China Agricultural Economic Review

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Received 25 May 2017
Revised 12 January 2018
Accepted 16 May 2018

Abstract

Purpose – The purpose of this paper is to examine the role of education in the labor market and to understand how returns to education change over time in rural China.
Design/methodology/approach – Using nationally representative survey data from 2004 to 2015, this study provides insights on wage determination in the labor market and examines how the returns to education in rural China differ with time and educational endowment. This study applies ordinary least squares estimation and the Heckman selection model to estimate the returns to education.
Findings – The returns to education decreased during the observed years from more than 6 percent in 2004 to only about 3 percent in 2011, rising to nearly 4 percent in 2015. The overall trend is robust and observed within groups defined by education. Additionally, the returns to education vary greatly with educational endowment. Tertiary education has always maintained a high rate of returns at nearly 10 percent, while returns to senior high school education and below have gradually diminished.
Originality/value – The authors believe that the results will not only enrich studies on the returns to education in rural China, but also provide a basis for diagnosing the changes of rural labor market in the early twenty-first century.

Keywords Returns to education, Off-farm wage employment, Rural labour market
Paper type Research paper

JEL Classification — I2, J24, J31

The authors would like to acknowledge the financial support of the National Natural Science Foundation of China (Grant No. 71333012).

China Agricultural Economic Review
Vol. 11 No. 1, 2019
pp. 2-19

1756-137X
DOI 10.1108/CAER-05-2017-0098

1. Introduction

Since the introduction of economic reforms in China in the late 1970s, China's rural economy has experienced rapid growth. The rural labor market has changed dramatically over the past few decades and its emergence and further development has contributed significantly to the rural economy (Zhang *et al.*, 2002; Li *et al.*, 2005).

The flow of China's rural labor force into the off-farm sector has been steadily growing. The proportion of the rural labor force engaging in off-farm employment rose from 34 percent in 1995 to 61 percent in 2011 (Rozelle *et al.*, 1999; Li *et al.*, 2013). According to China's statistical yearbooks, the number of migrant workers increased from 25m in 1985 to 169m in 2015. The income of farmers in China has also grown significantly over the past few decades. Most of the income growth has come from employment in the off-farm sector (Parish *et al.*, 1995; Rozelle, 1996; McNamara and Weiss, 2005; Zhang *et al.*, 2008). Plenty of studies find evidence that better education positively affects the off-farm earnings of the rural labor force. Thus, understanding the importance of education is beneficial not only to scholars but also to policy makers.

Returns to education have often been used to measure the significance of education. They represent the percentage of the increase in income resulting from the increase in education for one year. Therefore, they are an effective and reliable indicator that not only reflects the incentives for human capital accumulation and the efficiency of labor resource allocation, but also guides public and private investment in education (Zhang *et al.*, 2005). It is important to examine the role of education in the labor market and to understand how returns to education change over time.

This study aims to examine how wages are determined in the labor market and, more importantly, how the returns to education in rural China differ over time and with different educational endowments. To this end, this study performs three steps. First, using a multiyear nationally representative data set, we estimate the wage equations and determine the trend in the returns to education in rural China from 2004 to 2015. We validate the robustness of this trend by adding different control variables and using different regression model settings. Second, we examine how the returns to education differ with various educational endowments. These results provide insights into the nature of labor market changes and some possible reasons for changes in the returns to education. Third, using this knowledge, we interpret recent trends and assess the future implications for the development of the rural labor market and rural education.

The remainder of this paper is organized as follows. In Section 2, we briefly introduce the changes in China's labor market since the 1990s, focusing on institutions and situations likely to affect the wage determination. In Section 3, we provide a comprehensive review of previous research regarding the returns to education in rural China. Section 4 introduces the data used in this study and provides a descriptive analysis of the sample, while Section 5 presents the estimates of returns to education. Section 6 presents conclusions and discusses policy implications.

2. Labor market development in China

In recent decades, China's labor market has undergone profound changes and has shifted from having a seemingly infinite labor supply to a limited one (Cai, 2007; Garnaut and Song, 2006; Wu, 2007).

The 14th National Congress held in 1992 established the goal of creating a socialist market economic system, which led to China's rapid economic development in the early 1990s. Since then, the stranglehold maintained by state-owned enterprises on labor access, the "iron rice bowl," broke and the labor market maintained a long-term labor surplus (Ding *et al.*, 2000; Cai *et al.*, 2008). Fearing potential unemployment of urban residents, local governments adopted policies to restrict migrant workers, forming a split and discriminatory dual labor market, with rural laborer engaged in off-farm employment in cities also subject to discrimination (Zhao, 1999; Wang and Cai, 2006). Since China became a member of the World Trade Organization in 2001, many labor-intensive enterprises have entered China, raising the demand for labor (Deng and Ding, 2013).

Since 2005, with China's rapid economic development, labor surplus is no longer a characteristic of its labor market, and there has been a shortage of migrant workers in coastal areas (Cai and Du, 2011). The increase in wages in China is not confined to any specific sector, since wages have increased for both skilled and unskilled workers, exporting and non-exporting firms and coastal and inland areas (Li *et al.*, 2012). Off-farm employment has also become a main employment avenue for rural residents. With the long-term effects of the family planning policy beginning to emerge, the population surplus continues to shrink. The size of the population of working-ages between 16 and 59 peaked in 2011 and is continuously declining. Moreover, the aging population is growing, which will cause labor shortages and will contribute to rising wages.

