

The Accumulation of Rural Human Capital Impacts on the Growth of Farmers' Income

—On the Intermediary Role of Rural Labor Force Marketization

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Abstract

The influence of rural human capital accumulation on farmers' income growth is a hot issue in academic circles. This paper, using the panel data from 31 Chinese provinces from 2005-2020, examines the direct impact of rural human capital on rural income growth and the indirect role of rural labor marketization in the impact of rural human capital accumulation on farmers' income. The results show that the human capital reflected in education, health and migration plays a significant role in the increase of farmers' income. Moreover, the marketization of rural labor force plays an intermediary role in the influence of education, health and migration of human capital on farmers' income. In addition, there are regional differences in the impact of human capital on farmers' income growth and the intermediary role of rural labor market.

Keywords

Rural Human Capital, Farmers' Income, Rural Labor Force Marketization, Intermediary Effect

1. Introduction

Sustainable and steady growth of farmers' income is the key to economic and social development. Since the reform and opening up, the income of rural residents in China has increased substantially, but with the widening of the gap between urban and rural areas, the problem of relatively slow growth of farmers' income has not been solved. The formation and accumulation of rural human capital are conducive to the improvement of farmers "production capacity, and is an important factor affecting the growth of farmers" income. In recent years,

the investment level of rural human capital has been continuously improved, and the investment in rural education, medical care, communication and other fields has been paid more and more attention. By 2019, the total investment in rural education has reached 1518.414 billion yuan, with a net increase of 1199.951 billion yuan compared with 2007, with a growth rate of 376.79%. The policies on rural medical and health care and the flow of registered population are also constantly improved. However, on the whole, the educational level and comprehensive quality of farmers are still relatively low. In this case, it is necessary to deeply study the impact of rural human capital accumulation on the growth of farmers' income.

It should be pointed out that in China, the accumulation of rural human capital largely affects the growth of farmers' income through the factors of the rural labor market. The higher the marketization degree of rural labor force, the more favorable the rural labor force can flow to non-agricultural industries with higher productivity, expand income channels and obtain higher income, feed agriculture, promote the development of agricultural planning, and absorb more advanced agricultural production and management experience for agricultural development. Originally, in a developed market economy, there is a sound labor market. The elements of labor force can flow freely and be paid accordingly according to their scarcity. However, as a developing country, China still has the problem of underdeveloped urban and rural labor markets. Before the reform and opening up, in order to promote the strategy of priority development of heavy industry, China used the household registration system to divide the urban and rural labor market, strictly restricted the flow of rural labor force, and kept the vast majority of rural labor force in the field of agricultural production (Wang, 2005; CAI, 2018). After the reform and opening up, the absolute isolation of China's urban and rural labor market has been broken, and a large number of rural labor forces choose to find jobs in cities. Under the condition of the marketization of the rural labor force, the farmers with the human capital investment are more likely to enter the urban labor market and obtain a higher income than the farmers working in the rural areas. However, it should also be noted that the long-term household registration system in China has not changed substantially, the national unified urban and rural labor market has not been formed, and there are binary division problems, which hinder the marketization process of rural labor force and limits the growth of farmers' income (Wang & Yu, 2012; Feng, Luo, & Xu, 2016).

It can be seen that the accumulation of rural human capital in China can directly affect the increase of farmers' income, which is exerted to a large extent through the intermediary variable of the marketization of rural labor force. In this case, the direct impact of rural human capital accumulation on the growth of farmers' income, and the indirect role of rural labor force marketization in the influence of human capital accumulation on the growth of farmers' income, have all become a problem that needs to be discussed in depth.

2. Literature Review

Rural human capital is the key factor affecting the growth of farmers' income. Scholars generally believe that the accumulation of rural human capital can significantly promote the increase of farmers' income. For example, [Zhu & Yu \(2011\)](#) believe that through the accumulation of human capital, farmers will have a higher ability to obtain information, produce and allocate resources, thus increasing their income. [Yin \(2013\)](#) used the CHARLS micro-survey data to conduct an empirical test of the relationship between human capital and poverty, and believed that the accumulation of human capital can help farmers to increase their income and get rid of poverty. [Liu \(2014\)](#) believes that the investment in rural human capital has improved farmers' survival and production capacity, and has increased farmers' income. [Wang & Hong \(2016\)](#) took the data from Shanxi Province from 1978 to 2013 to conduct empirical tests, and affirmed the promoting role of human capital elements on increasing farmers' income. [Hou et al. \(2020\)](#) empirically tested the role of human capital investment in improving farmers' income by using the OLS regression model and propensity score matching.

