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Understanding the Long Term Impacts of the Critical Historic Event: the Cultural Revolution in China

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ABSTRACT OF THE DISSERTATION

Understanding the Long-Term Impacts of the Critical Historic Event: the Cultural Revolution in China

by

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This dissertation is to study the long-term impacts of the exposure to the Cultural Revolution in urban China. Following the literature on historic legacies, the first chapter provides a micro-analysis of the long-term impacts of a particular historical event: the Cultural Revolution in urban China. I use multiple datasets, construct indexes that measure the intensities of the impacts of the large-scale closure of schools as well as the forced migration, and evaluate the long-term impacts of exposure to the Cultural Revolution in urban China using synthetic cohort approach and multivariate models. Based on the theoretical framework of the life-cycle model, empirical evidence consistently shows that the Cultural Revolution produced a lasting negative effect on permanent income for the subjected birth cohorts (1946–1961) beginning in the 1990s, and this effect was amplified by around 25% to 45% from the mid-1990s to the early 2000s as the Chinese market economy increasingly evolved. Based on the approach of sequential covariate addition, evidence show that the mechanism of the impact includes channels of productivity determinants (e.g., educational attainment, work experience and health conditions), marriage, and attitudes toward the determinants of success. Interestingly, it is found that the Send-Down Movement has played a

positive role in the channel of attitude which contributes to individual's annual income. These conclusions are shown to be robust to contemporaneous as well as cross-regional comparisons, and placebo tests with samples of rural-urban migrants and permanent rural residents. Also the results are robust to a variety of controls for family background, exposure to the Great Famine and various model specifications.

The second chapter is to study the spill-over effects of the exposure to the Cultural Revolution onto their next generation. Specifically, it exploits the closure of senior secondary school in China to study the intergenerational transmission of human capital using Difference-in-Difference and Instruments Variables (IV) estimations. The closure of senior secondary schools from 1966 to 1971 in China gave rise to exogenous variations in parental educational attainment both over time and across city and town residential which are not correlated with the hereditory factors and make testing the existence of causality rather than pure selection possible. Using large Census data, the estimation results consistently show that there are statistically significant causal effects from parents to children. The results also imply stronger effects of intergenerational transmission from parents to daughters. These findings are robust to examinations within different treatment and control groups, different identification strategy and different model specification.

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Chapter 1

The Long Term Impacts of the Cultural Revolution: a Micro Analysis

1.1 Introduction

In the past decade, a growing branch of literature has emerged that examines the impacts of historic legacies, such as the origins of the colonizers in the Americas, the slave trade and colonial institutions. These studies provide empirical evidence demonstrating the persistent effects of historical events on current economic developments (Acemoglu et al., 2001; Banerjee et al., 2005; Engerman and Sokoloff, 1997; Glaeser and Shleifer, 2002; Ichino et al. 2004; Iyer, 2007; and Nunn 2007, 2008, 2009). A related article that investigated micro perspectives came from Dell (2013), who measured the impact of the institution of forced labor (Mining Mita) on current household consumption in Peru. My paper contributes to the literature by examining how a specific historic event affected individual economic development by quantifying the effects of the Cultural Revolution in urban China. As noted by Nunn (2008), the existing research has shortcomings in its inability to distinguish the channels through which historical events matter today. This study also adds dimension to the current literature by exploring the transmission mechanism from microeconomic perspectives, that is, the potential channels through which the Cultural Revolution persistently affected the exposed cohorts.

As the largest developing country, China has experienced substantial growth since its reform and opening to international trade. The Cultural Revolution (1966–1976) was deeply implicated in China's institutional transition away from a closed, planned economy to an open, market-oriented economy. It lasted for more than a decade, and during this period, dramatic and intricate policies were implemented nationally (Deng and Treiman, 1997). For example,

all levels of schools were shut down for certain years. No formal higher education was provided for a decade. Seventeen million urban youth were "rusticated" by being relocated to rural areas for years in what came to be known as the Send-Down Movement. Considering the uniqueness and scale of these programs, it is intriguing to explore their current impacts on the urban labor market and to understand the economic gains and losses to the population that was primarily subjected to them.

Research on the Cultural Revolution has gradually increased since the 1990s. Most studies are descriptive, with few empirical papers in publication. Gregory and Meng (2003) quantified the loss in education attainment caused by the closure of schools, but subsequent studies found no adverse role of the education interruption in reducing returns to schooling (Meng, 2003 and Zhang, 2007). The decision to return to school was explored by Han and Zhang (2007), who found substantial increases in the subsequent educational attainment of the subjected generations (Han and Zhang, 2010). Another branch of study analyzes how the Send-Down Movement affected individual life courses by comparing the sent-down youth with those who were not sent down. Hou and Zhou (1999) identified the sent-down group by the first year they entered the labor market and showed that the sent-down youth earned more and had more schooling than their counterparts. Li, Rosenzweig and Zhang (2013) utilized a twin survey in five cities and found that staying longer in the rural areas had a large positive effect on monthly earnings among sent-down twins. Did the forced rustication during youth truly benefit the young people? As will be discussed later, selection problems and simultaneous exposure to different interruptions continue to cast doubts on the validity of the allegedly positive effects of the Send-Down Movement when authors simply make comparisons between sent-down and non-sent-down urban youth.[1] In contrast to the existing

[1]Selective Sending and Returning: the well-educated elite and the youth with particular family backgrounds were more likely to be sent-down. Early returns to urban areas were related to regional policies and household social networks. Heterogeneous Exposures: the sent-down experiences varied depending on which regions youth had been sent to. Some places were difficult to live in because of the cumbersome manual labor. However, some rural

literature, this paper shows how the concurrent policies simultaneously impacted the subjected cohorts' permanent incomes based on deviations from the life-cycle model. Furthermore, this study also gauges how the effect changed as the market-oriented economy increasingly evolved and explores the channels of its transmission mechanism. To the best of my knowledge, this is the first paper that systematically and comprehensively evaluates the long-term impacts of the Cultural Revolution on individuals' annual earnings from different perspectives and at different points in time.

One important problem is that it is difficult to find a single measure for the Cultural Revolution owing to its complexity and the interrelationship of different conflicts. For example, the urban population was exposed not only to education interruptions but also to heterogeneous effects of the rustication because it was implemented unevenly. Additionally, other conflicts simultaneously affected them during the same period (e.g., public shaming). Estimations that simply focus on one aspect might lead to bias and to misunderstanding the subsequent influences of the Cultural Revolution. Using the rich urban micro-data of the Chinese Household Income Project Survey (CHIPS), I design three measures with the synthetic cohort approach that captures the variety of exposures to these policies to gauge the losses among the primary exposed cohorts and then track them over time.

Estimates from different measures and samples consistently show that the Cultural Revolution significantly lowered the subjected individuals' annual earnings, and this effect was amplified from the mid-1990s to the early 2000s as the market became more competitive. Comparing the school closures with the Send-Down Movement, empirical evidence shows that the latter policy played a significantly stronger adverse role. After establishing the existence of the impacts, I further look into the channels through which this adverse role

areas had better environments, e.g., there were expansions of construction of senior high schools in some rural areas (Zhang, 2010) and less violence. Meanwhile, the youth who were not sent-down during the same period encountered different conflicts in urban areas that were caused by the Cultural Revolution, for example, education interruptions, the Red Guard Campaign and public shaming (Zhou, 1999).

matters, including productivity determinants (e.g., schooling years, working experience, and health status), marital status and attitudes. Educational attainment is the major channel, accounting for approximately 50% of the overall effect. Interestingly, changes in the estimates imply that the Send-Down Movement shaped the sent-down youth's personalities in a positive way by making them more perseverant. Their attitudes toward the different determinants of personal success contributed to their earnings. These findings are shown to be robust to evaluations with different control groups and to a variety of controls for family background and confounding factors (e.g., the Great Famine: 1959–1961). Placebo tests for the permanent rural residents and the rural-urban migrants are conducted separately, and the results strongly support a causal effect of the impacts.

The remaining part of this paper is organized as follows. Section 2 documents the historical background and explains the identification methodology. Section 3 describes the theoretical framework and empirical models. Data and statistics summary are presented in section 4. Section 5 presents the primary results and examines the potential channels through which the Cultural Revolution matters. Robustness checks are also provided. Section 6 concludes the paper.

1.2 Historical Background and Identification Methodology

The Cultural Revolution lasted for more than a decade and involved abundant conflicts (Li et al. 2013; Spence, 2001; Treiman et al., 1997; and Zhou et al., 1999). It influenced the evolution of social values, political institutions and individual developments in China. Considering the prime stage of human capital development, I focus on urban children of school age during this period who were exposed to multiple interruptions to their development (birth cohorts 1946–1961). The first large-scale interruption was, as is well known, the education interruption. Different levels of schools were closed for certain periods, which disrupted students' advancement through the formal education system. Separate from

the school closures, the length and substance of education also changed. Second, at the same time, those cohorts were also forced to leave cities and live in rural areas (the Send-Down Movement). Third, there were other conflicts, for example, the Red Guard Campaign and public shaming. Overall, the first two were large-scale and more likely to have had lasting impacts. Details on these two policies and the identification methodology are documented in the following sections.

1.2.1 The Closure of Schools

Before the Cultural Revolution, the formal education system had a six-three-three-four structure in China: six years of primary school, three years of junior secondary school, three years of senior secondary school, and four years of university education. Children began formal primary schooling at the age of seven or eight. Primary and secondary schooling were the most important components and involved large portions of the population. Newly enrolled students in the secondary schools accounted for 17% of all enrollments, and the proportion of primary students constituted 83% in 1965. Meanwhile, the ratio of students enrolled in colleges to all newly enrolled students was far below 1%. In all, the number of schools and students below college level accounted for the major component in the formal education system before the Cultural Revolution (the data source is the China Education Statistics Year Books: 1972–2008). Correspondingly, the closure of secondary and primary schools would have affected the majority of the population.

After the May 16th Notification in 1966, the Cultural Revolution was initiated, and nearly all urban schools were closed or they stopped offering lessons after June 1966. Primary schools were temporarily affected, and many junior secondary schools did not resume until the fall of 1968. Senior secondary schools resumed in September 1971, and they grew in number from 500 to 4000 schools by 1972. The numbers of new enrolled students and full-time teachers in 1972 more than doubled compared with the situations in 1971 for urban

areas. A small number of universities, all of which had been closed since 1966, gradually began reenrolling students after 1972. The majority of colleges did not formally reopen until October 1977, the year in which the National College Entrance Examination was reinstituted.

Hence, secondary schools and above were shut down for relatively longer periods. Considering both the exposed population and the length of the school closures, the closure of the secondary schools should have had a greater impact. As is consistently illustrated in Figure 1.1, the completion of senior secondary schooling was significantly affected. The increasing trends in senior and junior high attainment were obviously disrupted for cohorts of school age during this period (especially for birth cohorts 1947–1959). Based on the regular age for attending secondary school and the timing of the school closures, an index "Closure" for measuring the intensity of being treated by birth cohort is constructed as follows:[2]

$$\text{Closure}_{ij} = \begin{cases} 6 & \text{if individual i was born in the birth cohort j: j =1952-1954} \\ 4 & \text{if individual i was born in the birth cohort j: j =1950-1951, 1955-1956} \\ 1 & \text{if individual i was born in the birth cohort j: j =1948-1949, 1957-1958} \\ 0.5 & \text{if individual i was born in the birth cohort j: j =1947, 1959} \\ 0 & \text{otherwise} \end{cases}$$

Unless otherwise specified, the subscript j always represents the birth year and i represents individual i in this paper. The value of the index can be approximately interpreted as number of years of formal secondary education that were denied for cohort j. The birth cohorts of 1952–1954 are identified as the potentially most affected group because their junior and senior secondary schooling were both disturbed. The second group (birth cohorts 1950–1951 and 1955–1956) partially experienced education interruptions at the secondary school level.

[2]In essence, the principle for categorizing the birth cohorts is from the most to the least affected. Considering different impacts when one was at the first year of junior high schools (as well as senior high schools) or the last year of junior high schools (as well as senior high schools), I do regressions of the outcomes (income and schooling years) on group indicators for the measure of Closure as well as indicators for each birth cohorts controlling for age, age squared, gender, famine and province fixed effects (see Appendix A). The impacts are similar within the same classification in the measure of Closure. For example, the birth cohorts of 1948-49 and 1958-1958 were impacted similarly in outcomes of education. On general, the estimators of affected group indicators or birth year indicators follow a quasi-symmetric u-shape. Different scales for the measure Closure are also considered for robustness checks. For example, I rescale the groups using 0-0.5-1-2-3 as well as 0-1-2-3 according to their different treatment intensities, rather than 0-0.5-1-4-6. In all, the empirical results are qualitatively consistent.

The third group comprises children born between 1957 and 1958 and those born between 1948 and 1949. These children were marginally affected in either their senior secondary or primary schooling, and both were delayed in potential college entrance. Grade repetition and early or delayed school entry could lead to bias in estimations if these cohorts are mistakenly considered to be treated or non-treated. Therefore, the birth cohorts of 1947 and 1959 are also taken into consideration. The mean of this measure is 1.5; that is, on average, the treated cohorts were denied 1.5 years of secondary schooling (see column 2 of Table 1.1).

In addition to the school closures, the length of schooling and the substance of education were also affected. For some regions, the length of each schooling level was shortened by half a year or one year.[3] The substance of education was transformed into half work and half study. Admission policies also deviated from being academic-merit-based. For example, colleges selected students from specific social classes with no academic merit criterion, e.g., workers, peasants and soldiers. These changes caused a downgrade in academic standards and an emphasis on political qualifications (Chang, 1974). Additionally, because of the large geographic scope of China, the intensity of the education interruptions varied across rural and urban areas. With the goal of reducing gaps between rural and urban areas, the experience in rural areas was quite different. First, there was no large-scale closure of schools in rural areas such as occurred in urban China (see Appendix A for administrative statistical evidence). Meng and Robert (2003) provided empirical evidence that the exposed rural children were not as significantly affected as their urban counterparts by the school closures. Second, Anreas et al. (2004), Han et al. (2001), Thogersen et al. (2002) and Zhang (2012) even mentioned that there was an expansion of middle schools in some rural areas between 1972 and 1978. Therefore, my evaluation particularly focuses on the permanent urban residents, with the rural residents used for placebo tests.

