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Changes in economic returns to higher education in urban China, 2003–2017

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Abstract:

The thesis investigates whether the higher education expansion policy, issued in 1999, China, improved individuals' schooling and wages. The thesis mainly applies Mincer functions. Empirical results show that higher education policy increased schooling years, but it does not change the economic returns to higher education dramatically. Heterogeneous return was evident in the region, type of work units, gender, and parents' education. Regression Discontinuity Design (RDD) is applied as a robust test. The results also show that the expansion policy positively impacts education years and wages, although estimates are not always significant.

Key words: return to higher eudcation, Mincer function, expansion policy evaluation, Regression Discontinuity Design

1. Introduction

This thesis studies the return to higher education in China in the period of 2003 to 2017. Education is increasingly becoming one of the most significant social and economic performance sources, particularly in knowledge-based economies. For individuals, many researchers have confirmed that higher-educated individuals earn more. The return of education has been studied since the late 1950s. To quantify the return, Mincer (1974) pointed out the Mincerian earnings function to estimate the economic return to education. Later on, scholars extended this function in order to obtain more precise estimates. The common wisdom concludes that there is a positive relationship between schooling and individuals' income. For example, Psacharopoulos and Patrinos (2018) selected 139 countries and measured the private average return to one year of schooling from 1950 to 2014 was 9%. With the increasing demand of the labour market for employees' skills and higher education, many countries have expanded the enrollment scale of universities to cope with the increasing demand (Devereux and Fan, 2011; Choi, 2015; Staneva, Arabsheibani and Murphy, 2010, etc.).

China experienced a higher education expansion since 1999 when the Chinese Ministry of Education issued a policy (*Action Scheme for invigorating Education Towards the 21st Century*) whose purpose was promoting higher education to develop actively and steadily, transforming higher education from elite education to mass education. In particular, universities provided more places and some independent colleges were merged by universities in order to extent enrollment places. In 2007, higher education continued to expand enrollment but the rate would slow down greatly. In 2008, the enrollment plan of colleges and universities nationwide was 5.99 million, with an increase rate of 5%. At the same time, the Ministry of Education began to reflect on the enrollment expansion, and for the first time said that the large-scale enrollment expansion of colleges and universities nationwide decided in 1999 was too urgent.

By 2019, the number of enrollment college students in China has reached ten million. The trend is present in figure 1. Higher education has become mass edcuation in China. Prior to China, many countries increased the number of college students to meet the demand for high skilled labor during the transition process. (Choi, 2015; Staneva, Arabsheibani, and Murphy, 2010). On one hand, based on human capital theory, individuals' incomes benefit from the increasing schooling years; on the other hand, although the expansion of available places has improved employers' quality, it has brought increasing pressure on graduates' employment at the same time, especially after the slowdown of China's economic growth in recent years. In this case, the labour market cannot provide jobs for millions of graduates. Therefore, many graduates accept jobs requiring less schooling than their actual educational levels or take non-graduate jobs that are not matched with their education and expectations to make a living or avoid being unemployed. From previous literature, it is known that excessive schooling may not bring returns but wage penalties (Korpi and Tåhlin, 2009) to individuals.

This thesis will investigate the effect of the expansion policy on economic return to higher education; in detail, (1) Does the policy increase education years? (2) Is there a significant change in the returns to higher education from 2003 to 2017? (3) Do heterogeneous returns exist? This paper used Mincer-type OLS regressions to explore the above three questions. For the first question, expansion policy improved the possibility of enrollment, therefore increasing the schooling years. Nevertheless, this thesis does not find a dramatic change in economic return to higher education from 2003 to 2017. Heterogeneous return was reflected among gender, regions and types of the work unit. The robust test also supports that the policy increases years of education and wages, whereas results are not always significant.

The remainder of this thesis is structured as follows: the second section will review human capital theory and return to higher education. Then college expansion research and empirical findings in China and other countries will be reviewed. The

third part of section two will summarise standard empirical methods in estimating the economic return. Section three will introduce the datasets employed in the thesis, after that variables definition and descriptive statistics. Section four will provide the methodology and related functions. Section five will analyze the empirical results, and section six will provide major conclusions and drawbacks in this paper.

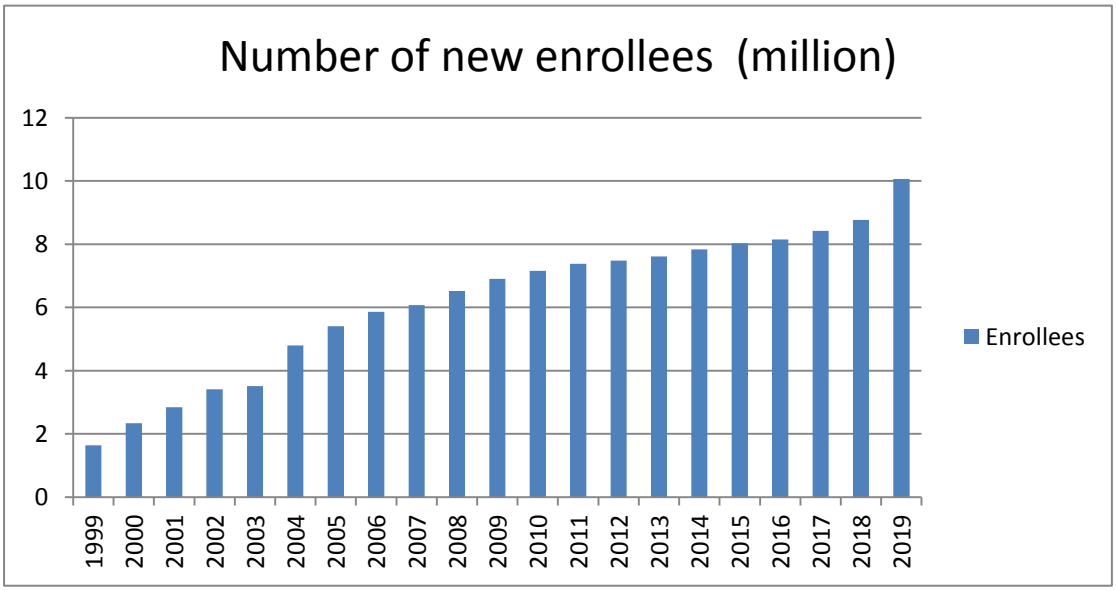


Figure 1[1]: The number of new enrollees,1999-2019

2. Theory and Literature Review

2.1 Human capital theory and education returns

Since the late 1950s, economists represented by Schultz (1961), Becker (1960) and Mincer (1974) have carried out pioneering research on the theory of human capital. Since then, the research on the relationship between education and income has risen and been widely discussed by scholars, and various methods for estimating the rate of return on education have emerged. For example, Trostel, Walker, and Woolley (2002) exploited return to education in 28 countries and found that the worldwide rate of return declines slightly over this period. Staneva, Arabsheibani and Murphy (2010)

[1] Data source: Educational Statistics in 1999-2019, Ministry of Education, China: http://en.moe.gov.cn/documents/statistics/2018/national/

discussed the same topic in four developing countries under several quantiles and found that the return to education is heterogeneous across the earnings distribution. Psacharopoulos and Patrinos (2018) reviewed schooling returns among 139 countries and showed that the increasing extra one-year education would increase 9 per cent income, and this trend was stable over decades.

However, with the development and reform of the social economy, primary education has been unable to meet the labour market requirements for high-quality employees. In this context, the role of higher education in economic development has received attention in the literature. Given current studies, there are two directions of the effect of colleges on economic return. For some countries, the economic earning has seemed to decrease after the higher education has turned to mass education stage, suggesting that the college degree was less effective in signal aspect. This view was supported by Card and Lemieux (2001). They discussed the stable wage gap between high school and college in the UK, Canada and US over two decades and found that the intuition behind the stable wage gap was the steadily rising supply of college-educated labour and a slowdown in demand for college-educated workers. Also, Yuan and Xie (2012), Wu and Zhao (2010) discovered the decreasing return trend in China.

In contrast, some researchers argued that the rate of higher education enrolment had risen dramatically in their studies, and its economic and social return increased significantly as well. For instance, Ashworth (1997) discussed whether higher education was still worthwhile in the post-expansion period since the 1990s in the UK. The conclusion present that higher education still yielded a high private return for most. Similarly, Ma, Cai and Yao (2016) obtained the same conclusion in China. Other than private economic return for individuals, social return is taken into account as well. Moretti (2004) measured the social return using NLSY data and present evidence that cities lie in the high-educated regions attracted more people with higher education degrees. In turn, those people bring more effective productivity. The spillover effect,

reflected by higher wages, still overpassed the move down the demand curve arises from fierce competition.

2.2 Outcomes of the expansion policy

There are several opinions regarding the effect of expansion policy on the Chinese labour market. Some studies hold the point that the expansion policy brings earning benefits to individuals. For example, Wang (2012) used a semiparametric method to construct a valid instrumental variable then explored the college premium during 1995 - 2002. The paper showed evidence of college premium; more specifically, it is more prominent in workers employed by state-owned enterprises, female, and graduates from high-quality universities. Peng (2011) used a propensity score to higher education premium; the author used the question “whether studying in a key middle school” as an instrumental variable. The research obtained that the wage premium of higher education degree owners was the most significant in large cities. However, the author argued that living costs in large cities required higher income, which promoted the nominal wage while it is not easy to isolate this part wage premium. Liu (2015) used a spouse’s education as the instrumental variable to explore earnings to higher education from 1988 to 2007. The study showed a continuously increasing trend no matter in the perspectives of regions or genders. Also, the return gap between female and male was narrowing. This finding was confirmed by Wang (2012) as well.

Some studies argued that the expansion policy did increase the number of college entrants, whereas it did not bring higher income for this group. For example, in Wu and Zhao (2010) 's research, the negative coefficient of education term implied that expansion policy caused the labour participation rate of new graduates to drop by 2.9 percentage points, and the unemployment rate rose by 5.1 percentage points. Yuan, Yuan and Xie (2012) analysed the relative slowdown wage for college graduates from supply and demand aspects and found that the slow growth of effective demand directly restricted the improvement of college students' employment and the ability of

salary negotiation. Jian and Ning (2013) also argued that the personal ability gap between college degree holders and high school degree holders was less evident. This implies that expanding the college enrollment rapidly would not benefit marginal graduates (students who attained college due to expansion policy).

The third view suggests that outcomes of the expansion policy vary among different samples. For instance, Yu and Hou (2019) used Regression Discontinuity to investigate the economic returns to higher education. They found that although the policy extended residents' average schooling years, it did not increase the wage from the national perspective. However, thanks to the expansion policy, individuals' income in the eastern region increase by 14% and the corresponding annual rate of return of higher education is 33%. In contrast, this benefit was insignificant in the western region. In terms of gender, the benefit of the male is significantly higher than that of the female. Assuming that the higher education degree was a signal of ability, Xu (2010) reckoned that though the expansion policy increased enrollment possibility for higher ability and lower ability students, their income would vary. The signalling game model supported this view under the framework of structural estimation.

According to the above research review, it is shown that the direction of a return to higher education during the post-expansion period is not alway explicit. In particular, the estimates are highly correlated to samples of the population, such as the year of participation, regions and genders.

2.3 The framework of estimating return to education

2.3.1 Common empirical methods

From previous literature, it is known that there are three mainstream empirical methods in estimating economic returns to schooling. Apart from Mincer functions (Mincer, 1974; Ashworth, 1997; Moretti, 2004; Psacharopoulos and Patrinos, 2018,

etc.), the rest two standard methods are regression discontinuity and propensity score matching.

Propensity score matching is often applied in estimating policies changes. The intuition behind it is comparing some units in the non-treatment with the treatment units, with different methods to match the observation in the treatment group to the one or more similar observation(s) in the non-treatment group. For example, Jian and Ning (2013) used propensity score with four matching algorithms to estimate the average annual economic return to high school and college in 1997 and 2006, respectively. They observed that compared with propensity score, OLS estimates were the biased result of heterogeneity and self-selection. Yan (2012) also used propensity score matching to investigate college premium and obtained that propensity score was more efficient to control individuals' characteristics, therefore, getting high validity estimates.

Regression discontinuity design (RDD) is efficient in evaluating policies changes as well. Since it is impossible to observe an individual being affected and not affected by the expansion policy simultaneously, looking for a similar counterpart but is not induced in the policy, then comparing their differences result from the policy (threshold) would be a helpful method. In this paper, the year that policy issued could be treated as a threshold. By comparing observations lying closely on either side of the threshold, it is possible to estimate the treatment effect. Scholarly have shown some findings under the RDD framework. For example, Wang (2019) constructed the RDD method to investigate the effect of expansion policy on college attainment rate before and post-expansion periods. She found that the policy improved both possibilities of entering college and residents' income. Yu and Hou (2019) applied the same empirical method in the eastern region of China and captured evident increasing attainment rate and income around the threshold.

2.3.2 Evidence on the heterogeneity in returns to education

This section reviews current observable sources of variation in the return to education. The heterogeneity of education return means that the influence of education on different people's income is different. Even if each individual obtains the same educational level, the rate of return on education is often different. Moreover, these heterogeneous factors cannot be fully captured via empirical models but usually influence the estimates.

From previous studies, it is known that there are several primary sources of heterogeneity. The first one is able. One can argue that individuals with higher ability earn more out of one additional year of schooling than others; in other words, more intelligent individuals naturally command more earnings, independent of the school. A standard earnings function would be biased upward because part of the return attributed to schooling comes from unmeasured ability (Polachek, 2008). Although ability has been discussed in many empirical works and measured by some specific instrument variables such as IQ scores or twin birth data; nevertheless, the validity of these variables is still questioned. Some studies concluded that ability biases would not essentially influence the estimate of the return to education (i.e. Card, 1999, 2001). Moreover, family background and individuals' role in paid employment also affect the financial return to education (Corliss, Lewis and Daly, 2013). Apart from individual-specific factors, other exogenous factors such as race, gender, city, industry, occupational structures (Polachek, 2008) and labour market conditions (Moretti, 2004) are also essential sources of heterogeneity.