Since the world financial crisis in 2008, China's internal and external economies have suffered varying degrees of shock, resulting in many business failures, manufacturing enterprises moving to other countries and China's central and western regions having cheaper labor (Qu *et al.*, 2013). With China's economic growth gradually slowing down, it should continue to optimize its economic structure and the industrial sector should make appropriate adjustments as well. This situation has presented new tasks for China's human capital.

3. Previous studies regarding returns to education

Since the development of human capital theory (Becker, 1964), a large body of studies have explored the economic benefits of investing in education for the individual. Psacharopoulos and Patrinos (2004) reviewed and presented the estimates of returns to education as found in the literature at the turn of the century. They draw the conclusion that the average return to education in the world is 9.7 percent, while developing countries have higher returns than developed countries. The returns to education in high-, middle- and low-income countries are 7.4, 10.7 and 10.9 percent, respectively.

Salehi-Isfahani *et al.* (2009) also examined the private returns to schooling in Egypt, Iran and Turkey. They found that returns to education increased for years of schooling in all three countries. Crespo Cuaresma and Raggl (2016) demonstrated that the return to schooling was more than 5 percent in Uganda. Biyase and Zwane (2015) used the fixed effects model and found that the return to education was 2.2 percent in South Africa. Peet *et al.* (2015) used 61 nationally representative household surveys from 25 developing countries between 1985 and 2012, and showed that the return to education in developing countries was 7.5 percent. Returns from this study appeared highly heterogeneous. Altogether, these studies verify the fact that more education ensures higher earnings.

However, whether education is a good investment in rural China remains controversial in the literature. Several empirical studies discuss the returns to education in rural China. Meng (1995) and Mallee (2000) showed, using a regression of off-farm earnings, that there was no reward for the education received by rural Chinese people. Johnson and Chow (1997) found that returns to education in rural China were higher than in urban areas. Using a survey of township enterprises in 1998, Ho *et al.* (2002) estimated that the rural education returns were between 3.2 and 5.4 percent. Using data collected from rural Sichuan, Anhui and Shandong provinces in 2006, Zhang and Li (2006) concluded that the average return to schooling was 9.9 percent.

Unfortunately, those studies did not use a measure of wages which we believe that would be suitably accurate. The measure of wages largely affects the estimates of the returns to education. In countries with poor financial markets like China, poorer people may drop out of school because they cannot keep up their studies (Schultz, 1988). This is why, in being able to continue their studies unabated, wealthier people are more likely to get more education. However, differences in wealth endowments, which depend on different choices for work and leisure, may cause poorer workers to work longer upon completing their own education. Therefore, poorer workers may work more hours per day or more days per month or year. As such, studies that utilize daily, monthly or annual earnings to estimate the returns to schooling may tend to underestimate returns to education. The hourly wage is a

more accurate measure (Schultz, 1988; Card, 1999), as it is not affected by the number of hours per day or days per month that laborers work.

Considering this, some studies began to use the hourly wage to measure the wages of rural labor, drawing the conclusion that investing in education in rural China is profitable (De Brauw and Rozelle, 2008; Zhang *et al.*, 2008). By using the Heckman (1979) sample selection model to correct for sample selection bias, these two studies were also able to improve on previous studies by deriving more accurate returns to education. However, the data sets they used have since become outdated, prompting a need for new investigation into estimates which describe the current situation in China. In addition, they did not document the trend of returns to education in rural China over time; instead, they each only found returns for one year.

To our knowledge, only a few studies reflect the changes in returns to education in rural China over time. While this was a step in the right direction, the data some of these studies used were limited in that they were not nationally representative. Li *et al.* (2005) investigated the returns to education and compared them to the same households in northern Jiangsu Province in 1988, 1992 and 1996. They showed that the returns to education have risen over time. Using the dynamic monitoring survey data of the floating population, Xing *et al.* (2013) found that the returns to education in 2011 was lower than those from 2005. The samples used here only encompassed rural laborers working in cities, and thus conclusions about the returns for rural laborers in throughout China cannot be reasonably drawn.

An additional limitation of previous studies on the changes in returns to education in rural China is their uncorrected sample selectivity bias. Yao and Zhang (2013) only used the ordinary least squares (OLS) model to investigate the education returns of rural residents based on CHNS data, and found that returns to education of rural residents was 2.18 percent in 2004, slightly to 3.28 percent in 2009. Deng and Ding (2013) applied a cross-classified multilevel model and found that the returns to education in rural China grew slowly and steadily from 4.02 percent in 1988 to 8.2 percent in 2005, followed by a downward trend. As the sample selectivity bias of these studies remains unchecked, it is uncertain how reliable results gleaned from them may be.

These studies made important contributions to the literature in regard to returns to education. That said, most studies on rural areas use data sets of a single year; due to differences in the specifications of wage functions, comparing the results across studies is difficult (Zhang *et al.*, 2005). Furthermore, to our knowledge, the latest study regarding the returns to education in rural China are based on 2011 rural survey data, which do not adequately reflect the latest changes in the returns to education. In summation, we diagnose four main limitations with previous studies: the focus on one year rather than on the trend over time; the use of data which is not representative of rural laborers nationally; the definition of the wage function which does not adequately account for different hours worked; and the presence of selectivity bias. In order to diagnose actionable opportunities which may improve conditions for the labor market, guide human capital investment and increase income for rural residents, we use the latest multi-period data to explore the changes of returns to education for off-farm wage employment. From there, by using more precise definitions for the wage function and correcting for sample selection bias, we hope to provide estimates of the returns to education which improve on the limitations of previous studies as much as possible.

