. Gao Suying (2009) also examined different levels' human capital's effect on economic growth and discovered that average people had a greater impact on economic growth than high-quality talents did. Yao Yilong (2011) found China's contribution rate of education to economy was higher than that of the US. To summarize those achievements above, both human capital and financial investment in education have some certain degree of positive effect on economic growth.

As an important pillar in the rise of western region in China, Sichuan's core economic status has already been the national focus. Chenhao (2007) pointed out that the effect of human capital on economic growth point was rather subtle compared with the well-developed east. For Sichuan province, the interdependence of human capital and financial investment in education concerning economic growth has become a crucial topic for the comprehensive development of our economy. This thesis expects to investigate the effect of human capital and education investment on economic growth on the basis of the economic growth model of neoclassical economics so as to prove the two economic factors affecting the economic growth in the region of Sichuan, and how and to what degree these two affect the economy. And therefore, this thesis could offer theoretical foundation of policy making in the economic development and the overall urban-rural comprehensive reform pilot trial. This thesis intends to discuss from the following aspects: The second part focuses on the illustration of data and the choice of proper measurements; the third part refers to the descriptive statistics of data and measuring analysis; and the last part is conclusion.

II. VARIABLE DEFINITION AND RESEARCH APPROACH

Since Sichuan's administrative region was defined in 1996, this thesis has selected the data from 1997 to 2011 for empirical research, and all data are from *Chinese Statistic Almanac* and *Sichuan Statistic Almanac*.

1. Model select

This thesis selects the economic growth model of the neoclassical, which believes that economic growth depends on capital, labor and technical progress. The Cobb-Douglas function of neoclassical growth theory is as following:

$$Y_t = A_t K_t^\alpha L_t^\beta \quad (2-1)$$

Where Y_t represents gross output, K_t capital stock, L_t labor input, A_t technical progress. After taking logarithm of the model, we can get:

$$\ln Y_t = \ln A_t + \alpha \ln K_t + \beta \ln L_t + \mu_t \quad (2-2)$$

As this thesis attempts to examine the effect of both human capital and education investment on economic growth simultaneously, the model is turned into:

$$\ln Y_t = \ln A_t + \alpha \ln K_t + \beta \ln H_t + \gamma \ln EF_t + \mu_t \quad (2-3)$$

With H_t as human capital, and EF_t as financial investment in education.

2. Variable definition

$\ln Y$: In order to eliminate the influence of inflation, this index is the value of the total GDP calculated on the prices in 1990 after taking natural logarithm.

$\ln K$: the natural logarithmic value of physical capital stock on the basis of the prices in 1990. We adopt the Perpetual Inventory Method established by Goldsmith in 1951 to calculate capital stock, and the formula is $K_{it} = \dot{K}_{it} + (1 - \alpha)K_{it-1}$, with \dot{K}_{it} indicating the newly-added fixed investments of region i in the t^{th} year; and K_{it} as the capital stock of region i in the t^{th} year; α representing depreciation rate set as $\alpha=5\%$. The empirical analysis in this thesis mainly refers to the statistics between 1997 to 2011, therefore, we will set the capital stock in 1997 as the initial value of capital stock K_{it} .

$\ln H$: logarithmic value of human capital stock. Since the calculations of human capital vary a lot, this thesis turns to method of degree weighing to measure, which calculates human capital costs of groups of different academic background by weighing and summation. The index adopts the education convert coefficients proposed by Hu Yongyuan (2003), Zhou Xiao and Zhu Nong (2003). The illiterate and the semiliterate weigh 1; primary school degrees weigh 1.1; junior high school degrees weigh 1.2; senior high school degrees weigh 1.4; and bachelor's degree and above weigh 1.6.

$\ln EF$: the natural logarithm of total educational expenditure.

3. Research Approaches

The research category of this thesis is macro regional economic issues. And since the data extraction intervals of macro-economy are rather short, using OLS approach to conduct regression analysis will inevitably cause endogenous problems and thus errors. Therefore, the thesis chooses VAR model to analyze data and expects to discover the correlativity between data. The research's approach and procedures are as follows: firstly, conduct descriptive statistics analysis, get a preliminary judgment on the trend and produce descriptive statistical table to illustrate data's normality. Then, conduct ADF unit root test. If the sequence is stationary, Grange causality test and the impulse response analysis on VAR model are available. Thirdly, decide whether or not there is Grange casual relationship among variables according to the Grange causality test result. Finally, obtain the estimated result of VAR model and the result of impulse response analysis.

Measurement Results and Analysis

Conduct descriptive statistics analysis in the first place:

Table 3-1 Descriptive statistical table

variables	$\ln Y$	$\ln K$	$\ln H$	$\ln EF$
mean	8.01	7.53	1.17	4.99
median	7.98	7.36	1.17	4.81
maximum	8.79	9.13	1.21	6.53
minimum	7.32	6.47	1.14	3.72
Std.Dev	0.46	0.91	0.017	0.92

Above table shows the data basically observe normal distribution and the discrepancy in financial investments in education is rather great. Then, conduct ADF unit root test, and analyze whether the data is a stationary sequence.

