Returns to education in China: Evidence from urban, rural and migrant workers

—An empirical study based on CHIP2013

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Last but not least, I could not say enough thanks to my dearest parents. Though thousands of miles apart, I am encouraged everyday by their love and support. Without my family, I would never have finished my study.

Thank you all!
Summary

This study analyses empirically the education returns for the urban workers, rural workers and migrant workers in China, using the data from CHIP2013.

Starting from the standard model, this study adds gender, age and province as control variables. OLS estimates are as follow: the rate of returns to education is around 8.5% for urban workers, 1.8% for rural workers, and 2.3% for migrant workers.

This study points out some econometric problems, and mainly aims to solve the endogeneity problem caused by “ability bias”. This study uses two instrumental variables to solve the endogeneity problems: the compulsory education law (1986) and the prohibition of child labor (1991) in China.

Using the compulsory education law as an instrumental variable, the rates of returns to education of urban and migrant workers are 2.7% and 6.8%. Using the prohibition of child labor as instrument variables, the rates of returns to education for urban and migrant workers are 3.4% and 7.6%. The returns to education for rural workers are not significant.

The results appear however to be sensitive to the inclusion of age as a control variable. When age is included as a control variable, whether as a linear term or a fixed effect, both the compulsory education law and the prohibition of child labor are weak instrumental variables, except for rural workers. When age is treated as a linear term, the prohibition of child labor did increase years of education by 0.4 year for rural workers. Using this as IV, the returns to education for rural workers are very small, and not significant at 10% level.

These results give an empirical explanation of the current situation in China: many rural workers claim that it is futile to go to school. And an increasing number of workers have been migrating from rural areas to urban areas to look for a better job.
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1 Introduction

Since the reform and opening up of the economic system in 1978, the Chinese economy has maintained a sustained and stably high-speed growth. The economic situations (in terms of wages and non-wage incomes, foods, living and traffic conditions, health care, culture and entertainment, leisure travel, etc.) of the residents have undergone great improvement. However, along with the rapid economic development, the income gap between urban and rural areas has been always wide (Liu & Cai, 2016; see also Li, Han, & Feng, 2016; etc.).

As a result of unbalanced economic development among regions, job opportunities are better in some urban areas than in rural areas, and some rural inhabitants choose to migrate to urban areas to get higher wages. Those who leave their hometowns and work in other provinces are regarded as migrant workers. Despite the difficulties caused by the household registration system\(^1\), an increasing number of people migrate to urban areas to get a better income. The constraints on labor mobility have been loosened in recent years. Migrant workers now are an important part of the labor force in China, and the share is increasing.

In 2015, for example, we can see that the number of migrant workers has continued to grow. According to the National Survey of Migrant Workers in 2015,\(^2\) the total number of migrant workers in 2015 reaches 277.47 million, an increase of 3.52 million over the previous year. The average age of migrant workers is 38.6 years, many of whom were born after 1980, accounting for 46.6% of all migrant workers. The per capita monthly income of migrant workers is 3072 yuan, an increase of 7.2%\(^2\).

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\(^1\) China has a special household registration system, *hukou* system, which stipulates that one belongs to a certain province or municipality, normally the province in which he/she is born. And the municipality of one’s birth place is responsible for his/her social security, unemployment benefits, health care, education for children, etc., all of which constrain the flow of labor, since, at the moment, there are no nationally unified systems of social security, unemployment benefits, health care and education in China. This, according to some scholars, has caused segregation of labor force (Lin, 2004; Zhang, 2005).

over the previous year. This per capita income far exceeds the figure released by China’s Ministry of Agriculture: the 2015 per capita monthly income in rural areas is short of one thousand yuan. Migrant workers, a large group of labor force, have an important impact on the economic development in both urban and rural areas (Zhou & Chen, 2016). According to National Bureau of Statistics (2007), migrant workers contributed 22.0% of China’s GDP growth.

In this context, it is interesting to study the income differences between urban, rural and migrant workers. The study takes an approach of human capital theory. Human capital theory holds that education will increase productivity, which results in higher wages. Education in China has drawn increasing attention from the government. From 2012 onwards, China has achieved its policy objective of increasing the percentage of its educational investment in GDP to over 4%. China’s spending on education in 2015 is as high as RMB 2.6 trillion yuan, equivalent to USD 0.416 trillion (Ministry of Education of the People’s Republic of China, 2016).

However, against this rapid and substantial growth in education funding, the distribution of public education expenditures is quite unequal. For a long time, there has existed a huge difference between urban and rural areas in education investment. In rural China, there has been a sustained lack of teaching resources and facilities (Wang, 2003). This status may lead to significant differences in the increase of productivity from education. In fact, we often hear that to receive education is futile, especially in rural areas (Hao, 2009; see also Wang & Zhao, 2011). Research on the rates of returns to education in urban and rural areas can resort to the human capital theory to interpret these phenomena.

There is a large number of studies which have focused on the rate of returns to education of urban workers or rural workers, and on the difference between the two

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3 For example, in 2013, the average government expenditure for a student in Beijing is RMB 28668 yuan for the period of basic education, while in Henan Province it is only 5458 yuan, and Guizhou Province 6872 yuan: the gap is about 5 times (China Rural Education Development Institute, 2016).
(see for example Li & Ding, 2003 and Li & Heckman, 2004). But so far, limited studies focus on migrant workers and the differences between migrant workers and urban and rural workers. The author believes that migrant workers are worth studying as they represent the floating of labor force in China.

This study conducts an empirical analysis on urban, rural and migrant workers in China, and uses the compulsory education law (1986) and the prohibition of child labor (1991) as instrumental variables (IV) to overcome the endogeneity problem in estimating the rates of returns to education.

The compulsory education law that was implemented in China in 1986 demands that children, when they reach six years old, must undergo nine years of compulsory education. Before this law, the education system in China was devastated by the Cultural Revolution (1966-1976), and had no official requirement for a minimum number of years of education. This law would in theory increase the years of education to minimum nine years, and people who are affected by this law are on average same in abilities as people who are not affected by this law.

The prohibition of child labor was implemented in 1991, which forbids the employment of child labor—those who are under 16. From the compulsory education law, I find that the minimum legal age to leave school is 15. One gap year appears between the completion of compulsory education and the age at which one could be legally employed. One possible choice for this year would be to get more education. Therefore, this law might result in an increase in years of education. And I can justifiably assume that people who are affected by the prohibition of child labor are basically the same in abilities as people who are not. These features make the compulsory education law and the prohibition of child labor suitable instrumental variables for this study.

This study aims to estimate the rates of returns to education among urban workers, rural workers and migrant workers in China. Based on the findings, I can hopefully
find out how much education contributes to income and understand individual’s choice of education. At the same time, this study utilizes the latest published Chinese household income survey data to update the current studies on the rates of returns to education.

1.1 Education system in China

Before I discuss the rate of returns to education, I shall give a short introduction of China’s education system, the major levels and categories of which are shown in Figure 1.

![China's education system](image)

Figure 1 China’s education system of major levels and categories

China’s education system consists of three parts: elementary education (compulsory education), secondary education and higher education. Elementary education includes primary school and junior high school. China’s compulsory education law\(^4\) stipulates

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\(^4\) This paper employs the compulsory education law as an instrumental variable, so the compulsory education law will be introduced in detail in Chapter 4.
that children at the age of six\textsuperscript{5} shall go to school to accept nine years of compulsory education.

For an education in primary school, there have been two systems: 5 or 6 years - different areas implement different systems. This practice has resulted mainly from the economic status of different areas in the early years and now the primary education of 6 years is predominant (Liu, 2017; see also Xu, 2012).

After graduating from primary school, children go to a junior high school: 3 years for the students who have received a primary schooling of 6 years and 4 years for those who have received a 5-year primary schooling. No matter what kind of system of primary schooling, when it is summed with the junior high schooling, it should be 9 years.

Nowadays, schools in China are divided into private schools and public schools. The vast majority of students attend public schools. Education is free at the stage of compulsory education in public schools.\textsuperscript{6} Students do not need to take examination to get enrolled. Which school a child goes to is based on where he lives, often the closest school to one’s home in the neighborhood. When there is more than one school in the neighborhood, the choice of school is randomly decided by a lottery system, to avoid selection of schools.

All levels of education, public and private, after compulsory education, are not free and an entrance examination is required. The junior high school graduates have three education options: senior middle school, vocational senior secondary school, and specialized secondary school. Senior middle school education demands for 3 years, focusing on the instillation of academic knowledge and preparing students, upon

\textsuperscript{5} The age is determined by the fact that, on September 1, usually also the date of enrollment, a child reaches the age of six.

\textsuperscript{6} Tuition has been free at the stage of compulsory education since the implementation of the compulsory education law, but there were out-of-pocket expenditures (for textbooks, registration fees, etc.) for a long time. Such expenditures were not a small burden for rural families. With the development of economy, Chinese government decided to cancel, from 2007, all these expenditures and, therefore, the compulsory education is now completely free of charge.
graduation, for participating in college entrance examination. Vocational senior second school is at the same level as a senior middle school, but the former is more technology- and profession-oriented, less demanding on the theoretical knowledge. Specialized secondary school requires a period of two years, attaching more importance to professional skills training. Education in a vocational senior secondary school and specialized secondary school is usually referred to as secondary vocational education.

After graduating from a senior middle school, most of the students will sit for the college entrance examination, which is regarded as the most important examination in the whole education system. Students are admitted to universities/colleges according to their scores.

Higher education is divided into university/college and polytechnic college education. Education in university/college generally takes 4 years, and there are some majors that need 5 years, such as medicine and engineering. After you have obtained a bachelor’s degree, you can further pursue a master’s degree or doctor’s degree. Generally, programs for master’s degree last for 3 years, and for doctor’s degree, 5 years.

