

# ***The Returns to Education in China: An Analysis of Demographic and Degrees' Heterogeneity***

**Xiaoyu Ge<sup>1,a,\*</sup>**

<sup>1</sup>*Chinese University of Hong Kong (Shenzhen), Shenzhen, 518000, China*  
*a. xiaoyuge@link.cuhk.edu.cn*

*\*corresponding author*

**Abstract:** Currently, education is pivotal for China's future development in economy and technology. This study used the OLS estimation to evaluate the private return to education in China. The results show that an extra year of schooling will increase one's yearly nominal income by around 6.95 percent. Moreover, the heterogeneous analysis indicates that the return rate is higher for male employees and workers who live in urban areas. This research supplements previous literature in two directions. First, it uses CFPS2020, which is relatively new data, to do the estimation. Second, interaction terms of years of schooling and the highest degree of education are created to figure out the various return to education of different degree holders. The regression results indicate that employees who have higher degrees of education will enjoy a higher return for one more year of schooling.

**Keywords:** return to education, social inequality, chinese education, demographic heterogeneity

## **1. Introduction**

As an essential tool for all countries to systematically nurture young generations and achieve sustainable economic growth, education always receives tremendous attention in academic circles worldwide. There has been intense discussion of the various returns on education depending on areas and how such differences are created.

The growth miracle of China is also driven by the popularization of education to a certain degree [1]. Existing research has already figured out substantial private return rates to education in China under various constraints, but they are not the end [2,3]. China's previous labor-based economy gradually transfers to a skill-based economy, implying that acquiring a mediocre degree of education no longer increases one's wage noticeably. Continuous supervision of the return to education should be taken to ensure that government can improve the education system and quality timely. The data on education and income level in China used by previous scholars is quite dated, and which collection only lasted until 2017. Therefore, this research uses the latest data from CFPS2020 to estimate the current private return rate of education in China.

Moreover, academic attainment plays a crucial role in determining the prospect of career development for the young generation as well as their income level, but its influence varies from place to place. Previous scholars have analyzed various causes of such differences in private return rates across individuals, identifying that education level, school performance, and grades all matter [4,5]. Based on previous analysis, the inequality among different groups' returns to education

deserves more investigation due to the lopsided distribution of educational resources and economic development. Accordingly, this work delves into the discrepancy in rates of return.

This paper contributes to the existing research in two aspects. Theoretically, it classifies the samples more reasonably. Practically, its result provides the Chinese government with an inference about the updated private return rate to domestic education, the degree of inequality in the Chinese education system, and how to prevent more severe social inequality in the future.

The rest of the content will be organized in the following structure. The next section summarizes the main findings of existing literature on private returns to education and how they are affected by various factors. Section 3 illustrates the research methodology. Section 4 describes the data used. Section 5 interprets the implication of estimated results and discusses how the result received in this research interacts with the findings of previous studies.

## 2. Literature Review

The popularization of education and its modification for adapting to the dynamic world becomes a major task for the current Chinese government. Previous scholars have done comprehensive research on how China can further improve its educational policy. This literature review discusses the different focuses of existing research and variant private returns to the education they have received. Then it presents the factors that create the difference in return to education across areas identified by previous scholars and their implication on China's future policy settings.

### 2.1. Private Return to Education in China and Worldwide

Existing research uses different methods and data sets to identify the private return to education in China and worldwide, providing references for Chinese policymakers to evaluate and modify the domestic return rates. While the expected return rate for higher education received by different research varies, all their results show that higher education has a positive effect on workers' wage rate, implying that education plays a decisive role in boosting GDP growth as well as the standard of living.

The return to education can be divided into the private return and social return [6]. Private return refers to the return wholly belonging to an individual and used to be represented by personal income. Social return, nonetheless, is hard to quantify. Accordingly, most of the previous research mainly focuses on private return while social return receives scarce attention. The global average private return rate of education is almost 10%, and the returns to tertiary education are the highest and to secondary education the lowest [7]. Besides, a meta-analysis was used to receive a general outcome, which is almost 18%, for the different return rates received by previous literature [8]. This result largely surpasses the world average, possibly explained by a higher return rate for developing countries that experienced rapid growth in GDP.