[3]For example, primary schooling was cut from six to approximately five years. Meanwhile, each level of secondary schooling was reduced to 2-3 years.

1.2.2 The Send-Down Movement

The major period of the Send-Down Movement was from 1968 to 1978, and it was implemented nationwide. At the early stage of the Cultural Revolution, the sent-down youth included a small group of adult social elites with higher education as well as young adults from families with particular social status ("chengfen"). During the major period, the predominant population that was rusticated was current students or graduates from secondary schools. Specifically, the highly exposed cohorts were those who were born between 1946 and 1961 regardless of province (see Figure 2, Table 1 and Appendix B). Details of the sending policy varied across regions and changed continuously over time. For some regions, the local governments required at least one child from each family to be sent to a rural location. Meanwhile, some cities established the criterion that only one child must be sent. An extreme case was Wu Han City in Hubei Province, where the government sent all age-eligible youth to the countryside in 1974 (Bernstein, 1977). The return policy also varied across regions and over time. Returns began sparsely in 1973 but were limited before 1978 (Deng, 1993). After 1977, the returns of the sent-down youth became common, and most of them returned to their original locations.[4]

Different policies and families' bargaining power led to varying durations of stays in the rural areas among the sent-down youth. On average, the older birth cohorts were likely to be sent down earlier and required to stay longer in the rural areas than were the younger birth cohorts (see Appendix A.2 for more empirical evidence). During their stays, all of the sent-down youth were forced to live with farmers, perform manual labor and spend years in rural areas. There were various exposures during their stays. First, they might have performed different economic activities because of their own capacities or family backgrounds. For example, the sent-down intellectuals could also work as part-time teachers in rural schools in

[4]Those who were married to local residents or who worked in local government might have never returned (Li, et al., 2013; Xie, 2008; Zhou et al., 1999).

addition to performing manual work while they stayed in the countryside. Some might have been assigned to harsh manual work. Second, any number of geographic and demographic factors in rural areas also endowed abundant heterogeneities across the sent-down population. Different living environments might have had fewer resources or fewer social conflicts than urban areas. A small group of sent-down youth could even continue schooling in some rural areas (Xie et al., 2008). Additionally, because of different adaptive capacities among individuals, the children might also have developed differently during their stays. Overall, this policy altered their life courses and affected their human capital accumulation, not only with regard to their receipt of formal schooling but also with regard to their accumulation of working experience, and it further shaped their future economic opportunities.

In Appendix A.2, I examine the determinants of being sent down or not. Estimation results show that the probability of being sent was highly correlated with family background. Considering the selection problems and the various exposures during their stays, caused by individual heterogeneities, the simple comparisons between sent-down urban youth and those who were not sent down in the existing literature might have captured biased estimations of the Send-Down Movement. Even the study of comparisons between twins has its limitations, not only related to data (e.g., limited observations, the twins' unobserved heterogeneities) but also related to the selection within and among families and the heterogeneous lives in the rural areas for the sent-down youth. The positive marginal effect of staying one extra year among twins might in itself capture the subsequent evolvement of adaptability or performance in the more able twin.

Correspondingly, I separately calculate the probability of being sent down and the average length of stay at the cohort level and construct their product, "Send-Down".[5] This

[5]I also consider three variations: the probability of being sent down, the average length of stay in the countryside and provincial differences. In this way, the measure Send-Down is the product of the average probability of being sent and the average length of stay for individual i born in birth year j in province o. And qualitatively consistent results were obtained.

measure gauges the expected length of staying in the countryside, reflecting the intensity of being treated by the Send-Down Movement over birth years. To some extent, this alleviates the selection bias and potential measurement errors at the individual level.

$$\text{Send-Down}_j = P_j L_j$$

P_j: the probability of being sent down for birth cohort j;

L_j: average length of staying in the rural area for birth cohort j.

Figure 1.2 visually describes the measure based on the individual dataset from CHIPS 2002. Compared with other cohorts, the birth cohorts of 1946–1961 were more likely to be rusticated and to have a larger Send-Down value, that is, a longer expected length of stay in the rural areas.

1.2.3 The Measure of the Cultural Revolution

As shown in the above paragraphs, the primary birth cohorts who were exposed to the school closures were also those who were exposed to the Send-Down Movement. These are individuals who were of school age during the Cultural Revolution and were at the prime stage of human capital accumulation, and they were relatively vulnerable to their surrounding environments. I further construct a single binary variable (CR) to capture the overall impact: CR=1 for agents born between 1946 and 1961.[6] The control group is the younger and older birth cohorts who potentially experienced no interruptions to their human capital accumulation during the Cultural Revolution.

Given the identified affected birth cohorts (1946–1961), the Great Famine (1959–1961) might be one confounding factor.[7] Although it impacted the rural areas directly, the Great

[6]This identified group is the same as that in the existing literature (Li, 2013; Meng, 2003; Xie, 2008; Zhang, 2007). Other specifications have also tested, for example, the birth cohorts 1946–1959 as well as 1947–1961.

[7]According to the literature, being exposed to famine during infanthood is likely to have a long-term effect on individuals' future performance. Meng and Qian (2009) show that inutero and early childhood exposure to the Great Famine had large negative effects on adult health conditions, education attainment and labor supply in rural areas.

Famine also marginally affected the urban areas. Without controlling for it, the resulting estimates could have been biased. Therefore, I constructed a discrete variable, Famine, to control for its effects based on the number of years the birth cohort was exposed to the Great Famine during infanthood (age 0 to 2; see column 7 of Table 1.1).

1.3 Theory and Empirical Model

It is common wisdom that the individual life-cycle earning profile commonly follows an inverse U-shape pattern, increasing during the working lifetime and declining later in the range of retirement age (Deaton et al., 2000; Modigliani, 1986). Similar hump shapes of age-earning profiles are widely documented in empirical studies that examine cross-sectional data. The cross-sectional profile also works as a surrogate for an individual life-cycle profile in nonstationary economies with increasing productivity growth over birth cohorts (Irvine, 1981). Given a growing economy such as that of China, the Cultural Revolution severely interrupted the human capital accumulation for a range of birth cohorts. The permanent loss in human capital led to deviations from the bump-shape profile because of the interruption to the increasing dynamics of cohort productivity growth over birth year.

Following Shorrocks (1975), it is assumed that individuals complete formal human capital formation at age of 25 and begin to work for pay. The earnings of the representative individual born in cohort j in year t in a cross-sectional profile are denoted as follows:

$$I(t, j) = \begin{cases} = 0 & \text{if } 0 \le t\text{-}j \le 25 \\ = h\, f(t\text{-}j\text{-}25)\, e^{k(j)} & \text{if } t\text{-}j \ge 25 \end{cases}$$

where h represents the resources that are common to all generations; f(.) is a concave function of age that can also be represented by a polynomial function of age; and k(j) represents the cohort productivity growth for cohort j. The cohort effect in the regressions for the log income increases almost linearly with the year of birth over the generation (Jappelli, 1999). One prime determinant is the increasing trend of human capital production over time (e.g., educational attainment) identified in the rich empirical studies (Mincer, 1996 and 1997;

Jappelli, 1999). Given the generation-specific productivity growth and no disturbances, the cross-section age earning profile can be reduced to a pure age effect when exhorting all of the generation-specific resources (King and Dicks-Mireaux, 1982). From this aspect, cohort productivity growth reveals the pattern of the generation-specific resources that contribute to human capital accumulation. In addition to productivity growth, the cohort effect can also reflect heterogeneities of preferences and mortality rates across birth cohorts (Shorrocks, 1975; Masson, 1986; and Jappelli, 1999).

Based on the above theoretical framework, with no interruptions or uncertainties, the cohort productivity growth should increase over the year of birth, and the life-cycle earning profile should exhibit the widely observed inverted U-shape. If particular generations experienced adverse interruptions during human capital production, the positive correlation of cohort effects with year of birth would be interrupted, giving rise to deviations from the life-cycle model. In other words, we can introduce cohort-level productivity disturbances into the model when large-scale interruptions destroy generation-specific resources and permanently cause the loss of human capital within a particular range of cohorts. Therefore, I can identify the impact of this plausible natural experiment, the Cultural Revolution, by testing the predictions of the life-cycle model using cross-sectional micro-data.

Considering the far-reaching influences and complexity of the Cultural Revolution, my baseline estimating model to evaluate the existence of the impact is

$$\mathrm{Y_{ij}}=\alpha+\beta\mathrm{Policy_{ij}}+\delta_1\mathrm{age}_i+\delta_2\mathrm{age}_i^2+\delta_3 G\mathrm{ender}_i+\delta_4\mathrm{Province}_i+\delta_5\mathrm{Famine}_{ij}+\varepsilon_{ij} \quad (1)$$

where the dependent variable Y is the natural log of annual income[8] for individual i of cohort j. *Policy* represents the Cultural Revolution, measured as three alternatives (CR, Closure and Send-Down). These capture different intensities of exposure to policies across cohorts (see

[8]In this paper, I compute the average annual income between 1993 and 1995 as well as between 2000 and 2002 to measure the individual's permanent income in the middle 1990s and the early 2000s, respectively, in consideration of measurement error.

section 2). Other independent variables include age, age squared, gender, and provincial indicators.[9] In addition, the Great Famine is also taken into consideration for an accurate estimation concerning mortality influence and potential contamination. The coefficients of the three measures are of interest, and consistent estimates will indicate the qualitative and quantitative effects of the Cultural Revolution.

Moreover, with repeated cross-sectional datasets (CHIPS 1995 and 2002), I can track the same cohorts over time and examine the differences between the affected and the control cohorts. In the theory of human capital production (e.g., schooling and working skills), various exposure to adverse childhood environments could have also resulted in differences in the slopes of the earnings life-paths among different population. Hence, the second proposition is to examine how the impact changed over time as the Chinese market economy increasingly evolved. In a more market-driven economy, workers should earn closer to their marginal product to labor so that the negative impacts should increase.

Third, I will further study the possible channels and identify how the Cultural Revolution created differences in generations using extended models of equation (1) using sequential covariate addition.[10] Following the basic technique to uncover the mechanism (Nunn, 2008), I control for individuals' characteristics in the regressions one by one and analyze how the coefficients of interest change. The pattern of changes interprets the mechanism and shows how the Cultural Revolution affected the population through particular micro-perspectives. In other words, the baseline regressions are extended by controlling for different channel variables: educational attainment, current marital status, work experience, schooling years, health status, attitudes, etc., one by one.

[9]Different model specifications with various age polynomials are tested, and the statistics support the age-earning profile. As the parameter tests cannot reject the null hypothesis that the estimated cubic age is equal to 0 at any significance level below 35%, the empirical model (1) is a better specification and fits better. Moreover, the estimation results obtained are consistent even when the cubic age is controlled for.

[10]To check the empirical robust estimation of sequential covariate addition, different orders of channels are examined and the conditional decomposition by Gelbach (2014) is applied. Consistent findings are found.

After controlling for one specific channel, the interested coefficients should increase with smaller absolute values if the Cultural Revolution negatively impacted through that channel or vice versa. For example, children affected by the Cultural Revolution had lower education attainment and were thereby likely to earn less. After controlling for this channel, the absolute value of the interested estimates will shrink. Based on patterns of changes, dominant channels can be identified. The interested estimates would become insignificant if the complete mechanism could be captured. Furthermore, I will examine subsamples of different control groups, control for family background and utilize datasets of rural residents as well as rural-urban migrants to construct placebo tests for robustness checks.

1.4 Data and Statistics Descriptions

1.4.1 Data

This paper draws mainly on data from the CHIPS, a representative nationwide survey.[11] It comprises multiple questionnaires and provides rich information on permanent rural residents, permanent urban residents and rural-urban-immigrants at the household as well as individual levels. The urban total from the 2002 wave randomly selected 20,632 permanent urban individuals and 6,835 urban households from 12 provinces. Most importantly, it includes Send-Down experience at the individual level, such as whether one was rusticated and how long one had stayed in rural areas, which makes it possible to measure this treatment. In addition to its credibility and capacity, another advantage of this dataset is that the identified cohorts were of working age, whereas the most recent datasets might have fallen short of the requirements for the interested cohorts who were out of the labor force.

To answer the question of whether there are persistent effects from the Cultural Revolution and the mechanism of its impact, the urban data from CHIPS 2002 are utilized.

[11]This survey is funded by the Ford Foundation and institutions from multiple countries. Its funding agencies are as follows: the Chinese Academy of Social Science, the Asian Development Bank, City University of New York, Leverhulme Trust (United Kingdom), Columbia University and the University of California, Riverside.

These contain a wide range of demographic and economic variables. First, the data provide detailed information about annual personal income[12] in 2002 and retrospectively for 2000 and 2001. I take the average of the three years' incomes as the dependent variable. To check robustness, regular wage and current annual income are also taken as dependent variables and consistent findings are found. Information about current employment status, current marital status, occupation and years of schooling is provided, and I utilize it to explore channels. Guided by this theoretical framework, I narrow the empirical sample to permanent urban residents age 25–60. Individuals who had not completed their human capital accumulation (full-time students) or who were older than the retirement age (60) in 2002 are excluded. To answer the question of how the impact changed over time, I turn to CHIPS 1995. The same strategy for the sample is applied to permanent urban residents. In addition, the Chinese Family Panel Studies (CFPS) of 2008, CHIPS 2007 and the Study on Global Ageing and Adult Health 2007 (SAVE 2007) are utilized to explore the channels in the transmission mechanism of the Cultural Revolution. For CHIPS 2007, I compute the average height and average weight at birth cohort level by gender to further merge into the main dataset (CHIPS 2002) for the channel of health status. For the CFPS 2008, the information of personal attitudes towards different determinants in personal success is provided. Similarly, I compute the ratio of values towards hardwork to luck, take the cohort average and merge into the main data for studying the channel of attitude (cohort trait). SAVE 2007 provides information on age to stop working for individuals and average ages to leave labor market at cohort level are calculated to support the impact of current employment status.

[12]The total annual income contains regular wages, bonuses, other revenues from working units and subsidies from other sources. A trivial number of observations haven't reported their incomes and these missing observations are eliminated.