Polytechnic colleges provide a higher vocational education, which takes a period of three years. The teaching here focuses on practicality of the knowledge and professional skills and techniques. Graduates are equipped with an education of vocational knowledge and vocational skills according to the requirements of targeted professions and positions.

Generally speaking, academic education is preferred to vocational education in China (Wang, 2006; see also Wang, 2012).
2 Literature Review

A summary of the main findings of the studies in China on the rate of returns to the education of urban, rural and migrant workers is shown in Table 1.

Table 1 Major Findings of Studies on the Returns to Education in China

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Year</th>
<th>Scope</th>
<th>Database</th>
<th>Returns to education</th>
<th>Control variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Johnson &amp; Chow</td>
<td>1997</td>
<td>Urban, rural</td>
<td>CHIP1988</td>
<td>4.01% (rural), 3.29% (urban)</td>
<td>Gender, party members, ethnicity</td>
</tr>
<tr>
<td>Li &amp; Ding</td>
<td>2003</td>
<td>Urban</td>
<td>CHIP1990-1999</td>
<td>1.2% (1990), 4.8% (1999)</td>
<td>Gender, party membership, corporate ownership, region</td>
</tr>
<tr>
<td>Luo</td>
<td>2007</td>
<td>Urban</td>
<td>CHIP2002</td>
<td>6.80%</td>
<td>Gender, party membership, parent background, working background, province</td>
</tr>
<tr>
<td>Qian &amp; Yi</td>
<td>2009</td>
<td>National</td>
<td>CHNS1999-2006</td>
<td>7.94% (1999), 6.4% (2006)</td>
<td>Gender, province, working background</td>
</tr>
<tr>
<td>Zhou et al.</td>
<td>2010</td>
<td>Rural</td>
<td>Survey (2008)</td>
<td>9.00%</td>
<td>Gender, family background</td>
</tr>
<tr>
<td>Zhang</td>
<td>2012</td>
<td>Urban, rural</td>
<td>CHIP2002</td>
<td>9.37% (urban), 6.28% (rural)</td>
<td>Gender, parental income, ability proxy variable, working background</td>
</tr>
<tr>
<td>Zhang &amp; Lin</td>
<td>2014</td>
<td>Migrant</td>
<td>Survey (2008)</td>
<td>5.38%</td>
<td>Gender, ability proxy variable, marriage, region, working background</td>
</tr>
<tr>
<td>Hu et al.</td>
<td>2014</td>
<td>National</td>
<td>CHNS2006</td>
<td>9.96%</td>
<td>Gender, household registration, industry</td>
</tr>
<tr>
<td>Li &amp; Luo</td>
<td>2004</td>
<td>Urban</td>
<td>CHIP1996</td>
<td>OLS 15.3%, IV 15.0%</td>
<td>Gender, age, ethnicity</td>
</tr>
<tr>
<td>Li &amp; Heckman</td>
<td>2004</td>
<td>Urban</td>
<td>Survey (2000)</td>
<td>OLS 7.25%, IV 14%</td>
<td>Gender, province, working background, parental income</td>
</tr>
<tr>
<td>Meng &amp; Gregory</td>
<td>2007</td>
<td>Urban, rural</td>
<td>IDS, UBIES1995-2002</td>
<td>OLS 5.9%, IV 7.8%</td>
<td>Gender, province, age</td>
</tr>
<tr>
<td>Fang et al.</td>
<td>2012</td>
<td>Urban, rural</td>
<td>CHNS1997-2006</td>
<td>OLS 9%, IV 20%</td>
<td>Gender, age, ethnicity, marriage, health, province</td>
</tr>
<tr>
<td>Mishra &amp; Smyth</td>
<td>2015</td>
<td>Urban</td>
<td>CHFS2012</td>
<td>OLS 7.43%, IV 25.7%</td>
<td>Gender, marriage, party membership, household registration, company status</td>
</tr>
</tbody>
</table>

Note: If there is no special indication, education returns rate in the table is the result of OLS regression.

Source: The table is prepared by the author of this paper according to the papers by the researchers listed in the table. For the detailed literature, see the References at the end of this paper.

Most researches on the returns to education in China have focused on the urban workers; and a few studies looked into rural and migrant workers. The most commonly used micro-dataset for the researches is that of the Chinese Household Income Project (CHIP). In addition, the China Health and Nutrition Survey (CHNS) and China’s Urban Household Income and Expenditure Survey (CUHIES) have also been used by some scholars in their studies.
A lot of studies used OLS estimation. These OLS results show that the returns to education in China have increased over time. Johnson and Chow (1997) found that China’s rate of returns to education in 1988 was 3.29% in urban areas and 4.02% in rural areas, far below the world averages. The nineties of the 20th century witnessed a tremendous improvement in returns to education in China, as China started to transform from a planned economy to a market economy.7 Li and Ding (2003) found that the rate of returns to education rose from 1.2% in 1990 to 4.8% in 1999. This increasing trend along with the passage of time has also been verified by other scholars. Chen and Hu (2013) used CHIP1988-2007 data to study the changes in returns to education over time. The study found that the rates were 2.6% in 1988, 2.9% in 1995 and 5.4% in 2002, up further to 5.8% in 2007. The authors attributed this to the outcome of economic reform. Yao, Fang and Zhang (2013) found that the rate of returns to education increased from 3.6% in 1998 to 7.0% in 2002. A recent study by Mishra and Smyth (2015) showed that the rate was around 7% in 2012.

From the above research results, I can summarize that the returns to education in urban China increased over time. However, different studies have yielded different rates of returns to education. This might be caused by data sources and different control variables. In the studies on China, most of the studies have added gender and province dummy variables. Besides, some control variables with Chinese characteristics were adopted, such as party membership and hukou (household registration) status. Some scholars also included employment background (industry, occupation, title, ownership of the firm). In addition, some studies added ethnicity control variables (Johnson & Chow, 1997; Li & Luo, 2004; Fang et al., 2012; etc.). The regression results showed that the ethnicity did not play a significant role in the rate of returns to education, which is consistent with the results of a study in China (Meng, Su, & Lai, 2007): no significant difference between the rates of returns to

7 Before the reform of China’s economy, workers rarely had the freedom and opportunities to choose and change the jobs and the sector of the industry. Many jobs were allocated to the urban dwellers by the state. And wages were also determined by the state.
education of the ethnic minorities and of the ethnic majority in China. This indicates that including ethnicity might also be unnecessary.

Age, on the other hand, is often not included as a control variable, which might cause biased results, as people born in different years are likely be influenced by the era, both in income and education.\(^8\) In the researches that have included age control variables (e.g., Li & Luo, 2004; Fang et al., 2012), age is treated as a linear term, that is, assuming that the effect of each year is the same. Meanwhile similar studies on other countries (such as Trostel et al., 2002) mostly have treated age as a fixed effect in the model, that is, assuming people born in each year have specific characteristics of the era. The empirical analysis in this paper will show the results of controlling age as a linear term and as a fixed effect.

In addition to studying urban areas, scholars have paid attention to the rates of returns to education for rural and migrant workers. Zhang (2012) found that the rates of returns to education were 9.37% for urban, and 6.28% for rural. Tan, Yu and Li (2017) found that the returns to education of migrant workers was significantly lower than that of urban migrants by 3.12%, which, as they explained, resulted from the segmentation and differentiation in labor market.

One problem with OLS estimation is caused by “ability bias” (Card, 1999). Income differences between individuals with different levels of education are partly due to education and partly due to differences in abilities. Education is not exogenous and this causes endogeneity problem in OLS estimation.

Many scholars have used different approaches to solve this problem. Twin study, for example, is one approach. Twins are assumed to have same abilities as they have the same genes. The problem caused by “ability bias” could be avoided by comparing the wage differences between twins who have different years of schooling. Sun (2014) used 457 identical twin data (containing one case of triplets) and found that the rate of

\(^8\) For detailed explanation, see 4.1.
returns to education was 4%, much lower than OLS estimate 14%. Li et al. (2007) used identical twin data in five cities, and found that the rate of returns to education fell from 8.4% (OLS estimate) to 2.7%. They held that this low rate of returns reflected the inefficiency of China’s education system. In OLS estimation, a large degree of returns to education reflected the ability rather than the actual improvement in productivity.

Another way to solve endogeneity problems is the instrumental variable (IV) method. Li and Heckman (2004) believed that parents’ education level and parental income affect the probability of entering university, and used these as instrumental variables. But this practice has in recent years received a lot of criticism, as it likely violates the exogeneity condition for instrumental variable.

Meng and Gregory (2007) employed the events of the Cultural Revolution (1966-1976) as an instrumental variable. The Cultural Revolution is a disastrous historical event in China which had a significant impact on education. People were involved in intensive political parades to protests, and the education system was basically paralyzed (Hou, 1998). People born in this era were similar in abilities as people born in another period of time, but they were unfortunately forced to drop out of school. In general, between 1966 and 1976, the education level was significantly reduced. This enables us to compare two groups of workers of same abilities. These researchers used the dummy variable of the population born between 1946 and 1962 as an instrumental variable. Based on the 1995 to 2002 Household Income Distribution Surveys (IDS) and the Urban Household Income and Expenditure Survey (UHIES) data, this research obtained the rates of returns to education that were between 7.6-7.8% (IV estimate), while the OLS estimate was 5.4-5.9%.

Fang et al. (2012) employed the implementation of the compulsory education law as an instrumental variable. The law, which was implemented in 1986, stipulates for the

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9 Released in 1986 by the central government. Actual enactive dates in each province are different, see detailed discussion in 4.3.
first time that children who reach the age of six must undergo nine years of compulsory education. Before the law, education system was devastated by the Cultural Revolution, and there was no regulation on years of education. It is expected that years of education would increase after the implementation of the compulsory education law. Therefore, this paper can compare two groups of people who are identical in abilities but different in years of education. This study shows that the IV estimate of the returns to education is 20%, much higher than OLS result of 9%.

