An Empirical Study on Rural Economic Growth in Hubei Province Based on New C-D Production Function

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Abstract Human capital is becoming a major driving force of promoting economic growth and social development. Hubei Province as a large agricultural province is significantly affected by the human capital. The paper selects the correlation data about rural economic growth in Hubei Province as samples to analyze the contribution of physical capital and human capital to rural economic growth by the new C-D function and SPSS22.0. The results show that the effect of the elasticity of human capital is greater than that of physical capital in rural economic development; the high quality rural human capital storage and the average years of schooling of rural labor force will increase the net income of rural household. Therefore, we should not only increase input of physical capital but also increase the input of human capital to raise the level of human capital in rural areas and promote sustainable development of rural economy.

Key words New C-D function, Human capital, Physical capital

1 Introduction

In the 1960s, human capital theory developed rapidly in Western economics, and was highly valued in most Western countries. Known as the "father of human capital", Schulz is a representative researcher who points out that the important factors that contribute to the country's economic growth have shifted from the increase of land, population and capital stock to improvement of human ability and technical level, namely the accumulation of human capital[1]. Since then, the contribution of human capital to economic growth has become the focus of attention for researchers. In the late 1980s, Romer established knowledge accumulation model based on Learning-by-doing Model, to study the effects of endogenous technological progress on economic growth, and concluded that human capital was the main factor to promote economic growth[2]. As the state has attached great importance to issues concerning agriculture, countryside and farmers, rural economic growth issue has become a hot topic of academic research. The scholars have conducted a series of in-depth studies on how to promote farmers' income from various angles. Although there are many ways to increase farmers' income, they can be broadly divided into two categories: one way is to use a series of income growth mechanisms inside agriculture to increase farmers' income; the other way is to expand the idea outside agriculture, and increase farmers' income by accelerating industrialization, urbanization, and transferring rural surplus labor. At present, academic circles have reached a consensus that the key to solving the problem of farmers' income lies in investing human capital in farmers, and improving the level of human capital for farmers. This paper studies the contribution of human capital and physical capital to farmers' income growth. According to the contribution rate of the two factors, combined with the capital distribution in rural areas, the reasonable arrangement for the ratio between the two kinds of capital can help to maximize the economic growth rate. This paper performs an empirical analysis of rural economy in Hubei Province, and draws some conclusions, so as to provide some reference for study on the relationship between human capital and economic growth. In addition, in existing studies, there are many articles reporting the use of Cobb-Douglas production function to analyze economic growth issues, and most of them use the C-D function to analyze the contribution of human capital to economic development. Zhao Xinglan (2009)[3] uses Cobb-Douglas function to study the contribution of China's human capital investment to economic growth, concludes that the elasticity of human capital stock to GDP is 2.381, and makes related recommendations to promote China's human capital investment. In addition, Shen Baohui (2009)[4], Cheng Xiaoping (2009)[5] use Cobb-Douglas function and Solow growth equation to do empirical analysis on economic growth factors in Shandong Province and Inner Mongolia. Cobb-Douglas function can be used to calculate the elasticity of capital and labor, and Solow residual can be used to calculate the contribution of technological progress to economic growth, to make up for the lack of simple function variables. This paper uses Cobb-Douglas production function and its variation form, establishes econometric model to do empirical analysis on capital and labor that affect rural economic growth in Hubei Province, and makes constructive recommendations for promoting rural economic development and increasing farmers' income in Hubei Province.

2 Empirical analysis of rural economic growth in Hubei Province

2.1 Establishment of econometric model

2.1.1 Model setting. The Cobb-Douglas production function is a particular functional form of the production function, widely used