Some scholars have also suggested that the impact of human capital on farmers' income is not significant or uncertain. For example, [Liu & Liu \(2016\)](#) believe that the impact of rural human capital accumulation on the growth of farmers' income is not obvious, and there are great differences in different regions and in different periods. [Liu & Zhai \(2017\)](#) believe that human capital investment in education and training will inhibit farmers "income growth in the short term and will promote the income increase in the long term; food consumption and healthy human capital investment will inhibit farmers" income growth; human capital investment in health care and transfer human capital investment will promote farmers' income increase. According to [He & Dong \(2018\)](#), there is no correlation between the education level and income of rural farmers in China.

Other scholars have also discussed the role of the rural labor market in the impact of human capital on farmers' income. [Lai \(1998\)](#) proposed that the impact of education on income distribution should be adjusted through the labor market. One of the main conditions for the rural labor force to enter the urban labor market for employment is the secondary professional education or above. [Wang & Yu \(2012\)](#) believe that, in addition to increasing the human capital investment in rural residents, promoting the rural labor force to participate in the marketization process is also very important to promote the increase of farmers' income. Through the verification of empirical data, they found that the marketization of rural labor force has a significant impact on the elasticity of human capital income of rural residents in China. [Cheng, Shi, & Jin \(2014\)](#) believe that human capital can increase farmers' income. With the outflow of rural labor force, the income from working and doing business has become an important part of farmers' income. [Chen et al. \(2020\)](#) proposed that health and education

human capital has a significant poverty reduction effect on rural families, and health and education human capital can reduce the incidence of poverty in rural areas by improving the level of non-agricultural employment.

It can be seen that the academic community has done a lot of research on related issues and achieved a lot of results, but there are still some problems in the existing research. For example, regarding the impact of human capital on the growth of farmers' income, although many mathematicians hold positive views, some argue that the relationship between the two is not obvious. In particular, although some studies have noted the role of rural labor marketization in the impact of human capital on farmers' income, they usually do not include rural labor marketization as a mediating variable in the analysis of formal intermediary effects. This paper analyzes the influence of rural human capital accumulation on the growth of farmers' income from the three aspects of education, health and migration, and studies the intermediary effect of the marketization on the influence of rural labor capital on farmers' income growth.

3. Theoretical Mechanism and Research Hypothesis

3.1. The Impact of Rural Human Capital Accumulation on the Growth of Farmers' Income

Schultz (1961) pointed out that it is of great significance to invest in farmers. Without such an investment, it is entirely impossible to achieve the achievements of modern agriculture and the prosperity of modern industry. Through investment in education and vocational training, health care, mobility and migration, rural human capital can be pooled on farmers. Investment in human capital will have a significant impact on farmers' production capacity, thus increasing their resources and affecting their future monetary and material income. Generally speaking, rural human capital is divided into educational human capital, healthy human capital and transfer human capital (Peng & Zhong, 2014; Wang & Liu, 2016). The accumulation of all kinds of human capital will have an important impact on farmers' income.

The influence of educational human capital on the growth of farmers' income is mainly reflected in: First, broaden the source of farmers' income. In general, farmers with high human capital stock are easy to accept new knowledge and technology, which helps to reduce their dependence on agricultural land and diversify employment and income growth (Wu, 2015; Nie & Zhong, 2017). Second, improve farmers' production capacity. After education and training, farmers' ideas have been updated, their vision has been constantly broadened, and their ability to "learn by doing something" in their work will be continuously improved (Wu, 2016). Third, improve farmers' production efficiency. The higher the education level of farmers, the more specialized they can make production according to the combination of low-cost elements (Ma & Liu, 2019; Wen, Yang, & Wang, 2017). Finally, there is a better development potential. Workers with higher education had greater chances of career promotion (Walder et al., 2000;

Rowe et al., 2008; Rohrbach-Schmidt & Tiemann 2016).

The impact of healthy human capital on the growth of farmers' income is reflected in: on the one hand, healthy farmers can work longer, be stronger physically and mentally, more adaptable to work, and have more energy to work, thus obtaining higher income (Bloom & Canning, 2000; Zhang, 2011). On the other hand, physical health is the basis of production. The higher the physical and mental quality of the farmers, the stronger the production capacity, and the higher the labor productivity and production quality (Liu & Jiang, 2020).

The impact of transferring human capital on the growth of farmers' income is mainly reflected in the following aspects: first, to promote the exchange of information and experience. The migration and investment of rural labor force can enable them to gain new understanding, new information, new experience, learning new technologies and new methods (Jin & Zhu, 2010), so as to promote the reasonable output of rural labor force and return to employment and entrepreneurship (Shi & Shi, 2020). Second, change the production and revenue structure. Investment in rural labor migration can also promote structural changes in the allocation of labor resources and enable farmers to obtain new employment options and employment opportunities (Ma & Liu, 2019).