There are very few studies on migrant workers, especially the one which aims to solve the endogeneity problem caused by “ability bias”. One study by Zhang and Lin (2014) used test scores in middle school as ability proxy variable in OLS regression, and found the rate of returns to education for migrant workers was 5.38%. However, I believe that this approach might not actually solve the problem, as test score can hardly represent general ability, especially in China. Cui et al. (2013) used geographical (origin of migrant workers) and health status as instrumental variables. They claimed that these variables were related with education, but in fact, these variables likely have a direct effect on wages. This approach is therefore problematic.

This study aims to contribute to the literature by: (1) providing updated results on the recent returns to education in China; (2) providing a comparison between urban, rural and migrant workers; and (3) employing suitable instrumental variables to solve the endogeneity problem caused by “ability bias.”

\[^{10}\text{For detailed explanation, see 4.2.2.}\]
3 Human Capital Theory

3.1 Human capital theory

In human capital theory, the abilities and skills of a worker are regarded as human capital. Different workers have different abilities and skills, which enable them to cope with different jobs. The wages of a worker depend partly on his abilities and skills. Education and training are believed to be investments in human capital, which will result in higher productivity. After education, people become more productive, and therefore are capable of performing more demanding jobs, which yield higher incomes.

Education is seen as an investment, same as other financial investments, and whether people invest in human capital depends on whether the investment is profitable, which depends on the cost and expected returns (see Borjas & Van Ours, 2000, pp. 235-281). Education cost consists of two parts. One part is the direct cost, that is, cost incurred by books, tuition, and other miscellaneous expenses. On the other hand, there is the opportunity cost: when individuals receive education, they cannot participate in full-time work, and therefore they cannot get wages.

The returns of education are reflected in the increase in income after the completion of education. Companies will pay higher wages for higher educated people. This must hold as it is obvious that if the higher the education level the lower the income, no one will ever choose to be more educated. Also, the magnitude of the increase in wages declines with the increase in years of education. This was pointed out by Psacharopoulos (1985): human capital accumulation has diminishing returns. Higher education has a lower marginal rate of returns.

Whether an individual would take an education or not depends on the present value of his lifetime earnings, which is determined by the wages (before and after education), the cost of education and the discount rate. When taking education yields a higher
present value of lifetime earnings than not taking education, the investment on education is profitable, which means that the individual should take the education. The percentage change in wages resulting from one more year of schooling is referred to as marginal rate of returns to education. When the rate of returns to education is high, people tend to choose more years of education, and a higher discount rate is associated with the choice of fewer years of education. The optimal choice of years of education occurs when the marginal rate of returns to education is equal to the discount rate (see, e.g., Willis, 1986).

Human capital theory provides a perspective that education is an investment in human capital, which will result in an increase in productivity. Therefore, it is interesting to estimate how much wages would increase when people have more education, that is, how profitable it is to investigate in education. Using wages after logarithm as the dependent variable and years of education as the independent variable and including control variables, for example, gender, age and ethnics, the coefficient of years of education is the rate of returns to education: the percentage change in wages associated with one more year of education. A lot of empirical studies (see for example, Becker & Chiswick, 1966; Mincer, 1974; Hanoch, 1967) used this approach to estimate the returns to education. In China, relevant studies were done by, among others, Li and Ding (2003), Qian and Yi (2009) and Yao et al. (2013).

### 3.2 Signaling theory

According to human capital theory, education increases productivity, and the higher the productivity the higher wages. In contrast, Arrow (1973), Spence (1973) and Stiglitz (1975) suggested that the role of education in an information asymmetric market is mainly filtering, screening and signaling.

In the job market with asymmetric information, employers observe the education attainments of job seekers rather than the abilities of job seekers. Such attainments represent, in the eyes of the employers, the levels of ability of those employees. The
education attainments may not improve the productivity of the individuals at all, but they do send a signal in the job market to prove that the specific person has a high ability to take on a high-income job.

Many studies have shown the “sheepskin” effect of education (e.g., Jaeger & Page, 1996): When years of education reach certain values, the rate of returns to education will increase significantly. For example, an individual who received a college diploma after 16 years of school education had a much higher rate of returns in the last year than the rate of returns for other years.

If the role of education were to increase productivity solely, there should not be such increase for years of receiving degree. As a matter of fact, diploma is often a stepping stone for a high-paying job. In a separating equilibrium, low ability workers voluntarily choose less education, signaling their low productivity. High ability workers choose more education to separate themselves from the pack.

Signaling theory provides a different point of view to human capital theory. Empirical studies have been conducted to find the exact role of education, for example, studies by Lang and Kropp (1986), Kroch and Sjoblom (1994), Bedard (2001), Spence (1973), Arrow (1973), Stiglitz (1975), Jaeger and Page (1996), and others.
4 Empirical Analysis

4.1 OLS regression

The empirical analysis in this paper begins with the simplest model:

$$lny_i = \beta_0 + \beta_1 edu_i + u_i$$ (1)

$y_i$ is the income of individual $i$, $edu_i$ is years of education of individual $i$. This model is referred to as model (1) in Chapter 5 Empirical Results.

This model, however, merely shows a correlation between years of education and income. There are so many other factors that affect wages. According to Gauss-Markov theorem (see Jeffrey, 2009, p.104), if variables are not related to education, omitting these variables does not affect the estimate of the rate of returns to education. But if a variable is related to education, not including this variable will make the estimated returns to education biased and inconsistent.

In China, most studies included gender and province as control variables. Some studies included employment background (industry, occupation, position, ownership of the company, etc.), party membership, etc., see Chapter 2 for literature review. Another variable age is, however, seldom included in the studies estimating the returns to education in China.

With a reference to the literature, I improve the model in the following ways:

First, I add gender as a dummy variable, gender =1 if the individual is a female. Due to regional disparities in China, province fixed effects are also included. A set of province dummies is created for all provinces, $province_n = 1$ if an individual belongs to $province_n$. This model is referred to as model (2) in the following analysis.
In addition, I believe that age is also an important control variable (see for example, Trostel et al., 2002). Age, determined by birth year, is related with social and economic background, which changes greatly over time. Over the past decades, China has undergone a rapid economic development. The characteristics of era are likely to have an impact on individual’s income and their choice of education. Out of this consideration, I believe that it is necessary to include age.

There are two ways of including age as a control variable. The first approach is to treat age as a linear term (e.g., Li & Luo, 2004; Fang et al., 2012), that is, assuming that the effect of each year is the same. I add age as a linear term in model (2), and this model is referred to as model (3) in the following analysis.

The second approach is to include age as a fix effect (such as Trostel et al., 2002), that is, assuming people born in each year have specific characteristics of the era. By including age as a fixed effect, the impact of era on income and years of education can be separated from the returns to education. Based on model (2), I include a set of age dummies for all ages, $age_{x} = 1$ if the individual is of $age_{x}$. This model is referred to as model (4) in the following analysis.

As discussed in literature review, other variables such as employment background (corporate ownership, industry, occupation, and so on), ethnics, marriage status, etc., are not included in this study. As these variables, even though they affect wages, do not affect individual’s choice of years of education (in China), therefore they will not cause omitted variable problem.

### 4.2 Endogeneity problem

#### 4.2.1 Measurement error
Measurement error occurs when we do not observe the true value of the variables. In this study, the dataset that I use is survey data. Measurement errors might occur in both the explanatory variables and the explained variables.

Measurement errors in wages may come from the following sources. For example, in this study, the hourly wages are calculated from annual income divided by total working hours, which are calculated from average working hours per day times average working days per month times total working months. As we can imagine, it is hard for people to have an absolutely clear and correct memory on these details. The answers which they give are likely to be a rough estimate. Also, some respondents may have misreported their income and working hours.

The explanatory variable education is measured in the years of schooling and the highest education attainment. They are two separate questions, but it might happen that people estimate years of education based on their attainments, such as the number of years of education in primary school education for 6 years, junior middle school education for 9 years, senior middle school education for 12 years, and so on. However, due to the differences in the education systems in terms of years of schooling at each level (e.g., some places implemented a 5-year primary school education, while some other places implemented a 6-year primary school education (Liu et al., 2017; see also Xu, 2012)), the estimated number of years of education may not coincide with the number of actual years of education of each individual.

These errors in the data can lead to bias in the estimated rate of returns to education.

### 4.2.2 Ability bias

The empirical analysis is based on the assumption that the changes in wages as a result of education are the same for everyone. But in fact this assumption is probably violated. People are different in abilities. People of higher ability accumulate more
human capital from one additional year of education than that of the people of lower ability. People of higher ability have higher marginal rates of returns to education.

When the discount rate is assumed to be same for everyone, according to optimality condition, it can be found that people with higher ability will choose more education to maximize the present value of lifetime income. The difference in income between high-income earners and low-income earners is due partly to the higher level of education of high-income earners and partly to the higher ability of high-income earners.

This causes problems in empirical analysis, as the observed data reveal only the wages and years of schooling of the lower ability workers and the wages and years of schooling of the higher ability workers. People who are able tend to choose higher education, and the higher wages that they get are the result of both education and ability. Those who have lower ability cannot get the same increase of wages even if they were to choose more years of education. In other words, the data on wages and education are contaminated by ability.

Card (1999) first elaborated on this problem, and he referred bias in regression result caused by the difference in ability as “ability bias.” The problem with ability is that it is a more subjective concept and difficult to capture. The estimated effect of education on wages might suffer from the endogeneity problem.

Many scholars have tried different ways to solve this problem. As this study aims to solve the endogeneity problem, I shall look into these methods in detail.