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to represent the technological relationship between the amounts of two or more inputs, particularly physical capital and labor, and the amount of output that can be produced by those inputs. The Cobb-Douglas form was developed and tested against statistical evidence by Charles Cobb and Paul Douglas during 1927-1947. The following hypotheses are made: (i) factor may substitute for each other; (ii) marginal output of factors is greater than zero; (iii) marginal output of factors is greater than zero is diminishing; (iv) non-negativity. Thus, the relationship between output and input is simplified into the following C-D production function form, namely assuming there are two kinds of input: physical capital input and human capital input[6]. Assuming Y is output, L is human capital input, K is physical capital input, A is the factor other than labor and capital, such as technology and institution, then: $Y = AK^{\alpha}L^{\beta}$. C-D production function was relatively applicable in the previous economic context, but with the economic development, the traditional C-D production function is difficult to explain the complex economic output. Firstly, the traditional C-D production function abstracts the important input factor-technology into a predetermined constant, which is inconsistent with the current rapid development of knowledge economy, and it is difficult to reflect the contribution of knowledge to output. Secondly, the traditional C-D function fails to examine the positive effect of institutional factors on output. Thirdly, the traditional C-D function believes that the factors can completely substitute each other, but in factor, this substitution is limited, and there is more or less loss of efficiency in the production due to "alternative stickiness". Given that taking the logarithm of sequence does not change the nature of sequence, this paper takes the logarithm of both sides of the above equation, and adds the random error term, to build a new C-D function:

$$\mathrm{Ln}Y = \mathrm{Ln}A + \alpha \mathrm{Ln}K + \beta \mathrm{LnL} + \varepsilon$$

where α and β represent the elasticity of physical capital and human capital output; ε represents the effect of random disturbance, and $\varepsilon < 1$.

2.1.2 Variable definition. In this paper, we choose the total income of rural residents as output Y, and fixed capital stock as physical capital input K. In the specific calculation, the commonly used "perpetual inventory method" is employed to measure the capital stock in a given year, namely:

$$K_t = K_{t-1}(1-\delta) + \frac{I_t}{P_t}$$

where t represents year t; I is fixed capital investment; P_t is the fixed asset investment price index (with 1993 as base period); δ is the depreciation rate, and based on the method of Liu Wen *et al*.[7], δ takes 5%.

As for the definition of capital stock in the base period (1993), this paper learns from the practice of Zhang Jun *et al*.[8], to use the fixed capital investment in the primary industry (mainly agriculture) to be divided by 10% as the initial capital stock of rural areas. As for the measurement of human capital stock L, we use the average years of schooling to measure human capital. For the application of method of years of education, we mainly determine the weight corresponding to different years of education. According to the China's educational system at all levels, we get the weight to measure of human capital accumulation: illiteracy or semi-illiteracy, 2 years; primary school education, 6 years; junior high school education, 9 years; senior high school education , 12 years; technical secondary school education, 12 years; junior college and above, 16 years. Thus, we get the following calculation formula:

$H = \sum_{i=1}^{6} L_i E_i$ (total human capital stock of rural labor)

$E = H / \sum_{i=1}^{6} L_i$ (capital stock of rural labor per capita (average years of schooling)

where L_i denotes the number of rural labor force with illiteracy or semi-illiteracy, primary school education, junior high school education, senior high school education, technical secondary school education, junior college and above, respectively; E_i denotes the human capital accumulation weight of rural labor force with illiteracy or semi-illiteracy, primary school education, junior high school education, senior high school education, technical secondary school education, junior college and above, respectively.

The data used in this paper are mainly from *China Rural Statistical Yearbook* and *Hubei Statistical Yearbook*, and in order to keep in line with the statistical standard, the total number of labor force at all levels of education is as follows:

$$\sum_{i=1}^{6} L_i = 100$$

where L_i is number of persons with education level i among every hundred rural labor forces.

By the above formula, we calculate the average years of education for the rural labor force in Hubei Province, so the rural human capital stock in Hubei Province L = per capita capital stock of rural labor force (average years of schooling) × rural working population.

2.2 Model parameter estimation, test and analysis The data related to rural economy in Hubei Province can be shown in Table 1. Using SPSS17.0 statistical software, based on the statistics in Table 1, we perform regression analysis on C-D production function (Table 2). The regression equation is: $\mathrm{Ln}Y = -27.577 + 0.273\ \mathrm{Ln}K + 3.331\ \mathrm{Ln}L$. t value of constant term and all parameters in this model is greater than t critical value, and the parameter value is greater than 0, so the model passes economic significance testing; the goodness of fit is 0.895, indicating that the above model well fits the observation value of sample. Tolerance is greater than 0.1 and $VIF < 10$, so two independent variables are within the non-collinearity test standards. The results of the econometric analysis show that the elasticity of rural physical capital input in Hubei Province to net income is 0.273, and the elasticity of human capital input to rural per capita income is 3.331, indicating that for each additional percentage point of physical capital input and human capital input, rural per capita net income will increase by 0.293 and 3.331 percentage points, respectively, and human capital makes greater contribution than physical capital.

