The Effect of Education Investment on Individual Lifetime Income

——Empirical Analysis based on Chinese Provincial Data

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Keywords: Education investment, Lifetime income, J-F method, linear regression.

Abstract: The education investment has always been the popular topic which people are concerned. From the perspective of the influence of the education investment on the lifetime income, this paper uses the modified Cobb-Douglas production function and joins the J-F method to analyze the process of the formation of lifetime income. During this process, we will pay attention to the role of education investment. The empirical results show that compared to fixed-asset investment, education investment has a more significant effect on life-long income. This effect is particularly prominent in underdeveloped regions, such as interior and west provinces and rural areas.

1. Introduction

Education investment and lifetime income have always been the hot topic in both China and abroad. Since the 19th National Congress, China has actively carried out economic restructuring and promoted economic transformation, emphasizing the role of knowledge and innovation in economic development. Under such a circumstance, investment in education has become a hot topic for both individuals and countries. In this article, we will analyze whether the increasing of the amount of the investment in education and the improving of the structure of the education investment will be helpful to improve the personal lifetime income and to promote the economic transformation. Combining the fixed-asset investment and the social economic development, starting from the relationship between education investment and lifetime income, this paper analyzes the impact of education investment on the personal lifetime income.

2. Literature Review

Scholars at home and abroad have extensive research on the relationship between education investment and lifetime income. The followings are the research perspectives of the domestic scholars:

In view of the unfairness of urban and rural education and the income difference between urban and rural residents, domestic scholars have the following views: Wei Lv (2015) analyzes the impact of rural-biased education investment on urban-rural income gap and urban-rural education inequality in his article "Urban-rural income gap, urban-rural education inequality and government education investment". The article expands the Geller-Slia theoretical model, introduces the urban-rural dual structure and government behavior into the inter-temporal model, and uses the provinces panel data from 2001 to 2011 in the China Statistical Yearbook and the China Population and Employment Statistics Yearbook. The author believes that narrowing the gap between urban and rural education investment can effectively improve education unfairness and narrow the income gap between urban and rural. While Ju Yu (2013) points out that there is inverted U-shaped fluctuation relationship between education investment and urban-rural income gap in her article "The research on the relationship between education investment level and urban-rural income gap".

The author uses the panel data of 31 provinces in China from 1999 to 2012 and Kalman-Filterin recursive algorithm to establish a state space regression model. The author believes that the government can narrow the urban-rural income gap through improving the level of education investment. Binkai Chen (2010) points out that the difference in education level is the most important factor which affects the income gap between urban and rural areas in China in his article "Government education investment, human capital investment and China's urban-rural income gap". The author studies the impact of government education investment on urban-rural income gap and its mechanism and establishes a four-sector theoretical model including manufacturers, consumers, government departments and education departments by using the 2002 CHIP data. By using the Oaxaca-Blinder decomposition method to analyze, the author thinks that the urban-oriented education funding input policy is an important determinant of the urban-rural education level and the widening income gap between urban and rural areas. While Hao Sai (2010) analyzes the impact of urban-rural residents' education investment on the gap of urban-rural income in his article "The causal analysis of the urban-rural residents' education investment and the gap of urban-rural income". By using the Granger test based on the regression hypothesis and using the statistical yearbook data of Jiangsu Province from 1986 to 2009, the author finds that the increasing on urban and rural education expenditure will help to increase the income of the residents no matter short term or long term. While this effect is more significant in the long run.

While for the relationship between the provincial education investment and the gap of income, the domestic scholars analyze from the following perspectives: Yanhua Zhang (2011) points out that the human capital has a strong role in promoting urban and rural income growth, and the output elasticity of rural human capital is significantly higher than that of urban in her article "The Spreading Effect of Educational Public Input and Income Gap". By studying the impact of human capital and its spillover effects on urban-rural income differences, using the data from the 2000-2008 China Education Funding Statistical Yearbook, and using Lucas's new economic growth theory framework, a fixed-effect analysis model of panel data was used. The author believes that the spillover effect of rural human capital and urban human capital makes the existing urban-rural gap further wide, which means that the balance between urban and rural areas can be mainly achieved through more human capital input. Yun Feng(2011) points out that the gap in regional financial education funding has experienced a process of first increasing and then shrinking sharply and there is a high positive correlation between the regional financial education funding gap and the regional income gap in his article "Research on the Relationship between Education Input Gap and Regional Residents' Income Gap". By using the National Bureau of Statistics data from 1995 to 2008, Mantel correlation analysis and spatial econometric analysis, the author believes that primary education and higher education investment can significantly promote the income of local residents. The unequal investment in higher education and primary education in various places is an important reason for the income gap between the local residents in China. While Meijuan Zhu (2003) points out there is unfairness in education input among different provinces, and the degree of the unfairness is tending to more serious in her article "An Empirical Study on the Equity of Education Input in China's Provinces". By using the data of the 1999-2001 China Statistical Yearbook and the Financial Yearbook, and the Gini coefficient in welfare economics to analyze, the author finds that the degree of unfairness of the state's overall education investment in the province is increasing. The allocation of education within the budget is the main cause of the increase in inequality.