Among studies focusing on economic returns to education in China, economic returns to education were counted under different suppositions and special constraints. Some scholars used OLS estimation and the Heckman selection model to investigate the private return to education in China. The problem of heterogeneity in previous research was addressed by assigning samples to different cohorts, and scholars found that the average private return to schooling is 7.9% in 2009 [9]. This result is congruent with China's transformation from a labor-based economy to a technology-based economy. Nonetheless, the rural area still lags behind the urban area. The private returns to education in the rural area decreased during the observed years from more than 6% in 2004 to only about 3% in 2011, rising to nearly 4% in 2015 [10]. But simply using the year of education as an independent variable leaves the experiment susceptible to endogeneity and selection bias. An instrumental variable (IV), which is the distance between the location of the school and residents' homes, was used in

previous research. The result indicated a private return rate of 7.6%, which is significantly larger than the numbers derived in other research [11].

## 2.2. Different Factors That Affect the Return to Education

Previous studies provide a comprehensive overview of factors that play a significant role in shaping the economic return to education in China, leaving consequential implications for policymakers to organize a plan that optimizes the benefits derived from education.

Two theories help explain the rationale of how education affects income. On one hand, Human Capital Theory proposes the claim that receiving an education helps people to accumulate knowledge and practical skills which improve their competitiveness in the labor market [12]. Therefore, there exists a causal relationship between education level and private return. Signaling Theory, on the other hand, considers education level as barely a signal of one's innate ability that education level itself does not correlate with the private return [13]. Chinese data strongly supports the Human Capital Theory by creating an interaction variable of education and experience [9].

Under the modern transformation from a labor-based economy to a technology-based economy, innovation, and high-quality teaching become important propellers for future returns to education [14]. A triple-helix model has been used to discuss how the cooperation among education institution, government, and industry promotes the upgrading of course design and address the provincial inequality of education that impairs the teaching quality [15]. Expenditure-per-pupil and pupil/teacher ratio have been calculated to examine the effects of school quality at the primary school level on future earnings in China, implying that workers educated in better-quality schools have significantly higher earnings than those who studied in lower-quality schools [16]. In rural areas, a negative correlation between education attainment and distance from residence to school is found, supposing the imperative need of renovating infrastructure in less developed areas [11].

Some scholars focused on the variance of return to education and decomposed the risk faced by students when deciding whether to pursue higher education into the choices of different subjects and types of education [17]. Their result of variance decomposition shows that the subject area explains nearly twice the variance in earnings compared with that explained by the type of education. An examination of 54 studies that focus on the causal effect of family income on several outcomes of children has been done. It found that most previous research received the conclusion that higher family income generates a positive effect on educational attainment and behavior outcomes of children. Nevertheless, the effect is non-linear, which is found to be stronger for poor families [18]. There is also a gender difference in how family income and parents' way of teaching affect children's educational attainment [19].

Previous scholars have made huge progress in the exploration of this topic, but there are still some limits to existing research. First, the independent variable used by previous studies may engender problems when interpreting the result. Some used the years of schooling, supposing that the marginal effect generated by different levels of education is constant. The effects of different educational endowments on earnings are unequal. Others who chose the degrees of education as an independent variable tend to receive overestimated regression results since some samples left schools before graduation and were counted as lower-degree possessors. Second, the data used by previous research is somehow outdated, so their conclusion may be no longer applicable to the current situation. More updated data should be used in future research.

## 2.3. Research Significance

This research will use the family census data collected by CFPS in 2020, which is relatively new and informative, to estimate the private return to education. Samples will be assigned to different groups

based on their highest degree of education. The marginal return of an extra year of schooling will be identified on a group basis. Therefore, this article can observe the various private return rates for people having different degrees of education.

### 3. Methodology

Previous scholars relied on the theoretical model generated by [20]. For the overall private return to education in China, this study also estimates the semi-logarithmic specification for nominal income and its increase in absolute value based on the Mincerian equation. The only change is that the previous variable “province” is replaced by a new variable “status of marriage”.

$$\ln w_i = \beta_0 + \beta_1 S_i + \beta_2 Exp_i + \beta_3 Exp_i^2 + \beta_4 Urban_i + \beta_5 Gender_i + \beta_6 Marriage_i + \theta_1 \quad (1)$$

Equation (1) is the regression equation of years of schooling on nominal income growth. The dependent variable  $\ln w_i$  is the log form of the nominal yearly income of employee  $i$ . Income consists of basic wages and extra earnings from other economic activities.  $S_i$  is the years of schooling for sample  $i$ .  $Exp_i$  is a supposed employee's working experience, measured as age minus the sum of years of schooling plus six.  $Urban_i$  is a dummy variable that captures the difference in returns to education between urban and rural areas,  $Gender_i$  is a dummy variable that equals 1 if sample  $i$  is a male, and  $Marriage_i$  is a dummy variable for one's status of marriage.