1.4.2 Statistics Description

As presented in Table 1.2.1, from the mid-1990s to the early 2000s, the average annual income of urban residents increased dramatically, with a larger deviation as the market-oriented Chinese economy rapidly grew. On average, the older birth cohort earned more than the younger cohorts. Interestingly, in comparing the older and younger cohorts, the rate of income growth for the affected group (birth cohorts 1946–1961) was lower from the mid-1990s to the early 2000s. Similarly, the natural log income of the interested cohorts increased by 5.8%, whereas that of the two control groups grew more than 6.5%.

For the 2002 wave, the full empirical sample is 12,304 observations. Approximately 50% of the samples are female, and 19.5% report being sent down. For the sent-down youth, the average length of their stay in rural areas is approximately 4 years. The natural log of average annual income from 2000 to 2002 is 8.966 on average, and in 2002, the average years of schooling are approximately 11 in urban China. One problem arises from the missing information on working experience and occupation for those who are unemployed. This is associated with the survey administrators, who have skipped the question for the unemployed population. Therefore, I examine current employment status for the full sample as one channel and further study the working experience channel for the subsample of the employed population. There are multiple classes of employment status in the 2002 wave of CHIPS: currently employed unemployed, retired, special status and other.[13]

Group comparisons are also shown in Table 1.2.1 and Table 1.2.2. The treated group is overall older than the control group and possesses less years of schooling as well as more

[13]Special status includes people who were "Laid-off" or currently "Lixiu". I group them together into the class of Laid-off. These special groups are more likely to have worked in the state-owned sector, and the layoffs likely resulted from the state-owned enterprises' (SOEs) efforts to deepen reform of the market-oriented economy after the late 1990s. This population was given related subsidies and compensations. I do regression of these compensations on the policy measures and the results indicate that the affected cohorts have more these sources of income. Also regular wage is taken as a dependent variable to evaluate the long-term impacts. Consistent conclusions are found. The sample size of employed population is 9637 and evaluations of the impact within this subsample are also done to deeply understand the mechanism.

working experience. Examining the educational attainment across groups, the treated cohorts have obtained 1.4 fewer years of schooling than the control group, which is similar to the mean of the measure Closure. Considering current employment status, there are more retired and laid-off observations among the treated group than among the control group. Regarding the average age of ceasing to work for pay, SAVE 2007 shows that the treated cohorts are more likely to have left the labor market (Table 2-B). Based on the 1995 wave, the statistics on working experience doesn't show significant difference when the treated group is compared with the control group of birth cohorts 1935–1945 and 1962–1970. Based on both waves, the sent-down youth have more working experience (for example, on average 28 years of working experience in 2002). Generally, the patterns follows the life-cycle profile: the older the cohorts, the more working experience they possess and the more of them were retired. Note that they have lower educational attainment as the result of interruptions.

The statistics on current marital status show that the treated group has more experiences with divorce or separation from their spouses (Table 1.2.1). Contemporaneous comparisons between the sent-down and non-sent-down youth within birth cohorts 1946–1961 show that the sent-down youth have a higher divorce rate (Table 1.2.2). Considering factors related with health, the proportion of smokers is higher among the interested group than in the control group based on CFPS 2008 and the treated cohorts are slightly shorter than the control group based on CHIPS 2007 (average height at cohort level by gender). Additionally, mean comparison shows that the treated group values diligence less than personal luck in determining success, but the T-tests showed no significant differences. Overall, individuals' attitudes toward the determinants of success (diligence versus luck) are positively related with year of birth, as is the experience of divorce.

In the next section, estimation results will be presented. To visually illustrate the Cultural Revolution's effects on shaping life-cycle profile, I first graph the coefficients of age

indicators from two basic regressions using CHIPS 2002: regressions of log income and schooling years on gender, age indicators and region indicators (see Figure 1.3). In Figure 1.3, the two vertical lines highlight the interested cohorts. The right and left axes represent the coefficients from the two separate regressions. As it shows, there was an overall increase in educational attainment trend overtime, but there is a dip in the range of the affected cohorts. The pattern of cohort effects in the regression of log income exhibits a quasi-bumped pattern over the age profile but with a similar dip for the interested group. These violations against the positive relationship between cohort productivity growth and year of birth as well as the inverted U-shape of age-earning profile visually imply the existence of impacts of the Cultural Revolution.

1.5 Estimation Results

1.5.1 The Impact on Income

The results of the empirical model established in equation (1) are presented to show the existence of the long-term impact in Table 1.3, and Table 1.4 shows how the impact changed over time. Different estimations of interest are separately obtained utilizing different measures for the Cultural Revolution. In all of the regressions, the fixed effects of region, gender, the effect of the Great Famine and life income profile are controlled for. Note that the interested estimates, regardless of which Cultural Revolution measures or which cross-sectional life-cycle profiles were adopted, are significantly negative.

Our main focus is the impacts in the early 2000s. The estimate of CR indicates that the affected cohorts experienced lower average annual incomes by roughly 11% (see regression (1) in Table 1.3). In addition to the measure of CR, the estimates for Closures and Send-Down were also negatively significant (regression (2) and (3) in Table 1.3). Empirically, one year of secondary schooling denied decreased annual income among the affected by 1.8 % in the early 2000s. As for the role of the school closures, frequent interruptions in formal education

on average lowered the earnings of the affected children by 2.7% among the empirical sample (-1.8%*1.5; 1.5 is the mean of Closure, which is also close to the average 1.4 years of schooling difference between the control and the treated groups). The magnitudes of the interested estimates imply a stronger and statistically negative influence of the Send-Down Movement. On average, the Send-Down Movement lowered the incomes of the affected population by 4.8% in the early 2000s (-6%*0.195*4.09; -6% is the coefficient of the estimate; 0.195 is the proportion of the full sample that was sent down; 4.09 is the average length of stay) among the full empirical sample. Compared with the school closures, the effect of the forced immigration was nearly double. Furthermore, to study the simultaneous policies in terms of multiple controls, two or three measures are simultaneously controlled for. Estimate results shows that at least one measure remained significantly negative, implying that the negative effect strongly persisted as the result not only of the policies measured in this paper (school the closures and the Send-Down Movement) but also of other characteristics of the Cultural Revolution. The above conclusions are consistent when the probability of being sent down in 2002 is instrumented with that of the 1995 wave, when other constructions of measures are applied and when different age spans are utilized (e.g., observations at ages 16–60). Additionally, when regular wage and current annual income are taken as dependent variables, consistent conclusions are found.

However, one may argue that the economic environment might have varied and the interested estimates may mainly capture the effects of changes in macroeconomic environments rather than the role of the Cultural Revolution in shaping the generation specifics. CHIPS 1995[14] is explored to investigate this concern as well as to examine how the costs of the Cultural Revolution evolved in response to macroeconomic environment changes.

[14]Note that no information on length of stay in the rural areas is reported in CHIPS 1995. Hence, Send-Down is computed based on the average duration at cohort level merged from CHIPS 2002 for the 1995 wave. For robustness checks, the probability of being sent down in one wave was instrumented by the other wave. Consistent conclusions are obtained.

As shown in panel A of Table 1.4, I examine the age-earning profile at two points in time and show that the Cultural Revolution significantly lowered the subjected children's average annual incomes by 9.1% in the mid-1990s. Comparing the estimates of CR, the negative effects are amplified by 20% from the mid-1990s (-9.1%) to the early 2000s (-10.9%). In panel B, I track the same birth cohorts 1942–1970 from the two different points in time. The changes in the interested estimates consistently show a substantial increase in the negative impact. The coefficient of CR changes from 6.1% to 10.3%. This amplification could be associated with the fact that as the Chinese market economy increasingly evolved the factor returns were more determined by their marginal productivity in the market. Historically, China began to transition to a market economy immediately after the Cultural Revolution (1979), and this market-oriented economic reform gradually deepened and induced rapid economic growth in China after the 1980s. The affected cohorts were at a disadvantage as the result of various interruptions in human capital accumulation during the Cultural Revolution. The loss in human capital was further amplified as the market became more and more competitive.

In all, the negative effects are consistent with the fact that the Cultural Revolution interrupted human capital production and thereby led to lower earnings in the current urban China. All of the evidence demonstrates the existence of a long-lasting negative effect of the Cultural Revolution on the permanent incomes of the exposed population, and this negative impact was amplified as the Chinese market economy increasingly evolved. In addition, estimates show a stronger role of the Send-Down Movement in lowering the affected cohorts' incomes than the role played by the school closures. This stronger role is also demonstrated by different specifications with multiple controls and principal factor analysis.

1.5.2 The Transmission Mechanism

To explore the channels that drove this negative impact, I proceed to estimate extended empirical models of equation (1) in the spirit of Nunn (2008). Specifically, I introduce productivity determinants (e.g., education attainment, work experience, and health), marital status and revealed cohort traits one by one to investigate how the treated population developed differently. The main estimation results for the full sample are presented in panel A of Table 1.5 from regressions (1) to (6). Three measures (CR, Closure and Send-Down) are controlled for.

The primary factor of human capital, schooling years, is controlled for in regression (2), and regression (3) contains current employment status. Further, current marital status is included in regression (4). In regression (5), a proxy for health, the average height at cohort level, is controlled for and provides a quantified estimate of health condition. I also compute cohorts' attitudes toward the role of luck and hardwork in determining individual success, and I control for it in regression (6) to explore the channel of cohort-specific attitudes. Testing is conducted to control for the channels in different orders in the model, and consistent results are found. Panel B presents the estimation results using the subsample of the employed population. Rather than current employment status, working experience and occupation are available and are examined for this subsample. In the following paragraphs, I will discuss specific channels through which the Cultural Revolution matters in detail.

Educational attainment

As a result of the Cultural Revolution, all levels of schools were closed, and there were campaigns against intellectuals as well as social elites. In addition, the rustication movement disrupted regular attendance in formal schools. The subjected individuals thereby acquired fewer years of schooling and were placed at a disadvantage in the labor market. From the demand side in the labor market, education completion is the primary signal for ability, skill

and knowledge. Hence, this loss was established as an important and permanent channel through which the Cultural Revolution affected the subjected cohorts' current average incomes. The overall effect of the Cultural Revolution, regardless of the measures adopted, reduced by more than 50% after controlling this channel (see panel A; from -10.9% to -5.4% for CR; from -1.8% to -1% for Closure; from -6% to -2.3% for Send-down). Rather than schooling years, I also use education attainment level to capture this channel, and consistent results are found. Note that the Closure estimates become insignificant or trivial as long as educational attainment is controlled for. Instead of years of schooling, levels of educational attainment are used to examine this channel. Considering the intergenerational transmission mechanism, the Cultural Revolution potentially has more far-reaching influence as the result of the fundamentally anti-intellectual atmosphere. In addition, cross-country placebo tests are conducted to show that the impact of the unusual closure of schools on the affected cohorts' human capital accumulation was causal (see Appendix A.3).[15]

Working Experience

Limited by the survey, current employment status is examined for the full sample, and years of employment and occupation are tested for the employed subsample. The estimate of CR changes from -5.4% to -4.5% when I control for current employment status, indicating that the Cultural Revolution affected the interested cohorts negatively through the current employment status channel. Individuals among the treated group were more likely to be retired, laid-off or unemployed. I also utilize the SAVE 2007 to analyze the intensive margin in terms of average age of ceasing to work for pay. The computed results show that members of the subjected group were likely to stop working for pay and leave the labor force earlier than the other cohorts (see Table 1.2.2 and Appendix A.3).

[15]Placebo tests are conducted across three Asian countries, and convincing evidence demonstrates the credibility of the loss in educational attainment for the interested cohorts. Group comparison between urban and rural areas also shows the loss in schooling years for the interested cohorts in urban areas. Meng (2003) and other researchers also found empirical evidence supporting this conclusion.

For the subsample of the employed population, the coefficients of CR and Send-Down also change to be negatively smaller when I control for years of employment in regression (3) of panel B. From regression (3) to regression (4), the estimates continue to shrink when controlling for occupation type. The changes imply that the Cultural Revolution played a negative role for the affected population through the working skills channel. In fact, the sent-down youth had on average two more years of employment than the youth who were not sent down (CHIPS 2002) at each cohort level. This difference is because the education system reform and the forced immigration to rural areas both led to early entry into the labor market. Early entry contributed to more working experience but might have led to a lower-paid path caused by insufficient education attainment. Moreover, the sent-down youth spent years in rural areas, and their accumulated working skills might have been unfit for the demands of the later urban market. Additionally, living in rural environments and doing manual work might have affected their working skills through increasing health hazards. In Appendix A.4, I utilize the 1995 wave of CHIPS to examine the same birth cohorts within the employed population and find a consistently negative role of the Cultural Revolution through this channel. If the data allowed for quality adjustment for the working experience variable, the sent-down youth's real work experience would be lower, and we could obtain a more accurate understanding of the working skills channel.

Marriage

Current marital status, an indicator for different outcomes, is controlled for to quantify the effect of this channel. Whereas it is commonly argued that a better-matched marriage or a stable relationship can enhance efficiency, marital instability (for example, separation and divorce) will contribute to more uncertainties and depressed economic performance.

Although current marital status is different from marriage history, it can still give us an idea of this channel. According to our empirical results, individuals' current marital status

accounted for a part of the overall negative effect of the Cultural Revolution on current earnings.

Using different datasets with marriage history (e.g., data from CFPS 2008), statistics show that the marital lives of the impacted cohorts were more unstable; for example, they experienced more divorces and separations. On average, the sent-down youth had 2% higher divorce rates than their counterparts (source: CFP 2008; see Table 1.2.2). There are a number of mediators for the marital instability caused by the Cultural Revolution. First, disturbed environmental factors psychologically influenced the interested cohorts' commitments to relationships. Second, interruptions and uncertainties increased their searching costs in the urban marriage market, especially for those sent-down youth who returned to cities after years. One direct consequence is that overall, the interested cohorts' first marriages were on average two years later than the before and after cohorts. Last but not least, separations caused by the Send-Down Movement and policies that prohibited the sent-down youth who married local residents from returning led directly to divorces.

