Government Policy, Human Capital and Regional Economic Growth — Taking the Shandong Province as an Example

Yang Jian

Abstract—By using the theoretical model and practical data analysis, the relationship between Shandong province's human capital and economic growth was researched systematically. The results indicate that the current public education system has simulative effect on human capital accumulation and economic growth; material capital and opening up is helpful for the talent aggregation and flow, promoting human capital accumulation, which is conducive to economic growth; Fiscal decentralization is conducive to economic growth and human capital accumulation; excessive financial burden has the opposite effect. Finally, the suggestion of accumulating of human capital and promoting economic growth was given from the perspective of the government.

Index Terms—Government policy, human capital, economic growth, Shandong province.

I. INTRODUCTION

The academic field has been long paid attention about the relationship, which is between the quality improvement of the education's system that enhance the local human capital and economic growth, in government policy study. Currently, most of the studies are within the frame of the endogenous growth, trying to describe the dynamic human capital formation mechanism. Viaene and Zilcha point out that the increasing public expenditure on education will beneficial to the economics' long term stable growth, as well as improving the income distribution gap (Viaene and Zilcha, 2006). [1] However, there are also some studies argue that it is the uncertainty within public education resource distribution that causes the volatility in narrowing the income gap and improving the economic growth. Su (2004) constructs a two-stage model of human capital accumulation, discovering that the basic education inclination in underdeveloped areas does not promote economic growth. [2] Barro and Sala (1999) point out that expenditure on public education has significant promotion for economic growth. [3]However, from Devarajan's (1996) empirical study, we can draw a conclusion that public expenditure on education hinders economic growth from the date of developing countries. [4] Blankenau's (2006) study found that public spending on education does promote growth to economic in developed countries, however, there is no significant impact on developing countries. Researchers on this aspect have not yet reached consensus. [5]

For Chinese scholars, Wang Jinying (2001) uses the C-D production function to estimating the contribution of human capital growth to economic growth spanning more than 20years since China's reform and opening: direct 9.99% and indirect 6.7%.[6] Wang Xiaolu and Fan Gang(2005) come to the conclusions that the uneven distribution of human capital stock becomes one of the most influential factors to the uneven economic development among China. In this study, they use the degree of education and professional & technical personnel as tools showing the gap between the eastern China and the western China. [7] Bian Yali and Shen Lisheng(2004) also confirm that human capital gap between eastern and western China has significant impact on economic growth. In western China, the physical capital and human capital are all in vulnerable state, which lead to the results of economics' slow growing and backwardness. [8] From the above, Chinese scholars hold positive opinions that human capital has the promotion effects to the economic growth.

From the previous literatures, most of them choose the whole country as the research object, lacking specifically. In this article, we choose Shandong province, one of China's most considerable province in education and economic volume as the analyzing object. We consider to construct a theoretical model of public education system, human capital and economic growth, and then using the actual data in Shandong Province for empirical analysis.

In this article we note the following points: (1) due to the education system has obvious stage characteristics: higher stage of learning depends on the study of lower stage, we divide the education system into three stage: basic education stage, secondary education stage and higher education stage, for the consideration of conclusions' reliability. (2) We pay attention to the macroeconomic environment's influences to the education system and human capital. And we take the fixed assets investment, the employment rate, the fiscal revenue and expenditure structure and the openness into consideration when construct the model. (3) Since the previous studies do not give the nature of public education variables and control variables, we consider several different situations: setting the public education variables and control variables as endogenous variables and exogenous variables respectively.

The rest of the article organizes follows: next section presents the constructing of the theoretical model, and then the third section for empirical analyzing. The last section is the conclusion and policy suggestion.

II. THEORY MODEL

Here we build a theoretical model including government education policy and the impact on economic growth. We assume that, when t, individual's human capital stock depends on t-1 period's investment in human capital, study time and quality. The volume of education is an increasing function on investment in education. Investment in public education system obtained from former taxes.