$$w_i = \beta_0 + \beta_1 S_i + \beta_2 Exp_i + \beta_3 Exp_i^2 + \beta_4 Urban_i + \beta_5 Gender_i + \beta_6 Marriage_i + \theta_1 \quad (2)$$

Equation (2) is the regression of schooling years on the absolute income increase value. The dependent variable  $w_i$  is the value of nominal yearly income. Except for the basic form of regression, this study also generates interaction terms to identify the diverse returns of an extra year of schooling on nominal income for people holding different degrees. Samples are divided into six groups based on their highest degree of education.

$$\ln w_i = \beta_0 + \beta_1 Exp_i + \beta_2 Exp_i^2 + \beta_3 Urban_i + \beta_4 Gender_i + \beta_5 Marriage_i + \alpha_1 S_i \times Primary_i + \alpha_2 S_i \times Junior_i + \alpha_3 S_i \times Senior_i + \alpha_4 S_i \times Undergraduate_i + \alpha_5 S_i \times Graduate_i + \alpha_6 S_i \times PHD_i + \theta_1 \quad (3)$$

Equation (3) regresses the logarithmic form of nominal income on the interaction term of the highest degree of education and years of schooling.  $Primary_i$ ,  $Junior_i$ ,  $Senior_i$ ,  $Undergraduate_i$ ,  $Graduate_i$ , and  $PHD_i$  are all dummy variables that equal 1 if the highest degree of education of sample  $i$  is corresponding to that variable. Interpretation of other variables is the same as their meanings in regression equation (1). Equation (4) contains the same independent variables that equation (3) has, but the dependent variable becomes the value of nominal yearly income.

$$w_i = \beta_0 + \beta_1 Exp_i + \beta_2 Exp_i^2 + \beta_3 Urban_i + \beta_4 Gender_i + \beta_5 Marriage_i + \alpha_1 S_i \times Primary_i + \alpha_2 S_i \times Junior_i + \alpha_3 S_i \times Senior_i + \alpha_4 S_i \times Undergraduate_i + \alpha_5 S_i \times Graduate_i + \alpha_6 S_i \times PHD_i + \theta_1 \quad (4)$$

### 4. Data

This study uses panel data to conduct the estimation. The data is sourced from CFPS, which includes detailed information on the aspect of education, economy, family relationship, and health of more than 10,000 people from 2010 to 2020. The base group of samples, which were randomly selected

from 25 provinces, was decided during the first time of the inquiry. In subsequent years, any new member of the sample's family, mainly referring to their offspring and adopted children, will be included in the group of samples. Nevertheless, given that the period of data tracing is longer than ten years, it is hard for researchers to reach every sample in the base group, leading to various numbers of data for every two years' inquiry. The panel data enables this research to investigate the trend of people's income and the level of education in the past ten years. Besides the overall trend, specific trends that focus on different groups of people are also evaluated. Samples are mainly divided by gender and areas they live.

Several restrictions are put on the raw data to guarantee the validity and unbiasedness of the regression results. First, samples whose age is larger than 65 or smaller than 18 are dropped not only because they are out of the labor force in China, but also because the inclusion of all samples may attribute the increase in average years of schooling to solely age increase. Second, samples with missing data in any variable that this study uses for estimation are eliminated since the missing value is represented by a negative number in the data set and may contradict the estimates.

Table 1: Fundamental information based on demographics.

	Year					
(mean value)	2010	2012	2014	2016	2018	2020
<b>years of schooling</b>	7.27	7.16	7.9	9.39	10.1	10.37
male	9.08	7.85	8.54	9.71	10.15	10.43
female	6.52	6.42	6.99	9.04	10.04	10.28
urban	8	8.67	9.6	10.49	11.12	11.57
rural	5.77	5.98	6.37	8.1	8.57	8.79
<b>Income</b>	11052.2	12348.3	14555.1	24286.9	40053.2	46600.8
male	15067.9	16835.5	18168.4	29860	45076.5	53595.9
female	7355.6	7996.1	9988.3	17530	32719.1	37516.8
urban	15552.0	16984.9	21317.6	28725.8	44655.2	53081.4
rural	7151.8	8654.9	8861.4	19149	32652.7	37223.2
<b>Log(income)</b>	8.75	9.57	9.93	10.04	10.26	10.39
male	9.1	9.75	10.1	10.21	10.41	10.57
female	8.34	9.31	9.68	9.8	10.03	10.14
urban	8.31	9.81	10.03	10.13	10.39	10.54
rural	9.23	9.31	9.78	9.89	10.04	10.16