Based on the above analysis, the following research hypotheses are proposed:

Hypothesis 1: The accumulation of rural human capital has a positive impact on the growth of farmers' income.

Hypothesis 1a: The accumulation of human capital in rural education has a positive impact on the growth of farmers' income.

Hypothesis 1b: The accumulation of rural healthy human capital has a positive impact on the growth of farmers' income.

Hypothesis 1c: The accumulation of human capital in rural migration has a positive impact on the growth of farmers' income.

3.2. The Influence of Rural Human Capital Accumulation on Rural Labor Force Marketization

Rural labor marketization refers to the process in which rural residents once bound to the land enter the labor market, choose jobs and find jobs in the market to obtain income (Wang & Yu, 2012; Qian & Ye, 2017). Generally speaking, the more rural human capital investment, the stronger the willingness of rural labor flow, the more it can break through the urban-rural division, regional division, industrial division, unit division and technology division of the labor market, and promote labor marketization (Cheng et al., 2006). In addition, the higher the human capital workers have, the more market information, the wider the way to search for labor market information, and the stronger the ability to search and process information.

The role of educational human capital in promoting the marketization of rural labor force is as follows: Compared with farmers with low education level, farmers with high education level are more inclined to transfer to areas with higher returns of education (Xing et al., 2013). Education enables farmers to acquire

knowledge, relevant professional skills and skills, improve their employability from rural to urban areas, and enhance their ability to choose jobs (Laszlo, 2002; Parman, 2012; Zhao & Zhou, 2019), and improve their competitiveness (Cheo, 2016). Higher education level is the “passport” for farmers to engage in non-agricultural industries from rural areas to cities. The higher the education level, the more farmers can break through the barriers of dual segmentation of urban and rural labor market.

The role of healthy human capital in promoting the marketization of rural labor force is reflected in the following aspects: the more healthy human capital farmers have, the better their physical condition and psychological quality, so they are more willing to work in the non-agricultural sector (Cai, 2010; Zucchelli et al., 2010). Farmers with good physique are also more competitive and can better adapt to the job-hunting life in high-income areas. They have a stronger ability to bear pressure and are easier to enter the labor market and achieve stable employment.

The role of migrant human capital transfer in promoting the marketization of rural labor force is reflected in the following aspects: high migrant human capital means that farmers have more overseas employment experience and master more information, which is more conducive to breaking the information asymmetry of the labor market and reducing the resistance from rural employment to urban employment. High migration of human capital also means that we can have more contacts. By guiding farmers to go out for employment, we can reduce the resistance of farmers in going out for employment and improve the enthusiasm of farmers in going out for employment.

Based on the above analysis, the following research hypotheses are proposed:

Hypothesis 2: rural human capital accumulation has a positive impact on the rural labor market.

Hypothesis 2a: Educational human capital has a positive impact on the rural labor market.

Hypothesis 2b: Healthy human capital has a positive impact on the rural labor market.

Hypothesis 2c: Transfer of human capital has a positive impact on the rural labor market.

3.3. The Intermediary Role of Rural Labor Force Marketization in the Influence of Human Capital on Farmers' Income

In China, the accumulation of rural human capital has an impact on the growth of farmers' income through the marketization of rural labor force. From the perspective of resource allocation, through the marketization of rural labor force, the allocation of rural labor force invested by human capital in different regions or departments can be changed, and the allocation of labor factors in agricultural and non-agricultural sectors is optimized, so that the rural labor force flows to the non-agricultural sector with high productivity, and the mar-

ginal output of labor force is improved (Sun, 2020; Liu & Liu, 2018). From the perspective of agricultural development, the marketization of rural labor force is conducive to reducing the carrying capacity of land production factors, promoting large-scale agricultural operation, and improving agricultural productivity. Non-agricultural employment income can be directly used in the field of agricultural production, improving the agricultural input capacity, and promoting the growth of farmers' income (Chen et al., 2020). Thus it can be seen that rural labor marketization plays an intermediary role in the accumulation of rural human capital to increase farmers' income.

The intermediary role of rural labor force marketization in the influence of educational human capital on the growth of farmers' income is reflected in the following aspects: the marketization of rural labor force is conducive to giving full play to the allocation ability of education, even if the existing human resources find opportunities, seize opportunities and get effective allocation, so as to increase the output (Lai, 1998). The higher the level of education, the more farmers can get productive employment in non-agricultural industries, resulting in a higher income. In addition, they have a strong competitiveness in the process of urban employment, and they can obtain a higher and more stable income (Xia, 2021).