Qian and Smyth (2008) pointed out that the effect of China economic reforms (since 1978) and the consequent market determination of returns to schooling, the quality and costs of education are critical heterogeneous factors. Similarly, Corliss, Lewis, and Daly (2013) showed evidence that Australia's business cycle affected economic return to higher education. In a word, since unobservables and limited data source,

heterogeneity sometimes cannot be fully captured. However, it is possible to reduce the level of bias through various econometrics methods.

3. Data and Descriptive statistics

3.1 Dataset and data selection

The dataset employed in this thesis is the Chinese General Social Survey (CGSS). CGSS is the first national, comprehensive, and continuous large-scale social survey project in China. The purpose is to summarize the long-term trend of social change by regularly surveying Chinese residents and Chinese society. Founded in 2003, CGSS has conducted ten annual surveys and published nine sets of high-quality annual survey data. The survey is divided into two phases; the first period is from 2003-2008, and 2010-2019 is the second phase. The second stage and the first stage have some adjustments in the format, but both cover the data needed in this paper. In order to investigate a long-term trend of economic return to higher education, this thesis includes all available sets, which range from 2003 to 2017. It is worth noting that the data is survey data; thus, measurement errors may occur due to respondents' understanding of questions. In addition, due to the structure of the survey, this thesis can only employ cross-sectional analysis. Although most empirical works use cross-sectional data, the estimates may contain more unobserved heterogeneity, therefore probably providing less efficient results than panel data.

Some observations are dropped from the sample before constructing empirical models. Firstly, only individuals living in urban areas in the datasets are retained; the intuition is migration from the countryside to urban was prevailing over recent two decades, and scholars pointed out that the income gap between urban and rural areas is significant (Wang, 2019; Hu and Hibel, 2014). However, the survey does not provide comprehensive individuals' migration information. In order to reduce estimation bias, this thesis only concentrates on urban residents. In addition,

respondents living in the countryside who received higher education are limited, especially in the early century. Secondly, the thesis excludes respondents who do not obtain labour income, i.e. students, the unemployed, and retirees. In terms of education level, this paper only includes those who have received higher education and graduated. Despite this, measurement errors and endogeneity problem may still exist after filtering data; since the survey lasted for more than ten years, social development and residents' changes may influence results significantly, but these factors may not be reflected via questionnaires. Last but not least, due to the lack of related questions in the survey, it is challenging to identify respondents who return to school after working for some years or those who pursue higher degrees but still work at the same time. For these groups, one cannot distinguish whether the wage increasing results from experience or higher education.

3.2 Variables description

Scholars argue the standard Mincer function since it assumes that wage is only affected by education and experience. At the same time, other important factors such as ability and family background are not contained. In order to reduce the estimate bias result from omitted variables, the standard method is to add some potential control variables. Although there are some differences, some variables are generally considered potential, influential factors through reviewing previous literature. Thus, apart from the three significant independent variables: education, wage, and experience, some control variables are also included in the extended equation.

As the literature review section introduced, the city is an essential source of leading to heterogeneous returns. Former literature (i.e. Wang, 2019; Kang and Peng, 2010; Hu, 2019) also concluded that regional development varies in China; thus, the income would be affected. Therefore, according to China's official regional classification standard, the provinces and municipalities in the datasets are divided into Eastern,

Western and Central regions[2]. Similarly, parents' education level is also directly related to their children's education years. Besides, gender is also included in the extended function as the gender wage gap has also been confirmed by many researchers (i.e. Ren and Miller, 2012; Hu and Hibel, 2014). It is important to note that scholars reckon that the type of work unit impacts wage as well. For example, there may exist a wage gap between two respondents with the same educational background, but one works in an enterprise, and the other is a government department. Therefore, this factor has also been included in the control variable. In the macroeconomic aspect, provinces' GDP per capita and unemployment rate are contained; macroeconomic data comes from the National Bureau of Statistics, statistical yearbook[3]. It is worth noting that GDP per capita is calculated at constant prices, which assumed the preceding year equals 100; the unemployment rate might be underestimated since it only concluded those who were unemployed and registered in their status. The following table 1 is a summary of variables of interest and corresponding explanations as well as descriptive statistics of table 2.

Notably, variables described in table 1 are only appliable to standard and extended Mincer regressions, i.e., equation (1) to equation (4) in section four. For the heterogeneous analysis subsection, some continuous variables will become dummy variables. More details would be shown in the latter section.

[2] Source for the classification: http://www.stats.gov.cn/english/ClassificationsMethods/
[3] Data source: http://www.stats.gov.cn/tjsj/ndsj/

Table 1：Variables in Standard Mincer function and extented Mincer function

Variable	Variable description	Note
Dependent variable		
lnwage	***log of monthly wage***	
Independent variables		
Years of education	***respondent's education years***	
	Short-cycle Bachelor	Years of education = 15
	Bachelor	Years of education = 16
	Master or above	Years of education = 19
Experience	***working experience***	Years of experience = age - schooling years - 6
Experience square	***square of working experience***	
Region	***provinces inhabited by respondents***	
	Eastern Region	region = 3
	Central region	region = 2
	Western Region	region = 1
Types of work unit	***types of respondent's work unit***	
	enterprise	work unit = 6
	no unit / self employed (including self-employed)	work unit = 5
	social organizations, neighborhood / village committees	work unit = 4
	government-affiliated institutions	work unit = 3
	party and government organs	work unit = 2
	others	work unit = 1
Gender	***gender of respondents***	
	male	gender = 0
	female	gender = 1
Fschoolingyear	***schooling of the respondent's father(years)***	
	uneducated	Years of education = 0
	primary school or equivalent	Years of education = 6
	secondary school or equivalent	Years of education = 9
	high school or equivalent	Years of education = 12
	Short-cycle Bachelor	Years of education = 15
	Bachelor or equivalent	Years of education = 16
	Master or above	Years of education = 19
Mschoolingyear	***schooling of the respondent's mother(years)***	Same as above
GDP	***indices of per capita GDP by province***	preceding year=100
Unemployment	***unemployment rate by province***	/

3.3 Descriptive statisitics

From table 2, one can see that log of wage increases gradually. However, it is reasonable to believe that education is not the only factor promoting wage increasing; other factors such as GDP growth and nominal wage increase should be taken into account. Additionally, more respondents tend to pursue higher education, which is reflected from higher percents of bachelor and master or above subgroups. Furthermore, from the upward trend of parents' schooling years, it is plausible that

society's education level has been increasing. In the context of the rapid growth of society's education level, the advantage of higher education would be weakened.

Table 2: Descriptive statistics of datasets

Year	2003	2005	2008	2010	2011	2012	2013	2015	2017
Dependent variable									
Log of monthly wages	7.12	7.38	7.68	7.95	7.91	8.19	8.23	8.43	8.68
Independent variables									
Experience(years)	14.13	13.23	12.59	15.38	15.12	14.92	14.77	14.89	14.91
Years of education(percent)									
Short-cycle Bachelor	0.68	0.65	0.52	0.51	0.51	0.48	0.51	0.45	0.40
Bachelor	0.29	0.33	0.44	0.43	0.45	0.48	0.44	0.50	0.53
Master or above	0.03	0.02	0.04	0.06	0.05	0.04	0.04	0.06	0.08
Region(percent)									
Eastern Region	0.49	0.58	0.57	0.63	0.63	0.78	0.70	0.67	0.11
Central region	0.28	0.21	0.20	0.20	0.25	0.13	0.17	0.21	0.17
Western Region	0.22	0.21	0.23	0.16	0.12	0.09	0.13	0.13	0.72
Gender(percent)									
male	0.57	0.56	0.57	0.60	0.53	0.56	0.59	0.53	0.53
female	0.43	0.44	0.43	0.40	0.47	0.44	0.41	0.47	0.47
Types of work unit(percent)									
enterprise	0.43	0.47	0.49	0.46	0.46	0.58	0.53	0.51	0.54
no unit / self employed (including self-employed)	0.02	0.09	0.10	0.10	0.11	0.09	0.08	0.08	0.10
social organizations, neighborhood / village committees	0.06	0.07	0.02	0.01	0.02	0.02	0.03	0.03	0.03
government-affiliated institutions	0.37	0.27	0.31	0.30	0.28	0.21	0.25	0.27	0.22
party and government organs	0.11	0.10	0.07	0.12	0.12	0.07	0.10	0.08	0.08
others	0.02	0.00	0.01	0.02	0.00	0.03	0.00	0.03	0.03
Parents' education									
father's schooling	8.99	9.23	9.21	9.07	9.06	9.47	9.20	9.19	9.35
mother's schooling	6.91	7.11	7.49	7.11	7.32	7.99	8.07	8.61	7.85
N	680	664	576	959	431	820	1072	904	1357

4. Methodology

4.1 Standard and Extended Mincer functions

As reviewed in the second section, the most common empirical model is the Mincer function. The function is present as follows:

$$\ln(\text{wage}_i) = \alpha + \beta_1 \text{education}_i + \beta_2 \text{experience}_i + \beta_3 \text{experience}^2{}_i + \varepsilon_i \quad (1)$$

where ln(wage$_i$) is the log of monthly wage, education is the schooling years that the

individual obtains, and experience is years of employment. ε_i is an idiosyncratic error term. Since the survey does not provide information regarding experience, this paper follows the standard measuring method, i.e. using the individual's birth year minus corresponding education years and six years for pre-school. Based on Mincer's findings, the coefficient of experience is supposed to be positive while the coefficient of the square of experience should be negative. The intuition behind it is that wage would increase with accumulating more experience, but it would not increase forever; instead, it increases at a decreasing rate throughout one's life until depreciation exceeds human capital accumulation. Another explanation is that the Mincer function measures an individual's lifetime income, which means it will decrease after the one gets retired. Thus, the pattern is concave and holds in many countries (Polachek, 2008).

Since Mincer (1958) pointed out the approach to measure the income arising from education, he and his colleagues extended the function based on the original model in order to improve the explanatory power of the model. Previous studies have confirmed that some variables such as race, gender, occupation and job mobility (Polachek, 2008) are correlated with income but not contained in the traditional Mincer function, thus extending the function usually offers less biased estimates. The extended function is shown as follows. The results for standard function and extended function would be present in the result section.

$$\ln(\text{wage}_i) = \alpha + \beta_1 \text{education}_i + \beta_2 \text{experience}_i + \beta_3 \text{experience}^2{}_i + \sum_k^K \beta_{4k} \text{X}_{\text{ik}} + \varepsilon_i \qquad (2)$$

where $\sum_k^K \beta_{4k} \text{X}_{\text{ik}}$ represents the sum of covariates, including gender, region, GDP per capita at province level, parents' schooling and types of work unit. Other variables are identical as equation (1).

4.2 Empirical specification using the expansion policy

As the OLS-based Mincer functions do not offer evidence of changes on economic earnings to higher education because of the expansion policy. This paper introduces the policy which was imposed in 1999 as the treatment and then investigates whether the expansion policy extends schooling year thereby increasing wage. The equations are shown as below:

$$S_i = \alpha + \beta_1 \text{exposed}_i + \sum_k^K \beta_{2k} X_{ik} + \varepsilon_i \quad (3)$$

$$\ln(\text{wage}_i) = \alpha + \beta_1 \text{exposed}_i + \beta_2 \text{experience}_i + \beta_3 \text{experience}^2{}_i + \sum_k^K \beta_{4k} X_{ik} + \varepsilon_i \quad (4)$$

where S_i represents the education years of the respondent i obtaining and $exposed_i$ is the indicator of treatment. $exposed_i$ equals 1 if the respondent was less than 18 when the policy was issued, which corresponds to 1981 or later years; otherwise, $exposed_i$ equals to 0. β_1 estimates the effect of the policy on the average increased (or decrease) years of obtaining higher education; $\sum_k^K \beta_{2k} X_{ik}$ represents the same covariates as in equation (2) that may affect individuals' income. Equation (3) is employed to investigate whether the policy increases individuals' schooling years, and equation (4) explores whether individuals who were affected by the policy improved their wage.

The survey only provides the birth year, some respondents born in the first several months, like January or February, might not be treated if she or he started primary school at five years and eight months. However, it is reasonable to assume that this case would not affect the estimates dramatically as samples are random, so it is less likely to cause the measurement error problem because of the individual's birth year.

Comparing with the extended Mincer equation, equation (3) and (4) would directly measure the effect of the policy on individuals' wage. Notably, Ma, Cai and Yao (2016)

employed the expansion policy as IV in order to estimate its effect on individuals' education and income. This paper argues that is it is hard to verify the validity of exclusion restriction when using 2SLS. The expansion policy indeed affects wage via the higher possibility of receiving higher education, but other channels such as macroeconomic environment and family background would also influence wages. Therefore, it is not easy to distinguish whether the wage increases from receiving higher education via the expansion policy or other factors that impact schooling and wage but are uncorrelated to expansion policy. For example, more students attain college not only because the enrolment rate has risen, but also their families are more able to pay the tuition when household's saving has been increasing rapidly over the years. In order to find an available instrument, Yan (2012) tried to use mother's education and college degree as IV and run a 2SLS regression but found that it was challenging to get a perfect instrument that had a solid first stage uncorrelated to all potential omitted variables. Carneiro and Heckman (2002) also pointed out that the instrumental variables used in the literature on the rate of return on education were often invalid because they were related to unobservable personal abilities.

In summary, although some potential explanatory variables have been included in the equation, other omitted variables and heterogeneity are still likely to affect the estimates. At the same time, it is hard to identify all of them. Therefore, the 2SLS approach might be biased.

5. Empirical Results

Based on the introduction and literature review chapters, it is reasonable to assume that return to education would change (increase or decrease) as more people obtain a college education. In order to investigate the change, the standard Mincer function and extended model are estimated.

5.1 Standard and extended Mincer function results

Table 3 shows the results of standard Mincer regression, which corresponds to equation (1). The positive coefficient of education on income is evident under the 1% significant level. This is consistent with the common wisdom that there exists a positive correlation between education and income. Moreover, from the coefficient of Years of education, one can notice that although the economic return to higher education presents fluctuation in some years, it keeps at 25% in general, suggesting that degrees do not bring more or less wage premium for graduates. In other words, the rate of economic return to a college degree for a respondent is usually 25%. Notably, experience contributes more proportion to income over time. The coefficient of experience is insignificant from 2003 and even negative in 2005. Later on, this term shows an upward trend.

