

College Hierarchy and Market Returns: Evidence from CFPS2010 Adult Data

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Abstract: As higher education expands, it is what types of colleges people are enrolled rather than whether people are enrolled by colleges that is becoming increasingly important to market returns. Using the adult data from the 2010 Chinese Household Panel Survey and basing on OLS regression model, the paper analyzes the variation of market returns of the laborers who graduated from 'Project 211' colleges and those who did not graduate from 'Project 211' colleges. The results show that the types of colleges have a significant impact on laborer's market returns, even after controlling for individual ability. Although the estimated coefficient based on PSM is slightly smaller than the coefficient based on OLS regression results, it is still significant. In addition, the paper finds that non-cognitive ability rather than intelligence has a significant impact on college-educated laborer's market returns.

Keywords: College Hierarchy; Non-cognitive Ability; Intelligence; Market Returns.

1. Introduction

Since the 1990s, both the number of colleges in China and the number of college students in China have increased significantly. According to the data from China's National Bureau of Statistics, from 1992 to 2017, the number of colleges in China increased from 1,053 to 2,631, an increase of 149.86%, while the number of college students in China soared from 2,184,000 in 1992 to 27,536,000 in 2017, the absolute number has expanded by more than 25 million [1][2][3][4]. The gross enrollment rate of higher education had reached 45.7% [5] in 2017, which is very close to Martin (1973)'s classification standard for the universalization of higher education - 50% [6].

With the increasing popularity of higher education, the marginal income and social reputation brought by attending colleges are decreasing gradually. Therefore, according to Lucas' theory, families from the dominant class turn to send their children to higher-quality schools; it is not just because they expect their children's earning higher vocational income, but also expect their maintaining their comparative advantageous social position [7]. In China, considering people's pursuit of benefits from more dimensions such as economic income, family prestige and so on, when they can't be effectively achieved by attending ordinary colleges, not only the advantageous class, but also working and peasant classes strongly expect their children to attend a better university.

Therefore, with the increase of laborers with a college degree, it is the influence of what type of college people are enrolled rather than whether people are enrolled by colleges that is becoming more important. However, the current research mainly focuses on the impact of family background on educational hierarchy [8][9][10][11] and the impact of whether people are enrolled by colleges on market returns [12][13][14] while the research about microeconomic consequences of college hierarchy is quite little. Basing on the reasons mentioned above, the paper will specifically analyze the variation of market returns for laborers graduating from different types of colleges.

2. Literature Review

At present, there are two main types of research focusing on the influence of college hierarchy on market returns. The first type generally treats higher education as a continuous variable, which is mostly taken by foreign scholars. They use indicators such as teacher salary, SAT score and repetition ratio of freshmen [15][16] or SAT, college tuition fees and loans, average salary of professors, student-teacher ratio and postgraduate ratio of freshmen [17][18] to measure the quality of higher education, in order to analyze the influence of college hierarchy on market returns. Although the data analyzed by researchers comes from different sources, it is generally found that the quality of higher education has a significant impact on market return. The second type treats higher education as a classification variable, for example, Zhong treats the respondents' five-categories evaluation to colleges as indicators to determine whether they have attended a high-quality college [19]. Lingli Xu and Chunrong Ai use the rank of government sector to measure quality of higher education, in order to estimate the impact of education quality on market return, the study found that colleges affiliated to higher administrative rank or had higher self-assessment marks have higher market returns [20].

Therefore, no matter what method is adopted, scholars at home or abroad generally find that graduating from high-quality colleges is conducive to improving market returns. However, both the two kinds of studies mentioned above have failed to solve two problems when analyzing the return of college hierarchy. First, whether college hierarchy has been effectively measured. Previous studies have taken different indicators due to personal research preferences and data availability. However, no conclusion has been given on which indicator is more effective. Second, how to avoid people's selectivity in choosing a college. Obviously, people enter different types of colleges that are not random. If they fail to overcome this problem, it will lead to biased results. Among the questions mentioned above, the result deviation caused by the individual's ability is more important. Previous studies use methods such as Propensity Score Matching (PSM),

Heckman Selection Model (HSM) and Instructive Variable (IV) to overcome it. However, in the case of failing to control or avoid the influence of individual ability, it is doubtful whether these methods are effective.