The intermediary role of rural labor marketization in the impact of healthy human capital on farmers' income is reflected in the following aspects: in the labor market, employers will consider their health status when employing labor force, and farmers with good physical quality are more able to work in the non-agricultural sector with higher productivity, so as to realize the appreciation of labor value. And in the case of the labor market, the outflow of labor force in the agricultural sector can promote the development of large-scale agriculture and increase the income of farmers in the large-scale agricultural operation.

Rural labor marketization in the migration of human capital influence on farmers' income growth intermediary role is as follows: in the case of labor marketization, farmers migration rich experience help them broaden their knowledge, change the traditional ideas, break through the narrow employment space, promote labor into high productivity non-agricultural sector, promote farmers' income growth. At the same time, the rural labor force can accumulate more experience, skills and information in the process of labor marketization and mobility, cultivate the ability and accumulate the network, so as to increase the income.

Based on the above analysis, the following research hypotheses are proposed:

Hypothesis 3: Rural labor market plays an intermediary role in the influence of rural human capital on farmers' income.

Hypothesis 3a: Rural labor market plays an intermediary role in the influence of educational human capital on farmers' income.

Hypothesis 3b: The rural labor market plays an intermediary role in the impact of health human capital on farmers' income.

Hypothesis 3c: The rural labor market plays an intermediary role in the impact of transferring human capital on farmers' income.

4. Models and the Data

4.1. Variable Setting and Description

4.1.1. Explanatory Variable

Farmers' income (income) is reflected by the per capita disposable income of rural residents. This paper mainly collects the per capita disposable income of rural residents in 31 provinces of China from 2005 to 2020, and calculates the real income into the price level in 2005. The data are from China Rural Statistical Yearbook and China Statistical Yearbook.

4.1.2. Explained Variable (According to the Teacher's Revision Opinions, Explanatory Variables and Explained Variables, I Think They Are Different, of Course, I Obey the Revision Teacher's Opinions)

Human capital. This paper mainly examines the effects of education, health and transfer of human capital on farmers' income. First of all, in education (educate), reference [Hu et al. \(2018\)](#) and [Chen et al. \(2020\)](#), this paper selects the average education of rural areas to represent education human capital, and the illiterate/half illiterate, elementary, junior, junior high school/vocational high school, college and above education as 0, 6, 9, 12 and 16, convert the labor education level into the corresponding education years, calculate the average education of the rural labor force. Secondly, in terms of health (health), using the practices of [Liu & Zhai \(2017\)](#) and [Li \(2018\)](#), we select the per capita health care expenditure in rural areas and take its logarithm as the proxy variable of health human capital. Finally, regarding the migration factor (migrate), this paper adopts the method of [Yin \(2013\)](#) to take the proportion of farmers' transportation and communication expenditure to farmers' consumption expenditure as the proxy variable for the migration of human capital. The above variable data are obtained from China Population and Employment Statistical Yearbook, China Rural Statistical Yearbook and China Statistical Yearbook.

4.1.3. Intermediary Variables

Rural labor market (market). Scholars sometimes use the proportion of urban employees of non-state-owned units in all employees of urban units ([Shen & Yu, 2011](#)) or the proportion of non-agricultural employment ([Jing, 2013](#); [Lu & Zhang, 2010](#)) as an indicator to measure the degree of marketization of rural labor force. Considering the characteristics of the marketization of rural labor force and the availability of data, this paper adopts the method of [Cai & He \(2008\)](#), [Wang & Yu \(2012\)](#) to measure the degree of marketization of China's rural labor force by the proportion of non-agricultural income to total income. Considering that in the four major sources of farmers' income (Namely wage income, operating net income, property net income and transfer net income), farmers' non-agricultural industry income is mainly wage income, so the pro-

portion of non-agricultural income is expressed by the proportion of wage income to farmers' net income. Relevant data come from the China Rural Statistical Yearbook and China Statistical Yearbook of each year.

4.1.4. Control Variables

Based on the research of Liu & Liu (2018), Liu & Liu (2016) and Zhao (2018), four variables are introduced as control variables: land management scale, progress of agricultural science and technology, adjustment of agricultural structure, and financial input in support for agriculture. Among them, the land operation scale (scar) is represented by the per capita land operation scale, that is, the proportion of the total sown area to the total rural population; the agricultural science and technology progress (sc) is represented by the total power of agricultural machinery, that is, the proportion of the total rural population; the agricultural structure adjustment (stru) refers to the proportion of the output value of agriculture, forestry, animal husbandry and fishery; and the financial support for agriculture (finance) refers to the financial input for agriculture related to agricultural production and operation. Due to the change in the statistical scope of the data, in order to ensure the comparability of the data, the data of financial support for agriculture from 2007 to 2020 was the expenditure on agriculture, forestry and water conservancy, and the data of financial support in 2005 and 2006 was the sum of the meteorological expenditure on agriculture, forestry, agriculture, forestry, and water conservancy, and the data was logarithmically processed. The data for the above four variables are obtained from the China Rural Statistical Yearbook and the China Statistical Yearbook. **Table 1** shows the descriptive statistical analysis of all the variables involved in the model.