Table 1 describes the noticeable information presented by the panel data from 2010 to 2020. It lists the average income level, the average growth rate of income, average years of education, and the highest degree that samples have attained for each time of the inquiry. People are sorted based on gender and the area of residence. Three major findings bear to mention. Firstly, all the average values of the three variables listed in the graph indicate upward trends. The average years of schooling increased by 3.1 from 2010 to 2020. The nominal income quadrupled, and the growth rate of nominal income rise almost 2 percent in ten years. Secondly, average years of schooling experienced a

relatively large increase from 2014 to 2016, which was driven by the implementation of the “9 Years Compulsory Education” policy. Thirdly, the values of all the variables for females are significantly lower than for males. A similar discrepancy exists between the urban area and the rural area. Nevertheless, the difference between genders keeps shrinking, especially in the average years of schooling and income growth. In contrast, the gaps in education and average income between the rural area and the urban area are still large, which need to be improved by scholars and governors in the future.

Table 2: The number of samples that hold each type of degree of education.

	Year					
highest degree(number)	2010	2012	2014	2016	2018	2020
Illiterate/semi-literate	7193	7488	3967	1151	1464	2414
Primary school	6026	6435	4495	1583	2273	2735
Junior school	8385	9171	6227	2522	4446	5633
Senior school	3903	4730	3084	1375	2599	3328
Junior school	1328	1613	1325	730	1628	1498
undergraduate	749	896	834	557	1355	1277
Graduate	52	62	59	53	109	119
Ph.D.	4	1	-	3	5	7
Total	27667	30396	19981	7974	13879	17010

Table 3: The percentage distribution of samples that hold each type of degree.

	Year					
highest degree(number)	2010	2012	2014	2016	2018	2020
Illiterate/semi-literate	26	24.63	19.85	14.43	10.55	14.19
Primary school	21.78	21.17	22.5	19.85	16.38	16.08
Junior school	30.31	30.17	31.16	31.63	32.03	33.12
Senior school	14.2	15.56	15.43	17.24	18.73	19.56
Junior school	4.8	5.31	6.58	9.15	11.73	8.81
undergraduate	2.71	2.95	4.17	6.99	9.76	7.51
Graduate	0.19	0.2	0.3	0.66	0.79	0.69
Ph.D.	0.01	0	0	0.04	0.04	0.04
Total	100	100	100	100	100	100

Table 2 and Table 3 summarize the educational level of all the samples. As this paper mentioned before, the numbers of samples vary for each inquiry due to the difficulty of tracing all targeted samples and data cleaning. Based on the two tables above, it is apparent that the percentage of people who have higher degrees of education increases from year to year, and the number of illiterate samples

keeps dropping, but people who have achieved master's degrees and Ph.D. are still scarce. To further encourage the development of the domestic economy, the Chinese government should make more effort in nurturing high-skill workers.

## 5. Result & Discussion

Table 4: Regression results.

private return to education				
	income growth (%)		increase in absolute value (nominal income)	
year of schooling	0.0695*** (-0.0033)		3596.925*** (172.715)	
exp	-0.0266*** (-0.0036)	0.0387*** (0.0037)	584.355*** (135.605)	1575.522*** (151.232)
exp <sup>2</sup>	-0.0007*** (0.0001)	-0.0009*** (0.0001)	-14.610*** (2.415)	-35.02*** (2.645)
gender	0.4657*** (.0206)	0.4995*** (0.0205)	17541.83*** (905.952)	19303.18*** (900.009)
marriage	0.1156*** (0.0273)	0.0714*** (0.0273)	5236.645*** (1364.027)	2664.83*** (1342.326)
urban/rural	0.2172*** (0.0218)	0.1971*** (0.0216)	7313.577*** (897.497)	6304.771*** (886.613)
constant			-13584.38*** (2617.562)	5.172.438*** (2168.632)
Primary school*years of schooling		0.0056 (0.0075)		-139.862 (210.904)
Junior school*year of schooling		0.0124** (0.0055)		92.907 (149.2178)
Senior school*years of schooling		0.0259*** (0.0044)		891.686*** (132.859)
Undergraduate*years of schooling		0.04891*** (0.0036)		2288.713*** (131.150)
Master*years of schooling		0.0737*** (0.0055)		5335.751*** (633.305)
Phd*years of schooling		0.0883*** (0.0086)		6783.077*** (993.391)
N	8337	8287	8337	8287

Notes: The standard error for each coefficient is listed in the parathesis below. \*\*\*Significant at 1%, \*\*significant at 5%, \*significant at 10%.