(1) Ability proxy variables

The idea of the ability proxy variable is very straightforward. I can use an observed variable to measure the ability of workers. Some studies (e.g., Griliches, 1977; Griliches & Mason, 1972; Kjellström, 1997; Meghir & Palme, 1999; Blackburn & Neumark, 1993; etc.) used the scores of school performance or IQ tests to represent individual abilities.
It is however unclear whether the observed variable can fully represent the individual’s ability. Especially in China’s examination-oriented education, we often come across graduates with high scores but weak ability, that is, students good at exams are not good at dealing with practical work. Test scores hardly capture actual ability and are therefore not suitable for solving the “ability bias” problem.

(2) Twin study

Another approach to solve the endogeneity problems is to study twins. The idea behind the twin study is that twins share the same genes, which can be interpreted as same ability. Supporters of this research method, such as Ashenfelter and Rouse (1998), argued that the educational differences between twins in the same family were “random.” By conducting twin study on the rate of returns to education, researchers might rule out the ability bias. However, Bound and Solon (1999) argued that twins were different in temperament and ability. It is these differences, though subtle, rather than “random” factors, that probably determine the twins in the different options of education.

Due to limitation in data, twin studies in China are very limited. Two studies were conducted by Li et al. (2007) and Sun (2014). They found that the OLS estimates overestimated the rates of the returns to education in China.

(3) Instrumental variables

A common solution to the endogeneity problem in the OLS regression model is the use of instrumental variables. The two-stage regression model using the instrumental variable is as follows:

First stage: \( education_i = \beta_0 + \beta_1 Z_i + u_i \)  \hspace{1cm} (5)

Second stage: \( \ln y_i = \alpha_0 + \alpha_1 education_i + v_i \)  \hspace{1cm} (6)

The instrument variable \( Z_i \) must satisfy the following conditions (Stock & Waston, 2015, p.421):
1. Instrument relevance condition: \( corr(Z_i, education_i) \neq 0 \) (7)

2. Instrument exogeneity condition: \( corr(Z_i, u_i) = 0 \) (8)

The first condition is the relevance condition, and the second condition is the exogeneity condition. The relevance condition requires that the instrumental variable be related to the explanatory variable. A good instrumental variable should be quite relevant to the explanatory variable in order to use this to explain the change in the explanatory variable (i.e., education in my model). The consistence of this condition can be tested in the first stage regression of the two-stage regression model.

The exogeneity condition implies that the instrumental variable must be independent of the error term and must not have a direct effect on the explained variable. It is difficult to directly test whether this standard has been met or not, because the error term is not observable. If the instrumental variable can satisfy both conditions at the same time, then the result \( \alpha_1 \) by the use of the 2SLS regression will be a consistent estimate, thus solving the endogeneity problem in the OLS model.

In the studies on returns to education, many scholars have used government policies, such as the compulsory education law, as instrumental variable. The law should satisfy the two instrument conditions. For the relevant condition, it is fair to assume that the compulsory education law is likely to increase years of schooling. For the exogeneity condition, it should hold that the law is uncorrelated to the unobserved variables. It is quite obvious that the law is uncorrelated with abilities. However, the exogeneity condition does not necessarily hold. People who are affected by the law are born later than people who are not affected by the law. Age is related with working experience and the characteristics of era, which presumably have impact on income. To make the instrumental variable plausible, age should be in the IV regression as a control variable.

One famous example of using the compulsory education law and the birth month as instrumental variables is by Angrist and Krueger (1991). They noted that there were 20
two very important education policies in the United States: (a) the school enrollment policy, which stipulated that the legal enrollment date was the first of January of each year. To be enrolled, the child had to reach the age of six, and (b) the compulsory education law, which stated that students should be at least 16 years old before they were allowed to leave school and join the labor force.

Therefore, the length of education would be different among people who were born before and after 1 January. For example, the biggest difference occurs between students born on 31 December and on 2 January. They are almost the same in age, but due to the enrollment policy and the compulsory education law, at the legal dropout age of 16, the former one has almost one more year of schooling than the latter one. It is fair to assume that, on average, people who are born earlier in the year are same in abilities as people who are born later in the year.

Similar studies have been carried out in many other countries, for example in the UK and in Sweden:

Harmon and Walker (1995) used the changes in the legal minimum age for leaving school as instrumental variables. In 1947 British education policy increased the minimum age for leaving school from 14 years old to 15 years old, and in 1973, this age was raised to 16 years old. This results in differences in the lengths of education among people of different ages. They used these as instrumental variables, and the IV estimation of rate of returns to education was more than 15%, much higher than the OLS estimate of 6%.

Meghir and Palme (1999) also used changes in the minimum years of schooling as instrumental variables. In 1949, Sweden started the reform of the compulsory education, which increased the minimum years of schooling from 7 or 8 years (depending on municipality) to 9 years. This reform was gradually implemented by municipality and fully implemented in the whole country in 1962. This study focused on the male population born between 1945 and 1955, and used the implementation of
the reform on municipality level as an instrumental variable. Their IV estimate was around 3.6% while the OLS estimate was about 2.8%.

Besides government policies, some other variables were also used as instrumental variables. Such as high school or university distance, see Card (1993); adolescence during the Second World War (Austria and Germany), see Ichino and Winter-Ebmer (1999); etc. Most of these studies are discussed in Card et al. (1999). Some of the earlier studies used family background variables (such as the years of education of parents or spouses) as instrumental variables, for example in China, Li and Heckman (2004). This approach is widely criticized (Bound et al., 1995; Trostel, Walker, & Woolley, 2002; Psacharopoulos & Patrinos, 2004; etc.), as family background is very likely to have a direct impact on the income of the workers, and the exogeneity condition for IV is not satisfied. Therefore, family background should not be used as an instrumental variable.

One of the difficulties in using instrumental variables is that it is not always easy to find such an instrument: such policy might not exist in some countries. Studies in China have used the compulsory education law (Fang et al., 2012) and the Cultural Revolution (Meng et al., 2007).

4.3 IV regression

To deal with the endogeneity problem caused by “ability bias” and measurement error, this study uses the instrumental variable method. I use government policies in China, namely the compulsory education law and the prohibition of child labor, as instrumental variables.

(1) The compulsory education law

The compulsory education law, which was implemented in 1986 (but the specific implementation dates in different provinces are different, see Table 4), provides for
the first time that children, starting from the age of six, must undergo nine years of compulsory education.

**Article 2.** The state shall institute a system of nine years of compulsory education. ...

**Article 5.** All children who have reached the age of six shall enroll in school and receive compulsory education for the prescribed number of years, regardless of gender, ethnicity or race. In areas where that is not possible, the beginning of schooling may be postponed to the age of seven.

**Article 7.** Compulsory education shall be divided into two stages: primary school education and junior middle school education. ...

Children who are under 15 years of age at the time of law enforcement must return to school before they reach the age of 15. Prior to this law, there was no provision for the minimum age of education in China. The implementation of the compulsory education law will in theory make the individual receive more education, while people affected by the law are on average same in abilities as people who are not affected by the law, which enables us to compare two groups of same abilities, thus solving the endogeneity problem caused by ability bias.

Table 2 Actual Effective Dates of the Compulsory Education Law on Provincial Level

<table>
<thead>
<tr>
<th>Province</th>
<th>Effective date</th>
<th>Province</th>
<th>Effective date</th>
<th>Province</th>
<th>Effective date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anhui</td>
<td>1-Sep-87</td>
<td>Henan</td>
<td>1-Oct-86</td>
<td>Shanghai</td>
<td>1-Mar-93</td>
</tr>
<tr>
<td>Beijing</td>
<td>8-Jul-86</td>
<td>Hubei</td>
<td>1-Mar-87</td>
<td>Shaanxi</td>
<td>1-Sep-87</td>
</tr>
<tr>
<td>Chongqin</td>
<td>**</td>
<td>Hunan</td>
<td>1-Sep-91</td>
<td>Shanxi</td>
<td>1-Jul-86</td>
</tr>
</tbody>
</table>

**Footnote:** In China, the central government directly governs 34 provincial administrative regions: 4 municipalities (Beijing, Shanghai, Tianjin, and Chongqing), 23 provinces (including Taiwan), 5 autonomous regions (Neimengu, Ningxia, Xinjiang, Xizang, and Guangxi), and two special administrative regions (Hong Kong, and Macao). The four municipalities: Beijing, Shanghai, Tianjin and Chongqing have the same administrative status as that of a province. In this study, municipalities and autonomous regions are referred to as provinces for simplification.
<table>
<thead>
<tr>
<th>Province</th>
<th>Effective Date</th>
<th>Province</th>
<th>Effective Date</th>
<th>Province</th>
<th>Effective Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fujian</td>
<td>1-Aug-88</td>
<td>Jiangsu</td>
<td>9-Sep-86</td>
<td>Sichuan</td>
<td>1-Jul-86</td>
</tr>
<tr>
<td>Gansu</td>
<td>30-Mar-02</td>
<td>Jiangxi</td>
<td>20-Dec-92</td>
<td>Tianjin</td>
<td>12-Nov-86</td>
</tr>
<tr>
<td>Guangdong</td>
<td>14-Mar-92</td>
<td>Jiling</td>
<td>9-Feb-87</td>
<td>Xinjiang</td>
<td>28-May-88</td>
</tr>
<tr>
<td>Guangxi</td>
<td>1-Sep-91</td>
<td>Liaoning</td>
<td>1-Jul-86</td>
<td>Xizang</td>
<td>1-Jun-08</td>
</tr>
<tr>
<td>Guizhou</td>
<td>1-Jan-88</td>
<td>Neimengu</td>
<td>15-Sep-88</td>
<td>Yunnan</td>
<td>25-Nov-92</td>
</tr>
<tr>
<td>Hainan</td>
<td>16-Dec-91</td>
<td>Ningxia</td>
<td>21-Aug-83</td>
<td>Zhejiang</td>
<td>11-May-88</td>
</tr>
<tr>
<td>Hebei</td>
<td>1-Jul-86</td>
<td>Qinhai</td>
<td>1-Oct-88</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heilongjiang</td>
<td>1-Jul-86</td>
<td>Shandong</td>
<td>12-Sep-86</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: * Excluding Hong Kong, Macau and Taiwan of China. ** Chongqing, once a city of Sichuan Province, was not a municipality directly under the central government before 1997.