Unlike many other countries, the educational stratification is formed naturally in the long-term evolution. Colleges hierarchy of China is generally established by government. In fact, the hierarchy of Chinese colleges is a classification difference rather than a continuous difference. Among various categories, the classification basing on whether a university are selected into 'Project 211' formed by China Education Ministry is generally accepted by enterprise, colleges and society. Therefore, we believe that it is more effective and credible to measure college hierarchy basing on whether the interviewee graduated from 'Project 211' colleges than other indicators. In addition, when existing studies control the interference of the individual's ability to analyze, they usually take parent's education level or mathematics/word level to represent individual's ability. However, parental education is also affected by many factors and therefore it is not a good instructive variable; meantime, individual's ability is a multi-dimensional variable containing cognitive ability and personality traits, so if researchers just had taken individual's mathematical/word level to control the influence of ability, and even they had taken advanced model such as PSM or HSM, sample selectivity still cannot be solved well.

Basing on this, the paper will use more reliable data and credible measurement methods to analyze the impact of college hierarchy on market returns. We will take PSM to answer our research question under the condition of using more accurate measurement to capture individual capabilities.

3. Theoretical Analysis and Research Assumptions

Scholars have been arguing about whether education has improved people's productive capacity or it's just a sheepskin. Human capital theory holds that education directly improves people's productive capacity by enhancing people's cognitive and execute ability and developing a more positive psychological state[21][22][23]. While screening theory doesn't agree with that, and argues that people's productive capacity is innate and education does not improve it in any way. Diplomas is used to determine the wages of employees not because diploma is equal to productivity, but because employers cannot directly observe their actual productivity in the early stage of employment, and therefore they have to take a cheap and easily recognized symbol to predict the productivity of laborers that is just diploma. However, after employees have undertaken a post for a while, employers can determine their wages by directly observing their actual productivity without relying on their educational diploma, and the signaling role of diploma will lose. Therefore, in the opinion of screening theory, education only plays the role of screening productive capacity of laborers rather than improving laborers' productive capacity[24][25].

Since 'Outline for China's Education Reform and Development' proposed to establish the 'Project 211' in 1993, the colleges selected into 'Project 211' have not only received strong financial support from government, but also gained higher social reputation, thus attracting a large number of excellent teachers and brilliant students. This has widened the

gap between 'Project 211' colleges and other colleges in a series of aspects, such as educational fund, academic communication, academic achievement and professor ratio. Therefore, according to human capital theory, laborers who graduated from 'Project 211' colleges will receive higher human capital and thus obtain higher market returns due to the higher quality of education. On the contrary, from the perspective of screening theory, 'Project 211' college is just a sheepskin, and it is not people's failing to attend '211-Project' colleges but people's innate ability that leads to the gap in human capital among laborers. Basing on this, the paper puts forward the following competitive assumptions:

Assumption 1: The market return of laborers who graduated from 'Project 211' colleges is significantly higher than that of laborers who graduated from non-'Project 211' colleges.

Assumption 2: Whether to graduate from 'Project 211' college has no impact on the market returns of laborers.

4. Data, Variables and Methods

4.1. Data

The data are from 2010 China Family Panel Studies (CFPS) implemented by Social Science Research Center of Peking University. The survey took a multi-stage, implicitly stratified and proportional sampling method proportional to the size of the population to extract a sample of 19986 households from 649 villages of 162 counties of 25 provinces in China. The first survey in 2010 visited to 14,960 families, and defined 57,155 genetic members, including 33,600 adults aged 16 and above, and 8,990 children aged 15 and under [26]. Our sample comes from the adult database. In the paper, our goal totality are laborers who got a bachelor's degree in 1993 and after. We define 1993 as the time boundary is because labor market system of college graduates and 'Project 211' were both established in 1993. After removing the noise data and missing values, the effective sample size is 592.

4.2. Variable

The dependent variable of the paper is market return, excluding transfer income and wealth income, and we take monthly average of annual income to measure it. The independent variable is college hierarchy. The question in the original questionnaire is 'Which school are you studying for undergraduate'. The CFPS2010 project team divides all colleges into national key-colleges ('Project 211' colleges), ordinary-key-colleges, ordinary colleges, military colleges, online-education colleges and so on. We code the 'Project 211' colleges as 1, and the others are 0.

The main control variables are ability, including cognitive ability and non-cognitive ability [27]. Among them, we take 7-level evaluation of the interviewee's intelligence to measure their cognitive ability; and following the methods of Guoying Huang and Yu Xie, we take average value of the interviewee's mark in the abilities of interacting with people, interesting in the survey, doubting to the survey and credibility of the answer to measure non-cognitive ability [28].

