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Return to education in China's rural labor market

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The purpose of this study is to estimate the return to education in China's rural labor market. We find that education increases off-farm employment participation and earnings. An additional year of schooling increases the earnings of a rural worker by 4.50%. Individuals with an education of senior middle school and above have significantly higher wages than those without. Furthermore, the type of education bringing strong economic benefits to rural Chinese is not limited to traditional school education; short-term skill training programs also boosts off-farm income.

Key words: Return to education, rural labor market, China.

INTRODUCTION

Since the introduction of Household Responsibility System[1] in 1978, China's rural population participating in non-agricultural activities has been steadily growing. In 1995 about 34% of the rural labor force worked in non-farm sectors for at least 30 days annually. By 2000, there were almost 200 million rural laborers who were working for at least 30 days in a year in non-farm sectors, accounting for 40% of the rural laborers (Zhang et al., 2002). Although the government has made great effort to place surplus rural labor into non-farm sectors, China still had 100 million of surplus rural labor by 2009 (Chen and Hamori, 2009). The large reservoir of surplus labor has been the backbone of China's economic growth in the past three decades, supplying inexpensive labor for the rapidly growing manufacturing sector.

However, the economic growth driven by increased use of rural labor did not narrow the urban-rural income gap, which is now one of the most acute problems facing the Chinese society. The urban-rural income ratio is about 3 to 1 in China in 2011, larger than any other country in Asia (Qin et al., 2013). Because of the limited land available to rural Chinese, off-farm work remains one of the most effective ways to increase their income and narrow the urban-rural income gap.

The human capital theory postulates that individuals with more education are more productive and are better rewarded in a market economy (Mincer, 1974). There is a large body of empirical literature supporting that theory. Numerous cross-country studies find that education is well rewarded (Psacharopoulos, 1994; Sanmartin, 2001; Shields and Shields, 2009; Long, 2010; Aakvik et al., 2010). Psacharopoulos (1994) find that, among the developing countries, the average return to education is 10.1% for the world and 9.6% for Asia. In the case of developed countries, Sanmartin (2001) find that the return to schooling in Spain was null until individuals complete junior school education, and from then, the earnings increased by 6.7% for an additional year of regular schooling. Aakvik et al. (2010) find that the return to education was 7.4% in Norway. Similar to Sanmartin's study, they find education does not bring in a return until senior middle school. Moreover, they find that the return to education is higher for the population with higher education. Long (2010) finds that the return to schooling

[1] In the People's Commune System (PCS) of Mao era, the efficiency was very low in crop production because of the collective team work. Household Responsibility System (HRS) instead of PCS was initiated in 1978. The villager was allocated farmlands. As a result, the productivity was enhanced dramatically. Therefore, the massive rural labor can be migrated into nonagricultural industry.

was 6.02% in USA, and that it was the greatest for male, Blacks and Hispanics. Shields and Shields (2009) find the presence of positive external benefits of education on production in USA, and recommend the government should subsidize public education.

However, whether or not education is a good investment in rural China remains controversial in the literature. Some studies find that formal education (that is, regular schooling), experience, and skill training are each rewarded in the labor market (Bowlus and Sicular, 2003; Glauben et al., 2008). Meng (1995) and Mallee (2000), on the other hand, find no reward for education received by rural Chinese, using a regression of off-farm labor participation and non-agricultural earnings. These authors find that such non-market factors as social network, land tenure, and transportation costs contributed to off-farm work participation.

In addition to conflicting evidence, data limitation and estimation techniques employed contribute to the controversy in this literature. Most of the studies mentioned earlier are based on provincial samples; some are county-level analysis. No study has employed a nationally representative sample. The question will not be resolved without a nationally representative sample (Schultz, 2004). Another important issue is the estimation techniques employed in those studies fail to account for the possibility of sample self-selection. To overcome these shortcomings, this article estimates the return to education received by rural Chinese from a nationally representative sample with the Heckman two-step method. We estimate and compare the returns to schooling over a five year span, and test the hypothesis that the returns to education increase with the level of education received by rural Chinese.