Sources: A collection of scattered information and data from the official websites of provinces and municipalities.

In Table 2, the actual effective dates of the implementation of the compulsory education law in each province are listed. I notice that the actual effective dates are widely different among provinces. The reasons are as follows:

First of all, regional disparity has been huge in China, in terms of both economic situations and cultural preferences. Some provinces were quite developed while some other provinces still suffered from poverty and the lack of infrastructure. It is virtually unfeasible to require all regions to adopt the law at the same time. For example, Xizang (Tibet) witnessed underdeveloped infrastructure, and its compulsory education started late: the law came into force in 2008—the last one.\(^{12}\)

Differences in local customs and culture also played an important role. In many rural areas, ideas and practices tinged with son bias are prevalent (such as “girls do not have to go to school”). It takes time to change people’s mentality in these areas. In addition, if all these school-age children go to school, there will be a grave shortage of teachers whose training needs a certain period of time (Liu & Wang, 2016).

This might cause violation to the instrument exogeneity condition, as the actual implementation date of compulsory education law is correlated with the province. And the fact that regional disparities exist among provinces indicates that province is related with people’s income. The compulsory education law does not affect the income entirely through years of education. I avoid this problem by including province fixed effects in my IV regression models. This allows me to control for time invariant differences between provinces.

In the enactment of this law, the National People’s Congress of China (China’s legislature) had a comprehensive understanding of national fundamentals, therefore it provided the provinces and municipalities with the freedom to decide on their dates of implementation of this law.

Article 2. … The authorities of provinces, autonomous peoples, and municipalities directly under the Central government shall decide on measures promote promoting education, in accordance with the degree of economic and cultural development in their own localities.

The central government did not specify which date for the unified implementation of the law all over the country and made no deadline for the enactment of law at the provincial level. Article 2 might have legally supported the local governments in their intentional or unintentional delays in implementation and disregard for the importance of this law.

Moreover, in terms of the financing of compulsory education, the law provides that the local governments are responsible for the implementation of compulsory education, the construction of schools, and part of the financing:
Article 8. Under the leadership of the State Council, local authorities shall assume responsibility for compulsory education, and it shall be administered at different levels. ...

Article 9. Local people’s governments at various levels shall establish primary schools and junior middle schools at such locations that children and adolescents can attend schools near their homes. ...

Article 12. The State Council and the local people’s governments at various levels shall be responsible for raising funds for the operating expenses and capital construction investment needed for the implementation of compulsory education, and the funds must be fully guaranteed. ...

Around 1986, when the law was implemented, China’s fiscal and taxation systems (in terms of the relations and responsibilities of the central and local governments) were undergoing transition and transformation. For example, from 1980 to 1985, there was a separation between the central and local fiscal and taxation systems, and between 1988 and 1993, various forms of contract system were tried in local fiscal system (Jia & Zhao, 2008). Provinces and municipalities needed time to adapt to the new circumstance and to negotiate with the central government, asking for the financial support of the central government to ease the financial pressure on the local governments. The implementation of the law at the provincial level must take into account the feasibility of local finance, so it varied from place to place.

In the CHIP2013 data, I can obtain the birth date and the province of each individual sample. Through calculation, I can obtain the information about the age of each individual on the actual effective date of the implementation of the compulsory education law in that specific province: if that individual is under the age of 15, he or she will be affected by the compulsory education law; and if that individual is over the age of 15, then he or she will not be affected by the said law.

(2) The prohibition of child labor law
The Labor Law and Regulation on the Prohibition of the Use of Child Labor, effective from April 15, 1991, stipulate that workers under the age of 16 are child laborers, and that no unit or individual may employ child labor. The law came into force from the date of release. The units or individuals who violate these provisions of the use of child labor should immediately send children back to their original residence. The cost of child labor being returned to the original place of residence is borne entirely by units or individuals who use child labor. For those units or individuals who do not comply with these provisions, they will be punished by a fine, administrative detention, and criminal penalties for those who repeatedly commit such violations (Articles 10, 12 to 15).

The implementation of this prohibition of child labor will deprive minors of the possibility of their legitimate jobs before they are at least 16 years of age, that is, the age above which it is possible for them to earn legal income. This makes the opportunity cost for education to be zero (in contrast to income), which may make them more likely to continue to receive education. Meanwhile, people who are affected by the law are basically same in abilities as people who are not affected by this law. Thus, the prohibition of child labor can be used as an instrumental variable to solve the “ability bias” problem. I can judge whether the individual is affected by the prohibition of child labor by calculating the age of the individual on the effective date of the law.

Based on models (2) to (4), this study uses the compulsory education law and the prohibition of child labor as instrumental variables to solve the endogeneity problem. However, unlike the compulsory education law, the prohibition of child labor is implemented in all provinces at the same time. Therefore, it is not possible to include age dummies when using the prohibition of child labor as an instrumental variable, otherwise it will cause multicollinearity problem. The prohibition of child labor does not apply for model (4), which includes age dummies.

The two stage least square regression is like the following:
First stage regression: Regress the years of education on instrumental variables (the compulsory education law or the prohibition of child labor), including other control variables in the model.

Second stage regression: Regress the wages after logarithm on the predicted values of the years of schooling and include other control variables in the model. The IV estimators are the estimators from the second stage regression.

Instrumental variables of this kind might have the issue of weak instrumental variables (Angrist & Krueger, 2001; Bound, Jaeger, & Baker, 1995). In Chapter 5, I will first provide the results of the first stage least square regression. Then I use the suitable models and instrumental variables for the second stage regression.

4.4 Data

4.4.1 Dataset

From the literature review in Chapter 2, I found that Chinese Household Income Project (CHIP) data have been widely used by researchers.

CHIP2013 data are the results of the latest Chinese family income survey in 2013. The data were published in May 2016, and are the latest figures for similar income data at micro-level in China. The 2013 data contain 18,948 families and 64,777 individuals from 14 provinces (specifically, Beijing, Shanxi, Liaoning, Jiangsu, Anhui, Shandong, Henan, Hubei, Hunan, Guangdong, Chongqing, Sichuan, Yunnan, and Gansu).

In addition to obtaining the most up-to-date data, CHIP2013 data present the following advantages for this study: first, the sample size is large; and second, the survey contains sufficient information. The details are shown in the following table.
Table 3 Summary of Data in CHIP2013

<table>
<thead>
<tr>
<th>Category</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic information</td>
<td>Gender, year of birth, month of birth, personal education years, highest degree of education</td>
</tr>
<tr>
<td></td>
<td>Employment status, annual work income, number of working months in a year, average number of working days per month, average daily working hours, initial year of work</td>
</tr>
<tr>
<td>Geographic information</td>
<td>Place of birth, province of residence, province of work</td>
</tr>
</tbody>
</table>

Source: The table is prepared, based on CHIP2013, by the author of this paper.

The information presented in the table above is the information used directly in this study and is also the information used for calculation.

For the dependent variable income, this study suggests that hourly income should be used. This is because taking into account the annual income does not fully reflect the labor productivity. Li et al. (2013) suggested that using hourly income is better than using annual income in China. For low-income groups, they tend to choose longer hours of labor to get more total income in order to make the both ends meet. For high-income groups, the marginal benefit of the income from longer hours of work is diminishing when the expenditure required to meet the basic living is limited and affordable, and the marginal benefit of the lost leisure time is increasing. So high-income groups tend to choose the balance of work and life, that is, they choose shorter working hours, and, by increasing the leisure time, enjoy a higher quality of life. This choice may result in a decline in annual income relative to working longer.

With reference to a large number of similar researches, this study suggests that including hourly wages can better reflect productivity. From the original data the hourly wages can be calculated:
Hourly wages = annual wages / (number of working months per year × average number of working days per month × average working hours per day)

### 4.4.2 Construction of data

CHIP2013 provides this study with a large sample size of urban, rural and migrant workers: 19887, 39065 and 2210 respectively.

In the data construction, I first remove missing values in annual income: 9753, 22605 and 943 observations are removed. I also observe negative values in annual income: rural workers, for example, have one sample of -30000, 27 observations of -2, and five observations of -1. These might be mistakes in typing in data, or codes for missing data, but this guess is not verified by the published manuals and instructions of CHIP. In any case, I should not use these data. I then remove namely 11, 33, 0 urban, rural and migrant samples. I am also not interested in zero income, which might be unpaid voluntary work (which does not reflect productivity in wages) or people who did not work but were mistakenly filled in this data. 4, 5, 2 samples are removed.

In this study hourly wages are calculated from dividing annual incomes by working hours, working days and working months. Any sample with missing value(s) in these variables should be dropped: 33, 42, 0 urban, rural and migrant samples. Negative values should not be included: 2, 1, 0. And zero values should also be dropped: 6, 1, 1.

I do the same for years of education, 70, 154, 3 missing values are dropped, and 3, 3, 0 negative values are dropped. Now I am left with individuals who participated in the job market in 2013, and contained education information. With a reference to a similar study (Xie & Mo, 2014), I have found that such studies usually include only samples older than or equal to 30 years of age, and less than or equal to 50 years of age.
The reasons for this screening are as follows: Individuals less than 30 years of age are not yet mature in the job market, especially for a group of people that choose higher education, and may not have completed higher education until the age of 30. This group is unable to work full-time, but is usually involved in summer projects, part-time internships, etc. The low payment that they receive cannot truthfully reflect the rate of returns to education.