Health

The average height at cohort level by gender is controlled for as a health proxy to provide a quantified estimate for the health condition channel (see regression (5) in panel A and regression (6) in panel B). I also compute the mean body mass index at cohort level by gender to control for as the health status channel. The estimates, regardless of which Cultural Revolution measures are used, do not change significantly (see panel A). However, for the employed subsample, the estimates of CR and Send-Down imply a significantly negative impact on the affected cohorts' health conditions (CR: from -3.8% to -3.6%; Send-Down: from -2.6% to -2.3%). Because the synthetic cohort approach has not provided a clear picture, I turn to other pieces of evidence to illustrate the potential effects of the Cultural Revolution through this channel: violence experienced during adolescence could have affected the

subjected children's physical development, and bad habits could have been cultivated by depression during this period. For example, the highly exposed cohorts had a higher proportion of smokers than other cohorts (the data sources are the 1995 CHIPS and SAVE 2007; see Appendix A.3 and Table 1.2.2). Third, when the rusticated youth were sent to rural areas, they were forced to live in rural environments and perform manual labor (Li, 2013 and Zhou, 1999). Inferior environments might have hindered their human capital accumulation, e.g., lack of nutrition and harsh manual labor.

Revealed Attitudes

The last regression controls for the cohorts' attitudes toward diligence versus personal luck in determining success. For the full empirical sample, the estimate of CR does not change significantly. Interestingly, the coefficient of Send-Down changes from -1.9% to -2.3% and becomes more significant. For the employed population, the estimate of Send-Down also becomes more significantly negative after controlling for this channel (changes from -2.3% to -2.9%). The patterns imply that the Send-Down Movement played a positive role in the exposed observations' current performance through this channel. Life in rural areas made the sent-down youth more perseverant, and they utilized their diligence to conquer personal misfortune.

In summary, there are multiple conclusions based on the above results. First, the estimates of interest consistently trend toward zero from the first to the last regression as additional potential channels are added, regardless of the measures (CR, Closure and Send-Down) or samples. Numerically, the impacts are larger within the employed population on average (CR, 10.9% for the full sample and 12.2% for the employed subsample). Second, the changes in the estimates' magnitudes indicate that educational attainment is the most important channel, accounting for roughly 50% of the overall effect. Third, channels were unexplored in this mechanism because the interested estimates (CR and Send-Down) were

still significantly negative in the last regression for both panels. More information is needed to complete the mechanism by exhausting all possible channels.

1.5.3 Robustness Checks

The estimation results are consistent with our hypothesis: past adverse interruptions during the human capital accumulation process will cause violations of life-cycle model predictions. They interrupted the positive increase of cohort-specific productivity growth and negatively affected the subjected groups' current economic performance. In this section, the robustness of the above results is checked.

I gauge the effects among different subsamples with different control groups to check the existence of the negative impact in panel A of Table 1.6. First, I study a shorter age span with control groups of birth cohorts four years earlier and five years later than the treated cohorts (total empirical sample: birth cohorts 1942–1967) for both waves, which can be considered contemporaneous comparisons. We consistently find that the subjected group earned significantly less on average and the Send-Down Movement played a stronger negative role than the school closures. Estimates of both measures negatively increased from the 1990s to the 2000s. Second, subsamples only including the control group born after 1961 are considered. Estimates for this sample (birth cohorts of 1946–1970) are also significantly negative. For the 2002 wave, the overall effect is -11%, whereas for the 1995 wave, it is -6.6%. In all, persistent negative impacts of the Cultural Revolution are found regardless of the control group chosen and regardless of the time point being examined. Moreover, in comparing the impacts in 1995 with those in 2002, the effects are amplified over time.

I further examine the subsample with family background considering potential selection bias, and the results are reported in panel B of Table 1.6. The survey provides family background information for household heads and their spouse, for example, their parents' social status ("chengfen"), education attainment and occupations. All of these predetermined

family background variables are controlled for in regressions simultaneously and respectively. Consistently, the significantly negative estimates of interest support the existence of long-term impacts (-12.5% for CR; -1.3% for Closure; and -7.8% for Send-Down). Differences in the interested estimates between before and after controlling for family background show that household background played a role to some extent.

As discussed above, the rural residents had very different experiences. Compared with permanent urban citizens, they were not exposed to such intensive human capital disruptions (large-scale school closures and the Send-Down Movement). Meanwhile, from the 1990s to 2002, annual income also largely increased for them because of the rapid growth in China (see the statistics in Appendix A.3). Therefore, it is expected that the Cultural Revolution did not have significantly persistent effects on the cohorts in the rural areas as the urban counterparts.

In Table 1.7, I conduct multiple placebo tests with rural-urban migrants and permanent rural residents from CHIPS 1995 and 2002. First, the results for rural residents show that the CR, Closure and Send-Down estimates are all insignificant and close to 0. Note that rural household income from agriculture production as well as other family production is recorded collectively at the household level and is indivisible. Therefore, observations with nonfarm individual revenue are examined. Second, as shown in Table 1.7, no negative impacts are found, and the coefficients of interest are insignificantly positive for rural-urban migrants. The sample of rural-urban migrants might have worked better as a counterfactual comparison because they migrated from rural areas after the 1990s, currently work in urban areas and share similar macroeconomic environments with the affected cohorts in the urban market. The insignificant estimates of interest that were obtained in all of the placebo-controlled studies provide convincing evidence supporting the causal effects of the Cultural Revolution on urban residents.

1.6 Conclusion

Following the existing literature, this paper documents and examines the impact of historical events on current economic development by focusing on one specific historic event in one specific country (the Cultural Revolution in urban China). Specifically, I gauge the impacts of the Cultural Revolution by testing its micro-effects on individuals' average annual earnings and explore the channels through which the effects persist. Moreover, I examine how the impacts changed from the 1990s to the 2000s as the Chinese economy became more market-oriented.

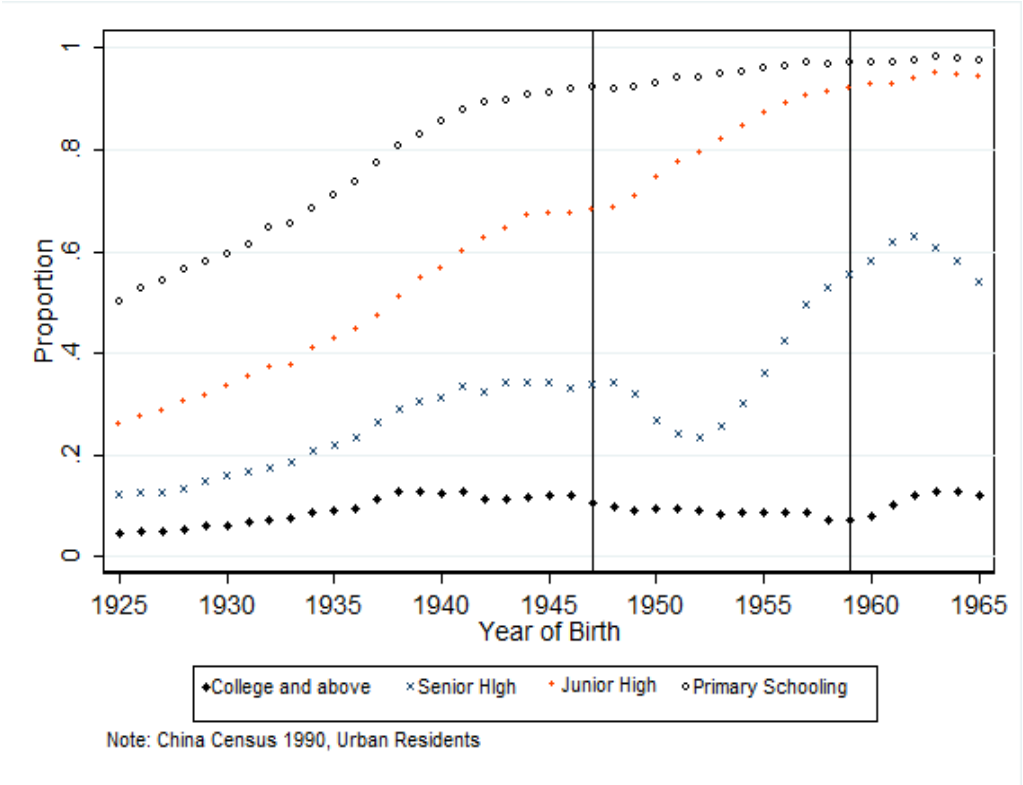
To accurately capture the impact, I designed three measures for the Cultural Revolution (CR, Closure and Send-Down) based on synthetic cohort approach and utilized multiple datasets. Send-Down and Closure revealed different intensities at the cohort level from being subjected to two specific policy shocks: the closure of schools and the Send-Down Movement. In this way, selection bias and measurement error at the individual level were alleviated. In addition, the Great Famine was controlled for to avoid contamination.

Consistent evidence supports that a Cultural Revolution effect lowered urban residents' average annual income in the middle 1990s and early 2000s, and the effect was amplified as the market-oriented economy increasingly evolved. Based on the results from CHIPS 2002, the magnitude of the negative impact on average annual earning was approximately -11%. The coefficient of school closure implies that one year of formal secondary schooling denied reduced the subjected individuals' annual incomes by approximately 1.8%. On average, the school closures lowered the exposed cohorts' annual income by 2.7%. Furthermore, the forced immigration (the Send-Down Movement) played a stronger role in lowering current earnings, by -4.8% overall within the empirical sample. The existence of long-term impacts is robust to contemporaneous population comparisons and to a variety of controls for family background and different control groups. Placebo tests of rural residents as well as rural-urban migrants

also support the existence of a negative causal effect of the Cultural Revolution on the subjected population's permanent incomes. I also study the mechanism through which the impacts of the Cultural Revolution persist based on sequential covariate addition. Evidence from the extended models reveals that the Cultural Revolution shaped many aspects of individuals' life courses: education attainment, work experience, marriage history, health conditions and attitudes toward the determinants of personal success. Among all of these explored micro-channels, education achievement is the major channel, accounting for approximately 50%. Additionally, it is intriguing to find that the Send-Down Movement affected the exposed observations' current incomes negatively through the health status channel and positively through the revealed attitudes channel. Their experiences made the sent-down youth more perseverant. Considering the complexity of the Cultural Revolution (which changed virtually every aspect of the exposed cohorts' life courses), the results also cast doubt on the existing empirical papers that use the school closures as an IV to measure the real return of schooling or that conclude a positive effect of the Send-Down Movement through simply comparing the sent-down youth with the non-sent-down youth.

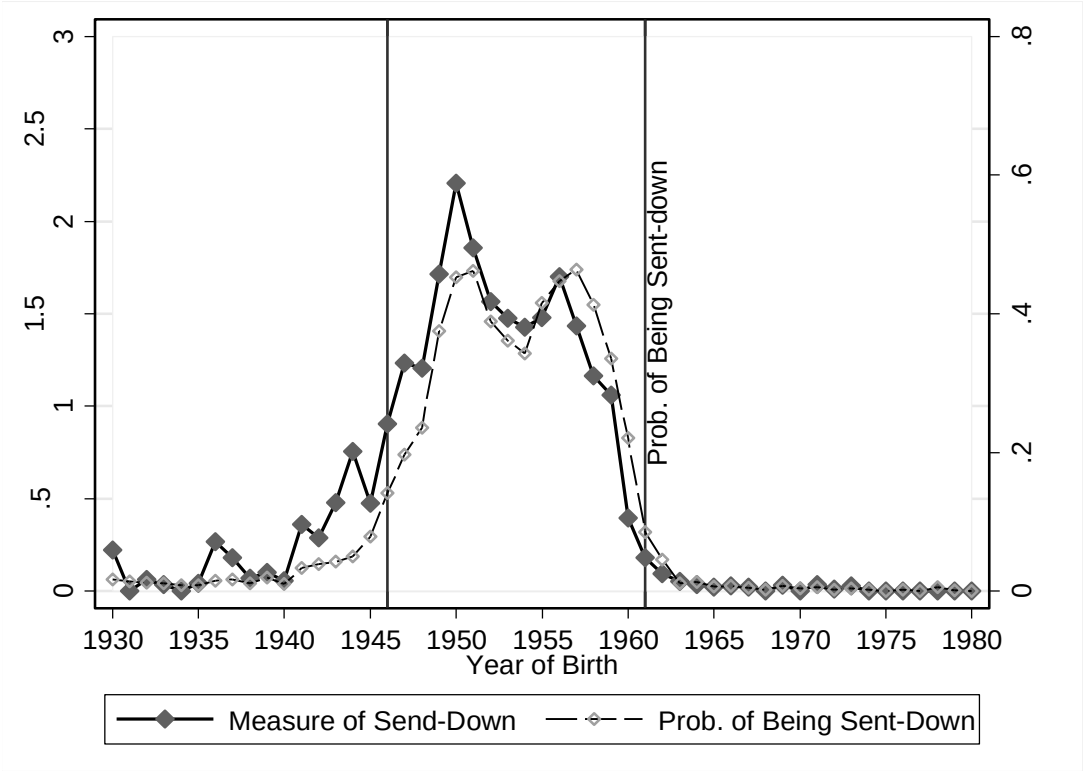
There are still parts of the black box that remain unopened. Additional questions requiring more study include the following. How did the Cultural Revolution impact the exposed populations' health conditions, preferences and personalities? How did the Cultural Revolution continue to have effects through institutional persistence? Separate from the impacts on labor market performance, we can also explore the impacts of the Cultural Revolution on other economic outcomes, for example, precautionary savings, consumption patterns and intergeneration transmission of human capital.