Table 3-2 Result of ADF unit root test

variables	Null hypothesis	Critical value (5%)	Value t	Value p	Result
$\ln Y$	Unit root exists	-3.09	3.41	1	Non-stationary
$\ln K$	Unit root exists	-3.09	2.86	0.99	Non-stationary
$\ln H$	Unit root exists	-3.09	-0.04	-0.94	Non-stationary
$\ln EF$	Unit root exists	-3.09	1.09	0.99	Non-stationary

Above table shows that all four sequences are non-stationary ones, the impulse response analysis, however, requires data's stability. Differential process is needed for the model to examine sequences' first difference definition. Since for the variables data of time series,

$$\Delta Y_t = \frac{Y_t - Y_{t-1}}{Y_t} = \ln Y_t - \ln Y_{t-1}$$

Therefore, we can define ΔY_t as GDP growth rate; ΔK_t as growth rate of physical capital stock; ΔH_t as growth rate of human capital; and ΔEF_t as growth rate of education investments. Then, conduct ADF unit root test and the results are as follows:

Table 3-3 Results of ADF unit root test on first differences of data

variables	Null hypothesis	Critical value(5%)	Value t	Value p	Result
$\ln Y$ first difference	Unit root exists	-3.17	-4.11	0.0015	stationary
$\ln K$ first difference	Unit root exists	-3.14	-4.48	0.0055	stationary
$\ln H$ first difference	Unit root exists	-3.11	-3.51	0.0256	stationary
$\ln EF$ first difference	Unit root exists	-3.17	-3.55	0.0276	stationary

From above tests, we can observe that the first differences of the data are stationary sequences, thus we can conduct Grange causality test and hopefully discover whether there is Grange casual relationship among variables.

Table 3-4 Grange causality test

Influencing factors	Null hypothesis	Value F	Value p	Whether accept the null hypothesis
Physical capital input	Physical capital is not the Grange cause of economic growth	6.94	0.031	No
	Economic growth is not the Grange cause of physical capital	2.66	0.264	Yes
Human capital	Human capital is not the Grange cause of economic growth	5.36	0.069	No
	Economic growth is not the Grange cause of human capital	0.11	0.948	Yes
Education investment	Education input is not the Grange cause of economic growth	0.67	0.716	Yes
	Economic growth is not the Grange cause of education input	29.90	0.000	No

From above tests, following conclusions can be perceived: investments of both physical capital and human capital influence economic growth while education investment has little effect, rather it is affected by economic growth. Above results fail to fully describe the effect of human capital and education investment on economic growth, thus a fuller explanation should be reached through establishing VAR model. We at first define the best lag interval as 2 based on AIC criteria. The following table shows the estimated result of VAR model:

Table 3-5 Estimated result of VAR model

	Model 1	Model2	Model3
	$\Delta \ln Y$	$\Delta \ln Y$	$\Delta \ln Y$
$\Delta \ln Y (-1)$	-0.3	-0.79	-0.82
	(-0.82)	(-2.55)	(-1.79)
$\Delta \ln Y (-2)$	0.26	0.65	0.38
	(-0.71)	(2.35)	(0.61)
$\Delta \ln K (-1)$	0.11	0.13	0.11
	(1.64)	(2.99)	(1.66)
$\Delta \ln K (-2)$	0.058	0.09	0.15
	(0.77)	(1.67)	(1.51)
$\Delta \ln H (-1)$		1.76	1.89
		(2.93)	(2.02)
$\Delta \ln H (-2)$		-0.53	-0.58
		(-1.12)	(-0.91)
$\Delta \ln EF (-1)$			-0.03
			(-0.51)
$\Delta \ln EF (-2)$			0.05
			(0.64)
R-squared	0.569	0.866	0.903
Value F	2.31	5.4	2.33
AIC	-5.14	-5.98	-5.79

The data in brackets refer to value t. From table 3-5, as the model 1 only considers physical capital, we can observe that the growth rate of physical capital of one order lag has positive effect on economic growth, while one percent point of physical capital increase will drive economic growth by 0.11 percent point. But regarding to R-square and value F, the goodness of fit is obviously not enough. Model 2 puts both physical capital and human capital into consideration and finds that one percent point of increase in physical capital of one order lag will drive economic growth by 0.13 percent point, while one percent point of increase in the human capital of one order lag will drive economic growth by 1.76 percent point. However, since the value T is not striking in the human capital of two order lag, the influence, in general, is not as notable as the one order lag. Meanwhile, R-square and value F are both significantly increased in the model 2, thus model 2 is superior to model 1. And the remarkable increase of effectiveness of physical capital in model 2 suggests that there is certain interaction effect between physical and human capital, which means that physical capital needs to be matched by correspondent human capital to achieve the maximum utility in promoting growth. Model 3 put all three factors-physical capital input, human capital and financial investments in education-into consideration. And we notice that the estimated value T of financial investment in education appears to be indistinctive, which proves the relatively insignificant effect of it on Sichuan's economic development. Also, value F in model 3 decreases compared with model 2, which indicates a inferior goodness of fit. Thus, given the applicability of models, we summarize above analysis and have gained several useful conclusions.