Similar to the domestic scholars, the abroad scholars analyze the relationship between education and lifetime income by using their own countries' data. The followings are the main views: Nikos Benos (2016) analyzes the impact of education quality spillover effects on production efficiency in his article "Do education quality and spillovers matter?". By using the AMECO database data from 1971-2011 in Greece, and the Cobb Douglas production function with human capital factor for analysis, the author finds out that education quality has a significant spillover effects on labor productivity, and higher education and advanced secondary education have a positive effect on the improvement of labor productivity. Burcu Kiran (2014) studies the impact of education expenditure on the economic growth in 18 Latin American countries in his article "Testing the impact of

educational expenditures on economic growth:". By using the H-J cointegration test model, based on the consideration of the two economic restructuring of Latin American countries, the authors believe that there is evidence that education spending and economic growth maintain a significant positive correlation in Latin American countries. While Manfred M. Fischer (2009) studies the impact of human capital on labor productivity in 198 regions of Europe in his article "The impact of human capital on regional labor productivity in Europe". Based on data from the Norwegian Bureau of Statistics and the Swiss Statistical Office from 1995 to 2004, using the spatial Dubin model and the LeSage and Pace's method, the author argues that human capital has a significant positive impact on labor productivity, but if other economic factors are considered to add into the model, it will be found that human capital has no significant impact on labor.

3. Methodology and Data

3.1 Theoretical Model and Empirical Model

In general, analyzing lifelong income is a micro-level problem in economics. However, when analyzing the lifetime income of all the citizens of a country, we can learn from some classic theories and methods in macroeconomic analysis. This paper draws on the Solow model for analysis. In the application of the Solow model, the Solow model in the form of the Cobb-Douglas production function is mainly used.

Formula 1 (Solow model):

$$Y = AF(K, L)$$

Formula 2 (Cobb-Douglas function)

$$Y = AK^\alpha L^\beta$$

Solow model analyzes the relationship between the output and input of the national economic. Solow believes that the input in the national economy can be divided into two types: one type is the physical capital investment K, and the other is the labor input L. In economic production, Solow sums up the factors in addition to factors assets and labor as A, which is the total factor productivity TFP. When we analyze the lifetime income of all nationals in a country or region, regardless of tax burden and trade, the economic output of a country or region can be used as a representative of the national current income. So, we consider replacing the Solow model K and L to analyze the determined factor of the personal lifetime income. Specifically, we replace Y (Gross National Product) with MI (Lifetime Income), replace K (physical capital investment) in Solow's model with PCI (Personal Physical capital Investment), and replace the L (labor input) in the Solow model with EI (education input), so we get

Formula 3 (Lifetime income function):

$$MI = A(PCI)^\alpha (EI)^\beta$$

Both PCI and EI are current values, which can be easily found in the macro database, so the difficulty in our model measurement is how to determine the individual's lifetime income MI. In order to calculate MI, we used Jorgenson-Fraumeni human capital calculation method.

Formula 4: (J-F method)

$$MI = \sum_s \sum_a \sum_e mi_{y,s,a,e} \cdot L_{y,s,a,e}$$

In formula 4, y, s, a, and e represent the year, gender, age, and education level, respectively, mi represents the expected future lifetime labor income, L represents population. The J-F method uses the idea of perpetual inventory when calculating lifetime income. It is divided into several groups according to factors such as age, gender, and education level for analysis. The JF method believes that individuals with the same level of education, gender, etc. will have the same expected personal income in the future, so after considering the factors such as the rate of enrollment and mortality, we can use a uniform discount rate to express lifetime income. Since the degree of education of a person

in the J-F method is an important determinant of his or her personal income, so, whether the individual is still receiving education is becoming more important in examining his or her lifetime income. When this paper draws on the J-F method for analysis, the individuals in economic activities are divided into two categories: one is the students in the school, and the other is the person who has completed the education. The data on lifetime income comes from the calculation results of human capital in China's provinces by the China Human Capital and Labor Economic Research Center.

From formula 3, we can see clearly that one person's current investment has a significant effect on his lifetime income. And a person's current investment usually has two directions, one is to invest in physical capitals such as stocks and real estate, and the other is to invest in education, whether it is general education or on-the-job training. To measure the impact of two types of investments on individual lifetime income, we introduce the least squares (OLS) regression analysis. The general form of least squares regression is shown in Equation 1.