Table 3 shows the results of standard Mincer regression. The finding of the stable trend of the economic return to higher education is consistent with Liu (2015) 's study, which also found that the growth rate of economic return to education did not rise rapidly since 2000. However, the steady trend was argued by other researchers. For instance, Yu and Chen's research (2006) argued that expansion policy weakened the effect of a college degree as a signal of labour ability, leading to lower returns. Zhang and Xu (2015) found that the economic return to bachelor's and master's education decreased by 5.1% and 12.5% in the post-expansion period. In contrast, Dong (2020) selected another official social survey dataset in 2010, 2013, and 2016 and estimated that the economic return increased over time. Similarly, Ma, Cai, and Yao (2016) used propensity score and DiD to explore how the policy affected the complier subgroup (those who attended higher education because of the policy). They found that compliers' income increased by forty per cent.

One possible explanation for these different conclusions is that the expansion policy allows people to get higher income because of the signal effect from degrees. More

specific, the college degree transfers a signal which helps employers distinguish the most productive and motivated workers the firm. However, the rising number of degree holders deteriorates such effect, thus cannot bring more premium for graduates. Moreover, employment is highly related to the macroeconomic environment; in detail, both the demand and supply in the labour market will affect graduates' employment. While some papers only selected one year to study. For instance, the unexpected lower return in 2008 may be a partial result of the financial crisis. The highest return in 2010 might be attributed to economic rebound policies; if the research focuses on education return in 2008 or 2010, its estimation may be biased..

There are two potential reasons for the upsurging trend of experience. On one side, the expansion policy increased the possibility of attaining college; therefore, the proportion of respondents who hold a college degree due to the college expansion is more significant than those not affected by the policy. Those policy beneficiaries born in 1981 or later were new graduates in 2003 and 2005. Thus it is reasonable to assume that they did not accumulate much experience; therefore, the coefficient experience showed a negative relationship with wages during these two years. Another explanation for the increasing trend is that the labour maker prefers experienced employees. When degrees has been less helpful to filter high ability workers, working experience plays an essential role in job hunting. Standard function missed many vital variables, such as ability and family background; therefore, it could not provide specific estimates and more information. In this case, the extended function would offer estimates with higher accuracy..

Tabel 3: Regression of standard Mincer function

Year	2003	2005	2008	2010	2011	2012	2013	2015	2017
lnwage									
Years of education	0.260***	0.253***	0.128***	0.277***	0.217***	0.249***	0.259***	0.191***	0.251***
	(0.032)	(0.036)	(0.033)	(0.027)	(0.042)	(0.031)	(0.023)	(0.027)	(0.020)
Experience	-0.01	-0.017*	0.025***	0.040***	0.034***	0.063***	0.039***	0.048***	0.040***
	(0.009)	(0.009)	(0.008)	(0.008)	(0.012)	(0.008)	(0.007)	(0.008)	(0.005)
Experience square	0.000*	0.001**	-0.000**	-0.001***	0.000	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	3.113***	3.548***	5.479***	3.286***	4.160***	3.789***	3.816***	5.032***	4.378***
	(0.495)	(0.572)	(0.526)	(0.435)	(0.670)	(0.488)	(0.367)	(0.433)	(0.331)
Observations	680	664	576	959	431	820	1,072	904	1,357
R-squared	0.100	0.080	0.047	0.113	0.088	0.132	0.132	0.084	0.126

(Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1)

Results for the extended Mincer function (corresponding to the equation (2)) are present in Table 4. From the R square, one can see that the extended Mincer function holds a higher explanatory power. Comparing the coefficient of years of education in extended and standard functions, one can conclude that the standard Mincer function overestimates the impact of education on income and underestimates the impact of the experience. This finding is consistent with previous literature (i.e. Hu, 2019 and Polachek, 2008) that suggested standard Mincer function tended to overestimate schooling earnings. The experience term only shows a slight difference in the two functions. In addition, respondents' income is closely correlated to regions, and more details would be present in the later section. Current studies reckon that the highest rate of return on education is in the eastern region, followed by the central region, and finally the western region. The negative coefficient of gender suggests that the gender wage gap is enlarging. This conclusion is also consistent with former research such as Polachek (2008), Zhang (2018), Yan (2012) and Hu (2019). The type of work unit also has an impact on income. In particular, since it is not a dummy variable and there is no control group, evidence of which type of work unit has the most significant impact on income cannot obtain from the extended function. However, more details would be present in the heterogeneity analysis section. Turning to

parents' education, one can notice that the mother's educational level has a more significant impact on children. Nontheless, the father's role also shows an upward trend, which is consistent with Zhang and Wan (2018) 's finding. Similarly, Trostel, Walker, and Woolley (2002) concluded that compared with a spouse's education, either parent’s education was more vital to children's education. Moreover, Zhang (2018) captured evidence that parent's education has a different influence on female and male children.

Besides individual-specific factors, the macroeconomic environment may affect employment and income as well. In this case, GDP per capita and unemployment rate by province are included in the extended function. Interestingly, the coefficients of this term present negative correlation with wages, which is contradicted with common wisdom. GDP per capita shows a stronger correlation to respondents’ income since it reflects the primary economic condition; it is more likely for a college student to seek a high-paid job or get a promotion under the booming economic environment. Nonetheless, GDP is unable to explain individuals’ income directly. This finding is supported by Yao, Fang and Zhang (2013); they explained that the increasing GDP per capita would promote the employment rate for college students, but it did not mean their income would increase as follows.

Table 4: Extended Mincer function results

Year	2003	2005	2008	2010	2011	2012	2013	2015	2017
lnwage									
Years of education	0.225***	0.226***	0.173***	0.245***	0.171***	0.215***	0.233***	0.168***	0.217***
	(0.031)	(0.034)	(0.031)	(0.026)	(0.038)	(0.028)	(0.021)	(0.025)	(0.019)
Experience	0.000	-0.002	0.039***	0.056***	0.040***	0.069***	0.046***	0.055***	0.045***
	(0.009)	(0.008)	(0.007)	(0.008)	(0.011)	(0.008)	(0.006)	(0.007)	(0.005)
Experience square	0.000	0.000	-0.001	-0.001***	-0.001**	-0.002***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Region	0.160***	0.141***	0.226***	0.147***	-0.026	-0.034	0.050	0.257***	0.298***
	(0.030)	(0.030)	(0.026)	(0.033)	(0.067)	(0.055)	(0.033)	(0.035)	(0.032)
Gender	-0.085	-0.124***	-0.157***	-0.229***	-0.352***	-0.317***	-0.264***	-0.322***	-0.292***
	(0.046)	(0.045)	(0.050)	(0.048)	(0.067)	(0.048)	(0.037)	(0.046)	(0.038)
Work unit	-0.018	0.029**	0.080***	0.077***	0.081***	0.034**	0.063***	0.041***	0.056***
	(0.014)	(0.015)	(0.016)	(0.015)	(0.022)	(0.015)	(0.012)	(0.014)	(0.012)
Fschoolingyear	0.00	-0.013**	0.00	-0.01	0.00	0.00	0.0144**	0.022***	0.013**
	(0.007)	(0.007)	(0.008)	(0.007)	(0.009)	(0.007)	(0.006)	(0.008)	(0.006)
Mschoolingyear	0.019***	0.021***	0.007	0.0144**	0.015	0.003	0.007	-0.006	0.007
	(0.006)	(0.006)	(0.007)	(0.007)	(0.010)	(0.007)	(0.006)	(0.009)	(0.005)
GDP	0.019	-0.007	-0.0370***	-0.0851***	-0.104***	-0.133***	-0.087***	0.051***	0.080***
	(0.013)	(0.014)	(0.011)	(0.013)	(0.020)	(0.020)	(0.015)	(0.014)	(0.018)
Unemployment	0.008	-0.132***	-0.017	0.070**	0.174***	0.051	-0.001	-0.137***	-0.055**
	(0.036)	(0.020)	(0.041)	(0.031)	(0.067)	(0.046)	(0.022)	(0.028)	(0.022)
Constant	1.047	4.706***	8.042***	12.390***	15.370***	18.530***	13.030***	-0.531	-4.575**
	(1.504)	(1.610)	(1.286)	(1.564)	(2.247)	(2.262)	(1.695)	(1.629)	(2.000)
Observations	680	664	576	959	430	820	1,072	904	1,357
R-squared	0.183	0.253	0.257	0.235	0.314	0.287	0.289	0.246	0.257

(Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1)

In summary, the economic return to higher education does not show a clear rising or decreasing trend. In other words, the contribution of higher education is not apparent, though the income is on the rise. It is worth mentioning that some control variables present evidence of heterogeneity, and specific analysis will be done in the following section.

5.2 Results based on the education policy

In order to exploit the effect of the expansion policy on education years and income more accurately, this paper conducts reduced-form regression analysis on individuals who were born after 1981, i.e. those who got treated by the expansion policy. The dataset in 2003 contains a small number of respondents having working experience; many graduates only had less than one year of experience or were looking for jobs.

Therefore, this part only remains the data from 2005 to 2017 for analysis.

It is evident that the expansion policy improved respondents schooling years from the significant coefficient of *exposed*. Previous studies confirmed this finding (Zhang and Du, 2017; Yu and Hou, 2019; Wang, 2019). Interestingly, the result does not show a strong correlation between schooling and region, which is inconsistent with Yu and Hou (2019)'s research that investigated the expansion policy caused schooling years variance in different regions. Another term needed to mention is the type of work unit. The results imply that the degree requirements in different type of work units vary. Chen (2012) also pointed out that government-affiliated institutions and state-owned enterprises had higher requirements for degrees.

Table 5: the effect of the policy on schooling years

Year	2005	2008	2010	2011	2012	2013	2015	2017
Years of education								
Exposed	0.387***	0.646***	0.603***	0.906***	0.747***	0.410***	0.378***	0.299***
	(0.068)	(0.110)	(0.120)	(0.154)	(0.105)	(0.097)	(0.109)	(0.101)
Experience	-0.008	0.039***	0.008	0.053**	0.077***	0.014	0.000	0.007
	(0.010)	(0.013)	(0.016)	(0.021)	(0.014)	(0.013)	(0.013)	(0.010)
Experience square	0.000	-0.008***	0.000	-0.001***	-0.002***	0.000	0.000	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Region	-0.006	0.006	0.228***	0.058	-0.044	0.039	0.065	0.133***
	(0.034)	(0.035)	(0.044)	(0.090)	(0.066)	(0.047)	(0.047)	(0.045)
Gender	-0.096*	-0.053	-0.055	-0.124	-0.056	-0.065	-0.033	-0.029
	(0.051)	(0.066)	(0.065)	(0.090)	(0.058)	(0.052)	(0.061)	(0.054)
Work unit	-0.067***	-0.107***	-0.084***	-0.048	-0.049***	-0.059***	-0.049***	-0.056***
	(0.016)	(0.021)	(0.020)	(0.029)	(0.018)	(0.017)	(0.019)	(0.017)
Fschoolingyear	0.006	0.017*	0.014	0.015	0.000	0.0317***	0.014	0.035***
	(0.007)	(0.010)	(0.009)	(0.012)	(0.009)	(0.008)	(0.010)	(0.008)
Mschoolingyear	0.006	0.005	0.015	-0.003	0.016**	-0.003	0.018	0.006
	(0.007)	(0.010)	(0.009)	(0.013)	(0.009)	(0.009)	(0.012)	(0.007)
GDP	-0.021	-0.015	-0.127***	-0.018	-0.050**	-0.056***	-0.041**	-0.008
	(0.015)	(0.014)	(0.018)	(0.027)	(0.024)	(0.021)	(0.019)	(0.025)
Unemployment	-0.047*	0.162***	0.195***	-0.217**	0.031	0.088***	-0.072*	-0.121***
	(0.023)	(0.054)	(0.042)	(0.090)	(0.055)	(0.032)	(0.037)	(0.031)
Constant	18.210***	16.450***	28.830***	17.570***	20.240***	21.230***	19.960***	16.400***
	(1.681)	(1.564)	(1.965)	(2.903)	(2.618)	(2.350)	(2.080)	(2.789)
Observations	664	576	959	430	820	1,072	904	1,357
R-squared	0.114	0.133	0.185	0.201	0.098	0.099	0.088	0.101

(Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1)

It is known that the policy extends the schooling years from the above analysis. Table 6 shows the relationship between education and income, given the fact that respondents extended their schooling years. Comparing the results with extended

Mincer regression (table 4), one reasonable conclusion could be obtained that the extended regression, in general, underestimates the positive effect of a higher education degree on individuals' income, which is in line with Jian and Ning (2013)'s paper. They explored the economic return to higher education in 2006 and discovered an underestimated OLS estimate due to selection bias and heterogeneity. Liu (2015) also obtained the same conclusion by analyzing a cohort from 1988 to 2007. Another feature is that the coefficient of the exposed term presents an unstable trend. Su and Meng (2011) thought that the demand for college graduates was dramatically affected by the economic cycle; thus, the rate of return on education also showed a fluctuating trend.

Turning to other control variables, as discussed above, experience term contributes more to wage in later years when young employees have worked for several years. Additionally, the coefficient of gender reflects that the gender wage gap has enlarged; in other words, female's college premium has decreased. Wang (2012), Liu (2015) and Zhang (2018) confirmed this view; all these studies suggested that female's return to education, albeit exceeded male's, the gender wage gap still exists, and with the college premium dropping, the gap seems rising. Type of work units and regions, specific analysis being present in subsection 5.3, also partially explain wage heterogeneity which has been verified by many studies in China and other countries (Wang, 2012; Zhang, 2018; Card, 2001; Choi, 2015).