Table 1. Descriptive statistics.

Variable name	Unit	Sample number	Mean	Standard deviation	Min	Max
income	100 RMB	496	72.598	40.398	18.770	237.908
market	%	496	39.310	13.630	7.877	76.337
educate	-	496	7.491	0.886	3.240	9.801
health	-	496	5.795	1.429	0.262	7.672
migrate	%	496	11.698	2.556	4.600	18.700
scar	-	496	26.154	17.037	3.066	136.165
sc	-	496	1.491	0.812	0.276	6.187
stru	%	496	52.030	8.657	30.173	74.580
finance	-	496	5.566	1.004	2.266	7.200

4.2. Model Setting

To study the impact of education, health, and transferring human capital on farmers' income, the benchmark model of this paper is as follows:

$$income_{it} = c_1 + \alpha_1 educate_{it} + \sum \gamma control_{it} + u_{it} \quad (1-1)$$

$$income_{it} = c_2 + \alpha_2 health_{it} + \sum \gamma control_{it} + u_{it} \quad (1-2)$$

$$income_{it} = c_3 + \alpha_3 migrate_{it} + \sum \gamma control_{it} + u_{it} \quad (1-3)$$

Among, Subscript i is the province, Subpt t is the year (2005-2020), income For the per capita net income of farmers, educate For educational human capital, health For healthy human capital, migrate For the transfer of human capital, control It indicates a series of control variables including the scale of land operation, progress of agricultural science and technology, adjustment of agricultural structure and financial input for agriculture, And c is the model constant term, α_1 , α_2 , and α_3 indicate the influence coefficients of education, health, and transferred human capital on farmer income, respectively, γ Represents the influence coefficient of the control variable, The u_{it} is a random disturbance term.

In order to study the influence of human capital on rural labor market, the following model is established:

$$market_{it} = c_4 + \beta_1 educate_{it} + \sum \gamma control_{it} + u_{it} \quad (2-1)$$

$$market_{it} = c_5 + \beta_2 health_{it} + \sum \gamma control_{it} + u_{it} \quad (2-2)$$

$$market_{it} = c_6 + \beta_3 migrate_{it} + \sum \gamma control_{it} + u_{it} \quad (2-3)$$

Among them, marketit indicates the degree of marketization of rural labor force, while β_1 , β_2 and β_3 respectively indicate the influence coefficient of education, health and transfer of human capital on the marketization of rural labor force.

To further study the intermediary role of rural labor marketization in the influence of human capital on farmers' income, the model is set as follows:

$$income_{it} = c_7 + \alpha'_1 educate_{it} + \theta_1 market_{it} + \sum \sigma control_{it} + u_{it} \quad (3-1)$$

$$income_{it} = c_8 + \alpha'_2 health_{it} + \theta_2 market_{it} + \sum \sigma control_{it} + u_{it} \quad (3-2)$$

$$income_{it} = c_9 + \alpha'_3 migrate_{it} + \theta_3 market_{it} + \sum \sigma control_{it} + u_{it} \quad (3-3)$$

Among them, α'_1 , α'_2 and α'_3 respectively indicate the influence coefficient of education, health and transfer of human capital on farmers' income after controlling the variables of rural labor force marketization, while θ indicates the coefficient of the influence of rural labor force marketization on farmers' income.

If the parameter estimates α , β , θ are all significant, and the parameter estimates β , θ , and α' are both positive numbers, there is a mediation effect. Further, if the parameter estimate α' is significant, there is a partial mediation effect; not significant, there is a complete mediation effect.

5. Empirical Test

5.1. Benchmark Regression

In this paper, the stata15.0 software was used to empirically analyze the relevant

panel data from 31 provinces in China from 2005 to 2020. The fixed-effects model was selected as the model based on the Hausmann-test results. The empirical results of model (1) are shown in **Table 2** and **Table 3** for model (2), and **Table 4** for model (3).