Equation 1 (least squares regression OLS):

$$y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n + u_i$$

In the specific application, we define the dependent variable yi as the individual's lifetime income (MI). There are two regression independent variables: one is the individual's physical capital investment pci, and the other is the individual's educational investment ei. We believe that there are two control variables: one is the gross national product gdp, which can well reflect the economic situation of a region, and the other is the total value of physical capitals pc, which can reflect the industrial structure of a region. From this we have obtained Equation 2, and we will use Equation 2 in conjunction with the data for regression analysis.

Equation 2 (Basic Regression Model):

$$y_i = \beta_0 + \beta_1 ei + \beta_2 pci + \beta_3 gdp + \beta_4 pc + u_i$$

3.2 Data

In combination with Equation 2, we need the following data for regression analysis: The first is the data of personal lifelong income. We mainly use the calculation results of China Human Capital and Labor Economic Research Center from 1985 to 2015.

The second is the data of gross domestic product (GDP) physical capital investment (PCI) and education investment (EI), which we obtained from the National Statistical Office's statistical yearbook. So, what we are going to measure is the relationship between the overall national investment situation of a region and its overall expected lifetime income, we only need to track the provincial level, and the data in the statistical yearbook of the National Bureau of Statistics can meet the requirements of our calculation. It should be noted that the data in the Statistical Yearbook of the National Bureau of Statistics uses the value calculated in the current period, and in order to eliminate the measurement error caused by price changes and inflation, we use the GDP deflator and the price deflator for the statistical yearbook, in which the data has been corrected. Finally, the data which the physical capitals form the total PC value is also from the results of the China National Capital and Labor Research Center's reference to the OECD method to calculate the total value of physical capitals in China's provinces.

4. Results and Analysis

4.1 Table Description

In order to fully understand the relationship between China's national lifetime income and its investment decisions, we use empirical data analysis methods for analysis. In addition to understanding the general situation in the country, we also analyzed whether the relationship between lifetime income and education input is different between provinces. Referring to the

provincial classification method commonly used by the National Bureau of Statistics, considering the differences in economic and social development levels between regions, we classify 31 provinces in the country into three regions, namely, the eastern, central and western regions. And the regression analysis was carried out on these three types of areas, and the results are shown in the following table 1.

Table 1. Least Squares (OLS) regression results

VARIABLES	Total MI	East MI	Interior MI	West MI
Education investment	23.88***	-6.531	13.82	28.92***
	(7.852)	(13.46)	(34.82)	(6.945)
Physical capital investment	-0.693	-2.572***	-0.0582	-6.671***
	(0.614)	(0.891)	(1.642)	(0.817)
Gross domestic product	8.346***	8.761***	9.202***	14.23***
	(0.421)	(0.629)	(1.725)	(0.638)
Physical capital stock	1.731***	1.254***	1.754***	2.303***
	(0.235)	(0.309)	(0.610)	(0.304)
Constant	10,811***	16,138***	11,449***	3,147***
	(812.5)	(1,481)	(2,733)	(537.1)
Observations	495	176	128	191
R-squared	0.908	0.937	0.752	0.933

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

In table 1, the first column represents the regression results of the national total sample, reflecting the relationship between the average educational investment and the expected lifetime income in nationwide. And the second column represents the results of the regression analysis of the eastern provinces. It is the relationship between the average education investment in the East and lifetime income. Similarly, the third column represents the results of the regression analysis of the central provinces, and the fourth column represents the regression analysis of the western provinces.

First, we can see that education investment (ei) has a significant positive impact on lifetime income nationwide. According to regression results, the impact coefficient is 23.88. The situation in the western provinces is basically the same as that at the national level. The educational investment income coefficient of lifetime income is 28.92, which is slightly higher than the national average coefficient. This shows that the investment in education in the western region has a greater impact on lifetime income. Similar to the western region, the educational investment income coefficient of the central provinces is 13.82, which is also a positive number. However, unlike the western provinces and national data, this result is not significant, indicating that education investment in the central region has promoted lifetime income not obvious. The situation in the eastern provinces is different from that in other regions. The regression results show that the educational investment income coefficient of the eastern provinces is -6.53, which indicates that increasing investment in education has a negative effect on lifetime income in the eastern provinces. This result is closely related to the development of the eastern provinces. After the reform and opening, the eastern provinces were the window of foreign investment, and the market economy has developed rapidly. In this context, a large number of "first rich" people have emerged. The income accumulation of these individuals is mainly from commercial and light industry whose demand for knowledge is not high and the income growth is mainly due to the special historical background. They have grasped the opportunity of reform and opening. Due to these reasons, the data shows a negative relationship between investment in education and lifetime income.