4. Data

The data for this study, obtained from the China Rural Development Survey, were collected from four rounds of household surveys conducted by the Center for Chinese Agricultural Policy under the Chinese Academy of Sciences in 2005, 2008, 2012 and 2016. The sampling process was as follows. Five provinces were selected from each of China's major agro-ecological

zones from a list of provinces arranged in descending order of gross value of industrial output (GVIO). GVIO was used based on the conclusion from Rozelle (1994, 1996) that GVIO is one of the best predictors of standard of living and development potential and is often more reliable than the net rural per capita income. China's major agro-ecological zones are the eastern coastal areas (Jiangsu, Zhejiang, Shandong, Fujian and Guangdong); the southwestern provinces (Sichuan, Guizhou, Yunnan and Guangxi); the Loess Plateau (Shanxi, Shaanxi, Inner Mongolia, Ningxia, Gansu, Qinghai and Xinjiang); the north and central provinces (Hebei, Henan, Anhui, Hubei, Hunan and Jiangxi); and the northeastern provinces (Liaoning, Jilin and Heilongjiang). Although we recognize that we have deviated somewhat from the standard definition of China's agro-ecological zones, the realities of survey work necessitated our compromises.

According to the above procedure, Jiangsu, Sichuan, Shaanxi, Hebei and Jilin were selected as the sample provinces. We compared the characteristics of the sample provinces in 2004 with the agro-ecological zones from which they come and found little difference between them (Table AI). Therefore, we believe them to be good representatives of their respective regions. From each province, five counties were selected, one from each set of a list of counties arranged in descending order of their GVIO. Within each county, we chose two townships, and within each township, we chose two villages, following the same procedure as the county selection. Hence, in each sample province, we selected 20 villages (1 province × 5 counties × 2 townships × 2 villages).

The sample framework for the four-round survey is the same. In each round of the survey, 20 households were selected as the sample households, except for the first round in 2005, where only eight households were selected for a detailed survey while the other 12 households participated in a group interview. All the samples were selected randomly.

Enumerators questioned all household members regarding their educational attainment, on- and off-farm work, working hours in an average day, working days in an average month, working months in a year, off-farm earnings and other individual traits in each round of survey.

There is no clear retirement line for rural residents; most elders above 60 years are still working in on- or off-farm sectors. Therefore, we considered the labor force in the age range of 16 to 64 years as our sample group. Individuals under the age of 16, those enrolled full-time in school, retirees, the self-employed and household members who did not work for health-related reasons were excluded. Thus, the numbers of individuals in the study sample were 1,774, 4,406, 4,641 and 4,099 in the four rounds of survey. To focus on wage determination in the rural labor market, we restricted our sample to those engaged in off-farm wage employment. Their wages were comprised of three major components: basic wage, subsidies and bonuses. As such, the remaining sample of wage earners that we use for our analysis from each year is 735, 2,002, 2,628 and 2,489.

As Table I reports, the percentage of wage earners gradually increased from less than 42 percent in 2004 to more than 60 percent in 2015 (column 5, row 1 to row 4). Reflecting the trends of China's general demographics, the average age of laborers increased from 40 in 2004 to 42.8 in 2015 (column 3, row 1 to row 4). Additionally, the proportion of females in the work force declined gradually from 50.7 percent in 2004 to 45.6 percent in 2015 (column 2, row 1 to row 4). The mean years of schooling for all rural laborers increased from 6.7 years

Table I.
Sample size and distribution in rural China, 2004–2015

Year	Sample (*n*)	Male (%)	Age	Mean schooling years	Wage owner (%)
2004	1,774	49.3	40.0	6.7	41.4
2007	4,406	50.5	41.1	7.1	45.4
2011	4,641	51.6	41.3	7.5	56.6
2015	4,099	54.4	42.8	7.8	60.7

Source: China Rural Development Survey

in 2004 to 7.8 years in 2015 (column 4, row 1 to row 4). Despite this small increment, dramatic changes occurred in the structure of educational attainment.

Table II presents the distribution of educational attainment by gender over time. Despite the increase in the schooling of rural laborers over time as shown in Table I, the mean years of schooling of wage earners also increased from 8.5 years in 2004 to 9.2 years in 2015 (column 5, rows 4 and 22). We have also observed that rural laborers with a wage income have a higher education level than all other laborer types. Compared with the education gap between male and female laborers of at least 1.6 years, there is no difference in the educational endowment between male and female wage earners. The most noticeable change is that more than 20 percent of rural laborers had an education of high school and above in 2015, and the number of workers with primary school education or less declined by nearly 25 percent from 2004 to 2015 (column 1, rows 1 and 19). This change is largely due to the implementation of nine years of compulsory education in 1986 and the higher education expansion policy in 1999. The share of junior high school graduates is also relatively stable at 43 percent (column 2, rows 1, 7, 13 and 19). The overall educational attainment of rural laborers has improved primarily due to the retirement of older, less-educated cohorts and the entrance of younger, better-educated laborers into the work force.

As shown in Table III, we clearly present the changes in the hourly wages between different education groups. First, an overall rise in wage levels is observed. The mean hourly wages rise steadily, and have tripled from less than 4 yuan in 2004 to over 11 yuan in 2015 (column 1, rows 1 to 4). The hourly wages of laborers with a college degree or above are high, while the mean hourly wages of workers with other education levels have been constantly converging over time.