DATA AND DESCRIPTIVE ANALYSIS

The data used in this study were collected from randomly selected households in a sample of Chinese villages representing various income levels in 2003 and 2007 by the Research Center for Rural Economy (RCRE), Ministry of Agriculture of China. The sample covers 16 out of China's 31 provinces. The relative levels of economic development among China's provinces declines from east to west. Five, six, and five provinces were respectively selected from eastern, central, and western China to ensure that the sample is representative of all development levels. Townships are excluded from the survey, so all households surveyed were living in villages. The villages in the selected provinces were classified by yearly net income per capita into high, middle, and low levels. In each income level, the surveyed households were randomly selected. The collected information includes the economic and social characteristics of all family members. 204 villages and 11,931 households were surveyed in the year 2003, and 203 villages and 11,604 households in 2007. Since our analysis uses wage differentials to measure returns on education, our sample should only include people in the working age. Following Glauben et al., (2008), we define the working age to be between 16 to 65 years old. Thus, the individuals outside of this age range are excluded from our analysis. Furthermore, all students are excluded from the analysis even if he or she is in the working age. After these deletions, the final dataset used in our analysis contains 48,935 individual observations, of which 25,550 are from year 2003 and 23,385 from 2007.

Table 1 presents the descriptive statistics of our sample. The average daily off-farm wage is RMB 32 *yuan* (1 U.S. dollar = 8.277 RMB *yuan* in 2003). 51% of the individuals in the sample were participating in off-farm employment in the survey year. An average rural Chinese in our sample received 7 years of education. 52% of the individuals in our sample has an education of junior middle school or above, very close to the 53 % ratio published by Chinese government in the year 2006 (Ministry of Agriculture of China). Only 2% of our sample are illiterate. The arable land per household in our sample is 12 *mu* (*mu* is unit of Chinese land, 1 *mu* = 1/15 ha), close to the official published number of 10.22 *mu* (Ministry of Agriculture of China). The average age of the individuals in our sample is 37, and 13% of them received skill training.

Table 2 presents the earnings of people with different education levels and the corresponding growth rates from year 2003 to 2007. Individuals with a higher education earn more, and training also increases wage. The daily wage of a person with a college degree is 18% higher than an illiterate in the year 2003, and 31% in 2007. Furthermore, income appears to grow faster for people with higher education. For example, the daily off-farm earnings increased 36% during the 5 years for people with a senior middle school education, while it increased 57% for the one with a college education in the same period. The general trend in Table 2 is that education and skill training are positively correlated with wage.

ECONOMETRIC SPECIFICATIONS

Following Mincer (1974), Zhang et al. (2002), and Shields and Shields (2009), we employ the Mincerian Wage Equation (MWE) to estimate the return to education in rural China. The conventional MWE, however, is subject to estimation bias because household traits, such as household size, area of land owned, number of children under 6 years, and number of elderly above 65 years, affect off-farm work participation but do not necessarily affect the off-farm earnings. Following Heckman (1979) and Zhang et al. (2002), we adopt the Heckman two-step method to account for such self-selection bias. In the first step we estimate the propensity for a rural resident to enter into the off-farm job market with the following Probit model (1).

$$Z_i^* = \gamma_0 + \gamma_1 G_i + \omega \quad (1)$$

where Z_i is equal to 1 if individual *i* participates in off-farm work for more than 30 days in one year and 0 otherwise. Upon obtaining the estimated parameters in equation (1), the probability of a rural resident participating in off-farm work can be calculated as follows

$$P(M_i = 1) = F(Z_i) = \int_{-\infty}^{z} f(u_i) du_i \quad (2)$$

where $F(Z_i)$ is the cumulative distribution function. With a fairly large sample, u_i can be taken as normally distributed, so that the job participation probability can be obtained as

$$\hat{P}_i = \Phi(\hat{Z}_i) = \int_{-\infty}^{z} (2\pi)^{-1/2} exp(-u_i^2/2) du_i \quad (3)$$

A test for self-selection bias can be formulated on the basis of the Inverse Mills Ratio, defined as follows;

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Table 1. Descriptive statistics and definition for the selected variables.