Individual accepted education is depended on the last generation's legacy and tuition. When $t = 0$, the knowledge endowment of the individual (i) equals k_i, and the knowledge endowment is the function of income distribution $B_0(\cdot)$. Function $B_0(\cdot)$ means μ_0, variance σ_0^2. We assume that individual has the same preference, then when t, the individual's (i) utility function as follows:

$$U_i = Lnn_t + LnC_{t+1} + Lne_{t+1} \qquad (1)$$

n_t represents the leisure in t, C_{t+1} is the cost in $t+1$, e_{t+1} is the education quality in $t+1$. Individuals distribute the time n_t for leisure, $1-n_t$ for study. When $t+1$ the human capital accumulation is the function among education quality e_t, the last generation lofted capital stock h_t and the time. Adopting C-D production function to present the human capital accumulation in $t+1$:

$$h_{t+1} = \delta(1-n_t)^\beta e_t^\lambda h_t^\alpha , \ \delta > 0 , \ \beta, \lambda, \alpha \in (0,1) \qquad (2)$$

Under the public education system, individuals' income tax rate will be π_{t+1} in $t+1$ period, and the public education quality is an increasing function of tax.

$$E_{t+1} = \pi_{t+1} H_{t+1} \qquad (3)$$

E_{t+1} represents the public education quality in $t+1$ and H_{t+1} is the income in $t+1$, which is depended by distribution function $D_0(\cdot)$, then:

$$H_{t+1} = \int h_{t+1} dD_{t+1}(h_{t+1}) \qquad (4)$$

At this point, everyone facing the same education quality, and during t, the only different among individuals is the previous generation's knowledge given.

Under the private education system, education quality e_{t+1} depends on individual income, consumption and previous legacy. Thus the quality of education varies.

We should consider the optimal decision for individuals

between these two kinds of education system.

In the public education system, the choices for individual between consumption and human capital investment depend upon which leads the maximize utilities:

$$V_i = Lnn_t + LnC_{t+1} + Lne_{t+1} , \text{ Constraint is:}$$

$$C_{t+1} = (1 - \pi_{t+1})_{t+1} , \text{ and } \quad h_{t+1} = \delta (1- n)^\beta E_t^\lambda h_t^\alpha \qquad (5)$$

Now, (1) h_t and h_{t+1} is the best choice for the people in t period, the former generation's human capital is h_t; (2) everyone's human capital is up to $h_{t+1} = \delta(1-n_t)^\beta E_t^\lambda h_t^\alpha$; (3) known the distribution $D_0(\cdot)$ in t period, then the distribution of income $D_{t+1}(\cdot)$ in $t+1$ is depended on $h_{t+1} = \delta(1-n_t)^\beta E_t^\lambda h_t^\alpha$; (4) tax rate π_t is determined by previous generations; (5) the schools quality in t is $E_t = \pi_t \int h_t dD_t(h_t)$. During the t period, the time individuals distribute for human capital investment is $1 - n_t = \dfrac{\beta}{1-\beta}$; and the human capital stock in $t+1$ depends on previous generation's knowledge.

$$h_{t+1} = \delta E_t^\lambda (\frac{\beta}{1+\beta})^\phi h_t^\alpha \qquad (6)$$

Thus, individual's optimal tax rate is $\pi_{t+1} = \dfrac{1}{2}$. According to the assumption, human capital is in accordance with the mean of μ_t and σ_t^2 variance log distribution in t period, same as the $t+1$, then:

$$\mu_{t+1} = Ln[\delta E_t^\lambda (\frac{\beta}{1+\beta})^\beta] + \alpha\mu_t \qquad (7)$$

And $\sigma_{t+1}^2 = \alpha^2 \sigma_t^2$, assuming that the tax rate unchanged, then:

$$h_{t+1} = \delta(\frac{1}{2})^\lambda (\frac{\beta}{1+\beta})^\beta (H_t)^\lambda h_t = A(H_t)^\lambda h_t^\alpha \qquad (8)$$