Other control variables include age, household registration, father's occupation, etc. The specific operating process of variables is shown in Table 1, and the descriptive statistics of variables are shown in Table 2.

Table 1. Definition and measurement of variables

Variable		Define and code	
Dependent variable	Market returns	Annual income/12 months, then logarithmic	
Independent variable	College hierarchy	'Project 211' college = 1, otherwise 0	
Control variable	Age		
	Age squared	The square of age	
	gender	Male=1, Female=0	
	Household registration	Non-agricultural hukou = 1, agricultural hukou = 0	
	Ability	Cognitive ability	Ordered variable: 1-7. 7 is the highest level, measured by the level of intelligence.
		Non-cognitive ability	Ordered variable: 1-7. 7 is the highest level. Four indicators were averaged: abilities of interacting with people, interest in the survey, doubts to the survey and credibility of the answer
	Number of siblings	Number of siblings	
	Cohort effect	Categorical variables, with entering labour market between 1993 and 1998 as reference variable.	
	Enter labour market between 1993 and 1998	is =1, otherwise 0	
	Enter labour market between 1999 and 2004	is =1, otherwise 0	
	Entr labour market between 2005 and 2010	is =1, otherwise 0	
	The maximum years of parents' education	Convert academic qualifications into years of education	
	Fatherhood occupation	Categorical variable: with producer or operator as reference variable	
	Producer and operator	is =1, otherwise 0	
	Head of company	is =1, otherwise 0	
	Professional technicians	is =1, otherwise 0	
	Clerical staff	is =1, otherwise 0	
	Other	is =1, otherwise 0	
	Employment area	Categorical variables, with western region as the reference variable	
	Western region	is =1, otherwise 0	
Eastern region	is =1, otherwise 0		
Central region	is =1, otherwise 0		

4.3. Research Method

4.3.1. A Modified Mincer Equation Model

The model applied in the paper is a modified Mincer equation, which adds college hierarchical and a series of control variables to Mincer equation. The final model is as follows:

$$\ln w_i = \alpha_{0i} + \eta_{qi}q_i + \delta_i c_i + \varepsilon_i$$

Among them, w_i represents the monthly wage of laborers, α_{0i} represents the income of laborers before attending colleges; q_i represents college hierarchy, η_{qi} is its coefficient; c_i is a vector representing the control variables (including gender, age, household registration, etc.), the constant terms are incorporated c_i , and δ_i is its coefficient.

4.3.2. Propensity Score Matching Method

In order to avoid the problem of sample selection caused by people's choosing colleges, and to identify the effect of college hierarchy on market returns more accurately, we will

apply PSM to further estimate. the basic logic of the matching method is as follows:

$$ATT = y_i^1(|x_i(\text{highedu}) = 1) - y_i^0(|x_i(\text{highedu}) = 0) [y_i^0(|x_i(\text{highedu}) = 1)]$$

$$ATC = y_i^1(|x_i(\text{highedu}) = 1) [y_i^1(|x_i(\text{highedu}) = 0)] - y_i^0(|x_i(\text{highedu}) = 0)$$

$$ATE = y_i^1 - y_i^0 = 0$$

ATT represents the average effect on the treated group, ATC represents the average effect on the control group, ATE represents the average effect on the whole sample. The blue fonts represent the result in the counterfactual state which is missing data. Because the paper is not to analyze the impact of whether laborers had attended college on the market return, but to analyze the return gaps between the laborers attending 'Project 211' colleges and their partners not attending non-'Project 211' colleges. So, in the final result, the paper just shows ATE.

Table 2. Descriptive statistics of variables

Variable	'Project 211' colleges		Non-'Project 211' colleges		T-test
	Average value	Standard deviation	Average value	Standard deviation	P-value
The logarithm of monthly income	7.966	0.904	7.514	1.003	-4.339
Age	30.755	5.944	31.661	6.859	2.664
The square of age	980.995	394.693	1,049.376	479.938	2.747
Man	0.605	0.491	0.536	0.499	-0.444
Non-agricultural hukou	0.901	0.300	0.905	0.293	-0.729
Number of siblings	1.218	1.426	1.519	1.487	3.943
Intelligence level	6.053	0.879	5.977	0.877	-0.690
Non-cognitive level	4.749	0.754	4.646	0.874	-0.299
Cohort effect					
Enter labour market between 1993 and 1998	0.116	0.321	0.071	0.257	-0.381
Enter labour market between 1999 and 2004	0.253	0.436	0.261	0.440	-1.054
Enter labour market between 2005 and 2010	0.631	0.484	0.668	0.472	1.204
Educational years of parents	10.759	3.765	9.825	3.800	-2.711
Fatherhood occupation					
Productor and operator	0.207	0.406	0.206	0.405	-0.306
Head of company	0.119	0.324	0.150	0.358	0.694
Professional technicians	0.101	0.302	0.109	0.313	0.392
Clerical staff	0.136	0.344	0.142	0.350	0.686
Other	0.437	0.498	0.392	0.489	-1.463
Employment area					
Western area	0.138	0.346	0.143	0.351	2.106
Central area	0.349	0.478	0.407	0.492	2.096
Eastern area	0.513	0.501	0.450	0.498	-3.476
Sample size	153		439		592