Table 6: the effect of the policy on wages

Year	2005	2008	2010	2011	2012	2013	2015	2017
lnwage								
Exposed	0.147**	0.793***	0.438***	0.575***	0.333***	0.430***	0.324***	0.459***
	(0.062)	(0.109)	(0.104)	(0.128)	(0.095)	(0.080)	(0.085)	(0.074)
Experience	-0.001	0.012	0.016	0.009	0.041***	0.045***	0.042***	0.063***
	(0.009)	(0.013)	(0.014)	(0.017)	(0.013)	(0.011)	(0.010)	(0.007)
Experience square	0.000	0.000	0.000	0.000	-0.001***	-0.001***	-0.009***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Region	0.139***	0.252***	0.126***	0.057	0.100*	0.060	0.316***	0.290***
	(0.031)	(0.034)	(0.038)	(0.075)	(0.060)	(0.039)	(0.036)	(0.033)
Gender	-0.146***	-0.110*	-0.176***	-0.449***	-0.292***	-0.245***	-0.269***	-0.265***
	(0.046)	(0.066)	(0.056)	(0.075)	(0.052)	(0.043)	(0.048)	(0.039)
Work unit	0.014	0.046**	0.045***	0.052**	0.030*	0.054***	0.018	0.042***
	(0.015)	(0.021)	(0.017)	(0.024)	(0.016)	(0.014)	(0.015)	(0.012)
Fschoolingyear	-0.012*	0.014	-0.005	0.002	0.005	0.020***	0.009	0.021***
	(0.007)	(0.010)	(0.008)	(0.010)	(0.008)	(0.007)	(0.008)	(0.006)
Mschoolingyear	0.022***	-0.003	0.016**	0.021**	0.018**	0.003	0.003	0.004
	(0.006)	(0.010)	(0.008)	(0.011)	(0.008)	(0.007)	(0.009)	(0.005)
GDP	-0.012	-0.029**	-0.059***	-0.074***	-0.081***	-0.067***	0.084***	0.028
	(0.014)	(0.014)	(0.015)	(0.022)	(0.022)	(0.017)	(0.015)	(0.018)
Unemployment	-0.140***	0.087	0.012	0.127*	0.027	-0.021	-0.105***	-0.023
	(0.021)	(0.054)	(0.036)	(0.074)	(0.049)	(0.026)	(0.029)	(0.022)
Constant	8.758***	9.750***	13.970***	15.280***	16.140***	14.530***	-1.497	3.977*
	(1.528)	(1.553)	(1.707)	(2.402)	(2.363)	(1.931)	(1.625)	(2.032)
Observations	664	576	959	430	820	1072	904	1357
R-squared	0.208	0.255	0.124	0.255	0.162	0.139	0.178	0.179

(Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1)

5.3 Heterogeneity analysis

As previous sections address, heterogeneous returns among different demographic groups are frequently discussed in former studies. This paper quantifies several regressions to estimate common sources of heterogeneity. Some dummy variables are added in this section.

There are two primary criteria to analyze region heterogeneity. One way is dividing regions according to regional economic development (Choi, 2015; Polachek, 2008; Peng, 2011; Moretti, 2004). The intuition behind it is that these studies assume that the regional economic levels are highly correlated to both income and the demand for high-quality labour. In particular, researchers usually explore regional heterogeneity in

China from eastern, western and middle regions. Current studies showed contradicted findings in terms of region heterogeneity. The reason for this contradiction is that scholars (Zhang and Xu, 2015; Liu, 2015; Yu and Hou, 2019) selected relative short periods or only one year. The supply and demand for the labour market changed dramatically; therefore, the interpretations varied. Since previous studies have provided various conclusions on region heterogeneity, this thesis would investigate the regression in a more extended cohort to obtain a comprehensive view.

The other dividing way is based on higher educational resources by provinces. Zhang (2018) pointed out that this classification is more in line with the actual situation in China because colleges are more inclined to enrol local students. It is reasonable to think that students from provinces rich in higher education resources are more likely to get university education after enrollment expansion. According to Ma et al. (2007), who summarised the higher education competitiveness ranking by provinces (Chinese mainland), this thesis selects the top ten and the last ten provinces[4] to compare variances in terms of schooling and related income result from the expansion policy. Specifically, this thesis runs the same regressions as equation (3) and (4) in two different samples and the results are shown in appendix B1 and appendix B2.

As appendix B1 presents, the impact of expansion policy on individuals in areas with rich educational resources shows a slight slowdown and tends to be stable. One likely explanation is that the admission rate in these provinces had reached a higher level before the expansion. Similar to the years of education, the return to higher education presents the same trend. However, for the provinces that are not rich in higher education resources, although there is a downward trend in recent years, the expansion policy has a more significant impact on these provinces both in schooling years and income. This conclusion is also consistent with that of Zhang and Wan (2018). They thought that the impact of the expansion policy on the provinces with

[4] Top 10 provinces: Beijing, Jiangsu, Shanghai, Shandong, Liaoning, Guangdong, Hubei, Shaanxi, Zhejiang, Sichuan
The last 10 provinces: Yunnan, Guangxi, Gansu, Xinjiang, Inner Mongolia, Guizhou, Hainan, Ningxia, Qinghai, Tibet

fewer educational resources was more significant than that on the provinces with rich educational resources.

It is worth noting that the observables from the provinces with fewer higher education resources are much fewer than those from the provinces with rich higher education resources, which may lead to biased empirical results. In addition, provinces with rich educational resources own relative stronger socioeconomics; therefore, income will also be affected by urban living cost premium.

Then turn to the second way of quantifying the regional heterogeneity. Equations make some changes in order to test regressions. In detail, the whole sample was divided into three subsamples according to the regions respondents came from. For example, when testing the economic return in the eastern region during the post-expansion policy, D_i equals to 1 if the respondent lives in the eastern region and was born later in 1981; otherwise, D_i equals to 0. Other variables keep the same meaning as before.

Comparing returns during the post-expansion period and the whole sample for each region, the evidence of degree premium is evident among the three regions. In particular, the eastern region, which contains most provinces with rich higher education resources, shows a slowdown trend after the policy increased enrollment possibility, which is similar to the above subsample of provinces with rich higher education resources. The middle region, less competitive than the eastern but more substantial than the western region, presents a fluctuating trend. The finding was favoured by other scholars who tested the economic return among several years but concluded different views to the middle region (Liu, 2015; Yu and Hou, 2019; Li and Xing, 2010). Economic return in the western region decreased gradually after 2008. Yu and Hou (2019) stated that a potential explanation for the trend was that before the enrollment expansion, the quality of middle school education in western China was relatively low. After expanding colleges and universities, many students with

insufficient ability may be admitted, which caused the decrease of the matching degree between the university degree signal and the actual ability in the western region, thus reducing the wage premium of college students in the labour market.

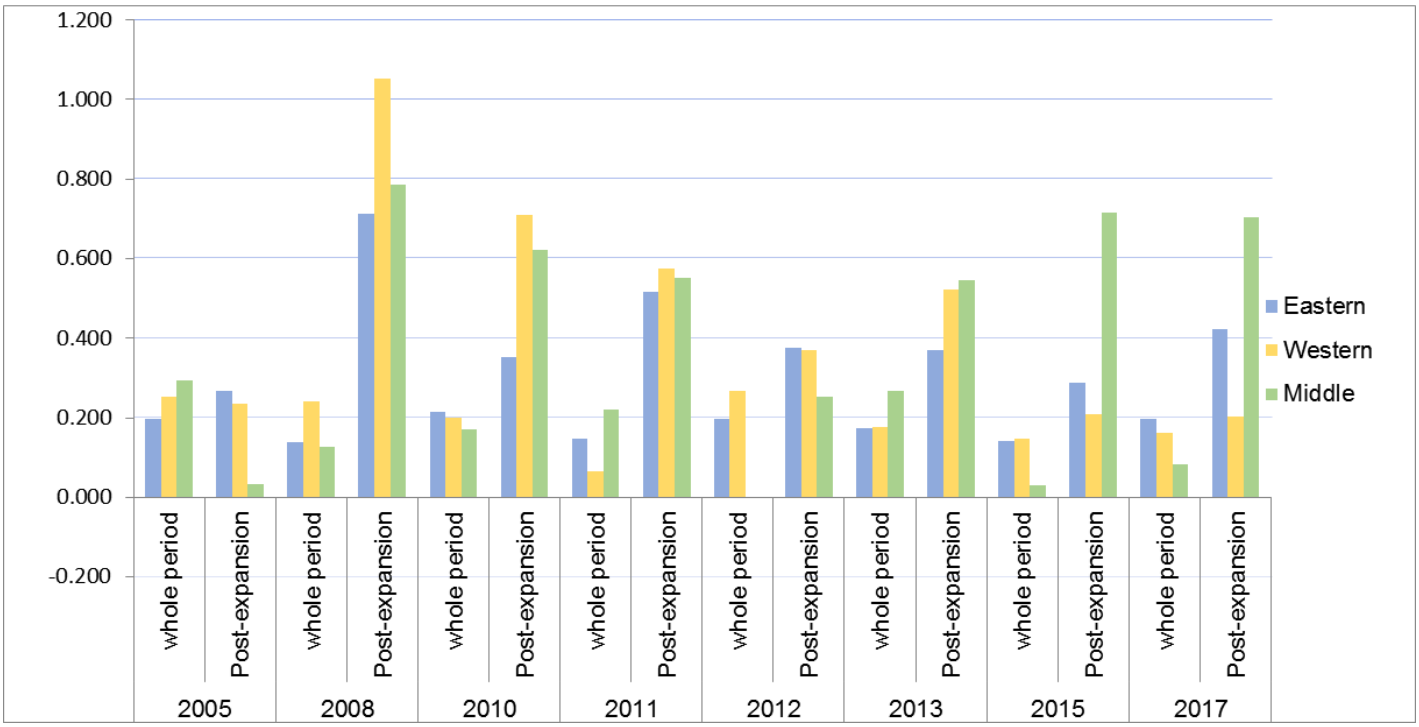


Figure 2[5]：Rate of return to higher education in different regions

Through descriptive statistics, one can know that only enterprise, government organizations and affiliated institutions have complete data, and the rest of the types of work units have few observations in some years. Therefore, this paper divides the types of work units into two categories: enterprises and government agencies, and explores the heterogeneity return of educational background in different work units. The average return to higher education is 0.199 in enterprise and 0.166 in government or related institutions. From the below figure, one can see that after 2010, both lines show the same trend. The decreasing heterogeneity means a fairer labour market, which was confirmed by Zhang (2018).

[5] Regression results are present in appendix C

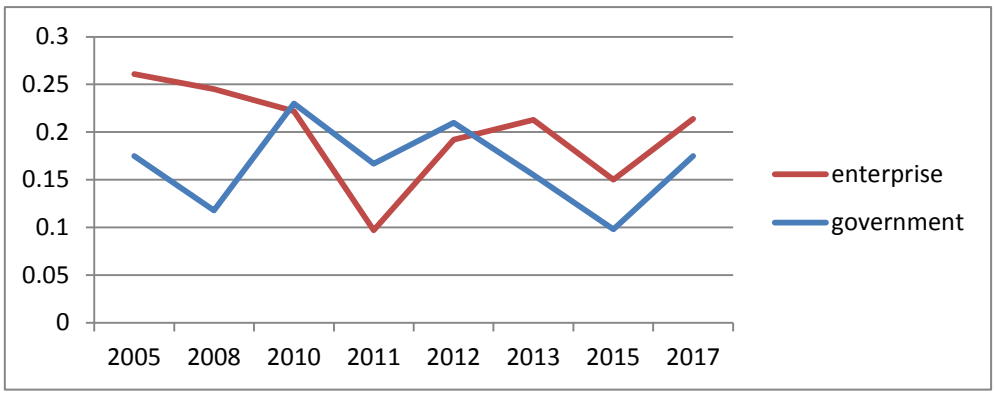


Figure 3[6]: Rate of return to higher education in different types of work units

Another two potential factors causing heterogeneous earnings are gender, discussed in the above section, and parents' education. Since higher education has made progress in recent two decades, the surveys do not contain many observables whose parents attained higher education (fewer than ten samples in every survey). In this case, it is hard to explore whether parents who went to college would increase children's possibility of obtaining higher education and earnings. However, from the above empirical results and previous literature, it is known that parents education is correlated to children's schooling and income.

5.4 Robustness checks

As the previous section introduced, regression discontinuity is another common approach. It is a helpful tool when a cutoff criterion is applied to identify the eligible beneficiaries of an intervention. It assumes that observations around the threshold own similar characteristics; thus, the only factor that affects individuals obtain different outcomes is the treatment. The thesis treats the year of the expansion policy issued, 1999, as the cut-off point and compares respondents who have a similar background (regions, types of the work unit, etc) but were born after 1981 and those born before 1981 in terms of schooling and wages. The regression provides the average treatment effect.

[6] Regression results are present in appendix D

According to appendix E3, it is apparent that both years of education and wages had jumped around 1981. This means that the policy changed individuals' schooling years and wages significantly. Before running the regression, this paper tests whether there is a significant difference in covariates at two sides of the breakpoint. From table E1, one can know that there is no significant difference in covariates. In other words, the result suggests schooling years and wages are only affected by the policy within the given bandwidth. Appendix E2 shows the regression results given the default bandwith in STATA (lwald) and the optimal bandwidth(lwald(bw)). It can be seen that except for several years, the expansion policy has a positive impact on the increase of education years and wage income whereas most results are insignificant. This result is consistent with the research results of Zhang and Du (2017). They concluded that only for high-income groups the enrollment expansion has a significant positive impact on their income while the whole sample did not capture evident impact. Since this thesis does not divide individuals' income into groups, it is reasonable that the results for the whole sample are insignificant. Another potential explanation comes from Yu and Hou (2019). They did not find significant changes in wage and education for the whole sample but the two variables showed significant results around the threshold in the regional subsample. Also, this paper captures the regional heterogeneity in the above analysis, implying that regional variance exists. It is reasonable to consider that the result is insignificant for the whole sample but may be significant in some subsamples.

5.5 Discussion

Future research could be applied in three dimensions. Many studies, including this thesis, only use cross-sectional data due to the limitation of datasets. Therefore, if more research could concentrate on panel data and longitudinal data, estimates would show higher validity. Moreover, although researchers tried various econometric methods to reduce heterogeneity, there is no standard approach for the empirical study on this topic. In this case, modifying the econometric methods would be a new

direction. Another dimension to enrich the research on this topic is to study other similar expansion policy either in China or other countries and evaluate and compare policies. For example, in recent years, the number of master students in China increases dramatically. This begs questions such as higher degrees will bring higher economic returns? Some scholars concern that expansion policy at the master degree level may arise from overeducating, which describes an individual's educational attainment exceeding his job's average requirement. Since few individuals have obtained a master degree in the sample, this thesis does not investigate the question. Additionally, this thesis only discusses personal return but does not include the social return to higher education; thus, the research would become more comprehensive if social return could be contained.