Year			Primary school and below (%)	Junior high school (%)	High school (%)	College and above (%)	Mean schooling years
2004	All sample	All	45.3	43.1	9.8	1.8	6.7
		Women	55.1	35.6	8.0	1.3	5.8
		Men	35.6	50.5	11.7	2.2	7.6
	Wage owner	All	24.0	55.5	16.6	3.9	8.5
		Women	25.4	51.2	19.3	4.1	8.5
		Men	23.3	57.7	15.2	3.8	8.5
2007	All sample	All	42.2	43.8	11.6	2.4	7.1
		Women	53.0	36.0	8.8	2.2	6.3
		Men	31.6	51.4	14.5	2.5	8.0
	Wage owner	All	22.1	56.1	16.9	4.9	8.7
		Women	24.1	52.5	16.8	6.6	8.7
		Men	21.2	57.9	17.0	3.9	8.8
2011	All sample	All	38.6	44.0	13.2	4.2	7.5
		Women	49.2	36.9	9.7	4.2	6.7
		Men	28.6	50.7	16.5	4.2	8.3
	Wage owner	All	23.0	52.1	18.1	6.9	8.8
		Women	26.3	48.6	15.5	9.6	8.7
		Men	21.3	53.8	19.4	5.5	8.9
2015	All sample	All	35.1	42.7	15.1	7.2	7.8
		Women	47.4	34.6	11.9	7.1	6.9
		Men	24.8	49.4	18.5	7.3	8.6
	Wage owner	All	21.0	48.1	19.4	11.5	9.2
		Women	26.5	42.1	17.0	14.4	9.0
		Men	18.0	51.3	20.7	10.0	9.3

Source: China Rural Development Survey

Table II.
Education category distribution by gender in rural China, 2004–2015

5. Modeling the effect of schooling on wages

5.1 Model specifications

Mincer's (1974) model of earnings is the basis for economic studies in education and is a cornerstone of empirical economics. Mincer provided a convenient and feasible method of estimating returns to education by means of the semi-log earnings function:

$$\log\ Y_i = \alpha + rS_i + \delta \mathrm{Exp}_i + \gamma \mathrm{Exp}_i^2 + \beta X_i + u_i, \quad (1)$$

where Y_i is the earnings measure for an individual i; S_i represents the years of education; Exp_i is the measure of experience, which is equal to age – education years−6, Exp_i^2 is the experience squared; X_i is a set of dummy variables assumed to affect earnings, which includes gender, laborer's home province, the industry they engaged in and their workplace. Furthermore, α is the intercept term, u_i is a disturbance term representing other forces that cannot be explicitly measured. We assume that X_i and S_i are independent. r is interpreted as the returns to an additional year of education. Table IV provides detailed descriptive statistics of the variables.

We also use the Heckman selection model to verify the robustness of the results. To avoid potential bias, we first estimate a Probit for all individuals in our sample, where the dependent variable takes the value of 1 if the individual works off-farm for a wage and

Table III. Hourly wage by education level and gender in rural China, 2004–2015

Year	All sample	Education level: Primary school and below	Junior high school	High school	College and above
2004	3.8	2.8	3.8	4.4	8.2
2007	5.6	5.0	5.3	6.3	9.4
2011	8.6	7.7	8.4	9.3	11.5
2015	11.4	9.9	10.8	11.5	16.7

Note: Measured in 2004 yuan
Source: China Rural Development Survey

Table IV. Descriptive statistics of variables

Independent variable	Measurement	Mean: 2004	2007	2011	2015
Years of formal schooling	Years	8.47	8.74	8.82	9.18
Experience	Age – year of formal schooling−6	18.77	19.59	21.39	22.40
Experience squared	Years	523.11	548.26	647.02	694.92
Gender	= 1, if male; 0, otherwise	0.65	0.67	0.66	0.65
Jiangsu	= 1, if Yes; 0, if No	0.26	0.26	0.24	0.22
Heibei	= 1, if Yes; 0, if No	0.16	0.18	0.16	0.19
Sichuan	= 1, if Yes; 0, if No	0.24	0.19	0.21	0.22
Shannxi	= 1, if Yes; 0, if No	0.18	0.20	0.21	0.23
Jilin	= 1, if Yes; 0, if No	0.16	0.17	0.18	0.15
Manufacturing industry	= 1, if Yes; 0, if No	0.25	0.23	0.20	0.26
Construction industry	= 1, if Yes; 0, if No	0.18	0.19	0.21	0.19
Service industry	= 1, if Yes; 0, if No	0.26	0.20	0.21	0.37
Other industry	= 1, if Yes; 0, if No	0.31	0.38	0.38	0.18
Within own county	= 1, if Yes; 0, if No	0.50	0.48	0.50	0.51
Within own province, but outside own county	= 1, if Yes; 0, if No	0.22	0.21	0.24	0.24
Outside own province	= 1, if Yes; 0, if No	0.28	0.31	0.26	0.25
Obs.	Number of individuals	735	2,002	2,628	2,489

Source: China Rural Development Survey

0 otherwise. Using the results from the Probit estimation, we compute an inverse Mills ratio that corrects for any possible truncation of the dependent variable in the estimation of Equation (1). To identify the probit equation, we include the number of laborers in the household, the area of land of the household and the migration network, which defined as the average size of off-farm employment of all other households in the same village excluding the household in question. We believe that these variables can identify the participation effect since none should affect the hourly wage of a specific laborer, except through their decision on whether to participate in off-farm wage labor.