Figure 1.1: Education Attainment in 1990, by Birth Cohort and School Level



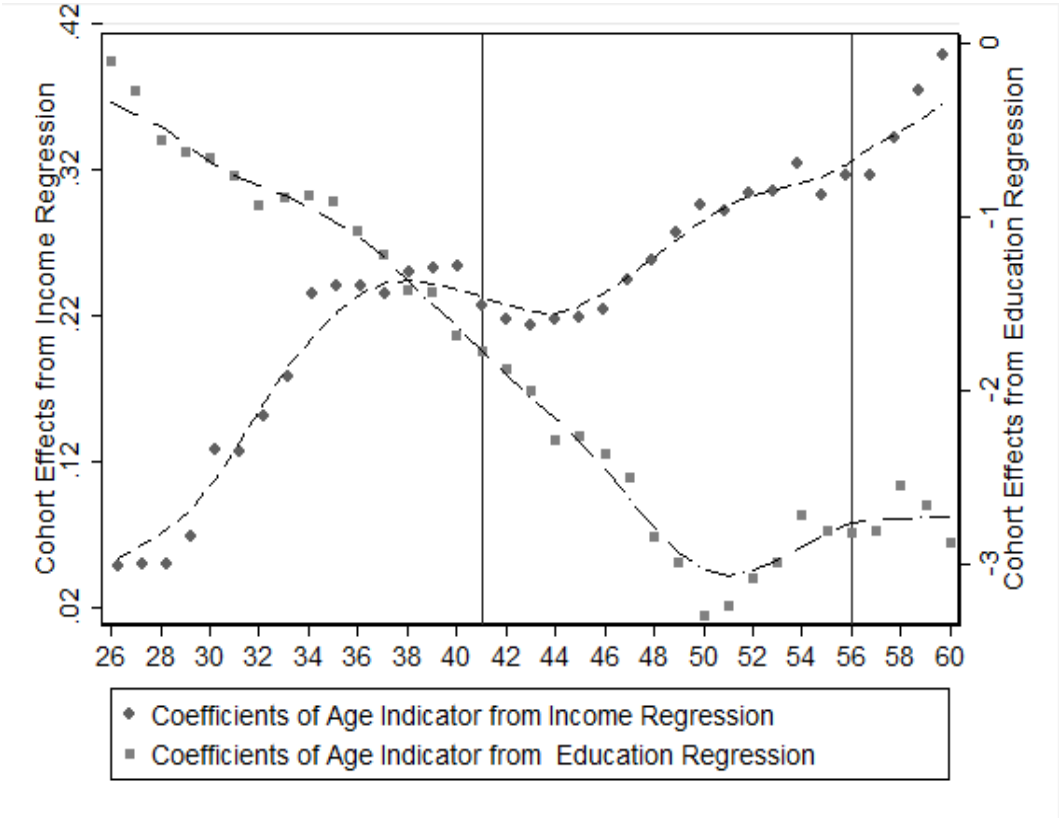
Data source: Urban Residents from China Census 1990. Consistent patterns are observed in our empirical sample of CHIPS 2002 (see Appendix A).

Figure 1.2: The Intensity of Being Treated by the Send-Down Movement



Data source: urban residents of CHIPS 2002 and 1995

Figure 1.3: Deviations from the Life-cycle Model



Note: The scatters are the coefficients of the cohort indicators in the regression of natural log of income as well as schooling years on cohort indicators, gender and region indicators based on the empirical sample. And the coefficients are smoothen by taking three continuous cohorts' moving average for graphing. Two vertical lines highlight the interested birth cohorts.

Table 1.1: Methodology Summary

Birth Cohort	(1) Age in 1966	(2) Years of Secondary Schooling Denied	(3) Probability of Being Sent-down (1995)	(3) Probability of Being Sent-down (2002)	(4) Length of Stay in the Rural (2002)	(5) Send-Down (1995)	(6) Send-Down (2002)	(7) Exposure to Famine
1946	20	0	0.16	0.14	6.32	0.98	0.96	0
1947	19	0.5	0.18	0.21	6.22	1.05	1.29	0
1948	18	1	0.24	0.24	5.04	1.16	1.26	0
1949	17	1	0.40	0.35	4.90	1.80	1.82	0
1950	16	4	0.45	0.46	4.83	2.17	2.32	0
1951	15	4	0.51	0.41	4.44	2.39	1.92	0
1952	14	6	0.44	0.34	4.60	1.87	1.60	0
1953	13	6	0.41	0.31	4.77	2.04	1.50	0
1954	12	6	0.33	0.36	3.96	1.31	1.48	0
1955	11	4	0.42	0.42	3.67	1.50	1.52	0
1956	10	4	0.41	0.49	3.49	1.42	1.70	0
1957	9	1	0.49	0.44	3.25	1.55	1.47	1
1958	8	1	0.41	0.42	2.75	1.09	1.20	2
1959	7	0.5	0.34	0.33	3.24	1.07	1.07	3
1960	6	0	0.27	0.17	2.28	0.60	0.40	2
1961	5	0	0.10	0.07	2.63	0.27	0.19	1
Mean	--	1.5	0.214	0.195	4.09	0.85	0.79	--

Data sources: 1995 and 2002 waves of CHIPS and values of measure "Send-Down" in 1995 are computed by the product of probability of being sent-down in 1995 wave and length of stay in the rural areas merged from 2002 wave because of lack of information in this wave.

Table 1.2.1: Summary Statistics

Outcome Variables	Older Group[a]	Birth Cohorts 1946-1961	Younger Group[b]
Permanent Urban Residents			
Average Income	5683.420	5653.050	4665.320
(1993-1995) obs. 12581	(3739.89)	(3304.25)	(3055.239)
Average Income	10546.730	10444.070	9823.650
(2000-2002) obs. 12304	(7105.054)	(7550.042)	(7650.936)
Income Growth	85.6%	84.8%	110.6%
CHIPS 2002	All	Control Group[c]	Treated Group
(Urban Areas)	(Obs. 12304)	(Obs. 5637)	(Obs. 6667)
Log (Income)	8.966	8.920	9.010
	(0.95)	(1.03)	(0.87)
Age	43.12	37.241	48.100
	(8.72)	(9.01)	(4.23)
Female	0.495	0.506	0.486
	(0.50)	(0.50)	(0.50)
Schooling Years	10.944	11.685	10.318
	(3.1)	(3.10)	(2.95)
Sent-down Youth	0.195	0.015	0.347
	(0.40)	(0.12)	(0.48)
Current Marital Status (composition)			
Other	0.04%	0.07%	0.01%
Single	4.71%	9.81%	0.39%
Married with Spouse	93.18%	88.34%	97.27%
Separation[d]	2.08%	1.78%.	2.32%
Current Employment Status (composition)			
Other	0.46%	0.18%	0.28%
Employed	78%	83.98%	73%
Unemployed	2.8%	3.14%	2.5%
Retired	15.2%	9.12%	20.4%
Laid-off	3.7%	3.58%	3.8%
Work Experience[e]	21.025	15.077	26.777
(2002)	(8.95)	(7.18)	(6.36)
Work Experience	21.846	21.353	22.240
(1995)	(9.09)	(12.12)	(5.56)
Working Experience of Sent-Down youth			28.00
(for birth cohorts 1946-1961; obs. 1690)			(4.97)

[a] Older group includes birth cohorts of 1935-1945 for wave of CHIPS 1995 and birth cohorts of 1942-1945 for wave of CHIPS 2002 respectively; [b] Younger group includes birth cohorts of 1962-1970 for wave of CHIPS 1995 and birth cohorts of 1962-1977 for wave of CHIPS 2002 respectively; [c] Control group includes birth cohorts 1942-1945 and 1962-1977 in the wave of 2002, while for the wave of 1995, it contains birth cohorts 1935-1945 and 1962-1970. The treated group contains birth cohort 1946-1961; [d] The group of separation includes observations who is currently divorced or separated from her or his spouse for other reasons; [e] Statistics summary for working experience only works for employed population of the wave of 2002.

Note: 1. Summary statistics is computed based on CHIPS 2002 and 1995. Means of variables are shown with the standard deviation within the parentheses; 2. Income growth for samples with the same birth cohorts that older cohorts of 1942-1945 and younger birth cohorts of 1962-1970 is also checked and consistent findings are obtained.

Table 1.2.1: Summary Statistics for Channels

CFPS 2008 (obs. 3948)	All	Control Group[a]	Treated Group
Attitude[b]	1.377	1.405	1.350
	(0.98)	(1.03)	(0.93)
Diligence	5.968	5.978	5.957
	(1.21)	(1.2)	(1.22)
Personal Luck	5.134	5.099	5.169
	(1.59)	(1.6)	(1.58)
Smoker[c]	0.317	0.309	0.325
	(0.46)	(0.46)	(0.47)
Divorce Experience[d]	0.041	0.043	0.039
	(0.20)	(0.20)	(0.19)
Divorce Experience of the Sent-Down Youth (obs. 378)			0.058 (0.23)
CHIPS 2007 (obs. 9562)	All	Control Group	Treated Group
Height	165.112	165.394	164.708
	(7.67)	(7.49)	(7.89)
Female	159.545	160.025	159.224
	(4.98)	(4.66)	(5.34)
Male	170.873	171.495	170.409
	(5.36)	(4.94)	(5.8)
Weight	63.226	62.695	63.891
	(10.79)	(10.618)	(10.96)
Female	57.651	56.598	58.975
	(8.515)	(7.91)	(9.05)
Male	69.054	69.096	69.002
	(9.79)	(9.24)	(10.43)
SAVE 2007 (obs.2550)[e]	All	Control Group	Treated Group
Age of Stopping Working for Returns			
Female	50.241	52.724	49.37
	(5.56)	(4.73)	(4.42)
Male	53.795	57.067	52.149
	(4.74)	(4.13)	(5.47)

[a] Control group includes birth cohorts of 1942-1945 and birth cohorts of 1962-1977. Treated group contains birth cohorts of 1946-1961.
[b] Variable of Attitude represents attitude towards determinants of success (diligence of the importance for different factors is measured from 1 to 7. The higher the value is, the more important the individual values the determinant.
[c] Variable of smoker is an indicator showing whether one smokes or not.
[d] Only observations with marriage experience in the sample are considered.
[e] Control group includes birth cohorts of 1942-1945 and the group treated cohorts is narrowed to be birth cohorts of 1946-1955 concerning the legal retirement age: 60 for male and 55 for female in 2007.
Note: 1. Means of variables are shown with the standard deviation reported within the parentheses; 2. Control group of birth cohorts 1935-1945 and 1962-1977 is examined and consistent conclusions are found.

Table 1.3: The Existence of Long-Term Impacts

	CHIPS 2002		
Measures	(1)	(2)	(3)
CR	-0.109*** (0.020)		
Closure		-0.018*** (0.003) [-0.027]	
Send-Down			-0.060*** (0.014) [-0.048]
R-squared	0.1	0.1	0.1
Obs.	12304	12304	12304

Note: 1. ***, ** and * represent significance at 1%, 5% and 10%, respectively. The robustness standard error is reported in the parentheses and adjusted for clusters in age. Bootstrap based improvement for clustering also has been done; 2. The three measures of the Cultural Revolution (CR, Closure and Send-Down) are examined separately from regression (1) to (3); 3. Control variables include gender, age, age squared, famine effects and province indicators. Dependent variable are natural log of individual's average annual income between 2000 and 2002; 4. For the closure of schools and the Send-Down Movement, the average impacts among the full empirical sample are reported inside the brackets.

Table 1.4: The Changes of the Impacts

Samples	Panel A		Panel B	
	At Ages of 25 to 60		Birth Cohorts: 1942-1970	
Measures	CHIPS 1995	CHIPS 2002	CHIPS 1995	CHIPS 2002
CR	-0.091*** (0.027)	-0.109*** (0.020)	-0.061** (0.023)	-0.103*** (0.03)
Closure	-0.007* (0.004)	-0.018*** (0.003)	-0.007 (0.004)	-0.01 (0.005)
Send-Down	-0.068*** (0.02)	-0.060*** (0.014)	-0.033*** (0.01)	-0.04** (0.02)
R-squared	0.25	0.1	0.24	0.15
Obs.	12581	12304	10801	10896

Note: 1. ***, ** and * represent significance at 1%, 5% and 10%, respectively. The robustness standard error is reported in the parentheses and adjusted for clusters in age. Bootstrap based improvement for clustering also has been done; 2. The three measures of the Cultural Revolution (CR, Closure and Send-Down) are examined separately. For the 1995 wave, the average duration of stay in the rural areas for the sent-down youth is merged from the 2002 wave to construct the measure of Send-Down because of the lack of information; 3. Control variables include gender, age, age squared, famine effects and province indicators both in panel A and panel B. Dependent variable are natural log of individual's average total annual income between 2000 and 2002 or from1993 to 1995.

Table 1.5: Examine the Mechanism of the Cultural Revolution (CHIPS 2002)

Panel A:	Full Sample Analysis					
Regressions	(1)	(2)	(3)	(4)	(5)	(6)
CR	-0.109***	-0.054**	-0.0447**	-0.0435**	-0.0435**	-0.0444**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Alternative Measures						
Closure	-0.018***	-0.007*	-0.003	-0.003	-0.002	-0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
Send-Down	-0.06***	-0.023**	-0.02**	-0.019*	-0.019*	-0.023**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Schooling Years		Yes	Yes	Yes	Yes	Yes
Employment- Status			Yes	Yes	Yes	Yes
Marital Status				Yes	Yes	Yes
Health					Yes	Yes
Attitude						Yes
R-squared	0.1	0.17	0.35	0.35	0.35	0.35
Obs.	12304	12304	12304	12304	12304	12304

Panel B:	Subsample Of Employed Population Analysis						
Regressions	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CR	-0.122***	-0.072***	-0.068***	-0.051***	-0.038**	-0.036*	-0.035**
	(0.025)	(0.026)	(0.023)	(0.019)	(0.016)	(0.014)	(0.014)
Alternative Measures							
Closure	-0.017***	-0.009	-0.008	-0.006	-0.005	-0.004	-0.0001
	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.003)	(0.003)
Send-Down	-0.071***	-0.044***	-0.042***	-0.034***	-0.026**	-0.023*	-0.029**
	(0.014)	(0.014)	(0.013)	(0.012)	(0.012)	(0.01)	(0.009)
Schooling Years		Yes	Yes	Yes	Yes	Yes	Yes
Working-Experience			Yes	Yes	Yes	Yes	Yes
Occupation				Yes	Yes	Yes	Yes
Marital Status					Yes	Yes	Yes
Health						Yes	Yes
Attitude							Yes
R-squared	0.13	0.18	0.25	0.29	0.29	0.29	0.29
Obs.	9637	9637	9637	9637	9637	9637	9637

Note: 1. ****, **and * represent significance at 1%, 5% and 10%, respectively. The robust standard error is reported in the parenthesis and adjusted for 36 clusters in age and bootstrap based improvement for clustering also has been done; 2. Measures of CR, Send-Down and Closure are controlled respectively into empirical models; Marital Status is a grouping variable and represents different marital status in 2002. Health proxy is average height at cohort level merging from CHIPS 2007. Attitude reveals how relatively important individuals value diligence against luck in determining personal success at cohort level which is merged from CFPS 2008; 3. Working-Experience is how many year individuals have been working and missing indicator is controlled for 67 observations who haven't reported the information. Employment-Status is a status variable grouping being unemployed, employed, laid-off, retired and others in 2002; 4. Other independent variables: gender, age, age squared, famine and province fixed effects.