The empirical regression results in **Table 2** indicate that the models were all tested at 1% in the models (1-1), (1-2) and (1-3), moreover, when the education human capital increases by 1 unit, the per capita disposable income of farmers increases by 1820.8 yuan; when the healthy human capital increases by 1 unit, the per capita disposable income increases by about 1342.1 yuan; when the transfer human capital increases by 1 unit, the per capita disposable income increases by 428.6 yuan. It indicates, The improvement of farmers' comprehensive quality, including education level, physical condition and experience cognition, is conducive to the increase of farmers' income, which is consistent with the research results of most scholars (Zou & Zhang, 2006; Wang & Yin, 2009; Zhang, Zhao, & Fan, 2007), that is, the improvement of education, health and transfer of human capital has a direct promotion effect on the increase of farmers' income.

Table 2. The empirical results of the effect of human capital on farmers' income.

	(1-1)	(1-2)	(1-3)
	Income	Income	Income
educate	18.208*** (1.31)		
health		13.421*** (1.21)	
migrate			4.286*** (0.67)
scal	-0.467*** (0.07)	-0.576*** (0.07)	-0.566*** (0.08)
sc	0.740 (0.46)	1.123** (0.49)	0.937* (0.55)
stru	-1.090*** (0.13)	-1.003*** (0.13)	-0.934*** (0.15)
finance	-2.451 (2.03)	-1.730 (2.15)	3.979* (2.25)
_cons	15.208 (13.80)	66.287*** (13.26)	59.166*** (15.84)
Observations	496	496	496
R-squared	0.445	0.381	0.282

p indicates the significance level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 3. Empirical results of the influence of human capital on the marketization of rural labor force.

	(2-1)	(2-2)	(2-3)
	Market	Market	Market
educate	7.052*** (0.48)		
health		5.677*** (0.43)	
migrate			0.465* (0.26)
scal	-0.522*** (0.02)	-0.567*** (0.03)	-0.535*** (0.03)
sc	1.373*** (0.17)	1.484*** (0.17)	1.792*** (0.21)
stru	-0.054 (0.05)	-0.018 (0.05)	-0.039 (0.06)
finance	0.546 (0.74)	0.629 (0.77)	2.973*** (0.87)
_cons	-6.736 (5.04)	11.458** (4.73)	24.683*** (6.11)
Observations	496	496	496
R-squared	0.634	0.609	0.471

p indicates the significance level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4. Empirical results of the impact of human capital and rural labor marketization on farmers' income.

	(3-1)	(3-2)	(3-3)
	Income	Income	Income
market	1.560*** (0.11)	1.705*** (0.10)	1.830*** (0.08)
educate	7.208*** (1.30)		
health		3.744*** (1.124)	
migrate			3.435*** (0.48)

Continued

scal	0.346*** (0.08)	0.391*** (0.08)	0.414*** (0.07)
sc	-1.402*** (0.41)	-1.407*** (0.42)	-2.344*** (0.42)
stru	-1.005*** (0.10)	-0.974*** (0.11)	-0.862*** (0.10)
finance	-3.302** (1.67)	-2.803 (1.71)	-1.463 (1.61)
_cons	25.716** (11.38)	46.755*** (10.59)	13.985 (11.42)
Observations	496	496	496
R-squared	0.625	0.61	0.64

p indicates the significance level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The fitting results all support the conclusion that higher human capital, higher farmers' income. Hypothesis 1 is verified.

The empirical regression results in **Table 3** indicate that the variables passed the 1% significance test in models (2-1), (2-2), and (2-3). When the educational human capital increases by 1 unit, the marketization of rural labor force increases by 7.052 units; when the healthy human capital increases by 1 unit, the marketization of rural labor force increases by 5.677 units; when the transfer of human capital increases by 1 unit, the marketization of rural labor force increases by 0.465 units. Education, health, and immigrants the improvement of the human capital can promote the flow of rural labor force, promote the marketization of rural labor force, and Huffman (1980), Nie & Zhong (2017), which improve the education level of farmers can increase farmers' non-agricultural labor supply, human capital can promote the marketization of labor force. The fitting results support the conclusion that the higher the human capital, the higher the marketization degree of the rural labor force. Hypothesis 2 is verified.

The empirical regression results in **Table 4** show that in models (3-1), (3-2), (3-3), educational human capital, healthy human capital, transfer human capital and rural labor marketization all passed the 1% test of significance level, and the parameter estimates α' and θ were significant. In addition, because the estimated values α and β of the parameters in model (1) and model (2) are significant, the marketization of rural labor force has some intermediary effect in the role of education, health and transfer of human capital on the growth of farmers' income. This indicates that the rural labor market plays an important role in the impact of human capital on farmers' income, that is, education, health and transfer of human capital not only directly affect farmers' income, but also indirectly through the rural labor market. The fitting results all support the conclu-

sion that there is an intermediary effect of rural labor marketization in the influence of human capital on farmers' income. Hypothesis 3 is verified. In addition, using the calculation method of intermediary effect ratio $\beta * \theta/\alpha$, we can find that about 60.4% of the role of educational human capital in increasing farmers' income is realized through the intermediary effect of rural labor marketization, about 72.1% through the intermediary effect of rural labor marketization; the effect of transfer of human capital on farmers' income is about 19.9% through the intermediary effect of rural labor marketization. This indicates that the intermediary role of rural labor marketization in the influence of education and health human capital on farmers "income is stronger than that in the influence of transfer human capital on farmers" income.