Furthermore, Equation (1) implies that returns to education are constant for each additional year. In fact, the effects of different educational endowments on earnings are unequal. To better understand the difference in returns to education, we follow the model set in studies which document the returns to different educational endowments (De Brauw and Rozelle, 2008; Zhang *et al.*, 2008). We adapt the model as follows:

$$\log\ Y_i = \alpha + r_{\text{pri}} p_i + r_{\text{jun}} J_i + r_{\text{sen}} S_i + r_{\text{col}} C_i + \delta \text{Exp}_i + \gamma \text{Exp}_i^2 + \beta X_i + u_i, \tag{2}$$

Equation (2) is the same as Equation (1), except for the variables representing schooling years. p_i refers to the years of schooling for primary school and below; J_i is the years of schooling for junior high school; S_i represents the years of schooling for senior high school; C_i refers to the years of schooling for college and above. For example, if an individual is a junior high school graduate, then p_i is equal to 6, J_i is equal to 3 and S_i and C_i are equal to 0. Here, we should note that we also want to reflect the returns to education for a given period of education, so we use the same method with previous studies and assign variables using the number of years the labor force has studied at a particular educational stage. Therefore, r_{pri} is interpreted as the returns to an additional year of primary and below. r_{jun} is the returns to an additional year of junior high school. r_{sen} and r_{col} are interpreted as the returns to an additional year of schooling in senior high school and college, respectively. The advantage of this specification is that it distinguishes the effects of one educational stage from another.

5.2 Results of the OLS estimation

Table V shows the results from the OLS estimation of each survey year for Equation (1). According to this measure, the returns to a year of schooling fell by nearly 60 percent: from 6.1 percent in 2004 to 2.5 percent in 2011 (row 1, columns 1, 5 and 9). After 2011, the returns to education increased to 3.5 percent by 2015 (row 1, column 13). We next want to test the robustness of the estimated decreasing trend in the returns to education and investigate whether education wage premiums occur mainly within or between workplaces and the job categories laborers are engaged in. We add job location and industry dummy variables to the Mincer equation one by one and observe whether these gradual additions change the estimated results. Columns 2, 3, 6, 7, 10, 11, 14 and 15 in Table IV report the schooling coefficients from the regressions that include work industry and location dummy variables separately. Columns 4, 8 and 12 contain regressions results that include both kinds of dummy variables simultaneously. The returns to education follow the same trend, and show no significant differences to the benchmark model.

The returns to education in rural China are lower than the average of 10.7 percent in other middle-income countries (Psacharopoulos and Patrinos, 2004). The trend also squares up well with the findings of other studies on the same period (Deng and Ding, 2013; Xing *et al.*, 2013).

Next, we use the Mincer equation to check whether the changes in the returns to education differ systematically according to educational endowment. This analysis provides evidence of the heterogeneity in the returns to education and reveals the possible causes of decreasing returns to education.

Table V.
Determinants of the log hourly wage, 2004 to 2015 (OLS)

	2004				2007			
Independent variable	Ordinary mincer	Add vocation	Add workplace	Add all two	Ordinary mincer	Add vocation	Add workplace	Add all two
Years of schooling	0.061*** (0.009)	0.059*** (0.009)	0.065*** (0.009)	0.061*** (0.009)	0.047*** (0.006)	0.045*** (0.006)	0.051*** (0.006)	0.049*** (0.006)
Experience	0.022*** (0.007)	0.020*** (0.007)	0.029*** (0.007)	0.027*** (0.007)	0.016*** (0.004)	0.015*** (0.005)	0.022*** (0.005)	0.021*** (0.005)
Experience squared	−0.000** (0.000)	−0.000** (0.000)	−0.000*** (0.000)	−0.000*** (0.000)	−0.000** (0.000)	−0.000** (0.000)	−0.000*** (0.000)	−0.000*** (0.000)
Male (1 = male, 0 = female)	0.198*** (0.052)	0.197*** (0.053)	0.202*** (0.050)	0.207*** (0.051)	0.248*** (0.035)	0.234*** (0.036)	0.226*** (0.034)	0.210*** (0.036)
Manufacturing industry		−0.047 (0.069)		−0.093 (0.067)		−0.089* (0.045)		−0.126*** (0.045)
Construction industry		−0.051 (0.075)		−0.123* (0.073)		−0.012 (0.047)		−0.035 (0.047)
Service industry		−0.152** (0.066)		−0.196*** (0.064)		−0.084* (0.046)		−0.102** (0.045)
Within own province, but outside own county			0.151** (0.064)	0.176*** (0.064)			0.116*** (0.044)	0.121*** (0.044)
Outside own province			0.435*** (0.060)	0.455*** (0.060)			0.335*** (0.040)	0.347*** (0.040)
Constant	0.123 (0.127)	0.219 (0.140)	−0.167 (0.133)	−0.040 (0.142)	0.514*** (0.087)	0.591*** (0.094)	0.291*** (0.092)	0.385*** (0.097)
Provincial dummy variable	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	735	735	735	735	2,002	2,002	2,002	2,002
R^2	0.124	0.130	0.184	0.195	0.080	0.082	0.112	0.116
	2011				2015			
Independent variable	Ordinary mincer	Add vocation	Add workplace	Add all two	Ordinary mincer	Add vocation	Add workplace	Add all two
Years of schooling	0.025*** (0.005)	0.027*** (0.005)	0.030*** (0.005)	0.031*** (0.005)	0.035*** (0.005)	0.039*** (0.005)	0.040*** (0.005)	0.042*** (0.005)
Experience	0.019*** (0.003)	0.016*** (0.003)	0.024*** (0.003)	0.020*** (0.003)	0.019*** (0.004)	0.017*** (0.004)	0.022*** (0.004)	0.020*** (0.004)
Experience squared	−0.000*** (0.000)	−0.000*** (0.000)	−0.000*** (0.000)	−0.000*** (0.000)	−0.000*** (0.000)	−0.000*** (0.000)	−0.000*** (0.000)	−0.000*** (0.000)
Male (1 = male, 0 = female)	0.305*** (0.027)	0.263*** (0.027)	0.274*** (0.026)	0.238*** (0.027)	0.291*** (0.030)	0.255*** (0.031)	0.263*** (0.030)	0.232*** (0.030)
Manufacturing industry		0.030 (0.036)		−0.000 (0.035)		0.064 (0.047)		0.011 (0.046)
Construction industry		0.203*** (0.035)		0.170*** (0.035)		0.220*** (0.050)		0.172*** (0.050)
Service industry		−0.028 (0.035)		−0.037 (0.034)		0.025 (0.043)		−0.007 (0.042)
Within own province, but outside own county			0.164*** (0.032)	0.148*** (0.032)			0.155*** (0.036)	0.148*** (0.036)
Outside own province			0.329*** (0.032)	0.317*** (0.032)			0.346*** (0.036)	0.338*** (0.036)
Constant	1.260*** (0.069)	1.268*** (0.074)	1.053*** (0.071)	1.088*** (0.075)	1.458*** (0.084)	1.401*** (0.097)	1.236*** (0.086)	1.238*** (0.098)
Provincial dummy variable	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,628	2,628	2,628	2,628	2,489	2,489	2,489	2,489
R^2	0.087	0.101	0.124	0.134	0.086	0.095	0.120	0.127