Secondly, we can see that from the perspective of physical capital investment (pci), whether at the national level or in the eastern, western and central regions, physical capital investment has a negative impact on individual lifetime income, and this effect is especially remarkable in the western region. Because according to economic theory analysis, there is an alternative relationship between physical capital investment and education investment. In the case of fixed disposable income, increasing investment in physical capitals necessarily means reducing investment in education, and with economic and social development, the demand for education and knowledge level is increasing, the lack of knowledge due to excessive investment in physical capitals will inevitably have a negative impact on a person's lifetime income.

Finally, by observing the control variable (GDP), it can be found that the level of the economic development of a region has a significant impact on the lifetime income of individuals in the region, and this effect is significantly positive at the national level or in the eastern, central and western regions. It means that when we analyze the relationship between investment in education and lifetime income, we cannot separate it from the macroeconomic environment. It is meaningful to join the factor of gross national product (GDP).

4.2 Discussion

First, the education investment has a positive impact on one's lifetime income. According to the regression results, increasing investment in education can effectively increase the individual's expected lifetime income. This result will become more significant with the development of the economy and the transformation of the industrial structure. For a long time, China has relied on low-end manufacturing in the primary and secondary industries to support economic development. In these industries, the level of knowledge is not important, and the large investment in energy and resources can effectively increase the output value. Therefore, the return on investment in education in China's history is not high. However, with the development of the economy, China's pillar industries are gradually turning into high-end manufacturing industries in the tertiary industry and the secondary industry. Among these industries, the most important resource is human resources. The increase in profits is driven by innovation and knowledge. And the level of education becomes very important. In this context, if a person wants to increase his or her expected future lifetime income, then it is very important for him or her to invest in education to improve an individual's level of knowledge.

Secondly, there is an alternative relationship between investment in education and investment in physical capitals. It is important to balance the quantitative relationship between investment in education and investment in physical capitals. According to the cycle theory of economic development, from the perspective of dynamic model, a person's current investment, whether invested in education or invested in assets, is derived from the personal income of the previous period, and when the individual income is fixed, if the education investment is increased, the investment in physical capitals will inevitably reduce, and vice versa. Especially in areas where the level of economic development is not high and the level of personal income is low, there is a greater problem of how to rationally allocate the two types of investment. From the regression results, this paper believes that for families with lower incomes, investing in education can better improve the expected lifetime income and improve the individual's expected economic situation.

Finally, the relationship between investment in education and lifetime income will be constrained by the level of economic and social development. The lifelong income of an individual comes from its investment income and professional compensation, both of which are constrained by the level of economic and social development. Only the high level of economic development can guarantee the individual occupational income and investment returns. From another point of view, according to Lucas's theory of human capital, if one's level of knowledge wants to transform into reality, then it needs to match the modern industrial structure whose development is also subject to the level of the society development. Therefore, we must consider the actual social and economic conditions if we want to influence lifelong income through education investment.

5. Conclusions

Combined with the results of empirical analysis, from the perspective of China's economic and social development, it is inevitable to attach importance to knowledge and education in order to achieve economic transformation. Therefore, countries and individuals should proceed from the following points to improve the level of investment in education and improve the structure of investment in education:

First, both countries and individuals should pay attention to investment in education. In particular, the state should increase the proportion of investment in education in personal and state expenditures. With the development of economic society and the arrival of the era of knowledge economy, the impact of education on one's future income is becoming more and more important. Increasing investment in education can effectively increase personal lifetime income. From the national perspective, increasing investment in education can help the economy transform.

Second, countries and individuals should reasonably allocate the amount of their education investment and physical capital investment. From the perspective of economic and social development, China's economic development has entered the stage of modern economy, and the traditional way of relying on investment to stimulate economic growth is gradually withdrawing from the historical stage. Innovation-driven economic development has become the main theme of China's economic development. Under such a background, reducing investment in physical capitals and rationally increasing investment in education should become an inevitable choice for the state and individuals.

Finally, while attaching importance to the investment in education, the state should also improve other social economic factors that affect the role of investment in education. The effect of education investment on lifetime income is not direct, but indirectly, it requires the social economy to provide an industrial structure which is suitable for talents with high knowledge levels. Judging from the current situation in China, the level of social development in the central and western regions is relatively low, and the industrial structure is relatively backward, which affects the role of education investment. The state and the government should increase the investment in education in the central and western regions, and at the same time help the central and western regions to achieve industrial upgrading, which can help to raise the income level of the people in the central and western regions, and to achieve the goal of building a comprehensive well-off society.

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