5.2. Robustness Test

Considering the openness, the level of urbanization and the proportion of non-state units in the employment structure of Beijing, Shanghai and Tianjin than in most provinces, this may make these three cities become outliers in the estimation process. According to the treatment methods of Lu & Chen (2004) and Qian & Ye (2017), the three municipalities directly under the Central Government were excluded and then returned again to ensure the robustness of the fitting results. Empirical results are shown in Table 5. The impact of education, health and transfer of human capital on farmers' income and labor marketization remains significant, and the direction of the impact has not changed. Labor marketization also plays a partial intermediary role in farmers' income in educational human capital, healthy human capital and transfer human capital, which is consistent with the benchmark fitting results and indicates the robustness of the fitting results.

Table 5. The robustness test.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Income	Income	Income	Market	Market	Market	Income	Income	Income
educate	19.289*** (1.30)			7.761*** (0.49)			8.461*** (1.39)		
health		15.062*** (1.16)			5.966*** (0.44)			6.196*** (1.13)	
migrate			5.708*** (0.71)			.825*** (0.29)			4.306*** (0.51)
market							1.395*** (0.11)	1.486*** (0.10)	1.7*** (0.08)
Observations	448	448	448	448	448	448	448	448	448
R-squared	0.541	0.502	0.396	0.675	0.64	0.496	0.67	0.664	0.692

p indicates the significance level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5.3. Endurance Test

In order to overcome the possible endogeneity problems in the model, in this paper, the lag-one-phase income* of farmers' income was used as the explained variable, and the systematic GMM method was used to test the endogeneity of the benchmark model, and then the fitting results were obtained as shown in **Table 6**. The results of the endogeneity test are basically consistent with the benchmark fit results.

5.4. Regional Differences

In order to investigate the influence of human capital on farmers' income and the intermediary difference of rural labor marketization in the influence, according to the study of Qian & Ye (2017), according to the regional division of the National Bureau of Statistics of China, the paper estimated the eastern, central and western regions. For a clear comparison, only the coefficient terms of the core explanatory variable human capital are listed. The estimated results are shown in **Table 7**.

The results presented in **Table 7** are shown, first of all, in terms of education, health, human capital, whether in the east or the Midwest, education and healthy human capital all have a positive impact on the increase of farmers "income and the marketization of rural agricultural power, and the marketization of rural labor force has some intermediary effects in the role of education and healthy human capital on the increase of farmers" income. However, compared with the central and western regions, the education and healthy human capital in the eastern regions generally have a greater impact on the increase of farmers' income and the marketization of rural labor force, and the marketization of rural labor force also plays a greater intermediary effect in the influence of education

Table 6. Shows the endogeneity test.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Income*	Income*	Income*	Market	Market	Market	Income*	Income*	Income*
educate	17.500*** (2.02)			7.057*** (0.49)			7.227*** (1.88)		
health		17.155*** (2.04)			4.754*** (0.54)			11.152*** (1.76)	
migrate			6.982*** (0.86)			0.582** (2.33)			6.591*** (0.60)
market							1.456*** (0.16)	1.263*** (0.14)	1.711*** (0.12)
Observations	465	465	465	465	465	465	465	465	465
R-squared	0.544	0.6	0.548	0.642	0.595	0.484	0.632	0.675	0.724

p indicates the significance level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 7. Test of regional heterogeneity.

	East			Midwest		
	Regional heterogeneity of human capital on farmers' income					
	Income	Income	Income	Income	Income	Income
educate	16.057*** (4.00)			5.786*** (0.61)		
health		7.259*** (1.12)			1.739*** (0.53)	
migrate			10.136*** (.86)			-2.229*** (0.28)
	Regional heterogeneity of human capital to labor marketization					
	Market	Market	Market	Market	Market	Market
educate	11.083*** (1.32)			5.338*** (0.61)		
health		3.268*** (0.40)			2.405*** (0.51)	
migrate			2.378*** (0.40)			-1.584*** (0.29)
	The regional heterogeneity of human capital and rural labor market on farmers' income					
	Income	Income	Income	Income	Income	Income
educate	19.509* (2.89)			4.994*** (5.14)		
health		2.477** (1.15)			1.178** (0.53)	
migrate			7.477*** (0.81)			-1.992*** (0.29)
market	1.303*** (3.03)	1.463*** (0.19)	1.118*** (0.15)	0.331*** (5.05)	0.233*** (0.06)	0.150*** (0.06)