Variable	Definition	Mean	Std. Dev.
Off-farm wage	Off-farm wage per day	32.131	31.336
Off-farm work participation	Engaging in off-farm work at least 30 days in one year is 1, otherwise 0	0.511	0.500
Education	Years of regular education	7.069	2.574
Education dummy			
Illiterate	Rural resident who doesn't know word coded as 1, otherwise 0	0.016	0.138
Primary school	Regular education year from 1 to 6 coded as 1, otherwise 0	0.386	0.487
Junior middle school	Regular education year from 7 to 9 coded as 1, otherwise 0	0.516	0.500
Senior middle school	Regular education year from 10 to 12 coded as 1, otherwise 0	0.074	0.261
College	Regular education year equals to 13 or above coded as 1, otherwise 0	0.008	0.091
Training	Trained in a formal program coded as1, otherwise 0	0.133	0.340
Age	Years of age	37.142	13.010
Gender	Male=1, female=0	0.581	0.493
Health dummy			
Excellent health status	Self-reported health status is excellent coded as1, otherwise 0	0.594	0.491
Good health status	Self-reported health status is good coded as1, otherwise 0	0.314	0.464
General health status	Self-reported health status is general coded as1, otherwise 0	0.066	0.248
Poor health status	Self-reported health status is poor coded as1, otherwise 0	0.026	0.160
Household size	Total family member	4.591	1.973
Number of children in household	Number of kid whose age is under 6 in household	0.250	0.523
Number of elderly in household	Number of older whose age is above 65 in household	0.187	0.484
Area of land in household	The quantity of land in one family (unit is mu, which is Chinese land unit and 1 mu=1/15 hectare)	11.709	19.228

Table 2. Earnings of different level of education.

Variable	Year 2003	Year 2007	Growth rate of earnings (%)
Off-farm wage	26.532(25.955)	36.125(34.114)	36.156
Education			
Illiterate	24.247(8.573)	34.221(62.698)	41.131
Primary school	25.280(19.175)	36.096(33.316)	42.789
Junior middle school	26.780(27.656)	36.363(32.633)	35.787
Senior middle school	27.686(30.532)	37.734(38.941)	36.293
College	28.547(33.337)	44.791(49.188)	56.900
Training			
No training	25.310(23.159)	35.067(32.975)	38.550
Training	32.873(36.602)	41.150(38.691)	25.176

Source: Standard deviations are in parentheses.

$$\hat{\lambda} = \begin{cases} \dfrac{\varphi(\hat{Z})}{\Phi(\hat{Z})} & \text{if the individual participates in off-farm work} \\ \dfrac{\varphi(\hat{Z})}{1-\Phi(\hat{Z})} & \text{otherwise} \end{cases} \quad (4)$$

The second stage regression estimates the following Mincerian Wage Equation.

$$LnWage_i = \gamma_0 + \gamma_1 Education_i + \gamma_2 \Pi_i + \gamma_3 \hat{\lambda} + \eta_i \quad (5)$$

where $Wage_i$ is the rural resident's daily off-farm wage. It is adjusted for inflation by CPI with a base year of 2003. The variable, $Education_i$, is years of schooling received by the rural resident, whose parameter, γ_1, measures the returns to education. Π_i stands for all other explanatory variables including individual traits, regional dummy, year dummy, etc.

If γ_3, the coefficient of $\hat{\lambda}$, is statistically insignificant, the hypothesis of no self-selection bias cannot be rejected, and the Ordinary Least Square method is adequate to estimate the earnings equation. If that coefficient is significant, indicating the presence of the sample self-selection bias, $\hat{\lambda}$ should be included in the

Table 3. Return to years of education in China's rural labor market.