### 5.1. Overall Return to Education and Demographic Heterogeneity

The estimate before the independent variable implies that an extra year of education will increase one's yearly income by 6.95 percent on average and rise one's yearly income by 3596.9rmb in 2020, which is lower than the 7.9 percent estimated by previous research in 2009. This decrease in growth rate conforms to the perspective of Fu and Larbi, who believe that the labor market has a higher demand for workers who are capable of high techniques and a contracted demand for workers who only have basic skills. The lower private return to years of education in 2020 corresponds to the



continuously decreasing trend of private return to the fundamental accumulation of human capital. In 2020, male workers and urban workers still enjoy higher nominal wages as well as a larger growth rate. Compared to female employment, male workers have an income growth for one more year of schooling which is 46.5 percent higher, which corresponds to the discrepancy described in previous graphs. The reasons behind this are diverse, probably due to gender discrimination in the labor market, or females tend to work less since they must take care of families.

Meanwhile, the growth of wages for an extra year of schooling for urban workers is 21.7 percent higher than for rural workers. This finding corresponds to the previous result that rural areas suffer from a lower return to education due to the less developed infrastructure and the lack of educational resources. The inequality of private return to education is still concentrated in gender and area. Although the effect of experience on income is negative, its effect is small and can be neglected. Being married also generates a positive effect on one's income, but this research does not further investigate the heterogeneity between different genders. Probably, the positive effect it generates on married males outdoes its negative effect on married females.

## 5.2. Heterogeneity in Returns to Various Degrees

After assigning the sample into different groups based on the highest degree of education they have achieved until 2020, the effect of an extra year of schooling on income is noticeably larger for people who have higher degrees, implying that the level of education is a more pivotal indicator for one's income level. On average, the income growth for an extra year of schooling is largest for people who have a Ph.D. degree and the increase in yearly income is 8.83 higher than illiterate people in percent. For people who have a master's degree, the income growth is 7.37 percent higher. For undergraduates, the income growth is 4.89 higher than illiterate people in percent. All these estimates are statistically significant. In contrast, the returns to an extra year of schooling for people who hold inferior degrees are much lower, especially for people who haven't received an education for more than nine years. The estimate before the interaction term of primary school and years of education is even statistically insignificant.

The private returns to education in absolute value perform a similar pattern. An extra year of schooling is the largest for people who have a Ph.D. degree, increasing their yearly income by 6783.1rmb compared to illiterate people on average. For people with master's degrees, one more year of schooling will rise their yearly income by 5335.8rmb. The relative increase in undergraduates' income is smaller, which is 2288.7rmb. The results of estimation for people who didn't finish nine years of compulsory education are statistically insignificant, meaning that there is almost no difference between their income and the income of illiterates. Previous research either investigate the income growth to an extra year of schooling for all samples or the different return rate for various degrees of education. The result of estimation in this research which classifies samples based on the highest degree of education complements previous literature by providing the respective return to an extra year of schooling for holders of different degrees, and it illustrates the specific yearly return to schooling for each degree of education. The higher return to a higher degree of education makes sense intuitively, otherwise, people have no incentive to pursue higher academic achievement. It also implies that government should create ample opportunities for students to practice their pursuit since previous literature mentions that people are unable to attain a higher degree of education in some circumstances.

## 6. Conclusion

This study focuses on the private return to education in China. It finds that the overall return to one year of schooling is 6.95 percent in China. Female and rural workers suffer from a much lower return



compared to male and urban residents. Also, this research discovered that people with higher degrees of education have a higher return on an extra year of schooling. Besides the contribution, this research still has several limitations. First, the sample size is still not large enough, which makes the result to be less representative. Especially for people who have a master's degree or above, the number of them is scarce: there are only 7 people who have achieved Ph.D. Second, the income used in this research is in its nominal value, which can't reflect the trend of real growth in one's purchasing power from 2010 to 2020. Finally, the results received in this research still suffer from the bias of missing variables since it is hard to quantify and eliminate the effect of innate ability on one's wage rate. And the individual selection of whether to attend work isn't randomly decided as the OLS estimator assumes. For example, people with higher education levels are more willing to work due to the high wage rate. How to alleviate these bias needs further investigation.

Given the limitations in this study, future research can make more effort in the data collection and gathering more statistics to undergird the credibility of the estimate. Scholars may also take into consideration of the consumer price index when calculating income growth, pay more attention to the public return to education by coming up with a method to quantify it, and delve deeply into the cause of the current pattern of return to education.

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