For the group of people older than 50 years of age, the consideration for excluding these people is as follows: due to poorer physical condition and so on, aged people are expected to show a decline in productivity. Second, under the China’s retirement system in 2013, women workers retire at 50 years old, and male workers 55 years old. If I include people over 50 years old, I will then include some of the workers who are employed after retirement. In the current situation, the choice of work for retirees is limited. Available jobs are mostly odd jobs. Moreover, the pay for these odd jobs is usually low, which, to a large extent, does not reflect the productivity of workers.

I removed 1536, 4590, 304 samples that are under 30, and 2014, 3378, 130 samples that are over 50 years old. I am left with 6455 urban workers, 8253 rural workers, and 827 migrant workers.

I noticed some abnormal values in hourly wages in rural samples. The maximum hourly wages of rural worker are RMB 40000 yuan (that is around 580 USD per hour). This is highly unlikely and basically unrealistic in China.

I looked into the samples with hourly wages that are larger or equal to 300 yuan (as 300 yuan per hour is very rare in China, especially in rural areas). All these samples have normal annual income, varying from 2500 yuan to 60000 yuan. The problem is

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14 In my samples, the maximum values of hourly wages for urban and migrant workers are 694.44 and 142.03 yuan. These hourly wages coincide with common sense and the current economic background in China.
resulted from the fact that most of these samples have 1 (or 0.1, 0.2) for total working month, and/or 1 for average working days per month and/or 1 for average working hours per day. Therefore, I get very few total working hours per year, and thus very high hourly wages when I divide annual income by total working hours. I believe that these might be mistakes in typing in the data or misinterpretation of the questions. Another possible explanation is that the respondents did not remember how many hours they worked, and just reported random numbers (like one) for these questions.

I believe that excluding these samples would yield more accurate results. Even in extreme cases where some of these values are true, these few people deviate in large degree from the whole population, therefore they should not be included. 16 observations in rural samples with hourly wages larger than 300 yuan are dropped. I have 8237 rural workers.

### 4.5 Statistical description of the data

After data construction, a statistical description of the available samples is as follows.

Table 4 Statistical Description of the Main Variables of Urban, Rural and Migrant Workers

<table>
<thead>
<tr>
<th></th>
<th>Urban</th>
<th>Rural</th>
<th>Migrant workers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>S. D.</td>
<td>Mean</td>
</tr>
<tr>
<td>Hourly income</td>
<td>19.06</td>
<td>22.82</td>
<td>15.74</td>
</tr>
<tr>
<td>Annual income</td>
<td>41157.4</td>
<td>43954.6</td>
<td>27525.4</td>
</tr>
<tr>
<td>Log hourly income</td>
<td>2.65</td>
<td>0.79</td>
<td>2.50</td>
</tr>
<tr>
<td>Log annual income</td>
<td>10.36</td>
<td>0.76</td>
<td>9.95</td>
</tr>
<tr>
<td>Years of education</td>
<td>11.87</td>
<td>3.22</td>
<td>8.34</td>
</tr>
<tr>
<td>Gender</td>
<td>0.47</td>
<td>0.50</td>
<td>0.37</td>
</tr>
<tr>
<td>Age</td>
<td>40.73</td>
<td>5.82</td>
<td>40.88</td>
</tr>
<tr>
<td>Compulsory education law</td>
<td>0.50</td>
<td>0.50</td>
<td>0.46</td>
</tr>
<tr>
<td>Prohibition of child labor law</td>
<td>0.40</td>
<td>0.49</td>
<td>0.39</td>
</tr>
<tr>
<td>N</td>
<td>6455</td>
<td>8237</td>
<td>827</td>
</tr>
</tbody>
</table>

Note: The compulsory education law and the prohibition of child labor law as dummy variables, =1 means that the individual is affected by the law.
This study employs all the applicable samples of CHIP2013 data: 6455 urban workers, 8237 rural workers, and 827 migrant workers. Urban and rural samples are larger compared with the samples of migrant workers. From the table, one can see that there are obvious differences in income and differences in education among urban laborers, rural laborers and migrant workers.

In terms of the annual income, the average annual income of urban workers is 41,157.40 yuan, 1.5 times the average annual income (27,525.40 yuan) of rural workers. Although this figure reflects to a certain extent the difference in incomes between urban and rural areas, the income gap is smaller than that obtained by other statistical means. The Statistical Communiqué on National Economy and Social Development, 2014 by the National Bureau of Statistics of China shows that: “per capita income of urban residents in 2014 is 2.9 times that of rural residents.”

These differences may be incurred by the differences in the statistical calibers and the sampling methods. In the *CGSS, CHIP, CHFS, CHFS and CFPS Income Comparisons* (Xu et al., 2012), the income data of CHIP are a bit high, especially in the low and middle income groups, compared to the income data of several other microeconomic databases in China, while the income gap is a bit too small. Although the CHIP data referred to in this report are the 2007 statistical data, this feature may still be present in CHIP2013.

On the other hand, the samples selected in my paper are samples of working force in the CHIP data. In the above statistical communiqué, per capita income includes members who do not participate in labor. Although there exists a big difference between the levels of urban and rural economic development and per capita incomes, for the workers who take part in the labor market, this difference may not be as large as the one that includes the non-employed residents. This also partly explains the higher average income of the sample employed in this study.
The average annual income of migrant workers in this sample is 38767.80 yuan, which is much higher than the average annual income of rural workers, and which is close to the average annual income of urban workers. By comparing the average hourly income gaps, one can see that the difference between the average annual income of migrant workers and the average annual income of rural laborers is mainly caused by the fact that the former have worked more hours. The data in the table show that: the average hourly income of migrant workers is 15.21 yuan, slightly lower than that (15.74 yuan) of the rural workers. This is quite surprising, for we usually suppose that the flow of labor from rural to urban areas is motivated by a higher labor remuneration, but the data in this study do not support this point of view. One possible explanation is that the urban areas attract migrant workers because they are able to provide more job opportunities and, through longer hours of labor, migrant workers can earn higher total incomes than in rural areas.

At the same time, the standard deviation of the hourly income of migrant workers is small, indicating that the hourly income difference among migrant workers is small, which may imply that their types of work and the industries that employ them are more concentrated, and that the unit labor remuneration is relatively fixed.

In the table, the other data with which I am concerned are the years of schooling. It can be found that the average figure of urban workers is 11.87 years, 3.53 and 2.73 years respectively higher than 8.34 of rural workers and 9.14 of migrant workers. This shows that there is a huge difference between the levels of education in urban and rural areas.

Table 5 Distribution of Highest Academic Attainment of Urban, Rural and Migrant Workers

<table>
<thead>
<tr>
<th></th>
<th>Urban</th>
<th>Rural</th>
<th>Migrant workers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>No schooling</td>
<td>0.1</td>
<td>0.3</td>
<td>1.0</td>
</tr>
<tr>
<td>Primary school</td>
<td>3.3</td>
<td>4.7</td>
<td>17.9</td>
</tr>
<tr>
<td>Junior high school</td>
<td>26.1</td>
<td>27.5</td>
<td>63.4</td>
</tr>
</tbody>
</table>
Table 5 shows the distribution of highest academic attainment, and it can be found that more than 70% of the workers in the urban areas choose to continue their studies after completing the nine years of compulsory education. The highest attainments of high school, vocational/technical school or secondary school account for nearly 30% of the total number. And the other 40% receive higher education: the proportions for college and undergraduate education are very close and the distribution of education is very similar for men and women. In groups of the rural and migrant workers, the highest education is achieved mainly in junior high school. Nearly 60% of the workers do not continue to receive education after completing their nine years of compulsory education. It is a particularly prominent phenomenon that women do not complete the nine years of compulsory education: there are more women than men who do not go to school or receive only primary school education.

From the distribution of the highest attainment and the years of education, I find that urban laborers are educated for a longer time and generally have a higher academic attainment, while rural and migrant workers are mainly concentrated in junior high school education. At the same time, women appear to obtain lower education attainment, especially in rural areas and among migrant workers.

In addition to observing the average educational level and the distribution of attainment, this study suggests that time trends should also be considered. The age of the individual is a good indicator of the time trend: people born in different years
grow up against different backgrounds.

Figure 2 Average years of schooling for urban, rural and migrant workers

Note: MW=migrant workers; RW=rural workers; and UW=urban workers.

Source: The figure is prepared, based on CHIP2013, by the author of this paper.

Figure 2 gives an intuitive and visual description of how the average years of education of people born in different years change over time. The horizontal axis is the year of birth and the vertical axis is the average years of education. It can be obviously found that the average number of years of education grows over time. People who are born late have on average more years of education than those who are born earlier. This increasing trend is particularly evident for urban workers and migrant workers. In the urban areas, the average years of education for people born in 1964 were 10.55, and, in 20 years, the figure increased to 13.43 years. In other words, the people born in 1984 received about three years of education more than the former group of people. The data for migrant workers were 7.3 years and 11.22 years, respectively, an increase of 3.14 years. Since China’s high school education needs three years, and college and undergraduate education requires four years, it can be estimated that, over the past 20 years, the education level of urban workers and
migrant workers has been generally upgraded to a higher level. The years of schooling in rural areas also showed an upward trend, reaching 11.22 years in 1984. All these show that China’s urban, rural or migrant workers have experienced a very great improvement in the level of education.

However, compared with urban workers, the educational level of rural and migrant workers is still relatively low. This gap is slightly widening. Urban workers born in 1964 obtained on average 2.4 more years of education than workers in rural areas, and in 1984 this gap widened to 3.67 years.