Table 1.6: Robustness of the Existence of the Impact on Incomes

Panel A	Different Control Groups					
	2002 CHIPS			1995 CHIPS		
Birth Cohorts	1942-1967	1946-1970	1942-1970	1942-1967	1946-1970	1942-1970
CR	-0.070***	-0.111**	-0.103***	-0.05**	-0.066**	-0.061**
	(0.024)	(0.04)	(0.03)	(0.02)	(0.03)	(0.023)
Closure	-0.01**	-0.01	-0.01	-0.003	-0.008**	-0.007
	(0.004)	(0.005)	(0.005)	(0.003)	(0.004)	(0.004)
Send-Down	-0.04**	-0.02	-0.04**	-0.025*	-0.03**	-0.033***
	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
R-squared	0.13	0.15	0.15	0.2	0.24	0.24
Obs.	9878	10198	10896	10081	9748	10801
Panel B	Controlling Family Background (CHIPS 2002)					
	(1) No	(2)Yes	(3)No	(4)Yes	(5)No	(6)Yes
CR	-0.141**	-0.125**				
	(0.04)	(0.04)				
Closure			-0.017*	-0.013*		
			(0.007)	(0.007)		
Send-Down					-0.83***	-0.78***
					(0.025)	(0.025)
R-squared	0.15	0.19	0.15	0.19	0.15	0.26
Obs.	3788	3788	3788	3788	3788	3788

Note: 1. Panel A tests subsamples of different age-spans from both waves of CHIPS. Panel B contains urban residents at age of 25-60 with respective parents' information in 2002. This subsample with family background is constructed by combining the household information with the individuals' data. Family background includes parents' occupation, parents' social status ("chengfen") and parents' educational attainments; 2. Other independent variables are gender, age, age squared, effects of famine and provincial fixed effect; 3. ***, **, and * represent significance at 1%, 5%, and 10%, respectively; the robust standard errors are reported in the parenthesis and adjusted for clusters in age.

Table 1.7: Placebo Tests within China

Data Source	CHIPS 2002			CHIPS 1995			CHIPS 2002		
Measures	Rural Residents 2002			Rural Residents 1995			Rural-Urban Migrants 2002		
CR	-0.015			-0.034			0.201		
	(0.050)			(0.075)			(0.163)		
Closure		-0.008			0.004			0.006	
		(0.007)			(0.013)			(0.035)	
Send-Down			-0.025			0.043			0.049
			(0.030)			(0.051)			(0.108)
R-squared	0.27	0.27	0.27	0.36	0.36	0.36	0.16	0.16	0.16
Obs.	7369	7369	7369	3819	3819	3819	3407	3407	3407

Note: 1. Empirical sample of permanent rural residents includes observations that currently work and at age of 25 to 60. The sum of the annual wage incomes and non-wage individual incomes (non-agriculture earnings) are computed as the dependent variable; 2. Empirical sample of rural-urban migrants includes migrants that are at age of 25 to 60 and migrated to urban after 1990s. Natural log of the total annual incomes are taken as the dependent variable. 3. Other independent variables are gender, age, age squared, effects of famine and regional fixed effect. For rural areas, the county fixed effects are controlled for while for rural-urban migrants, birth place fixed effects are controlled for; 4. ***, **, and * represent significance at 1%, 5%, and 10%, respectively. The robust standard errors are reported in the parenthesis and adjusted for clusters in age; 5. Various samples are examined for robustness checks, for example all population at age of 25 to 60 or longer age spans. And also individual's wage income is taken as the dependent variable to evaluate the impacts. Consistent findings are found.

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Chapter 2

Understanding the Intergenerational Transmission of Educational Attainment: Evidence from China

2.1 Introduction

The Educational attainment of parents is usually considered as the most fundamental determinant contributing to children's success in education (Haveman and Wolfe, 1995). An increase in parents' education can greatly benefit next generation. This robust positive correlation between parental education and children's schooling has been widely documented in the current literature. It motivates policy-makers to improve parents' education in developing countries with the target of "equality of opportunity" and reduction of poverty. For example, there are policies and programs: providing free primary education, enforcing mandatory education to certain level and issuing education voucher for high schools. They are designed to break intergenerational persistence, enhance the living standard for next generation and create pathways to move out of poverty. Despite the importance of the marginal effects of parental educational attainment on their offsprings' schooling outcomes, the current literatures are still limited to discern the causality and selection in this positive correlation. Does the increase in schooling years of parents really make the parents different? Behave differently? Value differently? Or simply do more able parents end up with more able children (selection)?

Distinguishing between the intergenerational selection and intergenerational causal effect is informative from a policy perspective. First, if higher parent's education does indeed improve children education attainment in the way of shaping parents' behaviors and personal traits, the social benefits of supply of public education might be underestimated. Answers can serve to provide insurance for initial conditions so that to curb lifetime inequality reaching

further. Second, understanding the important factors of nurture is also broadly beneficial. It can direct the policies to pay attention to the working lifetime of parents (e.g., unemployment insurance or subsidy with necessary requirements of educational expenditure imposed). So that it can help alleviate parents' current budget constraints and improve the outcomes of their children for the sake of long-run development.

In this paper, I study the intergenerational effects empirically in the case of China and examine the existence of causality with instrument variables. Formal education system was dramatically impacted from 1966 to 1977 by the Cultural Revolution in urban China. The majority of senior secondary schools were shut down between 1966 and 1971. Although the closure was nationwide, the intensity of implementation varied across residential regions: city areas and town areas. Given the regional variation and time series variation, I can utilize this plausibly exogenous shock which is exogenous to parental ability as IV. Specifically, I use interactions between parental ages and residential areas as instruments for parental senior secondary completion in my empirical model. The IV estimates and Difference-in-Difference estimates consistently prove the existence of causality between senior secondary attainment of parents and children's senior secondary attendance. The results are robust to different model specifications, different subsamples and other data source.

The primary contribution of this paper is examining the causal relation between parental senior secondary schooling attainment and kids' senior secondary attendance in the largest developing country, China. Most of the existing literature is limited by its focus on reforms at lower levels of education. For example, reforms for primary schooling; Second, implications of this paper are informative, both for the nature of the experiment, such a large scale of closure of senior secondary schools with such large affected population, and the utilization of the large sample (China Census 1990).

This paper is organized as follows. Section 2 reviews the current literature and discusses the historical background. Section 3 describes the data and the empirical strategy. Section 4 presents the empirical results. Robustness and mechanism discussions are provided in this section 5. Section 6 offers concluding remarks.

2.2 Literature Review and Historical Background

2.2.1 Current Literature

There exists a branch of literature focusing on differentiating the intergenerational causality and intergenerational association. However, it is still numbered and lacks of consensus. By sorting of the identification strategies, the literature can be classified into several types: identical twins, adoptees, and instrumental variables (including RDD).

The twins' approach is to utilize the difference between twin parents to identify the effect of parental education on children's schooling outcomes. Most of the twin-difference estimators show a significant and positive effect of fathers' education on children's schooling achievement (Antonovics and Goldberger, 2005; Behrman and Rosenzweig, 2002; and Pronzato, 2009). But the causal effect of maternal education on children's school outcomes was ambiguous. The adoption strategy also targets at taking out the genetic transmission between parents and biological children and identifying the existence of causality. As the absence of genetic transmission for adopted children, the difference estimators will capture the causal intergenerational effect. Bjorklund et al. (2006) and Sacerdote (2000, 2007) present supporting evidence for the causal effects from paternal education achievement to children's education performance. Most of these papers use the schooling years as the outcome variable and estimate least squares regression with fixed effect controlled.

By contrast, Haegeland et al. (2010) use exam marks as outcome variable and find no causal effect when apply both strategies. There are two main concerns for twins and adoptees approaches: sample limitation and individual specifics (e.g., unobserved differences between

twins, small sample size, unobserved parental characteristics or selective placement of adopted children).

Recently, studies utilize education reforms as instruments for parental education and examine the existence of causal effects. Basic technique is to regress parent's schooling years on the variation of parental exposure to the reform in the first stage estimation and to regress the children's schooling outcome on the predicted value of parental education completion in the second stage. Most of the reforms examined are at the lower level of schooling, like primary schooling reforms (Arnaud Chevalier, 2004; Black, Devereux and Salvanes, 2005; Holmlund, Lindahl and Plug, 2010; Oreopoulos et al., 2006). Concerning higher level of schooling, Maurin and McNally (2008) explores the reform of university as an instrument. Additionally, Carneiro, Meghir and Parey (2012) in their paper resort to regional economic outcomes as instruments. The instrumented outcome variables include years of schooling, grade repetition, school enrollment and exam scores. Generally the intergenerational transmission coefficients examined should be correct, consistent and informative as long as exclusion restrictions are satisfied. However, conclusions from those literatures vary across regions. For example, Black, Devereux and Salvanes (2005) show insignificant intergenerational causal effect when they study the Norwegian Primary School Reform. Meanwhile Holmlund et al. (2010) obtain positive evidences for the existence of the causal effect in their study of Sweden and Agüero et al. (2010) also prove the intergenerational causality in Zimbabwe case using RDD approach. The inconsistencies might be caused by the satisfactory level of the instruments, the selection of children's education outcomes and constraints of the available data. Also differences of economic environments between developed countries and developing countries are other sources for the above conflicts.

Empirical study in this research will start with the simple Difference-in-Difference estimates and then follow the IV approach to study the intergenerational transmission of

education attainment at a relative higher level, taking advantage of a dramatic educational policy in China (the closure of senior secondary schools).

2.2.2 Education Interruptions in China

The regular formal education system in China includes: 6 years of primary education, 3 years of junior secondary schools, 3 years of senior secondary schools and 4 years of college. After finishing the junior secondary schools, individuals can also choose technical secondary schools instead of regular senior secondary schools. Also, instead of regular university study, individuals can enter junior college (2-3 years) after graduation from senior secondary schools. However, this common trajectory was interrupted nationally by the Cultural Revolution in 1966.

Overall, the Cultural Revolution (1966-1976) was a far-reaching and profound historical event in China. Although it was initiated because of political conflicts, the formal education system had been dramatically impacted during this period (Deng and Treiman, 1997; Li, et al., 2010; Meng, 2003; Zhang, et al., 2008; Zhou, et al., 1999). Marked by May 16th Notification in 1966, the Cultural Revolution formally started (Chandra, 1987; Deng and Treiman, 1997) and at the very beginning, all levels of schools had been shut-down or stopped offering lectures, especially in urban areas. The primary schools responded to the reopening policy instantly and its closure was temporary. At the meantime, junior high schools also were marginally impacted and stopped offering regular lectures for a while.[16]

The senior high schools were shut down for a longer period in urban areas and senior high attainment was severely affected across urban population (see Appendix A). The prelude to recovery was marked by an official announcement from the central government in September 1971. Consequently, the large-scale interruption to senior secondary schools did not stop until 1972 and it lasted for 6 years (1966-1971). Although there is no official data of

[16]Spence in his paper (2001) stated that the majority of junior high school students did not regular return to schools and start receiving formal schooling in urban China until the fall of 1968.

the supply of secondary schools between 1966 and 1971 issued by the central government, we can still find some pieces of evidence supporting the time line of the interruptions. For the whole nation, the number of formal senior secondary school in 1965 was 4112 and became 28029 in 1972 (sources: China Statistics Yearbook: 1949-2009 and China Education Statistics Yearbook: 1971-1998). According to the administrative data, the number of senior secondary schools in cities was only 500 in 1971 and changed to be 4000 in 1972. For town areas, the number of secondary schools was 1100 in 1971 and was 3544 in 1972. After 1972, the number of senior secondary schools gradually increased for urban and town regions.[17] Town and city residents experienced similar educational interruptions during 1966-1977 except for the intensity. Given the spirit of the Cultural Revolution (Meng, 2003; Treiman, 1997; and Zhang, 2011), "equalization", the town regions were less likely to be impacted than the city areas. Differently, there was an expansion of senior secondary schools after 1972 in some rural counties (Zhang, 2011). Figures in Appendix A.1 graph the supply of formal junior secondary schools and senior secondary schools across three residential after 1971. They show that there are bumps exhibited after 1972 in rural areas and the supplies of secondary schools were pretty consistent over time in city and town residential. These policies gave rise to different exposure to the closure of schools for city, town and rural residents.

All the educational interruptions were ceased completely at the end of the Cultural Revolution and the formal education system return to normal. Considering the scale of the affected population, this paper focuses on the variations created by the closure of senior secondary schools.[18] This nationwide closure of senior secondary schools between 1966 and

[17]Generally, there are three residential types: city, town and county (village) in China. The Counties (village or "Xian") are rural grassroots regions. Towns (Zhen) are regions where county jurisdictions are located and suburban areas, at least 50% of which are non-agricultural population (the 1955 standard). Those who resided in a village or a rural production team were considered rural. Broadly speaking both town residential and city residential were considered urban.

[18]Although the closure of colleges lasted for a decade, the fraction of population impacted is small (the proportion of new enrolled college students among the total newly enrolled students) took far less than 1 one percentage in 1965 before the Cultural Revolution. The population with higher education attainment accounted for far less than 1% before 1990.

1971 can serve as a quasi-natural experiment and induces an exogenous shock to individuals' human capital accumulation. Two sources of variations created by the closure of senior secondary schools will be utilized in our empirical identification: the variations over birth cohorts (based on the regular ages to begin senior high schools) and the variations across city and town residents. There are two considerations for the chosen residential. First, in general, town and city are geographically neighboring and with similar economic environments; second is for the potential contaminations from the expansions of the secondary schools in rural counties at the second half of the Cultural Revolution.

To visually illustrate these variations, I graph the senior secondary completion against their ages in 1966 for female and male samples for town residents (low exposure) and city residents (high exposure) respectively. As shown in Figure 2.1.1 and Figure 2.1.2, for the birth cohorts at ages older than 20 as well as at ages younger than 12 in 1966, the trend of senior high attainment is slightly increasing over years of birth, both for female and male samples. Compared residents in town with the city residents, the two trends are parallel with each other. However, the birth cohorts at ages of 12-19 in 1966, who experienced their senior schooling ages during the school closure, were impacted by the closure of secondary schools and their senior high completion rates declined dramatically in city areas. I also make placebo tests for junior secondary completion. As shown in Appendix B, there doesn't exist such intensive impacts on junior secondary completion over birth cohorts across population.