(The data in the table has been weighted and the sample size is not weighted)

5. Research Finding

5.1. Regression Analysis

Table 3 shows the effects of college hierarchy on market returns. Model 1 mainly measures the impact of whether or not to attend 'Project 211' universities without controlling individual ability on the labor market. It is found that the market return of laborers who graduated from 'Project 211' colleges is 1.56 times ($e^{0.447}$) that of laborers who graduated from non-'Project 211' colleges. Model 2 directly examines the claims of screening theory that it is inner ability which improves market returns and finds that, after controlling for other variables, for laborers who have earned a bachelor's degree, it is their non-cognitive abilities rather than their intelligence contribute their return advantage. This may be caused by the fact that after the screening of the college entrance examination, people's differences in intelligence have been greatly narrowed, so, for laborers with the same educational level, their self-esteem, perseverance and mental attitude, and other non-cognitive factors have a greater impact on their market returns.

If you just observe Model 1 or Model 2, it seems that the argues of human capital theory and screening theory are both correct, because model 1 shows that attending colleges does improve people's market returns, while model 2 shows that people's ability also have improved people's market returns. So do the two works together, or as the screening theory

argues that only ability works. A better measurement method is to introduce colleges hierarchy and ability into the equation at the same time. As shown in Model 3, after further controlling individual ability, the partial regression coefficient of college hierarchy has decreased, but it is still significant, which shows that people's innate ability does have a significant impact on people's market returns, but this does not deny the important impact of education itself on the improvement of human capital. Compared with innate factors, the schooling is more important, and studying in higher-quality colleges is more effective in improving people's human capital. Therefore, the results here support assumption 1.

5.2. A Re-estimation Basing on PSM

As mentioned above, the estimation results basing on OLS are probably biased. Therefore, the paper continues to apply PSM to compare the market returns of the two groups. As can be seen from the figure below, there is a big difference in the propensity score between the two groups. If it is based on OLS regression, it is likely that there will be a large bias due to sample selectivity. After matching, the difference between the two groups is smaller and the matching effect is better. Figure 1 shows that after matching the two samples, the intervention group and the control group still have sufficient common support areas, and thus meeting the requirements for further analysis.

Table 3. OLS results of college hierarchy affect market returns

Variable	Model 1	Model 2	Model 3
College hierarchy	0.447***		0.438***
	(0.098)		(0.097)
Cognitive abilities		0.084	0.081
		(0.065)	(0.062)
Non-cognitive abilities		0.118*	0.116*
		(0.056)	(0.055)
Age	0.236***	0.251***	0.243***
	(0.053)	(0.053)	(0.051)
The square of age	-0.003***	-0.003***	-0.003***
	(0.001)	(0.001)	(0.001)
Man	0.092	0.092	0.069
	(0.092)	(0.095)	(0.093)
Non-farm hukou	-0.021	-0.066	-0.065
	(0.194)	(0.201)	(0.193)
Number of siblings	-0.001	0.004	0.008
	(0.034)	(0.034)	(0.033)
Cohort effect (entry into the labour market 1994-2004 = 0).			
Entered the labour market from 1994 to 2004	0.193	0.156	0.224
	(0.160)	(0.165)	(0.158)
Entered the labour market from 2005 to 2010	-0.156	-0.199	-0.117
	(0.148)	(0.157)	(0.148)
Maximum number of years of education for parents	0.001	0.006	-0.000
	(0.014)	(0.014)	(0.013)
Father's occupation (Productor and operator = 0)			
Other	0.267*	0.256*	0.287*
	(0.127)	(0.127)	(0.124)
Head of unit	0.030	0.000	0.048
	(0.174)	(0.179)	(0.171)
Professional technicians	-0.046	-0.119	-0.072
	(0.156)	(0.156)	(0.151)
Clerical staff	0.070	-0.015	0.024
	(0.131)	(0.135)	(0.126)
Employment area (West = 0)			
Central region	-0.119	-0.116	-0.109
	(0.159)	(0.160)	(0.153)
Eastern region	0.223	0.221	0.208
	(0.153)	(0.153)	(0.147)
constant	2.810**	1.677	1.689
	(0.922)	(1.042)	(1.006)
Pseudo-R square	0.302	0.291	0.322
Sample size	592	592	592