Among them, $A = \delta(\frac{1}{2})^\lambda (\frac{\beta}{1+\beta})^\beta$, the unit of capital income in t period is :

$$H_t = exp(\mu_t + \frac{\sigma_t^2}{2})^2 \qquad (9)$$

then:

$$\mu_{t+1} = Ln(A) + \lambda n(H_t) + \alpha\mu_t = Ln(A) + (\lambda + \alpha)\mu_t + \frac{\lambda\sigma_t^2}{2}$$
(10)

Though the above analysis, the effect of narrowing the income gap leaded by the education development has been determined by the comparison between σ_{t+1}^2 and σ_t^2. If $\sigma_{t+1}^2 < \sigma_t^2$, then the development of education do improve the income distribution gap, vice versa. Since $\alpha < 1$, then $\sigma_{t+1}^2 < \sigma_t^2$, the development of public education improves the income distribution gap. According to formula (10), if $\alpha < 1$, then h_{t+1}/h_t decrease with h_t, the low-income families have higher growth rate in human capital accumulation than high-income families, which narrowing the gap in income distribution.

III. EMPIRICAL RESEARCH AND ANALYSIS

In this section, we choose the GMM system estimation method and use the Shandong province's realistic data for empirical analysis. Aiming to reveals the relationship among Shandong province's education system, human capital and economic growth, we examine the impact of the current education system on human capital and economic growth exactly.

Traditional calculation methods for human capital such as future earnings method, cost method and the cumulative stock of education law only consider the single perspective: revenue or cost. However, using a single method to estimate the local human capital level is irregularities. Currently, the academic has yet gotten the consensus on the measurement of human capital, especially the "human capital stock" contents so much. So there is a necessity for us to design a comprehensive method to estimate human capital stock. Here, we reference Jingshui Sun and Lili Xu's research, and establish a multi-index measure of human capital evaluation system, see Table I.

TABLE I: HUMAN CAPITAL MEASUREMENT EVALUATION SYSTEM

Total index	Level indicators	Secondary indicators
	Quality of human capital	The average years of schooling
		The number of people get college diploma per 10thousand people
		professionals & technical per 10 thousand people
		average wage of employees
		The number people of urban technical training schools
		The number people of rural technical training schools
		Engel coefficient of urban
		Engel coefficient of rural
Human Capital Measurement Evaluation System	Human capital accumulation capacity	Expenditure on education per people
		Percentage of the education accounted in GDP
		Public Health Service expenses
		The number of doctors per 10 thousand people
		The number of hospital beds per 10 thousand people
		The number of university per 10 thousand people
		The proportion of related employees
		Population current ratio
		Cost of living index

We study the above indicators with the principal component analysis, which is a multivariate statistical method that simplifies the multiple indicator variables into few integrated variables. We select the data from 1992 to 2009 subject to the availability of statistics. First of all, we run the data for KMO Bartllet test, for determining whether it can go on factor analysis. KMO is the parameter to detect the appropriateness of Kaiser-Meyer-Olkin sample. The larger the KMO gets (indicating more common factors between the variables), the more suitable for factor analysis. The sample's Bartllet is 564.759, p <0.0001, factor analysis can be performed. We use SPSS software to get the first two principal components characteristic value, which reaches very representative level: 92.483%. Finally, we get the Shandong Province 1992—2009 comprehensive human capital stock data, see Table II.

IV. SETTING MODEL

Combining the above results from the theoretical model and pervious research, we set the model for empirical research as follows:

$$G_t = \alpha + \beta P_t + \lambda C_t + \delta H_t + \mu_t \tag{11}$$

Among them, G_t is the growth of GDP per people, P_t is the variable of public education system, including the scale of education expenditure(budget expenditure on education/ GDP), and the structure of public education expenditure(considering the percentage of basic, secondary and higher education budget in education expenditure budget). H_t is the index of human capital stock. C_t is the index of control variable, including fixed asset investment rate(Invest), for the impact of material capital accumulation; financial income rate: financial income/ GDP(Finance), for determining the impact of the financial burden of Shandong province; labor: employment rate = employees / total population (Labor), for examining the impact of the changing in labor market and the labor force participation rate; economic openness: total imports and exports / GDP (Open), examining the openness of Shandong province; fiscal decentralization: per capita income (expense) / per capita income (expense) + per capita central revenues (expenses) (Distr), examining the impact of government revenue and expenditure arrangements. Time spans from 1992 to 2009. Specific regression results are shown in Table III.