As previous sections mentioned, one of the major challenges is solving heterogeneity problems when measuring the economic return to education. Scholars figured out various alternatives, but there is not an effective method among current studies. Therefore, estimates in this thesis may be biased as well. Another drawback of the thesis regards raw data collection and data arrangement. Some measurement errors and sample size differences possibly lead to inaccurate empirical results. For further research, estimates will be more precise if some econometric methods effectively solve the heterogeneity problem. Moreover, it would be interesting if more potential heterogeneous factors could be explored. Besides, the thesis does not test whether there are correlations among these control variables and does not adjust wages based inflation rate, which may lead to biased estimates.

6. Conclusion

The thesis investigates whether the higher education expansion policy would impact individuals education years and income. In order to investigate the two questions, the thesis employed standard and extended Mincer functions. Both functions offered a positive relationship between schooling and income, but the relationship does not

present a clear trend. This finding is consistent with Yu and Hou (2019). Nevertheless, Mincer functions are not able to explain the effect of expansion on schooling. Through results of policy-specific regression, it is obvious that the expansion policy increases respondents' schooling years and wages.

Some covariables in regressions are significant, reflecting that the economic return to higher education varies among subsamples. Therefore, the thesis conducts a heterogeneous analysis. One of the potential heterogeneous return sources is regions. This thesis discussed it in two aspects. Given the classification of educational resources, one can see that regions with fewer higher education resources benefit more; this also promotes social equity to a certain extent. According to the level of economic development, individuals in the eastern region are least affected by the expansion policy. In contrast, return to schooling in the western region shows a rising trend while slightly decreases since 2008; middle region's trend fluctuates the most, verified by previous studies. In a word, expansion policy adjusted the unbalanced distribution of educational resources and economic development so that students with lower ability can enter colleges. However, the signal effect from a college degree does not improve their income significantly. This conclusion partially explains why it is harder for college graduates to obtain a job. Also, Xu (2010), Liang (2006), Feng and Li (2009) pointed out that it was necessary to correct the deviation of excessive enrollment expansion.

In terms of types of work units, respondents working in enterprises tend to earn more than those working in government departments, given the same educational backgrounds. The empirical results also present that gender and parents' schooling are other factors that influence respondents' schooling and income.

Appendix

A1: Indecies of per capita GDP by province: 2003 – 2017

Province	2003	2005	2008	2010	2011	2012	2013	2015	2017
Beijing	111	111.8	109.1	110.3	103.8	104.9	105.2	105.5	106.7
Tianjin	115	114.7	116.5	117.4	110.9	109.2	108	106.6	103.3
Hebei	112	113.4	110.1	112.2	109.7	108.9	107.5	106.1	105.9
Shanxi	115	112.6	108.5	113.9	110.4	109.6	108.4	102.6	106.5
Neimenggu	118	123.8	117.8	115	113.8	111.1	108.7	107.4	103.6
Liaoning	112	112.3	113.4	114.2	111.7	109.3	108.6	103.1	104.3
Jiling	110	112.1	116	113.8	113.5	111.9	108.3	106.3	106
Heilongjiang	110	111.6	111.8	112.7	112.2	110.1	107.9	106	106.7
Shanghai	112	111.1	109.7	110.3	105	105.7	106.2	106.9	106.8
Jiangsu	114	114.5	112.7	112.7	110.3	109.8	109.3	108.3	106.8
Zhejiang	115	112.8	110.1	111.9	107.2	107.7	107.9	107.6	106.6
Anhui	109	111.6	112.7	114.6	112.6	111.8	109.9	107.7	107.5
Fujian	112	111.6	113	113.9	111.6	110.5	110.2	108	107.1
Jiangxi	113	112.8	113.2	114	111.8	110.4	109.6	108.5	108.1
Shandong	113	115.2	112	112.3	109.9	109.2	109	107.3	106.5
Henan	111	114.2	112.1	112.5	112.5	110.1	108.9	107.9	107.4
Hubei	110	112.1	113.4	114.8	113.5	110.7	109.7	108.4	107.3
Hunan	110	111.6	113.9	114.6	111.2	110.7	109.3	107.8	107.4
Guangdong	115	113.8	110.4	112.4	108	107.4	107.8	107	106
Guangxi	110	113.2	112.8	114.2	112	110.4	109.4	107.2	106.3
Hainan	111	110.2	110.3	116	111.1	108	108.7	106.9	106.2
Chongqing	111	111.5	114.5	117.1	115.1	112.4	111.3	110.1	108.2
Sichuan	111	112.6	110	115.1	115.9	112.3	109.6	107.2	107.5
Guizhou	110	111.6	111.3	112.8	116.1	113.5	111.9	110.3	109.4
Yunan	109	109	110.6	112.3	112.9	112.3	111.5	108	108.8
Tibet	112	112.1	110.1	112.3	111.3	110.4	110.5	108.9	107.9
Shanxi	112	112.6	116.4	114.6	113.7	112.6	110.7	107.5	107.3
Gansu	111	111.8	110.1	111.8	112.3	112.2	110.4	107.7	103
Qinghai	112	112.2	113.5	115.3	112.3	111.3	109.9	107.2	106.4
Ningxia	113	110.9	112.6	113.5	110.8	110.3	108.6	106.9	106.7
Xinjiang	111	110.9	110	110.6	110.7	110.8	109.6	106.6	105.7

A2: Unemployment rate (percent) by province: 2003 – 2017

Province	2003	2005	2008	2010	2011	2012	2013	2015	2017
Beijing	1.4	2.11	1.8	1.37	1.39	1.27	1.21	1.4	1.4
Tianjin	3.8	3.7	3.6	3.6	3.6	3.6	3.6	3.5	3.5
Hebei	3.9	3.93	4	3.86	3.75	3.69	3.68	3.6	3.7
Shanxi	3	3.01	3.3	3.58	3.48	3.33	3.13	3.5	3.4
Neimenggu	4.5	4.26	4.1	3.9	3.8	3.73	3.66	3.7	3.6
Liaoning	6.5	5.62	3.9	3.63	3.68	3.55	3.35	3.4	3.8
Jiling	4.3	4.2	4	3.8	3.7	3.65	3.7	3.5	3.5
Heilongjiang	4.2	4.42	4.2	4.27	4.1	4.15	4.44	4.5	4.2
Shanghai	4.9	0	4.2	4.35	3.54	3.05	3.98	4	3.9
Jiangsu	4.1	3.56	3.3	3.16	3.22	3.14	3.03	3	3
Zhejiang	4.2	3.72	3.5	3.2	3.12	3.01	3.01	2.9	2.7
Anhui	4.1	4.4	3.9	3.66	3.74	3.68	3.41	3.1	2.9
Fujian	4.1	3.95	3.9	3.77	3.69	3.63	3.55	3.7	3.9
Jiangxi	3.6	3.48	3.4	3.31	2.98	3	3.17	3.4	3.3
Shandong	3.6	3.33	3.7	3.36	3.35	3.33	3.24	3.4	3.4
Henan	3.1	3.45	3.4	3.38	3.35	3.08	3.09	3	2.8
Hubei	4.3	4.33	4.2	4.18	4.1	3.83	3.49	2.6	2.6
Hunan	4.5	4.27	4.2	4.16	4.21	4.23	4.2	4.1	4
Guangdong	2.9	2.58	2.6	2.52	2.46	2.48	2.43	2.5	2.5
Guangxi	3.6	4.15	3.8	3.66	3.46	3.41	3.3	2.9	2.2
Hainan	3.4	3.55	3.7	3	1.73	2.01	2.17	2.3	2.3
Chongqing	4.1	4.12	4	3.9	3.5	3.3	3.4	3.6	3.4
Sichuan	4.4	4.61	4.6	4.14	4.16	4.02	4.11	4.1	4
Guizhou	4	4.2	4	3.64	3.63	3.29	3.26	3.3	3.2
Yunan	4.1	4.17	4.2	4.21	4.05	4.03	3.98	4	3.2
Tibet	/	/	/	3.99	3.2	2.58	2.47	2.5	2.7
Shanxi	3.5	4.18	3.9	3.85	3.59	3.22	3.32	3.4	3.3
Gansu	3.4	3.26	3.2	3.21	3.11	2.68	2.3	2.1	2.7
Qinghai	3.8	3.93	3.8	3.8	3.76	3.37	3.31	3.2	3.1
Ningxia	4.4	4.52	4.4	4.35	4.4	4.18	4.06	4	3.9
Xinjiang	3.5	3.92	3.7	3.23	3.22	3.39	3.36	2.9	2.6

B1: the effect of the policy on schooling years in provinces with different higher education resources

Year	2005		2008		2010		2011		2012	
	top ranking	low ranking	top ranking	low ranking	top ranking	low ranking	top ranking	low ranking	top ranking	low ranking
Years of education										
Exposed	0.295***	0.469	0.487***	1.273***	0.572***	1.218***	1.334***	1.011**	0.650***	1.380***
	(0.103)	(0.319)	(0.151)	(0.354)	(0.163)	(0.290)	(0.212)	(0.468)	(0.124)	(0.448)
Experience	-0.019	0.004	0.026	0.136**	-0.004	0.125**	0.083***	0.226**	0.066***	0.141**
	(0.015)	(0.039)	(0.019)	(0.059)	(0.021)	(0.055)	(0.031)	(0.090)	(0.016)	(0.061)
Experience square	0.000	0.000	0.000	-0.004**	0.000	-0.003**	-0.002***	-0.005**	-0.001***	-0.003**
	(0.000)	(0.001)	(0.000)	(0.002)	(0.000)	(0.001)	(0.001)	(0.002)	(0.000)	(0.001)
Gender	-0.113	-0.033	-0.129	-0.264	-0.016	-0.387**	-0.099	-0.072	-0.038	-0.092
	(0.077)	(0.139)	(0.092)	(0.232)	(0.091)	(0.149)	(0.136)	(0.260)	(0.070)	(0.222)
Work unit	-0.073***	-0.089*	-0.098***	-0.170**	-0.148***	-0.029	-0.023	-0.055	-0.039*	-0.175**
	(0.026)	(0.045)	(0.030)	(0.069)	(0.029)	(0.045)	(0.044)	(0.081)	(0.022)	(0.074)
Fschoolingyear	0.008	-0.008	0.009	0.028	-0.001	0.033	0.026	0.016	-0.001	-0.013
	(0.011)	(0.022)	(0.014)	(0.039)	(0.013)	(0.025)	(0.018)	(0.039)	(0.011)	(0.030)
Mschoolingyear	0.002	0.037*	0.008	0.021	0.019	-0.002	-0.002	0.011	0.024**	-0.009
	(0.010)	(0.020)	(0.014)	(0.034)	(0.013)	(0.020)	(0.019)	(0.047)	(0.010)	(0.031)
GDP	-0.025	-0.032	-0.035	-0.032	-0.301***	-0.051	-0.005	0.098	-0.060**	0.028
	(0.030)	(0.025)	(0.022)	(0.051)	(0.031)	(0.056)	(0.033)	(0.121)	(0.027)	(0.320)
Unemployment	-0.034	0.110	0.172***	0.652	0.276***	0.520**	-0.260**	0.535	0.079	-0.394
	(0.027)	(0.217)	(0.060)	(0.495)	(0.048)	(0.235)	(0.114)	(0.329)	(0.062)	(8.755)
Constant	18.860***	18.660***	18.810***	16.050***	49.310***	18.290***	15.850***	0.686	21.060***	13.260
	(3.367)	(2.765)	(2.459)	(4.843)	(3.490)	(6.104)	(3.344)	(13.610)	(2.779)	(64.760)
Observations	350	87	293	72	566	114	248	41	591	63
R-squared	0.104	0.155	0.112	0.352	0.267	0.301	0.262	0.308	0.088	0.271

Continue

Year	2013		2015		2017	
	top ranking	low ranking	top ranking	low ranking	top ranking	low ranking
Years of education						
Exposed	0.409***	1.101***	0.396***	-0.194	0.357***	0.701**
	(0.133)	(0.327)	(0.142)	(0.340)	(0.133)	(0.269)
Experience	0.005	0.141***	-0.002	-0.059	0.011	-0.037
	(0.017)	(0.044)	(0.017)	(0.043)	(0.013)	(0.029)
Experience square	0.000	-0.003***	0.000	0.000	0.000	0.000
	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)
Gender	-0.177**	0.091	0.008	-0.156	-0.072	0.038
	(0.075)	(0.159)	(0.081)	(0.180)	(0.072)	(0.125)
Work unit	-0.065**	-0.041	-0.067***	-0.002	-0.040*	-0.071*
	(0.026)	(0.048)	(0.024)	(0.055)	(0.023)	(0.039)
Fschoolingyear	0.039***	0.014	0.020	0.021	0.046***	0.017
	(0.012)	(0.022)	(0.013)	(0.032)	(0.011)	(0.022)
Mschoolingyear	-0.014	0.026	0.022	-0.028	-0.001	-0.006
	(0.013)	(0.023)	(0.015)	(0.038)	(0.010)	(0.018)
GDP	-0.095***	0.038	-0.035	-0.002	-0.034	-0.077*
	(0.028)	(0.062)	(0.028)	(0.064)	(0.047)	(0.039)
Unemployment	0.195***	-0.167	-0.081*	0.060	-0.136***	0.079
	(0.042)	(0.153)	(0.046)	(0.159)	(0.036)	(0.145)
Constant	25.300***	10.070	19.510***	16.500**	19.480***	24.770***
	(2.981)	(6.801)	(3.014)	(6.925)	(5.027)	(4.142)
Observations	633	101	574	83	908	95
R-squared	0.129	0.184	0.094	0.173	0.089	0.192

B2: The effect of the policy on wages in provinces with different higher education resources