In this figure, there is also a phenomenon that draws my attention. It can be found that in urban areas, people who are born before 1971 (i.e., 15 years before the earliest commencement of the compulsory education law) already have an average number of years of education of over nine years. This phenomenon can be explained by the fact that most of urban workers obtained an education of more than 9 years before the implementation of compulsory education law. So this law may not have a significant impact on the increase of years of education for urban residents. This might result in the fact that compulsory education law might be a weak instrumental variable for urban workers.

I further find that in urban areas, people born before 1975 (i.e., 16 years before the commencement of the prohibition of child labor) already have an average years of education of over 10 years. As explained in section 4.3, the prohibition of child labor creates one gap year between the completion of compulsory education and legal minimum age to start working. This prohibition will probably encourage people to stay at school until they can work legally, that is to increase years of schooling to 10 years. However, as the average years of schooling in urban areas is above 10 years before the implementation of the prohibition of child labor, this prohibition may not have a significant impact on the increase of years of education for urban workers. This indicates that the prohibition of child labor might be a weak instrumental variable for urban workers.
In general, the years of education show an increasing trend year by year. The increasing trends in urban and rural areas are relatively stable, without special changes in a certain period of time. There is a more drastic fluctuation of the years of education for migrant workers, and I consider this to be the result of the limited overall sample of migrant workers (for each year of birth, the sample is small), which may lead to an increase in the chanciness of the data.

Of course, this figure can only provide an intuitive, rough analysis. However, this serves as an important hint for further empirical analysis. First, I observe from the figure the obvious increasing trend of education with the trend of time, therefore, controlling age seems necessary. Otherwise, the rate of returns to education will include factors that grow naturally over time. And second, when using the compulsory education law and the prohibition of child labor as instrumental variables, I am likely to encounter weak instrumental variables after adding age control variables. In the empirical results of Chapter 5, I will present the results for each instrumental variable.
5 Empirical Results

5.1 OLS regression results

Table 6 Returns to Education OLS Estimates

<table>
<thead>
<tr>
<th></th>
<th>Urban</th>
<th>Rural</th>
<th>Migrant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Constant</td>
<td>1.577***</td>
<td>1.825***</td>
<td>1.464***</td>
</tr>
<tr>
<td></td>
<td>(0.035)</td>
<td>(0.076)</td>
<td>(0.113)</td>
</tr>
<tr>
<td>Years of education</td>
<td>0.090***</td>
<td>0.081***</td>
<td>0.085***</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.006)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.291***</td>
<td>-0.286***</td>
<td>-0.286***</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td>(0.024)</td>
<td>(0.023)</td>
</tr>
<tr>
<td>Age</td>
<td>0.076***</td>
<td>-0.001</td>
<td>-0.019***</td>
</tr>
</tbody>
</table>

Significant level: * P < 10%, ** P < 5%, *** P < 1%, the same below; and the standard errors are in parentheses.

(1) to (4) correspond to the models (1) to (4) in 4.1, respectively.

Model (1) is the model without any control variables; model (2) adds gender and province fixed effects, clustered on province; model (3) adds age as a linear control variable; and model (4) treats age as fixed effects. Both model (3) and model (4) are based on model (2), which means that they both contain gender as a control variable and province fixed effects.

I use these four models to respectively regress the logarithmic hourly incomes of the samples of urban, rural and migrant workers. Table 6 lists these OLS results. For models that contain age fixed effects, I omit the coefficient of all the age dummies in this table to avoid the excessive length of the table.

For all three groups: urban, rural and migrant workers, model (1) yields larger results than all the other models. This shows that I will get biased results when I only run a regression of wage income on education. After adding gender as a control variable
and province fixed effects, the rates of returns to education from model (2) are smaller, namely 8.1%, 1.8% and 3.0% for urban, rural and migrant workers. However, these results are only valid if the OLS assumptions hold. As age is not controlled in model (2) and due to measurement error, the assumptions might not hold. The following discussion provides a comparison with other previous studies using the same method.

Comparing these results with the results from previous studies that used the same estimation method and the CHIP database (see for example, Qian & Yi (2009)), I find that the rate of returns to education in urban areas is consistent with the conclusions drawn from other studies, with a significant increase over previous years. The rate of returns to urban education increased from around 2% in the 1990s to about 6% in the 2000s. This study shows that, in this decade, the rate of returns to urban education has risen to 8.1%. The hourly wages for urban workers will increase by 8.1% for every additional year of education. This growing trend indicates that the returns to education in urban China continue to be on a rapid rise. It also shows that education renders an increasingly important contribution to the income of urban laborers.

At the same time, I have noticed the great difference in the rate of returns to education among urban, rural and migrant workers. For every additional year of schooling for rural workers, hourly wages increase by only 1.8%. The rate of returns to education for migrant workers is slightly higher than that of rural workers, namely 3.0%. One study that may serve as a reference is the one by Johnson and Chow (1997) who made an OLS regression of the rural data from the CHIP 1988 and the result was 4.01%. Compared with their findings, my study yields a lower rate of returns to education in rural China.

This lower rate of returns to education in rural China may have been caused by the fact that this study uses different control variables, or may have been the result of the decline in the rate of returns to rural education while the returns to urban education enjoyed a growth, that is, the regional development imbalance becomes more serious. This phenomenon deserves our attention.
I also notice that gender has a significant negative impact on hourly income. In urban areas, women earn on average 27% less than men, and among rural and migrant workers, this difference is as high as 41% and 45%. This phenomenon shows that gender difference in the Chinese job market is serious, especially among rural and migrant workers. In addition to the traditional preference for boys which leads to this situation, another possible explanation is that a large part of rural workers and migrant workers are engaged in heavy physical labor, in which men just have a certain advantage in physical strength.

After the age control variables are included (whether as a linear term or fixed effects), the rates of returns to education in three groups show different changes: for rural workers, the rate of returns to education remains unchanged, while the rates of returns to education for urban and migrant workers become higher and lower respectively. For urban workers, the rate increases from 8.1% to 8.5%, and for migrant workers the rate falls from 3.0% to 2.3% (age as a linear term) and 2.4% (age as fixed effects). I find that the role of age in measuring returns to education is different among urban, rural and migrant workers.

We can see that in OLS regression, the rate of returns to education is much higher for urban workers than it is for rural and migrant workers in all three models.

However, the endogeneity problems still exist because the method of OLS cannot solve the problem of “ability bias” or measurement error. This study uses instrumental variable to solve this problem. As explained in section 4.3, I will use the compulsory education law as an instrumental variable in models (2), (3) and (4), and the prohibition of child labor in models (2) and (3).

### 5.2 IV regression results

#### 5.2.1 First stage regression results
Before conducting IV regression, I need to check whether the instrumental variable is a weak instrumental variable, i.e., whether the correlation condition of the instrumental variable is satisfied. The condition for judging the absence of a weak instrumental variable is: “Rule of thumb”: $F > 10$ (Staiger & Stock, 1997; Stock & Yogo, 2002).

Table 7 First Stage Regression Results Using the Compulsory Education Law as IV$^{15}$

<table>
<thead>
<tr>
<th></th>
<th>urban</th>
<th>rural</th>
<th>migrant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(2)</td>
<td>(3)</td>
<td>(2)</td>
</tr>
<tr>
<td>Compulsory education law</td>
<td>1.617***</td>
<td>0.100</td>
<td>1.236***</td>
</tr>
<tr>
<td></td>
<td>(0.138)</td>
<td>(0.129)</td>
<td>(0.156)</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.355***</td>
<td>-0.388***</td>
<td>-0.390***</td>
</tr>
<tr>
<td></td>
<td>(0.081)</td>
<td>(0.082)</td>
<td>(0.085)</td>
</tr>
<tr>
<td>Age</td>
<td>-0.154***</td>
<td>-0.120***</td>
<td>-0.157***</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.012)</td>
<td>(0.03)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Proportion of household</th>
<th>No</th>
<th>Yes</th>
<th>No</th>
<th>Yes</th>
<th>No</th>
<th>Yes</th>
<th>No</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>First stage F</td>
<td>137.297</td>
<td>0.601</td>
<td>0.134</td>
<td>159.069</td>
<td>0.002</td>
<td>0.058</td>
<td>55.124</td>
<td>0.054</td>
<td>1.775</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>6455</td>
<td>6455</td>
<td>6455</td>
<td>8237</td>
<td>8237</td>
<td>827</td>
<td>827</td>
<td>827</td>
<td>827</td>
<td></td>
</tr>
</tbody>
</table>

Table 8 First Stage Regression Results Using the Prohibition of Child Labor as IV$^{16}$

<table>
<thead>
<tr>
<th></th>
<th>urban</th>
<th>rural</th>
<th>migrant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(2)</td>
<td>(3)</td>
<td>(2)</td>
</tr>
<tr>
<td>Prohibition of child labor</td>
<td>1.623***</td>
<td>-0.017</td>
<td>1.398***</td>
</tr>
<tr>
<td></td>
<td>(0.126)</td>
<td>(0.163)</td>
<td>(0.104)</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.361***</td>
<td>-0.389***</td>
<td>-0.401***</td>
</tr>
<tr>
<td></td>
<td>(0.082)</td>
<td>(0.083)</td>
<td>(0.115)</td>
</tr>
<tr>
<td>Age</td>
<td>-0.162</td>
<td>-0.089***</td>
<td>-0.149***</td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td>(0.01)</td>
<td>(0.023)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Proportion of household</th>
<th>No</th>
<th>No</th>
<th>No</th>
<th>No</th>
<th>No</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>First stage F</td>
<td>165.919</td>
<td>0.011</td>
<td>180.696</td>
<td>17.671</td>
<td>37.219</td>
<td>0.352</td>
</tr>
<tr>
<td>N</td>
<td>6455</td>
<td>6455</td>
<td>8237</td>
<td>827</td>
<td>827</td>
<td>827</td>
</tr>
</tbody>
</table>

Table 7 and Table 8 list the main results of the first stage of IV regression for each of

$^{15}$ The standard errors are clustered at the province level.