TABLE II: COMPREHENSIVE HUMAN CAPITAL IN SHANDONG PROVINCE COMPREHENSIVE INDEX

year	F4	F2	Human capital stock	year	F4	F2	Human capital stock
1992	123.5833	56.3843	104.5547	2001	548.5849	167.4843	457.4845
1993	134.0948	65.9203	121.5832	2002	608.4821	185.3921	439.9584
1994	158.94782	57.5933	134.2844	2003	748.5835	324.3426	560.2848
1995	190.7535	76.6932	181.4826	2004	699.7398	495.6939	540.2841
1996	234.8271	89.4356	189.5831	2005	799.3753	586.3958	709.4821
1997	182.4832	68.0328	174.4732	2006	1095.3843	604.2854	889.2842
1998	289.4825	78.4329	239.4356	2007	1283.4735	774.5825	982.7491
1999	302.5739	68.4592	228.5739	2008	1489.6849	794.7829	1094.8569
2000	365.9403	108.4278	382.4842	2009	1754.5832	896.4382	1397.3495

Note: The data from the "Statistical Yearbook of Shandong," GTA database and CEI

We use the GMM method to estimate the regression equation (Monterio，2008). Comparing with the lag order's Arellano-Bond residual in different autocorrelation tests, we decide the optimal lag order is 2. Because the nature of education system and control variables do not meet the consensus, we consider to examine three different situations: 1. set the education system variables and control variables as exogenous variables; 2. Set the education system variables and control variables as endogenous variables; 3. Set the education system, material capital investment and labor variables as endogenous variables, and other control variables as the exogenous. Present them as model (1), (2), (3).

From the estimated increase over the Arellano-Bond AR (1)test and Arellano-Bond AR (2) test, it can be seen the residual series of three model all are first-order autocorrelation but there is no second order autocorrelation.

We can come to the conclusion that the estimated model results are desirable.

When we set the public education system variables and control variables as the exogenous variables, the regression results show that the increasing public spending contributes to the growth of per capita GDP, and the impact factor up to 0.545. Breakdown of view, basic education, secondary education and higher education expenditure all contribute to the growth of per capita GDP, especially the basic education. In addition, the rate of fixed asset investment, openness and fiscal decentralization also play the role of promoting, but the effect is not significant enough, which suggests that there may be a great potential. Human capital stock has the positive effect to the growth of economic under the increasingly sophisticated education system. It is worth noting that the excessive fiscal pressures may impede economic growth. Although the revenue year after year

highs, the rapid growth may has negative effect on economic stable growing. When we set the public education system variables and other control variables as endogenous variables, the regression results are similar with model (1). But the impact factor of secondary education variable turns to be negative. This may be related to the changing of public education variable. However, the rest of the variables' impact factor changes a little and the overall impact are substantially same with model (1). Model (2) and the model (3) have the substantially same results. The impact factors of secondary education variable turn to be negative, the remaining variables are not a major change. In summary, we can assume that the public education system and human capital in Shandong province have played positive role in economic growth. Because of the model setting and local development situation, our research has slightly different with previous studies, but the basic conclusions are similar.