Year	2005		2008		2010		2011	
	top ranking	low ranking	top ranking	low ranking	top ranking	low ranking	top ranking	low ranking
lnwage								
Exposed	0.176**	0.180	0.788***	0.296	0.170	0.755**	0.493***	0.124
	(0.085)	(0.289)	(0.156)	(0.260)	(0.134)	(0.298)	(0.159)	(0.479)
Experience	0.000	0.019	0.014	-0.072	0.007	-0.060	0.016	-0.145
	(0.012)	(0.035)	(0.019)	(0.044)	(0.018)	(0.057)	(0.023)	(0.092)
Experience square	0.000	0.000	0.000	0.002*	0.000	0.001	0.000	0.003
	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.002)	(0.001)	(0.002)
Gender	-0.065	-0.105	-0.182*	-0.152	-0.156**	-0.261*	-0.432***	-0.295
	(0.063)	(0.126)	(0.095)	(0.170)	(0.075)	(0.153)	(0.102)	(0.266)
Work unit	0.036*	-0.073*	-0.012	0.076	0.009	0.116**	0.089***	-0.070
	(0.021)	(0.040)	(0.031)	(0.051)	(0.024)	(0.046)	(0.033)	(0.083)
Fschoolingyear	-0.011	-0.021	0.007	0.045	-0.022**	0.025	0.004	-0.002
	(0.009)	(0.020)	(0.015)	(0.028)	(0.011)	(0.025)	(0.013)	(0.040)
Mschoolingyear	0.016*	0.033*	0.007	-0.034	0.023**	-0.004	0.033**	-0.019
	(0.008)	(0.018)	(0.014)	(0.025)	(0.011)	(0.021)	(0.014)	(0.048)
GDP	0.005	0.037	-0.115***	-0.040	-0.176***	-0.025	-0.053**	-0.088
	(0.025)	(0.022)	(0.023)	(0.037)	(0.026)	(0.058)	(0.025)	(0.124)
Unemployment	-0.166***	-0.172	0.175***	0.254	0.108***	0.053	0.088	0.408
	(0.022)	(0.196)	(0.062)	(0.364)	(0.040)	(0.241)	(0.085)	(0.337)
Constant	7.262***	3.834	20.19***	10.85***	27.69***	10.54*	12.92***	17.960
	(2.771)	(2.500)	(2.537)	(3.560)	(2.873)	(6.270)	(2.499)	(13.930)
Observations	350	87	293	72	566	114	248	41
R-squared	0.229	0.113	0.252	0.231	0.137	0.313	0.196	0.282

Continue

Year	2012		2013		2015		2017	
	top ranking	low ranking	top ranking	low ranking	top ranking	low ranking	top ranking	low ranking
lnwage								
Exposed	0.378***	0.301	0.359***	0.717**	0.336***	0.038	0.397***	0.456**
	(0.106)	(0.307)	(0.098)	(0.288)	(0.105)	(0.312)	(0.094)	(0.227)
Experience	0.053***	0.059	0.053***	0.026	0.054***	0.070*	0.056***	0.071***
	(0.014)	(0.042)	(0.013)	(0.039)	(0.013)	(0.040)	(0.009)	(0.025)
Experience square	-0.001***	-0.002	-0.001***	0.000	-0.001***	-0.002*	-0.001***	-0.001
	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)
Gender	-0.275***	-0.137	-0.208***	-0.044	-0.279***	-0.049	-0.308***	0.036
	(0.060)	(0.153)	(0.056)	(0.140)	(0.060)	(0.165)	(0.051)	(0.105)
Work unit	0.010	-0.028	0.035*	0.050	0.023	0.025	0.058***	-0.017
	(0.019)	(0.051)	(0.019)	(0.042)	(0.018)	(0.051)	(0.016)	(0.033)
Fschoolingyear	0.001	0.014	0.0156*	0.000	0.000	0.044	0.030***	0.012
	(0.009)	(0.020)	(0.009)	(0.019)	(0.010)	(0.029)	(0.007)	(0.018)
Mschoolingyear	0.019**	-0.021	-0.002	0.015	0.015	-0.032	0.004	0.012
	(0.009)	(0.022)	(0.009)	(0.021)	(0.011)	(0.035)	(0.007)	(0.015)
GDP	-0.142***	0.462**	-0.123***	0.019	0.117***	0.102*	-0.013	-0.036
	(0.023)	(0.220)	(0.020)	(0.054)	(0.021)	(0.059)	(0.033)	(0.033)
Unemployment	0.142***	9.680	0.115***	-0.117	-0.166***	0.104	-0.034	0.073
	(0.053)	(6.011)	(0.031)	(0.135)	(0.034)	(0.147)	(0.025)	(0.123)
Constant	22.71***	-76.58*	20.60***	5.535	-4.064*	-4.002	9.170***	11.11***
	(2.370)	(44.460)	(2.203)	(5.991)	(2.230)	(6.364)	(3.548)	(3.498)
Observations	591	63	633	101	574	83	907	95
R-squared	0.167	0.191	0.130	0.153	0.137	0.129	0.120	0.241

C1: Regressions of return to higher education in three regions

Year	2005			2008			2010			2011		
Region	Eastern	Western	Middle	Eastern	Western	Middle	Eastern	Western	Middle	Eastern	Western	Middle
lnwage												
Years of eudcation	0.198***	0.252***	0.293***	0.138**	0.242*	0.126	0.216***	0.199**	0.171**	0.146***	0.066	0.219**
	(0.043)	(0.076)	(0.085)	(0.058)	(0.135)	(0.083)	(0.031)	(0.084)	(0.085)	(0.044)	(0.168)	(0.101)
Experience	-0.004	0.033	-0.009	-0.036***	-0.162***	-0.109***	0.006	-0.124***	-0.020	-0.032**	-0.129**	-0.018
	(0.010)	(0.025)	(0.018)	(0.012)	(0.039)	(0.021)	(0.011)	(0.028)	(0.019)	(0.016)	(0.062)	(0.020)
Experience square	0.000	-0.001	0.001	0.000	0.005***	0.003***	0.000	0.003***	0.000	0.001	0.003	0.001
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.002)	(0.000)
Gender	-0.143**	-0.058	-0.193*	-0.140	-0.310	0.067	-0.177**	-0.123	-0.222**	-0.440***	0.020	-0.531***
	(0.059)	(0.102)	(0.099)	(0.090)	(0.213)	(0.146)	(0.070)	(0.134)	(0.108)	(0.094)	(0.250)	(0.145)
Work unit	0.031	0.029	0.033	0.030	0.004	0.131***	0.059***	0.010**	0.045	0.072**	-0.044	0.042
	(0.020)	(0.033)	(0.032)	(0.029)	(0.069)	(0.047)	(0.022)	(0.041)	(0.033)	(0.031)	(0.072)	(0.046)
Fschoolingyear	-0.016*	0.002	-0.010	0.012	0.031	-0.003	-0.020**	0.032	-0.004	-0.004	-0.005	0.010
	(0.008)	(0.016)	(0.015)	(0.014)	(0.032)	(0.021)	(0.010)	(0.020)	(0.014)	(0.012)	(0.037)	(0.018)
Mschoolingyear	0.022***	0.013	0.0281*	-0.005	-0.006	0.028	0.0215**	-0.013	-0.004	0.031**	-0.024	0.018
	(0.01)	(0.02)	(0.01)	(0.01)	(0.03)	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.04)	(0.02)
GDP	-0.042**	0.041**	-0.002	-0.039*	0.004	-0.109**	-0.033*	-0.003	0.129*	-0.047*	0.028	0.001
	(0.021)	(0.021)	(0.106)	(0.022)	(0.037)	(0.045)	(0.017)	(0.063)	(0.066)	(0.026)	(0.097)	(0.100)
Unemployment	-0.126***	0.063	0.213	0.037	0.062	0.877***	0.023	-0.287	-0.543***	0.134	0.503	-0.342
	(0.023)	(0.154)	(0.271)	(0.060)	(0.320)	(0.230)	(0.038)	(0.255)	(0.146)	(0.083)	(0.345)	(0.226)
Constant	9.569***	-2.175	1.877	10.40***	3.960	14.81***	8.350***	6.929	-7.493	10.72***	3.514	5.398
	(2.437)	(2.747)	(12.940)	(2.569)	(4.640)	(4.680)	(2.036)	(7.082)	(7.540)	(2.742)	(10.760)	(10.800)
Observations	386	136	137	331	79	114	608	150	193	272	52	106
R-squared	0.238	0.125	0.191	0.099	0.326	0.383	0.148	0.298	0.114	0.201	0.286	0.233

Continue

Year	2012			2013			2015			2017		
Region	Eastern	Western	Middle	Eastern	Western	Middle	Eastern	Western	Middle	Eastern	Western	Middle
lnwage												
Years of eudcation	0.196***	0.267***	-0.001	0.174***	0.176**	0.267***	0.141***	0.146	0.031	0.196***	0.161**	0.084
	(0.032)	(0.085)	(0.157)	(0.027)	(0.078)	(0.079)	(0.029)	(0.094)	(0.067)	(0.021)	(0.070)	(0.057)
Experience	0.013	0.024	-0.019	0.019**	-0.052**	0.014	0.019**	0.087***	-0.014	0.030***	0.046**	0.057***
	(0.009)	(0.025)	(0.031)	(0.008)	(0.022)	(0.020)	(0.009)	(0.021)	(0.015)	(0.006)	(0.018)	(0.013)
Experience square	-0.001**	-0.001	0.001	-0.000*	0.001**	0.000	-0.000*	-0.002***	0.000	-0.001***	-0.001	-0.002***
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Gender	-0.294***	-0.159	-0.425**	-0.208***	-0.217*	-0.377***	-0.337***	-0.070	-0.191*	-0.322***	-0.143	-0.221**
	(0.055)	(0.143)	(0.200)	(0.049)	(0.124)	(0.103)	(0.057)	(0.137)	(0.105)	(0.046)	(0.092)	(0.091)
Work unit	0.017	0.052	0.062	0.048***	0.058	0.047	0.015	0.056	0.045	0.050***	-0.001	0.091***
	(0.018)	(0.051)	(0.056)	(0.017)	(0.037)	(0.033)	(0.017)	(0.038)	(0.035)	(0.015)	(0.029)	(0.027)
Fschoolingyear	0.001	0.009	0.008	0.010	0.012	0.023	-0.001	0.035	0.020	0.015**	0.026	-0.005
	(0.009)	(0.019)	(0.027)	(0.008)	(0.017)	(0.015)	(0.009)	(0.024)	(0.018)	(0.007)	(0.016)	(0.014)
Mschoolingyear	0.0165*	-0.009	0.019	-0.003	0.016	-0.003	0.008	-0.030	-0.010	0.003	0.005	0.013
	(0.01)	(0.02)	(0.03)	(0.01)	(0.02)	(0.02)	(0.01)	(0.03)	(0.02)	(0.01)	(0.01)	(0.01)
GDP	-0.118***	0.113**	0.047	-0.102***	0.008	0.058	0.143***	0.099*	0.059**	0.072***	-0.009	-0.165**
	(0.023)	(0.054)	(0.109)	(0.020)	(0.053)	(0.080)	(0.021)	(0.051)	(0.026)	(0.021)	(0.035)	(0.078)
Unemployment	0.128**	-0.197	-0.368	0.055*	-0.037	-0.220**	-0.171***	0.066	0.018	0.011	-0.248***	0.196**
	(0.051)	(0.364)	(0.270)	(0.030)	(0.111)	(0.100)	(0.032)	(0.118)	(0.089)	(0.024)	(0.091)	(0.091)
Constant	17.60***	-8.426	3.984	16.12***	4.669	-1.944	-8.374***	-6.002	1.648	-2.434	7.039*	23.53***
	(2.475)	(6.796)	(12.340)	(2.203)	(6.008)	(9.073)	(2.283)	(5.720)	(3.188)	(2.329)	(4.105)	(8.521)
Observations	642	71	107	755	137	180	602	114	188	977	148	232
R-squared	0.182	0.269	0.099	0.139	0.134	0.183	0.174	0.180	0.151	0.171	0.198	0.273

C2: Regressions of return to higher education in three regions during post-expansion period

Year	2005			2008			2010			2011		
	Eastern	Western	Middle	Eastern	Western	Middle	Eastern	Western	Middle	Eastern	Western	Middle
lnwage												
Exposed	0.269***	-0.236	0.033	0.712***	1.053***	0.785***	0.353***	0.711***	0.621***	0.517***	0.576	0.551*
	(0.082)	(0.213)	(0.115)	(0.142)	(0.355)	(0.247)	(0.129)	(0.258)	(0.224)	(0.149)	(0.475)	(0.316)
Experience	0.000	0.009	-0.013	0.023	-0.048	-0.037	0.024	-0.045	0.047	0.014	-0.045	0.020
	(0.011)	(0.032)	(0.019)	(0.017)	(0.056)	(0.031)	(0.017)	(0.041)	(0.030)	(0.022)	(0.091)	(0.034)
Experience square	0.000	0.000	0.001	-0.001*	0.002	0.001*	-0.001*	0.001	-0.001	0.000	0.001	0.000
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.002)	(0.001)
Gender	-0.161***	-0.079	-0.193*	-0.140	-0.319	-0.002	-0.185**	-0.188	-0.202*	-0.438***	-0.078	-0.602***
	(0.060)	(0.106)	(0.104)	(0.088)	(0.205)	(0.141)	(0.073)	(0.129)	(0.107)	(0.094)	(0.255)	(0.144)
Work unit	0.018	0.009	0.028	0.031	-0.005	0.109**	0.033	0.092**	0.027	0.076**	-0.037	0.011
	(0.020)	(0.034)	(0.034)	(0.028)	(0.064)	(0.043)	(0.023)	(0.041)	(0.032)	(0.031)	(0.070)	(0.045)
Fschoolingyear	-0.014*	0.001	-0.007	0.013	0.032	0.008	-0.016	0.029	0.000	-0.001	0.005	0.012
	(0.008)	(0.017)	(0.016)	(0.014)	(0.031)	(0.021)	(0.011)	(0.020)	(0.014)	(0.012)	(0.037)	(0.018)
Mschoolingyear	0.0227***	0.013	0.025	-0.004	-0.007	0.020	0.0249**	-0.012	-0.002	0.0299**	-0.033	0.011
	(0.008)	(0.016)	(0.016)	(0.013)	(0.030)	(0.021)	(0.010)	(0.018)	(0.014)	(0.013)	(0.040)	(0.020)
GDP	-0.039*	0.040*	-0.003	-0.040*	0.002	-0.097**	-0.061***	-0.020	0.094	-0.054**	0.028	0.080
	(0.021)	(0.022)	(0.111)	(0.021)	(0.036)	(0.043)	(0.017)	(0.061)	(0.067)	(0.026)	(0.095)	(0.101)
Unemployment	-0.130***	0.073	0.265	0.047	0.139	0.897***	0.073*	-0.239	-0.516***	0.105	0.490	-0.330
	(0.023)	(0.160)	(0.283)	(0.058)	(0.306)	(0.222)	(0.039)	(0.252)	(0.145)	(0.082)	(0.330)	(0.228)
Constant	12.26***	2.155	6.261	11.99***	6.479	14.65***	14.59***	11.02*	-1.745	13.26***	3.689	-0.511
	(2.366)	(2.456)	(13.470)	(2.338)	(3.950)	(4.471)	(1.874)	(6.519)	(7.379)	(2.637)	(10.210)	(11.140)
Observations	386	136	137	331	79	114	608	150	193	272	52	106
R-squared	0.216	0.059	0.115	0.149	0.375	0.425	0.091	0.308	0.131	0.204	0.307	0.220