2.3 Data, Identification Strategy and Empirical Models

2.3.1 Data

The main data source used is the China Population Census of 1990. This census has been considered national efforts, mobilizing millions of census takers and hundreds of millions of participants. It used household as the unit of census and all members within households were asked a series of demographic Information. It was conducted under the direct leadership of

China's State Council, which forms a special leadership group composed of high level officials from relevant governmental ministries and organizations. These organizations include statistics, public security, economic planning, family planning, civil affairs, ethnic affairs, education, finance, labor, and others. The actual design, implementation, and processing of census data are carried out by China's State Statistical Bureau (SSB, also known as the National Bureau of Statistics).

It contains important individual information and household variables which include birth year, region of residence, province of birth, sex, relationship to the head of the household, location of biological parents within household, education attainment by level, ethnicity, number of kids born for female, family size, occupation types, and the number of family within household and dwelling of individuals. Individuals only can be registered in one household (mostly due to family relationships), regardless of the type of working places and the type of household registrations (agricultural or non-agricultural), and whether they have the formal household registrations (Hukou).

Two methods are utilized to match parents with children. Both ways are applied and we obtain similar results. The first one is based on the relationship to household head. The survey coded relationship to the household heads within households. I can link their spouses to the household heads and separate them into samples of mothers and fathers. And then I can further match the children to their parents at household level. The second way is using the individual's self-reported code of parents within household to match the children to their biological parents. For each individual, they have unique code within the household and are asked the code for their biological parents within the households. I match individuals with their biological parents according to the self-reported unique code of their biological parents. Parents who were dead or were not in the same household are missing. The results of the second way-individual based-are presented. In this way, rule for linking parent is not only

based on linkage to household head or spouse of household head but also biological linkage to other members.

The common ages to start formal schooling were 7 to 9 during the Cultural Revolution. Individuals attended senior high schools at ages of 16 to 18 and were around 19 to 21 when they completed the senior high education. Given the timeline of school closure, parents older than 20 in 1966, ideally should have had completed senior secondary schools and their senior high attainments have not had been affected by the closure of secondary schools. By contrast, individuals younger than 19 in 1966 were affected, for they were about to attend or were attending secondary schools when the secondary schools were closed. For the center relationship to gauge is the effect of senior secondary attainments of parents on senior secondary attendance of their children, I restrict the sample of analysis to parents at age 12-26 in 1966 (year of birth: 1940-1953; age in 1990: 37-50) born in residential of town and city with children at ages of 16 to 22 in 1990 (year of birth: 1964-1974) to study the effect of parental senior high completion on children's senior secondary attendance in 1990. The year of birth is adjusted by school calendar. There are two reasons for the selection of the children sample. The children at ages over 16 were attending senior high schools in 1990 or had completed the senior secondary schooling already. Second, according to the marriage law in China, the legal age to get married for male is 22 and above and for female is over 20. Attrition problem for married children is discussed in the Appendix B.[19] Additionally, for better illustrating the effects of the school closure, I also represent group comparisons

[19]For empirical sample, I also adjust to the age gaps between parents and children and drop the unreasonable samples，dropping samples with age gap under 16 and over 45. Discussions of concerns about data are provided in the Appendix B.3 for example the timing of childbearing and the attrition problem of the adult children. Evidence indicates decisions of the timing of childbearing haven't been affected and no evidence supports the existence of gender selection for both residential. Moreover, data shows similar patterns of attrition problems for adult children across residents and city households. When the identification strategy is applied, the potential estimation bias can be differenced out. Based on empirical sample, the attrition indicator is negatively correlated with the younger mothers (IVs) and negatively correlated with the senior high completion of mothers. For more educated mothers, their kids were more likely to move out and left the household. For older mothers, they have more kids move out the household already as the result of marriages. Therefore, based on the paper of Nevo and Rosen (2008), the true estimators will be larger than the OLS estimators and smaller than the instrumented estimator. More details please see Appendix B.3.

between a clear control group (parents at ages of 22-26 in 1966) and treated group (parents at ages of 14-18 in 1966).

Statistics summaries for the empirical sample are presented in Table 2.1.1 and Table 2.1.2. In addition, for better illustrating the effects of the school closure, I also represent statistics for group comparisons between a clear control group (parents at ages of 22-26 in 1966) and treated group (parents at ages of 14-18 in 1966). Later, I will use this clear sample to make difference-in-difference estimation. Overall, our empirical sample includes 231891 observations for mother-to-child sample and 169716 for father-to-child sample. The treated parents are younger than the control group and have lower proportions of senior secondary completion. Correspondingly, observations of the younger parents with kids at ages 16 to 22 are less the older parents. For the children sample, those in the treated group are around 1.5 to 2 years younger than those born by parents in the control group. Similarly, the proportion of attending senior secondary schools as well as junior secondary completion for children born by affected parents was lower than the kids of unaffected parents in 1990. Female children account for similar proportions in different sample groups. It exhibits similar quarter patterns across groups.

2.3.2 Identification Strategy

As discussed above, the year of birth adjusted by school calendar and residential for individuals before 1985 are used to identified the exposed parents. Parents born before 1947, older than 20 in 1966 ideally should have had completed senior secondary schools and their senior high attainments have not had been affected by the closure of secondary schools. By contrast, individuals at ages of 12 to 19 in 1966 were affected (born between 1948 and 1954, especially in city areas), for they were about to attend or were attending secondary schools when the secondary schools were closed. Earlier entry, delay school entry or grade repetition might cause the cut-off age to become imperfectly accurate and lead to bias. Hence, I will

allow flexibility to the cut-off ages and utilize interactions of residential dummy and age dummies as instruments for parents' senior secondary completion.

To better illustrate the validity of the identification strategy within my empirical sample, I regress maternal and paternal senior secondary educational attainments on dummies of ages of parents, the dummy of parents' residential regions and the interaction terms of age dummies with regional dummy controlling for province fixed effect, season pattern and ethnicity fixed effects. The reference group in the graph is the cohort of age 26 in 1966. Note that all age dummies represent ages in 1966 for the parents. The time-varying differences across cohorts which affected the regions similarly are differenced out by the comparison between city and town locations. Same regressions have been applied to different samples: mothers and all children and fathers and all children. If without any educational interruptions in both residential regions, the coefficients of the interaction terms will be insignificant or close to 0 as long as the dummies of age and the dummy of residential are included for capturing all the differences among age cohorts and regions. If the closure of secondary schools were fully and firmly enforced in urban areas while residents in towns didn't encounter any interruptions at all, the coefficients of interaction terms for the control group should be close to zero or insignificant and the coefficients of interactions for the treated cohorts should be significantly negative.

As presented in Table 2.2, most of the coefficients of interactions representing younger city parents (parents aged below 20 in 1966 in city areas) are negative and significantly deviate from 0 while for the parents in control cohorts (majorly above age 20 in 1966), the estimates of interactions are on average insignificant or close to 0. F-statistics for joint significance are also presented. The F statistics for sample of mothers is 0.93 and fail to reject the null hypothesis that that the estimates are jointly insignificantly different from 0. By contrast, for the urban parents in the affected group, the coefficients of interactions are

strongly jointly significant and the F statistics are 91.90 for mothers and 54.47 for fathers which significantly reject the null hypothesis. The coefficients of interactions from the regressions are also plotted in Figure 2.2 for a visual representation.

At last, I also make the placebo regressions of parents' junior secondary completion on the same group of independent variables. There are no similar patterns as the impacts on parental senior high attainments. For sample of mothers, most estimators of the interactions are insignificant and F-statistics for joint significance are pretty low (see tables in Appendix B). The comparison between the impacts on parent junior and senior high completions further supports the fitness of the instruments.

2.3.3 Empirical Models

My empirical model is summarized by the following two equations (2SLS/IV):

$$ED_{ij}^{p} = \alpha_0 + \alpha_1 Age_{ij}^{k} + \alpha_2 Girl_{ij}^{k} + \alpha_3 Age_{ij}^{p} + \alpha_4 \mathrm{Pr}ovince_{ij}^{p} + \alpha_5 Ethncn_{ij}^{p} + \alpha_6 City_{ij}^{p} + \alpha_7 \mathrm{Pr}ovince_{ij}^{k} + \alpha_8 Ethncn_{ij}^{k} + \delta X_{ij} + \sum Age_{ij}^{p} * City_{ij}^{p} + \nu_i \quad (1)$$

$$ED_{ij}^{k} = \beta_0 + \beta_1 \tilde{ED}_{ij}^{p} + \beta_2 Age_{ij}^{k} + \beta_3 Girl_{ij}^{k} + \beta_4 Age_{ij}^{p} + \beta_5 \mathrm{Pr}ovince_{ij}^{p} + \beta_6 Ethncn_{ij}^{p} + \beta_7 City_{ij}^{p} + \beta_8 \mathrm{Pr}ovince_{ij}^{k} + \beta_9 Ethncn_{ij}^{k} + \delta X_{ij} + \varepsilon_i \quad (2)$$

In equation (1) and (2), the superscript "p" denotes parent and "k" represents kids in all cases. The subscript "i" denotes individual i and "j" represents birth year of j. ED is the educational attainment and it is measured by dummies variables indicating whether the parent has completed the senior secondary education or not. For the children, it indicates whether the child is attending (or has attended) senior secondary school or not. The educational attainment (ED) of the child is a function of his parental educational attainment controlling for other related factors. Age refers to a full set of indicators of ages in 1966 for parents, Province refers to a full set of birth provincial indicators, and Ethncn are a full set of the ethnicity indicators. $City^{p}$ is the residential indicator (city or town) for parents. X refers to other individual specifics, for example the number of kids born by the mother, family size, the

marriage status of the parent and birth quarter fixed effects. I study mother-to-child as well as father-to-child educational transmission relationships with the same methodology separately. Model specifications excluding the provincial and age fixed effects for children or including a time trend are also tested (as Black, Devereux and Salvanes, 2005).

Equation (1) is the first stage and $\sum Age^p * City^p$ serve as instrumental variables for ED^P . In other words, the interactions of ages in 1966 for parents and residential indicator are used as IVs to catch the different intensities of treatment across age cohorts of mothers or fathers. In this way, we can avoid bias as the results of one simple binary instrument: inaccurate identifications of the cutting-off age. Also cohort-invariant differences across regions as well as the time-varying differences across cohorts are differenced out by the comparisons across regions and across cohorts. Statistics for the Durbin and Wu-hausman tests of endogeneity significantly rejected the null hypothesis (parental education attainment is exogenous) and the P values are 0.0002 when standard errors are adjusted for 15 clusters in ages. Over-identifying restrictions are tested. Most of estimates in Table 2.4 are over identified as result of large sample size and some of the instruments are indifferent. Only the regression of father-to-daughter doesn't reject the null hypothesis (Score chi2 is 11.02 and P value is 0.61).

Correspondingly, I practice models with a single instrument and over 400 instruments (interactions of residential dummy, age indicators and provinces; allowing the educational interruption to age cohorts and residential to vary by province of birth) in Table 2.7 for robustness checks. This identification strategy takes the fact that educational interruptions in some big cities were relatively more severe than the others, for example Wuhan, Beijing and Shanghai. For models with multiple instruments in Table 2.7, all of the Score statistics for the over identifying restrictions tests are supporting the null hypothesis with p-value of 1. For robustness check, I also implement the simple binary instrument which indicates whether one

born in city residential was affected by the school closure or not (younger treated group at ages younger than 19 in 1966). These two alternative specifications can be formulized using the following first stage regressions.

Alternative First Stage One:

$$ED_{ij}^{p} = \alpha_0 + \alpha_1 Age_{ij}^{k} + \alpha_2 Girl_{ij}^{k} + \alpha_3 Age_{ij}^{p} + \alpha_4 \text{Province}_{ij}^{p} + \alpha_5 Ethncn_{ij}^{p} + \alpha_6 City_{ij}^{p} +$$

$$\alpha_7 \text{Province}_{ij}^{k} + \alpha_8 Ethncn_{ij}^{k} + \delta X_{ij} + \sum Age_{ij}^{p} * City_{ij}^{p} * \text{Province}_{ij}^{p} + \nu_i$$

Alterative First Stage Two:

$$ED_{ij}^{p} = \alpha_0 + \alpha_1 Age_{ij}^{k} + \alpha_2 Girl_{ij}^{k} + \alpha_3 Age_{ij}^{p} + \alpha_4 \text{Province}_{ij}^{p} + \alpha_5 Ethncn_{ij}^{p} + \alpha_6 City_{ij}^{p} +$$

$$\alpha_7 \text{Province}_{ij}^{k} + \alpha_8 Ethncn_{ij}^{k} + \delta X_{ij} + City_{ij}^{p} * TreatedGroup_{ij}^{p} + \nu_i$$

Linear probability models are applied for both stages[20] and robust cluster standard errors will be computed. In the application process, parental educational attainments in the second equation will be replaced by the predicted values of ED for parents from the first stage regressions separately. Consistent estimations can be achieved as long as the unobserved characteristics ν is uncorrelated with the implementation of the closure of schools. The variations of parents' education caused by the school closure are not correlated with the genetic factors or ability of parents. The intergenerational transmission coefficients obtained should imply the effects of parental education attainments onto their children through other channels rather than the selection process. Significantly positive estimates of ED^P in the second stage will prove the existence of causal effects of the parental schooling outcome on their offsprings' schooling outcomes.

[20]Probit probability models are applied for robustness checks. Consistent conclusions are found. For more information on the advantages of linear probability model, please see "Mostly Harmless Econometrics: an Empiricist's Companion" by Joshua D. Angrist and Jorn-Steffen Pischke.