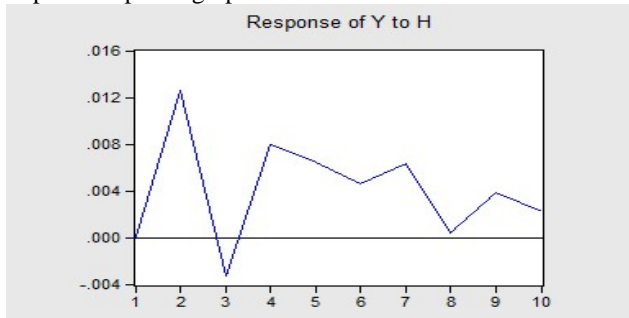
1 One percent point of increase in physical capital of one order lag drives economic growth by 0.13 percent point;

2 One percent point of increase in the human capital of one order lag drives economic growth by 1.76 percent point. However, the human capital of two order lag is not as notable;

3 Financial investment in education proves to have

relatively insignificant effect on Sichuan's economic development.

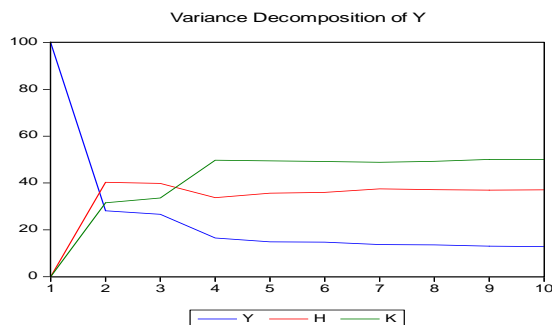
On the basis of VAR model, this thesis further applies impulse response function to analyze the dynamic influence human capital has on economic growth. Graph 3-1 is the impulse response graph:



(Y: GDP; H: Human capital stock)

Graph 3-1 Impulse response graph of human capital

Above graph illustrates that one percent of positive impulse in human capital will result in 1.2% upward fluctuation in the next stage of economy and its effect will last for a long time, which again prove the increase in human capital will have a long-term influence on Sichuan's economic growth. This conclusion suggests that Sichuan government should also attach significance to human capital while making and carrying out economic policies, because human capital will affect the economic growth not only in the next stage, but also in the later stages. In the end, this thesis makes a rough assessment on the contribution of human capital on economic growth, which is illustrated by variance decomposition showed in Graph 3-2:



(Y:GDP; H: human capital stock; K:physical capital stock)

Graph 3-2 Contribution rate of variables to economic growth

From the graph, economic growth rate can be explained by three parts, namely economic growth rate, physical capital input and human capital input in earlier stage. We can notice that the influence of all three main factors on economic growth tend to steady gradually after stage five; GDP's influence on economic growth in earlier stage is most profound, but then it's on a declining curve and after leveling off, its economic contribution is only 10% to 20%;

physical capital input has a relatively large economic contribution with a rate of 50%. The contribution of human capital in earlier stage to economic growth rate is as high as between 35% and 40% and remains ever after.

III. BRIEF SUMMARY AND OUTLOOK

The thesis has conducted empirical test about the effect of Sichuan financial investment in education and human capital on Sichuan regional economic growth based on the related data from 1997 to 2011. And the result shows: The contribution of human capital in earlier stage to economic growth in Sichuan province is significant, while the relation between financial investment in education and economic growth is relatively weak. Meanwhile, the input of human capital will affect the effectiveness of physical capital, that is to say that there is interaction effect between physical and human capital, and human capital could enhance the effect of physical capital on economic growth. At the end of the test, by impulse response function, we find that human capital has a long-term influence on economic growth with an economic contribution rate as high as between 35% and 40% after variance decomposition. Above conclusions possess certain reference value to the readjustment of economic structure for Sichuan government. While focusing on economic growth as well as making economic policies, the government should increase physical capital input, enhance the effectiveness of human capital, and raise the level of education investment so as to heighten the overall quality of Sichuan residents. These will do more good to its adjustment of economic structure and boost coordinated economic development. As for the internal causes behind the fact that financial investment in education has a rather indistinctive influence on economy, the author will do further research and investigation in the future.

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