continue

Year	2012			2013			2015			2017		
	Eastern	Western	Middle	Eastern	Western	Middle	Eastern	Western	Middle	Eastern	Western	Middle
lnwage												
Exposed	0.377***	0.370	0.253	0.370***	0.523**	0.547**	0.287***	0.210	0.717***	0.422***	0.202	0.705***
	(0.100)	(0.307)	(0.400)	(0.089)	(0.262)	(0.220)	(0.101)	(0.255)	(0.183)	(0.086)	(0.197)	(0.186)
Experience	0.0503***	0.062	0.007	0.0479***	0.008	0.0707**	0.0382***	0.0983***	0.0430**	0.0547***	0.0533**	0.110***
	(0.013)	(0.043)	(0.050)	(0.012)	(0.036)	(0.033)	(0.013)	(0.030)	(0.021)	(0.008)	(0.022)	(0.019)
Experience square	-0.001***	-0.002	0.000	-0.001***	0.000	-0.002**	-0.001**	-0.002***	-0.001**	-0.001***	-0.001*	-0.002***
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)
Gender	-0.282***	-0.184	-0.449**	-0.232***	-0.230*	-0.337***	-0.335***	-0.081	-0.169*	-0.315***	-0.139	-0.191**
	(0.056)	(0.152)	(0.200)	(0.050)	(0.125)	(0.104)	(0.057)	(0.138)	(0.100)	(0.047)	(0.094)	(0.089)
Work unit	0.009	0.009	0.063	0.0384**	0.042	0.026	0.004	0.059	0.047	0.038**	-0.017	0.085***
	(0.018)	(0.051)	(0.055)	(0.018)	(0.037)	(0.033)	(0.018)	(0.039)	(0.033)	(0.015)	(0.029)	(0.026)
Fschoolingyear	0.002	0.007	0.009	0.017**	0.009	0.023	0.000	0.043*	0.022	0.022***	0.029*	-0.005
	(0.009)	(0.020)	(0.027)	(0.008)	(0.018)	(0.015)	(0.010)	(0.024)	(0.018)	(0.007)	(0.016)	(0.013)
Mschoolingyear	0.0185**	-0.011	0.020	-0.006	0.022	-0.004	0.012	-0.037	-0.011	0.002	0.003	0.017
	(0.009)	(0.021)	(0.028)	(0.008)	(0.018)	(0.016)	(0.011)	(0.029)	(0.020)	(0.006)	(0.014)	(0.013)
GDP	-0.130***	0.114*	0.056	-0.119***	0.013	0.026	0.139***	0.0981*	0.055**	0.076***	-0.021	-0.119
	(0.023)	(0.059)	(0.109)	(0.020)	(0.053)	(0.080)	(0.021)	(0.052)	(0.024)	(0.022)	(0.035)	(0.077)
Unemployment	0.138***	-0.480	-0.361	0.077***	-0.083	-0.274***	-0.185***	0.075	0.022	-0.012	-0.214**	0.213**
	(0.052)	(0.375)	(0.269)	(0.030)	(0.113)	(0.100)	(0.033)	(0.119)	(0.085)	(0.024)	(0.093)	(0.088)
Constant	21.47***	-3.577	2.517	20.19***	6.310	5.184	-6.004***	-3.928	1.617	-0.156	10.53***	18.92**
	(2.429)	(7.113)	(11.930)	(2.122)	(5.967)	(8.847)	(2.250)	(5.615)	(2.690)	(2.379)	(3.796)	(8.374)
Observations	642	71	107	755	137	180	602	114	188	977	148	232
R-squared	0.151	0.171	0.103	0.113	0.127	0.160	0.153	0.166	0.217	0.121	0.174	0.311

D1: the effect of higher education on wage (working unit: government)

Year	2005	2008	2010	2011	2012	2013	2015	2017
lnwage								
Years of education	0.175***	0.118**	0.230***	0.167***	0.210***	0.155***	0.098***	0.175***
	(0.041)	(0.051)	(0.035)	(0.056)	(0.045)	(0.035)	(0.037)	(0.026)
Experience	0.039***	-0.053***	-0.045***	-0.058***	0.002	-0.006	-0.008	0.011
	(0.012)	(0.015)	(0.014)	(0.016)	(0.014)	(0.010)	(0.012)	(0.007)
Experience square	0.000	0.001**	0.001***	0.001***	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Region	0.096**	0.220***	0.018	0.112	0.268***	0.045	0.308***	0.223***
	(0.037)	(0.053)	(0.044)	(0.100)	(0.088)	(0.050)	(0.047)	(0.041)
Gender	-0.083	-0.075	-0.053	-0.331***	-0.098	-0.170***	-0.188***	-0.170***
	(0.059)	(0.103)	(0.069)	(0.104)	(0.085)	(0.062)	(0.069)	(0.054)
Fschoolingyear	-0.007	0.005	-0.003	0.001	0.007	0.009	0.013	-0.006
	(0.009)	(0.016)	(0.010)	(0.014)	(0.013)	(0.010)	(0.012)	(0.008)
Mschoolingyear	0.022***	0.010	0.009	0.013	0.005	0.008	-0.002	0.012
	(0.008)	(0.015)	(0.009)	(0.014)	(0.013)	(0.010)	(0.014)	(0.008)
GDP	-0.003	-0.015	0.016	-0.038	0.025	-0.045*	0.077***	0.014
	(0.015)	(0.022)	(0.022)	(0.040)	(0.037)	(0.026)	(0.018)	(0.025)
Unemployment	-0.140***	-0.032	-0.199***	0.087	-0.243***	-0.144***	-0.027	-0.034
	(0.030)	(0.092)	(0.053)	(0.132)	(0.090)	(0.042)	(0.048)	(0.034)
Constant	4.696**	7.650***	3.472	9.489**	2.158	10.930***	-1.929	3.759
	(1.823)	(2.523)	(2.589)	(4.286)	(4.095)	(2.854)	(2.117)	(2.804)
Observations	243	221	401	173	233	375	320	416
R-squared	0.35	0.185	0.215	0.229	0.213	0.173	0.199	0.233

D2: the effect of higher education on wage (working unit: enterprise)

Year	2005	2008	2010	2011	2012	2013	2015	2017
lnwage								
Years of education	0.261***	0.245***	0.222***	0.0970*	0.192***	0.213***	0.150***	0.214***
	(0.054)	(0.086)	(0.040)	(0.051)	(0.040)	(0.035)	(0.035)	(0.027)
Experience	-0.014	-0.049***	-0.016	-0.014	0.026**	0.023**	0.031***	0.058***
	(0.012)	(0.014)	(0.014)	(0.017)	(0.011)	(0.011)	(0.011)	(0.009)
Experience square	0.000	0.001**	0.000	0.000	-0.001***	-0.001*	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Region	0.150***	0.222***	0.129**	-0.004	-0.028	0.018	0.258***	0.256***
	(0.049)	(0.050)	(0.062)	(0.114)	(0.082)	(0.062)	(0.059)	(0.050)
Gender	-0.172**	-0.018	-0.261***	-0.433***	-0.305***	-0.210***	-0.323***	-0.311***
	(0.069)	(0.100)	(0.083)	(0.110)	(0.067)	(0.062)	(0.067)	(0.054)
Fschoolingyear	-0.011	0.021	-0.005	-0.010	-0.006	0.011	0.011	0.0252***
	(0.010)	(0.015)	(0.012)	(0.015)	(0.010)	(0.010)	(0.012)	(0.008)
Mschoolingyear	0.019**	-0.009	0.003	0.028*	0.022**	0.002	-0.001	0.005
	(0.010)	(0.015)	(0.012)	(0.016)	(0.011)	(0.010)	(0.014)	(0.007)
GDP	0.006	-0.035	-0.052**	-0.089***	-0.116***	-0.068***	0.101***	0.058**
	(0.023)	(0.022)	(0.021)	(0.029)	(0.027)	(0.025)	(0.025)	(0.025)
Unemployment	-0.121***	0.090	0.054	0.141	0.127**	0.052	-0.116***	0.044
	(0.029)	(0.078)	(0.049)	(0.093)	(0.061)	(0.035)	(0.038)	(0.029)
Constant	2.930	7.591***	10.480***	16.410***	17.620***	12.090***	-4.928*	-2.012
	(2.727)	(2.826)	(2.597)	(3.254)	(3.079)	(2.848)	(2.806)	(2.783)
Observations	315	282	437	200	474	570	460	734
R-squared	0.267	0.188	0.170	0.243	0.217	0.131	0.170	0.219

E1：Balancing test results of covariates

Year	2005	2008	2010	2011	2012	2013	2015	2017
lnwage								
Gender	2.519	0.260	0.155	0.026	-0.095	0.181	-0.247	-0.187
	(5.449)	(0.195)	(0.423)	(0.210)	(0.551)	(0.232)	(0.647)	(0.269)
Region	0.581	0.007	-0.555	-0.238	0.342	-0.108	1.390	0.503
	(3.539)	(0.416)	(0.946)	(0.244)	(0.708)	(0.250)	(1.491)	(0.423)
Work unit	10.530	-0.696	-0.799	-2.148*	2.264	0.089	-0.701	-0.226
	(23.940)	(0.480)	(1.290)	(1.101)	(2.733)	(0.652)	(1.945)	(0.793)
Fschoolingyear	-20.590	-0.171	2.640	1.954	1.137	0.331	-5.474	0.389
	(47.200)	(1.141)	(3.813)	(1.644)	(3.365)	(1.567)	(7.481)	(1.953)
Mschoolingyear	-18.280	-1.597	0.987	0.475	4.892	1.166	-1.246	1.176
	(45.070)	(1.416)	(3.596)	(1.461)	(5.453)	(1.506)	(4.632)	(2.193)
GDP	13.740	1.260	1.318	3.403	0.107	0.805	1.825	-0.619
	(30.350)	(1.032)	(1.949)	(2.374)	(2.659)	(0.844)	(2.950)	(0.605)
Unemployment	0.373	0.285	0.315	0.931	0.958	0.769	-0.256	-0.327
	(5.580)	(0.298)	(0.856)	(0.668)	(1.257)	(0.537)	(1.039)	(0.529)
lwald	-5.777	0.169	2.255	0.029	0.313	0.266	1.825	0.524
	(13.670)	(0.294)	(2.059)	(0.296)	(0.793)	(0.266)	(1.880)	(0.399)
Observations	664	576	959	431	820	1,072	904	1,357

E2: Regression discountinuity results

Estimates of the effect of the policy on schooling years

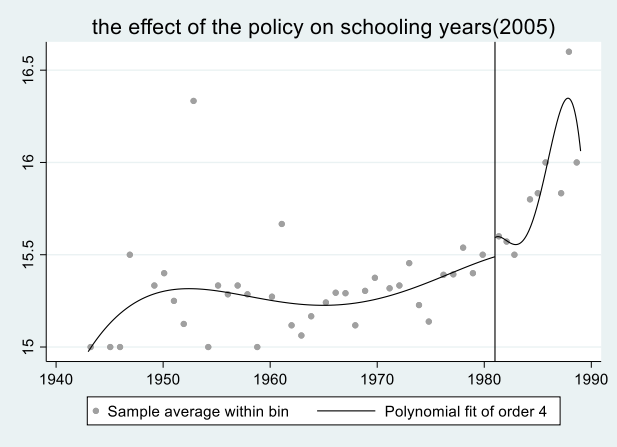
Year	2005	2008	2010	2011	2012	2013	2015	2017
Years of education								
lwald	0.120	0.590**	0.382	1.216***	0.245	0.655**	0.315	0.488**
	(0.189)	(0.246)	(0.334)	(0.424)	(0.254)	(0.257)	(0.208)	(0.226)
lwald(bw)	0.136	0.601**	0.428	1.189***	0.237	0.656**	0.302	0.508**
	(0.182)	(0.241)	(0.301)	(0.411)	(0.242)	(0.256)	(0.198)	(0.215)
Observations	664	576	959	431	820	1,072	904	1,357

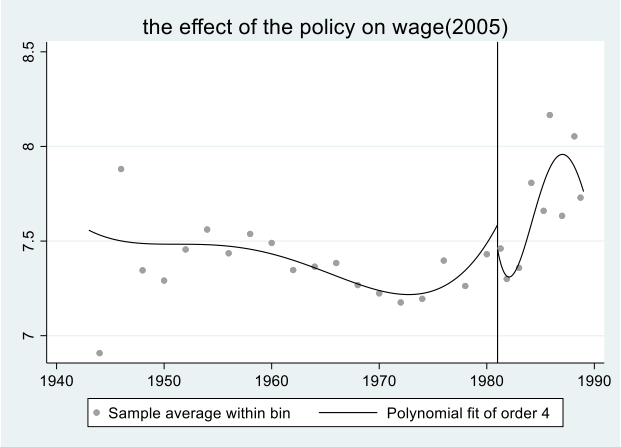
Estimates of the effect of the policy on wages