TABLE III: System GMM Estimation Results

variable	（1）	（2）	（3）
Constant term	-0.252（0.14）*	-0.389（0.18）**	-0.227（0.13）*
The proportion of public education	0.545（0.63）	0.898（0.65）	0.413（0.51）
The proportion of basic education	0.213（0.13）**	0.343（0.15）**	0.231（0.14）**
The proportion of secondary education	0.194（0.12）	-0.051（0.17）	-0.164（0.17）
The proportion of higher education	0.128（0.08）*	0.189（0.08）**	0.115（0.07）*
Invest	0.024（0.04）	0.029（0.05）	0.028（0.04）
Finance	-0.212（0.21）	-0.139（0.22）	-0.152（0.19）
Labor	-0.089（0.07）*	-0.084（0.05）**	-0.092（0.07）*
Open	0.003（0.00）	0.005（0.00）	0.001（0.00）
Distr	0.057（0.08）	0.042（0.09）	0.062（0.07）
Human capital stock	0.019（0.01）**	0.028（0.01）**	0.018（0.01）**
Arellano-Bond AR(1)test	-2.01**	-1.89*	-2.13***
Arellano-Bond AR(2)test	-0.32	-0.17	-0.36
Hansen over identification test	23.58	18.27	27.62
DHansen GMM instrumental variables validation	0.00	0.15	-0.00
DHansen IV instrumental variables validation	3.92	—	2.81
Wald	527.3**	462.1***	603.7***

V. CONCLUSIONS AND POLICY RECOMMENDATIONS

In this article, we start from the government policy of public education system, through theoretical models and empirical analysis trying to analyze the relationship between human capital and economic growth in Shandong province, which is one of China's largest province in volume of education and economic. The conclusions are as follows: (1) in government policies, no matter basic education, secondary education or higher education all have positive effect on economic growth; (2) physical capital investment and openness contribute to the growth of economic through the increasing of human capital stock; (3) fiscal decentralization is conducive to human capital accumulation and economic growth; (4) revenue indicators should be reduced, because too much financial pressure will suppress the continued steady growth of human capital and the economy. So here we present the following policy recommendations:

First, increase investment in human capital and physical capital. From the result of the model, Shandong province is in the gold period of economic growth, and investment in physical capital is bound to drive the flow and accumulation of human capital. So the government should increase investment in physical and human capital, particularly in financial expenditure. However, in this process, they also should pay attention to the coordination of physical capital and human capital investment. Rather than focusing on short-term physical capital investment for GDP growth, using the physical capital investment as the tool to increase the human capital stock in the period of high-speed economic growth should be taken into consideration. And later on, the accumulation of human capital stock will contribute to the physical capital accumulation. Ultimately

achieve the purpose of GDP growth. Such a virtuous cycle system should be the main idea of future development.

Second, government should play the role of improving the human capital stock. Although the level of education in all stages of Shandong province forefronts the nation, there are still some problems: educational funds may not be implemented properly; secondary vocational education may not be taking seriously. We should recognize that the normal accumulation of human capital cannot rely on simple education stage, but to the coordination of them, which requires the government's macro guidance. The government should undertake the responsibilities to develop a comprehensive education system, and increase financial support to provide a fair, just and open environment, aiming to eliminate the obstacles in system and promote the rational development of education system and human capital flow.

Thirdly, the government should pay attention to improving the overall quality of the labor. As the country's second most populous province, power resources in Shandong Province is very rich, and how to guide and rational use of these labor should be considered deeply. Because large volume of low quality population will bring the economic development and social stability into risks, the government should not just focus on the number of labor force, but should pay attention to the quality of the workforce. The government should strengthen the urban and rural human capital investment for enlarging the effect of accumulation of human capital and make full use of learning effects, knowledge effects as well as spillover effects in order to creating spillover environment in rural human capital and effectively improving the quantity and efficiency of labor. But also, the government ought to promote the reform and incentive system in the labor market for the aim of improving the operating efficiency of human capital. In this way, the human capital may play the real role of promoting economic growth.

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Yang Jian was born in Lanzhou, Gansu Province, China in, 1975, He received his master's degree in regional economics in Lanzhou University, in 2005. He received his doctor's degree in regional economics in Lanzhou University in 2013. He research fields are regional economy and industrial economy

He is working in China university of petroleum (east China) teaching in school of economics and management Since July 2005.