Notes: Standard errors in parentheses. *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$
Source: China Rural Development Survey

Table VI presents the returns to schooling for primary school and below, junior high school, senior high school and college and above, based on separate regressions for different educational endowments. Using OLS to estimate the earnings equations, based on the different educational endowments, the returns to primary school, junior high school and senior high school have a downward trend (rows 1, 2 and 3, columns 1, 2, 3 and 4). The results for college and above decrease from 15.9 to 10.4 percent, and then rise to 15.5 percent (row 4, columns 1, 2, 3 and 4).

Table VI indicates that the returns to education increase with higher educational endowment, which is consistent with the conclusions of Li (2003) and Fan (2011). The education level for college and above maintained a more than 10.4 percent return rate from 2004 to 2015 (row 4, columns 1, 2, 3 and 4), while the returns for senior high school decreased from 6.3 percent in 2004 to 4.1 percent in 2011, yet are no longer significant in 2015 (row 3, columns 1, 2, 3 and 4). The returns to junior high school decrease from 7.3 percent in 2004 to 3.3 percent in 2007, and are no longer significant in 2011 (row 2, column 1, 2, 3 and 4). Finally, the returns to primary school and below have been insignificant from 2004 to 2015 (row 1, columns 1, 2, 3 and 4).

5.3 Results of the Heckman selection model

To further verify the robustness of our results using OLS estimation, we also estimate using models of earnings while controlling for sample selectivity bias, and report the results in Table VII. According to the results of Heckman selection model, the results maintain a high degree of consistency with the results estimated by the OLS. Returns to education fell from 5.2 percent in 2004 to 2.9 percent in 2011 (row 1, columns 2, 4 and 6). Since 2011, the returns to education increased to 3.7 percent by 2015 (row 1, column 6).

We also use Heckman selection model to check whether the returns based on different educational endowments obtained using the OLS model are robust. The detailed results are presented in Table VIII. The education level for college and above still maintained a more than 9.5 percent return rate from 2004 to 2015, while returns to education for senior high school and below have a gradual diminishing trend. Laborers with an education level of

Independent variable	2004	2007	2011	2015
Primary and below	0.008 (0.023)	−0.003 (0.017)	−0.018 (0.013)	−0.009 (0.015)
Junior high school	0.073*** (0.023)	0.033** (0.016)	0.018 (0.012)	0.024 (0.015)
Senior high school	0.063*** (0.023)	0.058*** (0.015)	0.041*** (0.012)	0.022 (0.013)
College and above	0.159*** (0.038)	0.156*** (0.024)	0.104*** (0.016)	0.155*** (0.015)
Experience	0.032*** (0.007)	0.028*** (0.005)	0.029*** (0.004)	0.033*** (0.004)
Experience squared	−0.000*** (0.000)	−0.000*** (0.000)	−0.001*** (0.000)	−0.001*** (0.000)
Male (1 = male, 0 = female)	0.222*** (0.051)	0.237*** (0.036)	0.264*** (0.027)	0.267*** (0.030)
Manufacturing industry	−0.055 (0.068)	−0.092** (0.045)	0.031 (0.035)	0.084* (0.047)
Construction industry	−0.100 (0.073)	−0.027 (0.046)	0.182*** (0.035)	0.215*** (0.049)
Service industry	−0.164** (0.065)	−0.075* (0.045)	−0.009 (0.034)	0.062 (0.043)
Within own province, but outside own county	0.156** (0.064)	0.107** (0.044)	0.137*** (0.032)	0.127*** (0.036)
Outside own province	0.448*** (0.060)	0.350*** (0.040)	0.319*** (0.031)	0.327*** (0.035)
Provincial dummy variable	Yes	Yes	Yes	Yes
Constant	0.171 (0.160)	0.622*** (0.116)	1.290*** (0.087)	1.350*** (0.107)
Observations	735	2,002	2,628	2,489
R^2	0.209	0.133	0.149	0.153