and healthy human capital on farmers' income. Secondly, in terms of the transfer of human capital, in the eastern region, the transfer of human capital can promote the increase of farmers' income, and the intermediary role of rural labor marketization; in the central and western regions, the transfer of human capital not only does not promote the increase of farmers' income, but also has a negative impact on the increase of farmers' income. There are obvious regional differences in the influence of human capital on increasing farmers' income and

the intermediary role of rural labor marketization. This may be due to the fact that the economic development level and marketization degree in the central and western regions are lower than that in the eastern regions, while as a group with strong mobility and homogeneity, migrant workers face lower benefits and higher costs in the process of their flow to the central and western regions.

6. Conclusions and Policy Implications

This paper studies the direct influence of rural human capital on farmers' income and the intermediary effect of rural labor marketization on human capital on farmers' income. The study found that: 1) human capital investment in education, health, migration and other aspects improves the comprehensive quality and ability of farmers and promotes to increase their income. Specifically, when the educational human capital is increased by 1 unit, the per capita disposable income of farmers increases by 1820.8 yuan; when the healthy human capital increases by 1 unit, the per capita disposable income increases by 1342.1 yuan; when the transfer human capital increases by 1 unit, the per capita disposable income increases by 428.6 yuan. 2) Education, health and migration of human capital can have a positive impact on the increase of farmers' income through the marketization of rural labor force. Specifically, 60.4%, 72.1% and 19.9% of education, health and transfer of human capital increased farmers' income through the intermediary of rural labor force marketization. 3) There are obvious regional differences in the effect of human capital on increasing farmers' income. When the educational human capital is increased by one unit, the per capita disposable income of farmers in the eastern regions is increased by 1605.7 yuan, and that in the central and western regions by 578.6 yuan; when the healthy human capital is increased by one unit, the per capita disposable income is increased by 725.9 yuan and 173.9 yuan; when the transferred human capital is increased, the per capita disposable income is increased by 1013.6 yuan, and the farmers in the central and western regions by 222.9 yuan. Generally speaking, the return on human capital in the eastern region is higher than that in the central and western regions.

The policy implications of this paper are as follows: First, we should further increase the investment in the education, health and transfer of human capital for farmers. In the problem of increasing farmers' income, we should pay attention to the labor force as the most active element, improve the comprehensive quality of farmers, and build a long-term mechanism of increasing farmers' income. At present, China's rural compulsory education, medical care, health care, information network and other aspects of the investment have made great progress, but there is still a large gap in the human capital investment in urban and rural areas, and the problem of insufficient investment in rural human capital still exists. Therefore, it is necessary to increase the investment of human capital in rural areas and give full play to the promoting role of human capital accumulation in increasing farmers' income. Secondly, vigorously promote the

process of rural labor force marketization. Through the reform of the economic system, China has eliminated the identity difference between farmers and urban residents to a certain extent, and reduced the resistance to the free flow of rural labor force. However, there are still institutional barriers to the free flow of rural labor force, such as the household registration system, the urban-rural dual system structure still exists, and a large number of rural labor force is still stuck in agriculture and rural areas with low productivity. Therefore, it is necessary to further promote the marketization reform of rural labor force elements, build a comprehensive information platform for farmers to understand the external employment information, and promote the orderly flow of rural labor force. Third, we should take the initiative to create an environment for agricultural development and make full use of rural human resources to promote agricultural development. The more knowledge and skills, the higher the health level, the higher the labor productivity of farmers, thus driving the economic activities of farmers. At present, the main economic source of China is still agriculture industry as the main economic pillar, we must pay attention to its driving effect on agriculture, and introduce it into the countryside; promote the integration of the three major industries, continuously improve the cultural quality and health conditions of farmers, so as to realize the maximum use of human resources. Fourth, accelerate and promote the sustained and sound social and economic development in central and western China. Through empirical analysis found that the rural human capital accumulation to the role of increasing farmers' income and rural labor marketization in rural human capital influence the intermediary role of increasing farmers' income, especially in the eastern region, this also means that accelerate the development of the Midwest, is conducive to play the rural human capital and rural labor market role of farmers' income growth. At present, we must implement the strategy of balanced regional balanced development, strengthen the investment and policy support to the west, and promote the industrialization and urbanization process in the central region of China.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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