Variable	Wage equation		Participation equation	
	Coefficient	Standard error	Coefficient	Standard error
Education	0.045***	0.012	0.031**	0.015
Education square	-0.000	0.000	0.004***	0.001
Education*Gender	0.046***	0.017	0.020	0.021
Education square *Gender	-0.004***	0.001	-0.005***	0.001
Training (training=1, no training=0)	0.137***	0.014	0.030	0.020
Age	0.068***	0.003	-0.030***	0.003
Age square	-0.001***	0.000	0.000***	0.000
Gender (male=1, female=0)	0.136*	0.071	0.835***	0.074
Health dummy (Reference: excellent)				
Good health status	-0.051***	0.012	-0.032**	0.015
General health status	-0.062**	0.029	-0.060*	0.033
Poor health status	-0.225***	0.060	-0.427***	0.058
Household size			0.024***	0.005
Number of children in household			-0.094***	0.015
Number of elderly in household			-0.001	0.014
Area of land in household			-0.011***	0.000
Region Dummy (Reference: western)				
Middle	0.144***	0.014	-0.231***	0.017
East	0.158***	0.014	-0.208***	0.018
Year dummy (Reference: year 2003)	0.404***	0.012	0.277***	0.013
Constancy	1.248***	0.080	0.073	0.086
Lambda ($\hat{\lambda}$)	-0.352***	0.076		

Source: ***, ** and * represent at 1 %, 5 % and 10 % level of significance respectively.

Mincerian Wage Equation (5) in order to correct the estimation bias.

RESULTS

Table 3 presents the regression results for off-farm labor participation equation (1) and Mincerian Wage Equation (5), in which education is measured in years of schooling. Table 4 presents an alternative version of the two equations where education dummies are included as independent variables. The values of Inverse Mills Ratio ($\hat{\lambda}$) in wage equations are significant at 1% level in each set of regressions, confirming the presence of self-selection bias in our sample and justifying the Heckman two-step method.

In the wage equation in Table 3, the sign of the parameter on *education* is positive and significant at 1% level, indicating an additional year of schooling increases off-farm wage by 4.50% for an average rural Chinese, half of the 9% rate of return to education obtained by Zhang et al. (2002). The difference is likely due to the fact that data used in their study were collected from North Jiangsu Province, a relatively well developed rural area with better natural resources and market access. Our result is close to the 3.80% rate of return to education in urban China estimated by Li et al. (2012), but is generally lower than that obtained in the past literature: for example, 9.6% in Psacharopoulos (1994) for developing countries in Asia, and 6.02% in United States of America in Sanmartin (2001), 6.7% in Spain in Long (2010), and 7.4% in Norway in Aakvik et al. (2010).

The results in Table 4 also confirm that education increases earnings in off-farm employment. The daily wage of the educated is 1, 11, 19 and 33% higher than that of the illiterate if the highest level of education received is primary school, junior middle school, senior middle school, and college, respectively. These wage differentials, however, are only statistically significant for senior middle school and college graduates. Li et al. (2012) find that the return to high school education is zero in urban China. But in rural China, it appears from our results that the same diploma does boost the earning potential. This difference might be due to the different types of jobs urban and rural Chinese are pursuing. The rural Chinese tend to work in labor intensive sectors such as manufacturing and construction, where a high school diploma represents a relatively higher level of education. In contrast, urban Chinese tend to pursue a career in less labor intensive sectors such as services and government, where a high school diploma represents a relatively lower

Table 4. Return to different levels of education in China's rural labor market.