Constant term value is −27.577, mainly containing the influence of technical, institutional and policy factors and errors. Technological progress is not an independent factor. Farmers can purchase the means of production with high technological content to organize production and business activities, and education and training for farmers and other human capital investment forms can be used to achieve the diffusion effect of social technology. The technological progress factors are also integrated into physical capital and human capital.

Table 1 The data related to rural economy in Hubei Province

Year	Per capita net income//yuan	Total rural population//10^4	Output Y//10^8	Fixed assets investment//10^8 yuan	Price index	Physical capital stock K	Rural working population//10^4	Per capita human capital level	Total human capital stock L
1993	670.80	3887.78	260.790	12.16	/	121.60	2149.6	6.82	14660.272
1994	626.92	4079.27	255.740	12.48	135.8	115.61	2173.3	7.07	15365.231
1995	677.82	3942.17	267.210	12.42	148.6	121.68	2195.5	7.18	15763.690
1996	783.18	3921.82	307.150	11.89	161.4	127.39	2216.7	7.26	16093.242
1997	1172.74	4114.68	482.540	14.97	174.2	132.33	2216.8	7.28	16138.304
1998	1511.22	3971.18	600.130	27.22	182.9	140.01	2217.5	7.45	16520.375
1999	1863.62	3859.73	719.310	29.76	190.2	158.88	2224.7	7.73	17196.931
2000	2102.23	4038.00	848.880	41.02	194.2	179.27	2240.7	7.88	17656.716
2001	2172.24	4022.82	873.850	59.48	195.2	209.38	2234.6	7.92	17698.032
2002	2217.08	3947.86	875.270	71.22	194.2	255.49	2247.6	8.05	18093.180
2003	2268.50	3547.80	804.820	70.60	192.5	310.39	2261.1	7.99	18066.189
2004	2352.16	3349.50	787.860	77.48	197.5	361.99	2265.8	8.10	18352.980
2005	2444.06	3323.80	812.360	80.08	197.3	417.53	2266.0	8.12	18399.920
2006	2566.76	3297.30	846.340	88.80	203.8	472.78	2265.0	8.13	18414.450
2007	2890.01	2466.70	712.880	77.55	216.0	533.45	2262.0	8.20	18548.400
2008	3099.20	3243.30	1005.160	92.88	220.8	580.53	2266.0	8.23	18649.180
2009	3419.35	3199.50	1094.020	107.64	224.8	639.82	2267.0	8.31	18838.770
2010	3997.41	3174.30	1268.900	149.40	234.0	710.27	2262.0	8.38	18955.560
2011	4656.38	3129.60	1457.260	231.25	256.0	816.98	2270.0	8.42	19113.400
2012	5035.26	3088.80	1555.290	321.59	252.9	996.23	2265.0	8.50	19252.500

Data source: *China Rural Statistical Yearbook* and *Hubei Statistical Yearbook* (1994 – 2013).

Table 2 Regression analysis of C-D production function

Coefficient										
Model	Non-normalized coefficient		Standard coefficient	t	*Sig.*	Correlation			Collinearity statistics	
	B	Standard deviation	Trial version			Zero order	Partial	Part	Tolerance	*VIF*
Constant	−27.577	11.791		−2.339	0.032					
Physical capital stock//10^8 yuan	0.273	0.165	0.360	1.652	0.017	0.851	0.372	0.178	0.245	4.083
Human capital stock//10^4 persons	3.331	1.288	0.564	2.587	0.019	0.878	0.531	0.279	0.245	4.083