$^{16}$ Ibid.
the instrumental variables for each model, and the dependent variable is years of education.

First, I look at the case of using the compulsory education law as an instrumental variable. In the absence of age control variables, the compulsory education law appears to be a very good instrumental variable. The first stage F statistics are larger than 10 for urban, rural and migrant worker. The compulsory education law as IV in the model (2) has passed the test of weak instrumental variables. In model (2), compared with those who are not affected by the compulsory education law, individuals affected by the compulsory education law increase 1.64 years of education (rural workers), 1.57 (migrant workers) and 1.62 (urban workers).

However, with the comparison of models (3) and (4), it can be found that, once the age control variables are added, there is no significant effect of the compulsory education law on the years of education in all samples. Thus I believe that in model (2), the influence of the compulsory education law has much to do with the factor of age. It is obvious that the individual affected by the law must be older than those who are born later and not affected by this law.

This situation is somewhat different from what I have envisioned. Intuitively, I would argue that the implementation of the compulsory education law will have a direct and positive impact on the increase in years of education. In other countries, for example USA, UK and Sweden (see 3.2), similar laws or regulations were used as instrumental variables.

One possible explanation might be that the implementation of the compulsory education law in China is too late, and that the years of education of the individual have increased with the development of economy and have not been greatly promoted by the implementation of the law. As shown in Figure 1, the average number of years of schooling is over 9 years before the law is implemented. The increase in years of education has, to a greater extent, resulted from a continuous, natural trend.
On the other hand, in rural areas, this law may not have been effectively implemented in the early stages of implementation. The law only stipulates that underage children are subject to nine years of compulsory education, but there is no clear provision for punitive measures against offenders (minors and their guardians). In the Compulsory Education Law (1986), the punitive measures against the offenders were only criticism and ordered correction. There is no serious penalty. Due to the fact that China has a huge population, there are numerous problems in the actual implementation of the law in rural areas. In the longer term after the effective implementation of the law, rural areas still witness, in some places, many dropouts of school-age children (Sima, 2005).

The prohibition of child labor has similar results in model (2). When age is not controlled, the first stage F statistics are larger than 10 in all groups, which means that the prohibition of child labor could be used as an instrumental variable in this model. Being affected by the law would increase years of education by 1.6, 1.4 and 1.6 years respectively for urban, rural and migrant workers. However, the impact of the prohibition of child labor on education is also quite related to age. For urban and migrant workers, when age is included as a control variable, either as a linear term or a fixed effect, the prohibition of child labor is a weak instrumental variable. It is possible that the use of child labor was virtually not popular in urban areas before the prohibition of child labor, therefore there were few laborers who were really affected by the prohibition of child labor.

In rural areas, when the age is controlled as a linear control variable, the prohibition of child labor in model (3) has a significant effect on the years of education. Individuals affected by this law will increase the years of education by 0.4 year. This shows that the prohibition of child labor, to a certain extent, has increased the years of

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17 Article 15. In cases where school-age children or adolescents do not enroll school and receive compulsory education, with the exception of those who, on account of illness or other special circumstances, are allowed by the local people’s governments not going to school, the local people’s governments shall admonish and criticize the parents or guardians of those children or adolescents, and adopt effective measures to order them to send the children or wards to school.
education of the rural workers. In rural areas, the use of child labor was more common before the law was implemented. So that after the law came into effect, the companies and/or individuals that hired child labor before could no longer continue this offense. For the laid-off child labor, there were no more job opportunities for them and to return to school was a good choice. Therefore, the prohibition of child labor has a significant impact on the years of schooling in rural areas.

To sum up, when I strictly control the age variable, that is, age as a fixed effect, the compulsory education law cannot be used as an instrumental variable for the returns to education of urban, rural, and migrant workers. When age is a linear control variable, the prohibition of child labor can be used as an instrumental variable for rural areas. When I do not include age control variables, the compulsory education law can apply to all groups as an instrumental variable, and the prohibition of child labor applies to rural and migrant workers. This, however, is less plausible, as the instrument exogeneity condition might not hold. I accordingly conduct the second stage regression.

5.2.2 IV regression results

Table 9 Returns to Education IV Estimates

<table>
<thead>
<tr>
<th>Instrumental variable</th>
<th>Compulsory education law</th>
<th>Prohibition of child labor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>urban</td>
<td>rural</td>
</tr>
<tr>
<td>Years of education</td>
<td>0.027*</td>
<td>0.025</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.019)</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.307***</td>
<td>-0.411***</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td>(0.023)</td>
</tr>
<tr>
<td>Age</td>
<td>-0.003</td>
<td>(0.007)</td>
</tr>
</tbody>
</table>

| Age fixed effect | No | No | No |
| Province fixed effect | Yes | Yes | Yes |
| N                  | 6455 | 8237 | 827 |

The standard errors are clustered at the province level.
IV regression results differ greatly from OLS estimates. I first look at the results when age is not controlled. Using the compulsory education law as instrument variables, the rates of returns to education are 2.7%, 2.5% and 6.8% for urban, rural and migrant workers. However, the returns to education in rural areas is not significant at 10% level, which indicates that there is no significant impact of education on hourly wages for rural workers. Comparing with OLS results, I find that the returns to education decrease for urban workers and increase for migrant workers, and for rural workers, there are no longer significant returns. Using the prohibition of child labor as an instrumental variable yields similar results, in which the rates of returns to education are 3.4%, 2.5% and 7.6% for urban, rural and migrant workers. And it is not significant at 10% level for rural workers. When age is controlled, I can only conduct IV regression using the prohibition of child labor for rural workers. The rate of returns to education is 0.2% and not significant at 10% level.

The differences between IV estimates and OLS estimates suggest that there exists endogeneity problem caused by “ability bias” or measurement error. By employing instrumental variables, I can avoid the “ability bias”. But these results, though much improved from OLS estimates, may still not be unbiased, as I am unable to find an instrumental variable for all groups when age is controlled. Without controlling age in the IV regression, the instrument exogeneity condition might not hold.

I notice that both urban and migrant workers have positive returns to education, and this coincides with human capital theory: education results in higher productivity which yields higher income. I also notice that migrant workers have a higher rate of returns to education than urban workers. At the same time, migrant workers have, on average, fewer years of education. This coincides with the assumption that education has a diminishing scale of returns. The returns to education are higher when the education level is lower.

The decision of taking less education for the migrant workers could be explained by their high discount rate. Coming from underdeveloped rural areas, migrant workers
normally have heavy economic burdens and are expected to support their families as early as they can. Compared with urban workers, migrant workers prefer income today much more than income in the future. In addition, the cost of education also results in the choice of less education for migrant workers. The education cost (tuition, fees, expenses, etc.) of one year, especially for undergraduate and professional education, usually exceeds the annual income of the low-income family (Wang, 2000). It is too costly for migrant workers to decide on a higher level of education.

The insignificant rate of returns to education in rural areas seems to be a violation of human capital theory. However, it does coincide with the prevalent perception of “it is futile to go to school”. It might be explained by the following two facts: first, the relatively poor quality of education in rural area. Chinese government has focused on the increase of years of education in rural area, especially the completion of the nine years’ compulsory education. However, the quality of education in rural area has been lagging behind (Zhang, 2007; Wu, 2008). It is often difficult to realize, through education, the significant improvement of productivity.

Second, the insufficient demand for technology-intensive labor (Zhang, 2008). In rural areas, the majority of jobs are labor-intensive. I can easily find that the productivity of a large number of the jobs, for example, farmers who cultivate in the traditional way, coal miners, assembly-line workers, and so on, is rarely affected by the level of education. When the demand of rural labor markets is still targeted at labor-intensive sector, growth in productivity from education may not be fully utilized.

When the rural laborers migrate to the urban areas, they have access to a larger job market. Many of these jobs demand for specific expertise and skills, and by this time, the improvement of education in terms of labor productivity can be actualized. Thus, I have observed a higher rate of returns to education for migrant workers.
6 Conclusions

This study estimated the rates of returns to education for urban, rural and migrant workers in China. The main conclusions of the study are as follows:

The OLS results, which include age and provincial fixed effects and cluster on province level, show that, according to CHIP2013 data, the rate of returns to education is around 8.1% for urban workers, 1.8% for rural workers and 3.0% for migrant workers. When age is included as a linear term, the rates are 8.5%, 1.8% and 2.3% respectively. The results from controlling for age as fixed effects are similar: 8.5%, 1.8% and 2.4%. OLS results show that urban workers enjoy higher returns to education.

These results are likely biased, as the “ability bias” and measurement error causes endogeneity problem in OLS estimates. This paper uses the compulsory education law and the prohibition of child labor in China as instrumental variables to solve the endogeneity problem.

When age is not controlled, using the compulsory education law as an instrumental variable shows that the rates of returns to education for urban, rural and migrant workers are 2.7%, 2.5% and 6.8% respectively. The IV estimates yield 3.4%, 2.5% and 7.6% for urban, rural and migrant workers. The rates of returns to education for rural workers are not significant at 10% level. However, when age is not controlled, the instrument exogeneity condition is likely violated.

When age is included as a control variable, both the compulsory education law and the prohibition of child labor are weak instrumental variables for urban and migrant workers. The prohibition of child labor could be used as an instrumental variable for rural workers. IV estimate for the rate of returns to education in rural areas is very small and not significant.
The results show big differences between OLS estimates and IV estimates, which indicates that OLS estimation might result in biased results. I also find different rates of returns to education for urban and migrant workers. This can be explained by the diminishing returns to education and the time preference of migrant workers. This study shows that the rate of returns to education for rural workers is not statistically significant, which coincides with the prevalent perception of “futile education” in rural areas. The quality of rural education is likely low and there is a lack of demand for high educated labors.
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