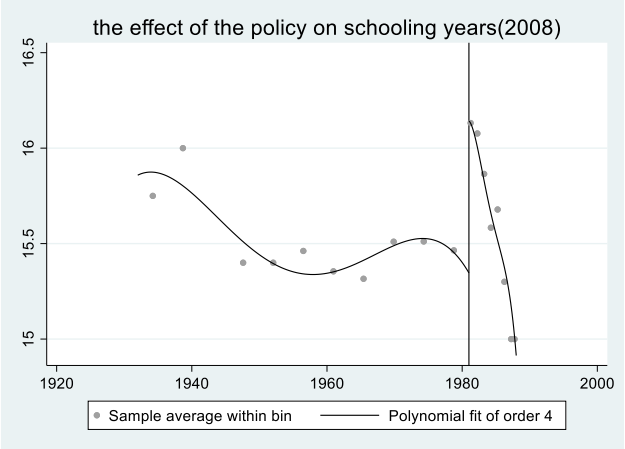
Year	2005	2008	2010	2011	2012	2013	2015	2017
lnwage								
lwald	-0.612***	0.104	0.838***	0.143	-0.013	0.231	0.436	0.278
	(0.236)	(0.344)	(0.244)	(0.309)	(0.215)	(0.188)	(0.269)	(0.241)
lwald(bw)	-0.585**	0.194	0.825***	0.170	-0.015	0.292*	0.437*	0.305
	(0.231)	(0.291)	(0.240)	(0.303)	(0.214)	(0.163)	(0.265)	(0.202)
Observations	664	576	959	431	820	1072	904	1357

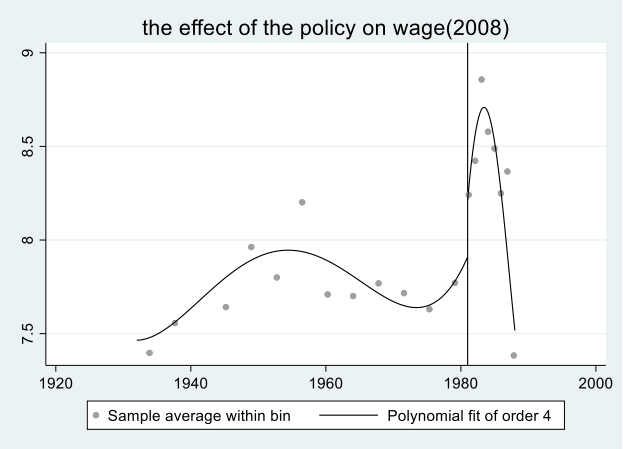
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

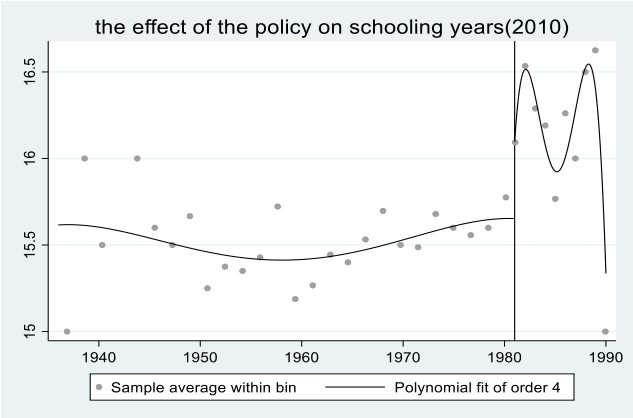
E3: Plots around the threshold

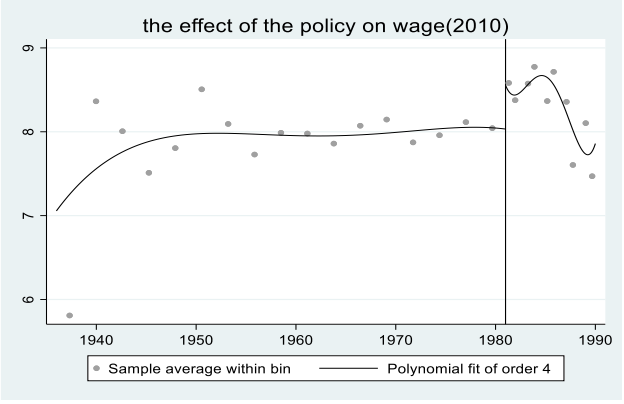


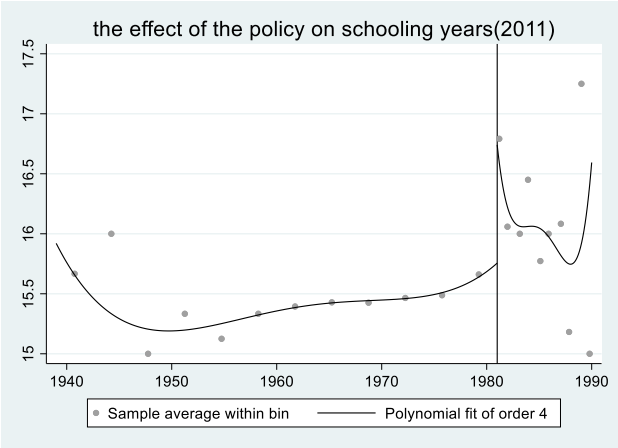


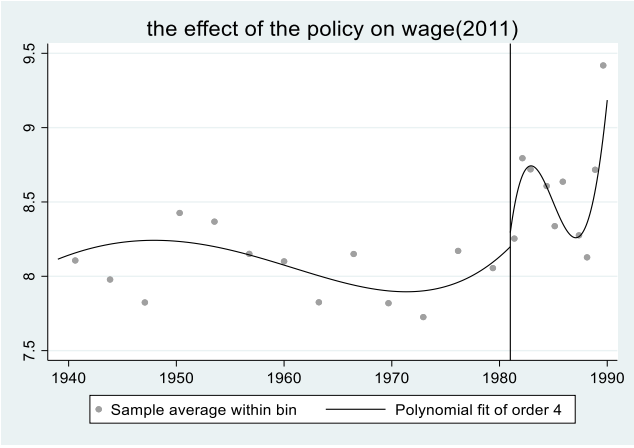


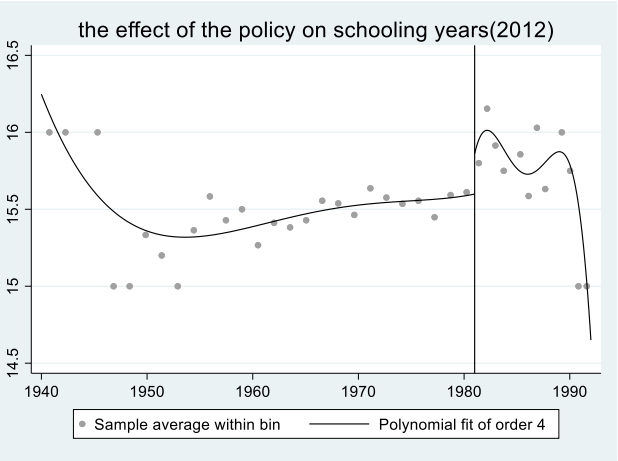


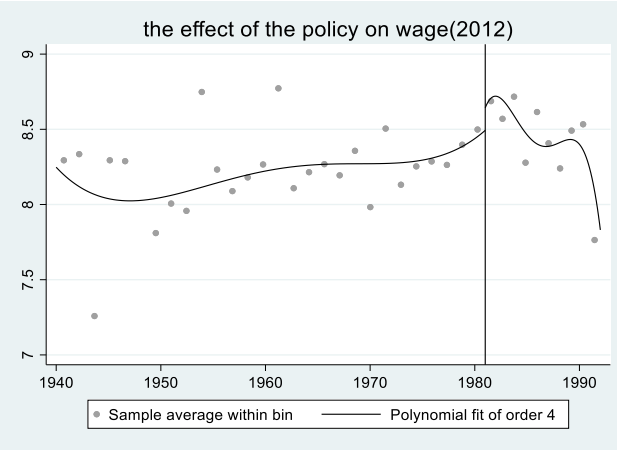


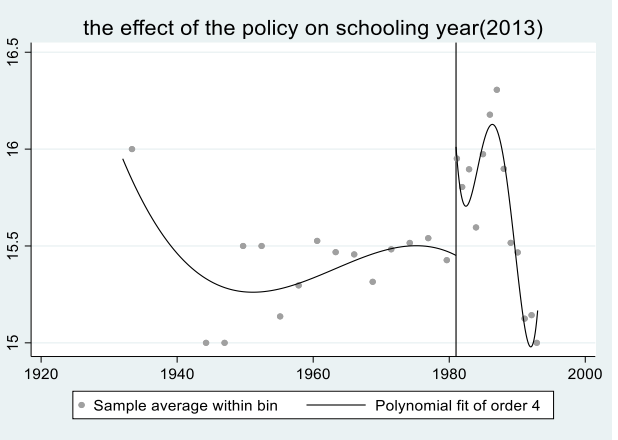


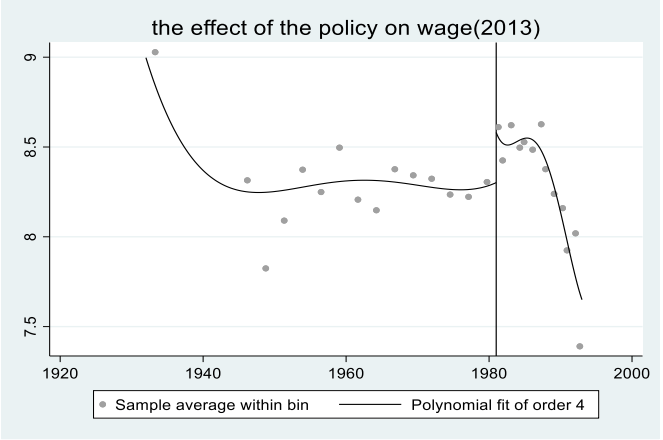

the effect of the policy on schooling years(2011)
15
15.5
16
16.5
17
17.5
1940
1950
1960
1970
1980
1990
Sample average within bin
Polynomial fit of order 4

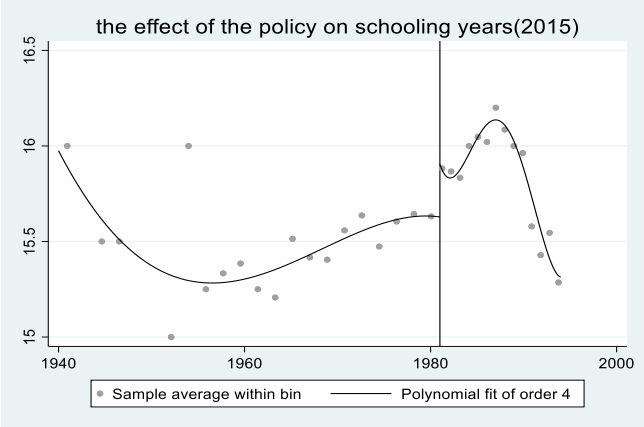

the effect of the policy on wage(2011)
7.5
8
8.5
9
9.5
1940
1950
1960
1970
1980
1990
Sample average within bin
Polynomial fit of order 4

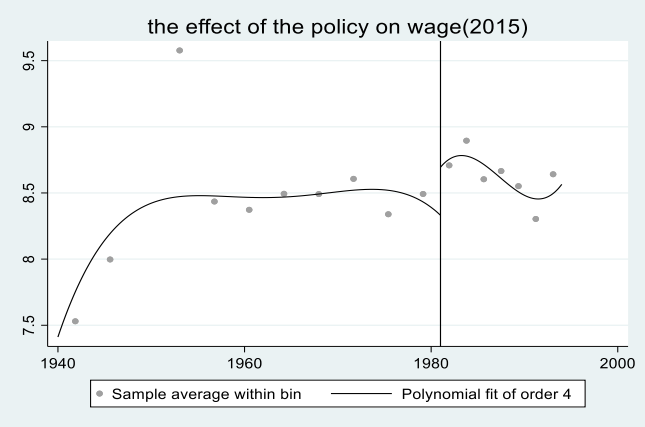

the effect of the policy on schooling years(2012)
14.5
15
15.5
16
16.5
1940
1950
1960
1970
1980
1990
Sample average within bin
Polynomial fit of order 4

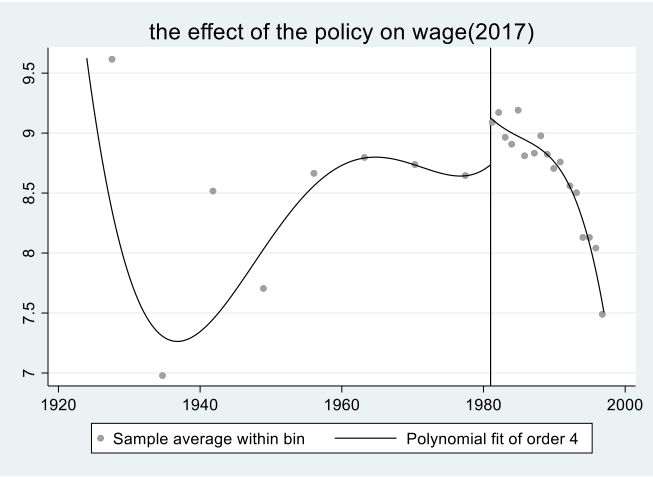

the effect of the policy on wage(2012)
7
7.5
8
8.5
9
1940
1950
1960
1970
1980
1990
Sample average within bin
Polynomial fit of order 4

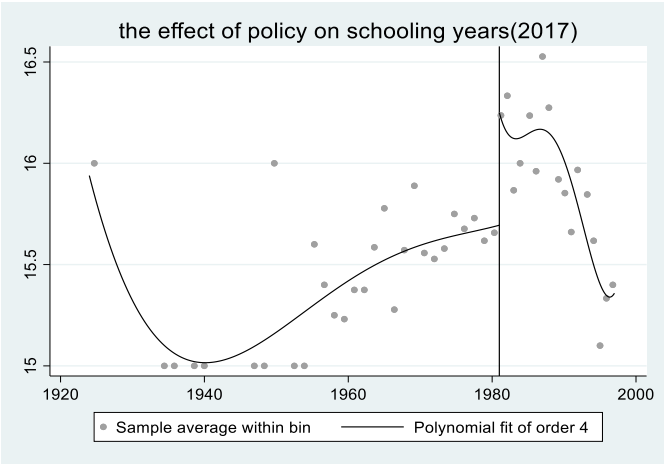

the effect of the policy on schooling year(2013)
15
15.5
16
16.5
1920
1940
1960
1980
2000
Sample average within bin
Polynomial fit of order 4


the effect of the policy on wage(2013)
7.5
8
8.5
9
1920
1940
1960
1980
2000
Sample average within bin
Polynomial fit of order 4









Note: the X-axis represents birth years of respondents, thus respondents who were born in 1981 and later years corresponds to getting treated by the policy.

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