3 Conclusions and recommendations

3.1 Conclusions The paper selects the correlation data about rural economic growth in Hubei Province as samples to analyze the contribution of physical capital and human capital to rural economic growth by the new C-D function and SPSS22.0. (i) Human capital input makes greater contribution to farmers' income than physical capital input. This can also explain the reason for the current transfer of considerable rural labor to the non-agricultural sector. The productive inputs to agriculture contribute little to farmers' income growth. From farmers' income structure, we can also see that the proportion of agricultural income to total income shows a downward trend with the transfer of rural labor in recent years. (ii) The government and farmers' emphasis on human capital investment needs to be further improved. We can see from Table 1 that the average years of schooling for Hubei's farmers are still less than 9 years (compulsory education). Human capital investment is different from material investment, and it is very difficult to make the investor get the profit quickly in the short period, so many farmers have weak consciousness in human capital investment. (iii) Farmers' income-generating capacity can be improved by optimizing allocation of factors of production. For example, the government can increase the investment in human capital for farmers, formulate relevant training policies for farmers according to local conditions, effectively organize and guide the production and flow of rural labor force, and construct incentive mechanism to im-

(To page 12)

and insufficient disclosure of credit information, thus, financial institutions usually adopt more labors and materials to reinforce examination and review. In addition to regional concentration of small and medium-sized enterprises, many regions have established small and medium-sized enterprise credit system to simplify and promote financing of small and medium-sized enterprises. When credit investigation organizations in both Taiwan and mainland China cooperate with each other, they may incorporate the small and medium-sized enterprise credit system into the scope of cooperation and use the system to promote cooperation of credit investigation exchange. Specifically, financial supervision organizations, credit investigation department and financial institutions of mainland China can examine and approve credit data provided by small and medium-sized enterprise credit system of Taiwan and apply the credit data in various related fields, while financial supervision organizations and credit investigation department of Taiwan may learn mainland mode and adopt data submitted by mainland small and medium-sized enterprise credit system, to promote exchange of credit information between Taiwan and mainland China for handling of businesses of enterprises and individuals.

4.2.4 Jointly establishing punishment mechanism for action of breaking faith. Joint establishment of scientific, strict, prompt and effective punishment mechanism is an integral part of credit investigation cooperation. Financial supervision organizations, credit investigation department, and financial institutions of both Taiwan and mainland China should jointly establish punishment mechanism for action of breaking faith in accordance with existing bilateral agreement and public announcement, mutually approve respective punishment provisions through judicial cooperation mechanism, so as to establish the joint punishment mechanism for action of breaking faith. Specifically, related departments of both Taiwan and mainland China may make a record of those entities with bad credit on the basis of the fact of breaking faith, and jointly take policy of no admittance for entities in blacklist, to reach the purpose of punishing those entities with bad credit.

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(From page 8)

prove the enthusiasm of farmers for investing in human capital.

3.2 Policy recommendations (i) Increasing investment in human capital in rural areas. The government should change the thought of over-emphasizing physical capital but neglecting human capital. On the basis of optimizing physical capital input structure and improving physical capital use efficiency, there is a need to increase the proportion of investment in rural education and farmers' training, so as to gradually raise the education level of rural labor force. In the process of technical and skill training for farmers, it is necessary to conduct job training concerning primary, secondary and tertiary industries, provide services for the transfer of rural labor and agricultural development, and enhance the skill training and advanced farming and breeding technical training. At the same time, it is necessary to actively guide farmers to invest in education, medical skill training to improve rural human capital stock, and further increase the support for rural areas and agriculture to make high-quality labor force find ways to get rich in rural areas and achieve a virtuous circle of agricultural and rural development. (ii) Establishing two-way flow mechanism of rural human capital. The government can provide employment information, rights protection and other services, to ensure the effective transfer of rural surplus labor and reduce the transfer cost of rural human capital. In addition, it is necessary to allot special funds for the development of all types of adult education in rural areas, and organize cultural quality education and labor skill training for the rural labor, so that farmers' basic quality and professional level are improved, and the new generation of farmers become both educated technicians and hard-working laborers, thereby increasing the rural per capita human capital stock and promoting the rapid development of rural economy. At the same time, it is necessary to improve the rural employment environment, improve the benefit of talent in rural areas, and attract high-quality talent to flow to rural areas.

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