Notes: Standard errors in parentheses. *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$
Source: China Rural Development Survey

Table VI. Determinants of the log hourly wage by education level, 2004 to 2015 (OLS)

Table VII.
Determinants of the log hourly wage, 2004 to 2015 (Heckman)

	2004		2007		2011		2015	
Independent variable	Selection equation	Wage equation	Selection equation	Wage equation	Selection equation	Wage equation	Selection equation	Wage equation
Years of formal schooling	0.060*** (0.013)	0.052*** (0.011)	0.040*** (0.008)	0.051*** (0.007)	0.026*** (0.008)	0.029*** (0.005)	0.035*** (0.008)	0.037*** (0.006)
Experience	−0.057*** (0.010)	0.032*** (0.008)	−0.036*** (0.006)	0.021*** (0.005)	−0.022*** (0.006)	0.020*** (0.003)	−0.051*** (0.007)	0.021*** (0.004)
Experience squared	0.000 (0.000)	−0.000*** (0.000)	−0.000** (0.000)	−0.000*** (0.000)	−0.000*** (0.000)	−0.000*** (0.000)	−0.000 (0.000)	−0.000*** (0.000)
Male (1 = male, 0 = female)	0.780*** (0.073)	0.117 (0.079)	0.859*** (0.046)	0.237*** (0.057)	0.961*** (0.045)	0.203*** (0.054)	0.672*** (0.049)	0.163*** (0.041)
Manufacturing industry		−0.096 (0.066)		−0.124*** (0.045)		−0.002 (0.035)	0.311***	0.163*** (0.047)
Construction industry		−0.119 (0.072)		−0.034 (0.047)		0.168*** (0.035)		0.161*** (0.050)
Service industry		−0.195*** (0.064)		−0.100** (0.045)		−0.039 (0.034)		−0.015 (0.042)
Within own province, but outside own county		0.179*** (0.064)		0.120*** (0.044)		0.150*** (0.032)		0.154*** (0.036)
Outside own province		0.457*** (0.059)		0.346*** (0.040)		0.318*** (0.032)		0.342*** (0.036)
Migration network	0.105 (0.082)		0.268*** (0.047)		0.199*** (0.047)		0.318*** (0.041)	
Household labor size	0.050 (0.033)		0.069*** (0.020)		0.022 (0.019)		0.014 (0.020)	
Area of responsibility land (mu)	−0.058*** (0.009)		−0.033*** (0.004)		−0.025*** (0.003)		−0.018*** (0.003)	
Inverse Mills ratio		−0.232 (0.154)		0.064 (0.107)		−0.079 (0.106)		−0.267** (0.106)
Provincial dummy variable	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.187 (0.207)	0.129 (0.243)	0.336*** (0.127)	0.064 (0.158)	1.147*** (0.109)	0.291* (0.156)	1.367*** (0.111)	1.020*** (0.180)
Observations	1,774	735	4,406	2,002	4,641	2,628	4,099	2,489

Notes: Standard errors in parentheses. *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$
Source: China Rural Development Survey

Table VIII.
Determinants of the log hourly wage by education level, 2004 to 2015 (Heckman)

	2004		2007		2011		2015	
Independent variable	Selection equation	Wage equation	Selection equation	Wage equation	Selection equation	Wage equation	Selection equation	Wage equation
Primary and below	0.011 (0.025)	0.000 (0.023)	0.021 (0.017)	−0.002 (0.017)	−0.019 (0.016)	−0.021 (0.013)	0.025 (0.018)	−0.020 (0.015)
Junior high school	0.075** (0.032)	0.060** (0.024)	0.050** (0.020)	0.034** (0.016)	0.033* (0.020)	0.013 (0.013)	0.013 (0.023)	0.019 (0.015)
Senior high school	0.130*** (0.043)	0.047* (0.025)	0.021 (0.025)	0.058*** (0.015)	0.048** (0.024)	0.037*** (0.012)	0.052* (0.027)	0.016 (0.014)
College and above	0.137 (0.110)	0.144*** (0.040)	0.226*** (0.064)	0.157*** (0.025)	0.168*** (0.048)	0.095*** (0.017)	0.169*** (0.057)	0.146*** (0.016)
Experience	−0.054*** (0.010)	0.036*** (0.008)	−0.032*** (0.006)	0.028*** (0.005)	−0.012** (0.006)	0.028*** (0.004)	−0.042*** (0.008)	0.034*** (0.004)
Experience squared	0.000 (0.000)	−0.000*** (0.000)	−0.000*** (0.000)	−0.000*** (0.000)	−0.001*** (0.000)	−0.000*** (0.000)	−0.000 (0.000)	−0.000*** (0.000)
Male (1 = male, 0 = female)	0.806*** (0.074)	0.116 (0.079)	0.871*** (0.047)	0.240*** (0.057)	0.988*** (0.045)	0.170*** (0.054)	0.692*** (0.050)	0.172*** (0.041)
Manufacturing industry		−0.055 (0.067)		−0.092** (0.045)		0.027 (0.035)		0.073 (0.047)
Construction industry		−0.094 (0.072)		−0.026 (0.046)		0.178*** (0.034)		0.203*** (0.049)
Service industry		−0.161** (0.064)		−0.075* (0.045)		−0.012 (0.034)		0.057 (0.042)
Within own province, but outside own county		0.158** (0.064)		0.107** (0.044)		0.141*** (0.032)		0.135*** (0.036)
Outside own province		0.451*** (0.059)		0.350*** (0.040)		0.323*** (0.031)		0.333*** (0.035)
Migration network	0.094 (0.082)		0.266*** (0.047)		0.203*** (0.047)		0.324*** (0.041)	
Household labor size	0.048 (0.033)		0.071*** (0.020)		0.023 (0.020)		0.016 (0.020)	
Area of Responsibility land (mu)	−0.058*** (0.009)		−0.034*** (0.004)		−0.025*** (0.004)		−0.018*** (0.003)	
Inverse Mills ratio		−0.273* (0.152)		0.008 (0.106)		−0.213** (0.104)		−0.379*** (0.104)
Provincial dummy variable	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.427** (0.213)	0.327 (0.254)	0.615*** (0.144)	0.103 (0.165)	1.447*** (0.116)	0.393** (0.160)	1.544*** (0.119)	0.964*** (0.185)
Observations	1,774	735	4,406	2,002	4,641	2,628	4,099	2,489