(Note: The data is weighted according to the sampling probability, and the standard error is adjusted at the county and village levels at the same time. *** P<0.001, ** P<0.01, *P<0.05)

Table 4 shows the estimated results based on PSM. It can be seen from table 4 that the partial regression coefficient obtained basing on the five matching methods is less than the partial regression coefficient value (0.438) of colleges hierarchy in model 3, indicating that OLS regression overestimates the impact of colleges hierarchy. However, the five partial regression coefficients are significant, which shows that even if the individual's gender, family background and work experience, especially the ability are controlled, studying in 'Project 211' colleges still significantly improves people's market returns. Therefore, the results here once again show that the education process itself will improve people's human capital, thus supporting hypothesis 1.

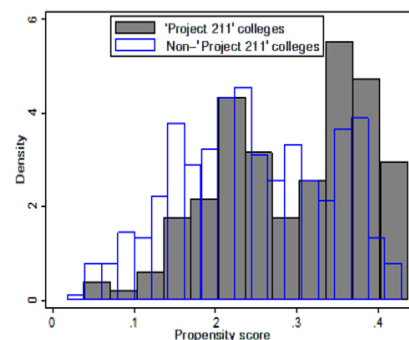


Figure 1. Common support areas of intervention groups and control groups

Table 4. Estimation results of tendency matching

Matching method	Sample size		ATT	
	Control groups	Intervention group	Average value	standard deviation
Neighbor matching (1:3)	439	149	0.297*	0.138
Hierarchical matching	439	149	0.297*	0.124
Nuclear matching	439	149	0.396***	0.097
Radius matching (0.01)	439	149	0.371***	0.104
Radius matching (0.001)	439	129	0.344*	0.170

6. Results and Discussion

The increasingly popular higher education has greatly reduced the marginal economic returns, so people now are more eager to attend 'good' colleges rather than just attend universities after the expansion of colleges enrollment. However, scholars have long been concerned about the impact of attending colleges on market returns, and little attention has been paid to the microeconomic consequences of what kind of colleges people attended.

The paper takes the debate between human capital theory and screening theory as the basis of the research, and thus deduces two competitive assumptions. Using CFPS2010 adult data and basing on OLS regression model, the paper analyzes the impact of colleges hierarchy on labor market returns. It was found that in general, attending 'Project 211' colleges can significantly improve people's market returns, which is similar to the findings of Zhong (2011), Zeyun Liu, Muyuan Qiu(2011), Lingli Xu and Chunrong Ai (2016) [19][20][12]. In order to overcome the problem of sample selection in people's choosing colleges better, the paper applies PSM to carry out further estimates, and the results once again support the discovery of OLS regression results.

In addition, the paper found that for laborers with a bachelor's degree, non-cognitive ability rather than intellectual factors has an important impact on their market returns. This shows that after the screening of the college entrance examination, the cognitive ability of these workers is not very different. On the contrary, non-cognitive ability represented by self-esteem, self-confidence and perseverance is an important factor affecting people's professional income. This enlightens us that in the process of training college students, we should not only pay attention to cultivate college students' logical thinking ability, logical reasoning ability and language expression ability, but also to develop a quality of actively responding to potential risks and setbacks, so as to achieve greater achievements in the future career. In addition, in the three models, age and fatherhood are also very significant, indicating that work experience and the intergenerational and occupation has an important impact on market returns.

The disadvantage of the paper are as follows. First, the self-choice problem has not been overcome totally. Although the paper controls the main confusing variables such as intellectual and non-cognitive ability, the damage to the randomness of the sample is not solved due to the choices in filling out college application (such as being admitted by the first-choice college or the second-choice college). Second, the division of labor force in China has not been taken into account. In fact, different labor market sectors in China (including the public economy, the state-owned/collective economy, and the private economy) have very different

market return mechanisms. For example, the private economy is much more incentive for capable workers than the public sector. However, due to the limitation of the sample size, the paper does not carry out a detailed analysis. We hope to continue to improve the research in future.

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