Variable	Wage equation		Participation equation	
	Coefficient	Standard error	Coefficient	Standard error
Education dummy (Reference: illiterate)				
Primary school	0.009	0.090	0.082	0.079
Junior middle school	0.109	0.090	0.392***	0.078
Senior middle school	0.194**	0.095	0.638***	0.088
College	0.333***	0.115	1.028***	0.144
Education*Gender(Reference: illiterate*Gender)				
Primary school*gender	0.077	0.135	0.017	0.142
Junior middle school*gender	0.047	0.134	0.204	0.141
Senior middle school*gender	-0.025	0.139	-0.400***	0.149
College*gender	-0.150	0.160	-0.678***	0.208
Training (training=1, no training=0)	0.139***	0.014	0.033*	0.020
Age	0.068***	0.003	-0.030***	0.003
Age square	-0.001***	0.000	0.000***	0.000
Gender (male=1, female=0)	0.186	0.135	0.822***	0.140
Health dummy (Reference: excellent)				
Good health status	-0.052***	0.012	-0.034**	0.015
General health status	-0.064**	0.029	-0.069**	0.032
Poor health status	-0.224***	0.060	-0.438***	0.058
Household size			0.022***	0.005
Number of children in household			-0.091***	0.015
Number of elderly in household			-0.001	0.014
Area of land in household			-0.012***	0.000
Region Dummy (Reference: western)				
Middle	0.142***	0.014	-0.233***	0.016
East	0.156***	0.014	-0.208***	0.018
Year dummy (Reference: year 2003)	0.404***	0.012	0.278***	0.013
Constancy	1.270***	0.105	0.232**	0.102
Lambda ($\hat{\lambda}$)	-0.362***	0.079		

Source: ***, ** and * represent at 1 %, 5 % and 10 % level of significance respectively.

level of education. Thus, high school education does have value for rural Chinese, but has little for urban Chinese.

The estimation results from the participation equations in Tables 3 and 4 shows that the better educated are more likely to participate in off-farm employment. This is not only true for high school and college graduates, but also true for middle school graduates. The result is consistent with the findings of de Brauw et al. (2002) and Bowlus and Sicular (2003), but differs from those in Meng (1995), Mallee (2000), and Glauben et al. (2008). Glauben et al. (2008) finds that even the primary school graduates are more likely to participate in off-farm work than the illiterate. Meng (1995) and Mallee (2000) find that years of schooling do not affect participation in off-farm employment.

Whether skill training increases earnings or not is another important question because the Chinese Government has invested substantially in skill training for rural workers. Our results suggest that individuals with skill training earn 14% more in an off-farm job than those without. Similar results have been found by de Brauw et al. (2002) and Meng (1995).

There exists a gender differential in earnings. A male on average earns 19% more than a female (Table 4), corroborating the findings in de Brauw et al. (2002) and Schultz (2004). However, the wage of a male, senior middle school or college graduate is less than that of a female with the same education. We also find that bad health and aging can significantly reduce the participation rate in off-farm employment. And households with more children are less likely to participate in off-farm work.

Conclusions

In this study we have estimated the return to education for rural Chinese with a randomized household survey conducted in a nationally representative sample of villages. The results show significant benefits of education for rural Chinese in terms of off-farm participation and earnings. The return to education is estimated at 4.50% for each additional year of schooling in rural China. And the better educated earn more from off-farm employment. In addition, we find that such nontraditional education as skill training also increases the off-farm income.

These results bear important implications for rural development policy in China. First, more investment in rural education is strongly needed; more government funding for rural education means more job participation and higher rural income. At present, only 27% the public funds in education in China goes to rural areas which are home to 65% Chinese students (National Bureau of Statistics of China, 2011). Second, more skill training programs will help rural residents to become more productive. Thirdly, improved healthcare services and affordable medical insurances will improve health status of rural workers and thus increase their earnings. Finally, abolishing the *Hukou* system will encourage freer labor movements.

Although our results are based on a nationally representative sample and an estimation technique accounting for self-selection bias, the research can be further improved in the future when better data become available. For instance, unobserved ability may affect both education attainment and wages earned. Such estimation bias can be corrected when data are available to control for unobserved ability. Future research may also consider expanding the survey to include both urban and rural residents, which will permit estimation of the return to education in China as a whole.

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