Notes: Standard errors in parentheses. *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$
Source: China Rural Development Survey

primary and below did not receive any returns in the labor market between 2004 and 2015. This phenomenon also occurred for laborers with a junior high school education after 2007, and again for those with senior high school education after 2011.

6. Conclusion and discussion

China's economy has grown rapidly and has completed the transition from a low-middle-income country to an upper-middle-income country in 2010. Analyzing the returns to education at this stage of development is not only beneficial for China's future development, but also significant for other developing countries.

In this study, we estimate the returns to education over the period of 2004–2015 using nationally representative data for rural China. Using OLS estimation and the Heckman selection model, we show a decrease in the returns to education in rural China, although there was a slight increase in 2015. The returns for different educational endowments follow almost the same trend as the overall returns to education. Furthermore, the absolute values of the returns to education for different educational endowments varies greatly from each other. Tertiary education has always maintained a high rate of returns to education, while returns to senior high school education and below are at much lower levels.

Considering that education has had a positive and significant impact on income from 2004 to 2015, increasing the educational investment in rural areas is important for income growth for rural residents, poverty alleviation in rural areas and narrowing the income disparities between urban and rural areas.

The decline in the returns to education should gain our attention. This phenomenon might be due to differences in the relative scarcity of human capital compared to physical capital within different years. The rapid expansion of foreign trade since China's accession to the WTO in 2001, which has promoted the development of labor-intensive industries, has led to a rapid rise in the wage levels of unskilled workers regardless of education (Deng and Ding, 2013). The pervasive skill mismatch in the labor market continues to emerge; those who have qualifications may be unable to find work, while those without them may. Additionally, training all too often instills outdated skills in those who undertake it, further preventing efficient matches of jobs to potential candidates with adequate skill levels (Doan *et al.*, 2016).

The convergence in returns to different educational endowments reflects the diminishing income gap between workers with different educational endowments. We believe that with modernization of industry in China, the requirements for labor quality are also increasing. Junior high school graduates have shown no more wage advantage than those with lower education levels in the labor market in 2011, while high school graduates also saw a similar situation in 2015. Like the graduates from junior high school and below, senior high school graduates are often engaged in positions that do not require high academic qualifications. In contrast, the return to tertiary education remains high, which indicates that labor requiring the highest education still nets the highest returns.

Universities are the cradle of high-quality talent, where learning experiences help students to develop the ability to solve problems and adapt new technologies to meet their needs. Despite challenges posed by industrial transformation, college students will perform better than non-college students in the labor market on average (Zhang *et al.*, 2005; Zhang, 2006). Considering the poor returns for senior high school in 2015, it is necessary to invest in access to tertiary education to face future challenges. Moreover, the Chinese Government should make policies to both popularize and incentivize senior high school education, so that more of the future labor force can go through before continuing on receiveing tertiary education. This would help China meet the future demand for human capital.

Although our results are based on nationally representative samples and thorough robustness tests, unobserved individual ability is a problem that we have not addressed. This may affect the final estimates since it affects not only educational attainment but also off-farm wages earned by the labor force. Therefore, this research will be further improved when better data become available in the future.

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(The Appendix follows overleaf.)

Appendix

Table AI.
Descriptive statistical averages sample province and regions, 2004

Sample characteristics	Jilin	The northeastern provinces	Hebei	The north and central provinces	Jiangsu	The eastern coastal areas	Sichuan	The southwestern provinces	Shannxi	Loess plateau
(1) Per capita net income of urban households	8,227	8,246	8,381	8,340	11,237	12,875	8,261	6,906	8,043	6,482
(2) Per capita net income of rural households	3,000	3,104	3,171	2,790	4,754	4,532	2,519	1,827	1,867	1,760
(3) Ratio of urban and rural residents' income	2.7	2.7	2.6	3.0	2.4	2.9	3.3	3.9	4.3	3.7
(4) Per capita annual consumption expenditure	5,136	5,276	3,858	3,837	6,159	6,234	3,643	2,855	2,893	3,286
(5) Sex ratio (males per 100 females)	100	101	105	105	99	102	102	105	106	105
(6) Life expectancy in 2000(years)	73.1	72.9	72.5	71.1	73.9	73.7	71.2	68.5	70.1	69.0
(7) Average family size (person/household)	3.2	3.2	3.5	3.4	3.2	3.2	3.3	3.6	3.6	3.6
(8) The proportion of rural labors who have received above high school education (%)	10.1	11.0	16.1	13.3	14.8	15.7	8.3	8.2	13.8	11.8

Source: National Bureau of Statistics

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