2.4 Empirical Results

2.4.1 Differences-in-Difference Estimates

Before presenting the estimation results, I first compute simple difference-in-difference tables showing the intuition behind the IV approach based on the sample of the clear control and treated groups. Table 2.3.1 is for the sample of mothers-and-children and Table 2.3.2 is for sample of fathers-and-children. Consistent with Table 1, no matter for sample of parents or children, city residents obtained more education than town residents for any specific cohort because of regional differences. The difference in the difference estimators show that causal negative effects on urban parents' senior high completion in treated group and thereby their children were less likely to attend senior secondary schools (-0.108 for fathers' senior high attainment; and -0.098 for children's senior secondary attendance; -0.105 for mothers' senior high attainment; and -0.082 for children's senior secondary attendance).

Furthermore, I can calculate the Wald estimates (a simple-but imprecise-instrumental variables estimator) of the effects of parents' education attainment on children's schooling outcome. They are the ratios of these two difference-in-difference estimates. The marginal effect of mothers' senior education attainment can contribute to enhancing their children's secondary attendance by-0.082/-0.105=0.781 (Table 2.3.1). The intergenerational effect from fathers' senior high completion to children's senior attendance is -0.098/-0.108=0.907 (Table 2.3.2). It suggests that the marginal effect of the completion of senior secondary education of parents increases the probability of their children to attend senior secondary by 78 to 91%. Before controlling for the provincial fixed effects and age fixed effects, these simple estimators can firstly provide suggestive evidences for the existence of the causal transmission between parents' education attainment and children's education outcome.

2.4.2 OLS and IV Estimates

The main estimation results of the empirical sample are presented in Table 2.4. Column (1) and (3) show the positive transmission of parents' senior secondary completion and children's senior secondary attendance in 1990 with OLS regressions for various relationships separately. All the estimates consistently point out significantly positive effects ranging from 0.30 to 0.34.

Column (2) and (4) present the estimates with the IV approach. All the IV estimates again are significantly positive at level of 1% and the magnitudes of the interested estimates are consistent with the Wald estimates. The completion of senior secondary schools for mothers enhances the probability of children to attend senior secondary schools by 80% controlling for kinds of fixed effects and related factors. The IV estimators are larger than the OLS estimates because the closure of schools negatively impacted the parents' education attainment and lowered the linear correlation. If fathers obtain senior secondary education, the marginal effect is to increase their children's senior secondary attendance by 71 percents. These evidences prove the existence of causality for the intergenerational transmission of human capital. The instrumented results also weakly support that there is gender difference effect: the parents-to-daughter transmissions are stronger than parents-to-sons although the results of OLS show indifference. The mother-to-daughter transmission effect exhibits to be stronger under the TSLS methodology (mother-to-son 0.659; mother-to-daughter 0.882). Similarly, for daughters, the marginal effect of fathers' education attainment on their senior attendance is 0.749 which is stronger than the effect on sons (0.640).

2.5 Robustness Checks

For robustness checks, I first examine different samples of various age-spans. Table 2.5 presents the regression estimates for two subsamples: 1. parents of ages 12-26 in 1966 with children of age 16-20; 2. Parents at ages of 14-18and 22-26 in 1966 with children of age

16-22. The variables of interest are still the indicator showing whether mothers or fathers have obtained senior secondary schooling or not and the indicator representing whether the children have attended or were attending senior secondary schools in 1990. Overall, the OLS estimates are consistent across different subsamples (around 0.30-0.34) which are similar with results of Table 2.4. Consistently, the IV approach again indicates significantly stronger intergenerational transmission and the existence of causality. Also, we find that the parents-to-daughter relationship is weakly stronger than the parents-to-son. In addition, other subsamples with various treatment and control groups are also tested: 1. parents at ages of 17-24 in 1966 with children of age 16-20; 2. parent at ages of 17-24 in 1966 with children of age 16-24 in 1990; 3. parents at ages of 13-26 in 1966 with children of age 16-20 as well as 18-24; 4. parents at ages of 13-26 in 1966 with children of age 16-26. Consistent conclusions are found.

Second, I examine a different schooling outcome of children: the junior secondary completion. As shown in Table 6, significantly causal effects of intergenerational transmissions are found again, no matter for the mother-to-children relation or father-to-children relation. And the marginal effects of parents' senior high attainments on daughters' schooling outcomes are stronger than the parents-to-sons side. I also include younger children (children at age of 13-16 in 1990 for parents at age 13-26 in 1966) and gauge the intergenerational transmission using different schooling outcome of children (junior and senior secondary attendance). Additionally, alternative model specifications, for example excluding children's birth places, age cohort effects and ethnicities, or considering time trend, are also tested. For example independent variables, such as age indicators of children are excluded for the possible existed endogenous problem of timing of childbearing; the regression models are weighted by the cohort population size; inclusion and exclusion of other related variables, for example marriage status of parents, are tested; the probit

probability models are also explored for the second stage to check the nonlinear intergenerational effects. Consistent conclusions are found with the main results (results can be provided if request).

Third, I also implement various identification strategies: 1) a single binary instrument, the interaction of city residents and the overall treated group (parents at ages of 12-19 or at ages of 14-18 in 1966), as the instrument and examine the causality (see Table 2.7); 2) interactions of age indicators, residential indicator (city or town) and province indicators. TSLS estimators allow the parents' education attainments to vary across different residential as well as across different provinces as the results of the school closure. Over identifying restrictions are tested and statistics strongly support the validity of this identification at P value of 1. Both approaches give us consistent results supporting the existence of causality.

2.6 Concluding Remarks

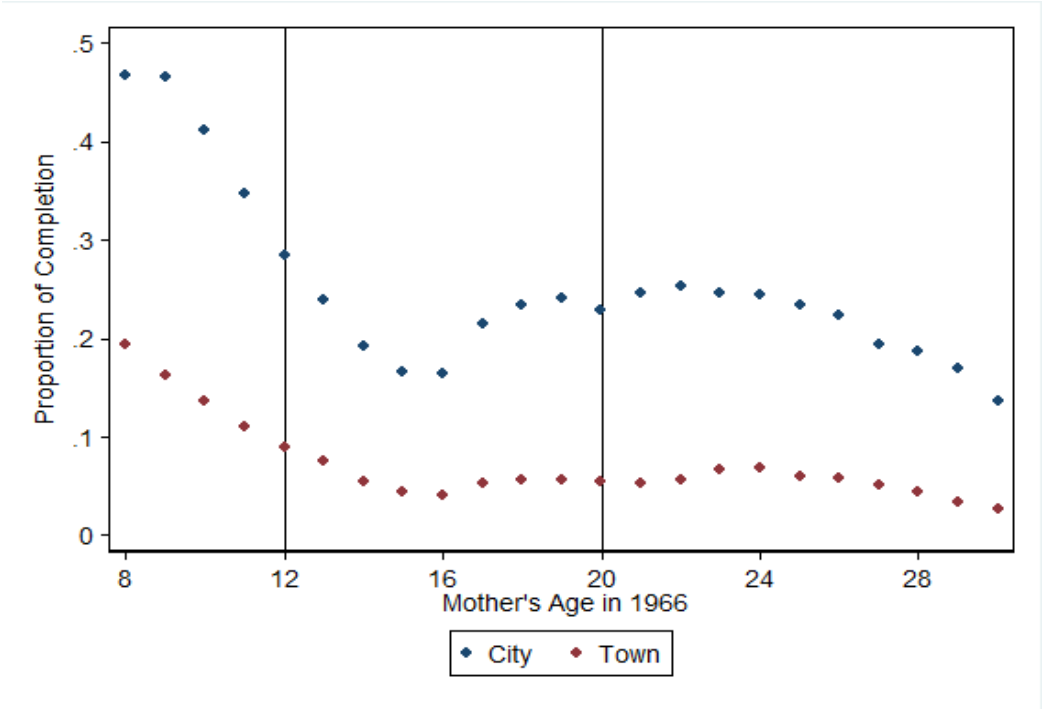
Using the exogenous variation of parental senior secondary schooling induced by the closure of senior secondary schools from 1966 to 1971 in urban China, I am able to estimate the causal intergenerational effects based the IV approach (2SLS). The 1990 China census shares considerable information allowing me to match the parents with their children and identify a large exposure sample which makes the empirical results more convincing.

All significant IV estimators consistently indicate that there exists a causal relationship between the parents' and children's educational attainment, no matter for mothers and children (including mothers and sons, and mothers and daughters) or for fathers and children (including fathers and sons, and fathers and daughters). As demonstrated by most of the literatures, I also find weak evidence for that the parents and daughter relation is stronger. This relative stronger spillover effect for girls implies that better education policies can contribute to alleviating gender differences in the long term.

More information is needed to study channels in the mechanism. For example, parents

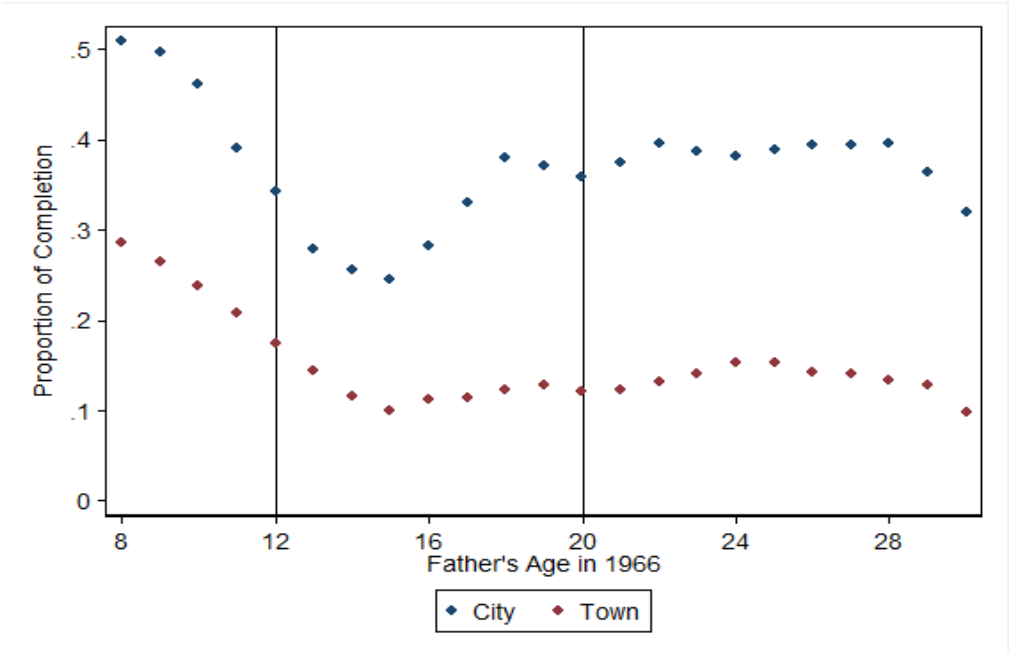
with less education have lower earning, more working hours and lower probability to be hired. Limited resources can be provided to invest on next generation. In addition, education policy might shape individuals' attitude toward education. It will be intriguing to explore changes in personal preference toward education induced by the school closure in future.

Figure 2.1.1: Females' Senior Secondary Completion, by Region



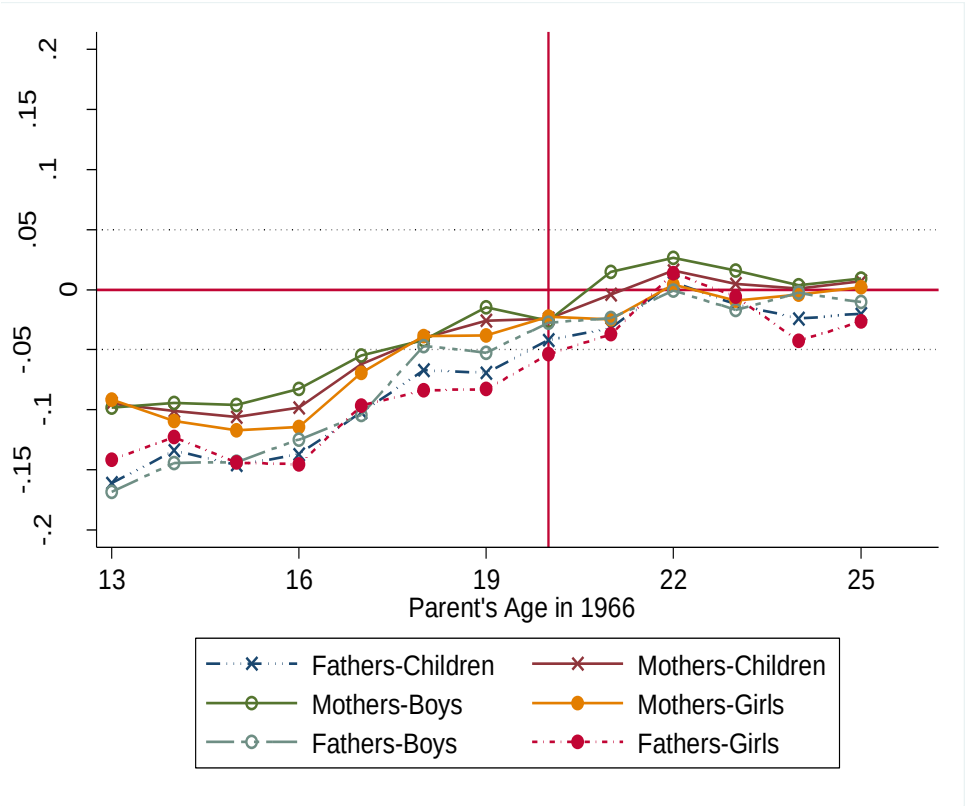
Source: All the mothers sample based on the 1990 China Census

Figure 2.1.2: Males' Senior Secondary Completion, by Region



Source: All fathers subsample based on the 1990 China Census

Figure 2.2: The Impacts on Parents' Senior High Educational Attainment



Note: scatters in Figure two are the coefficients of the interaction of age indicator and the residential dummy in the regressions of parents' senior secondary completion on interactions, age indicators, residential indicators, ethnicity, birth quarters fixed effects and fixed effect of provinces.

Table 2.1.1: Statistics Summary

Panel A	Mean	Std. Dev.	Control Cohorts (22-26)	Treated Cohorts (14-18)
	Mother's Characteristics			
Age	43.735	3.537	47.351	39.988
Senior Secondary Attainment	0.106	0.308	0.152	0.052
Marriage Status	0.968	0.177	0.957	0.978
Numbers of Children	2.686	1.076	2.602	2.778
Number of Children Born	3.273	1.239	3.639	2.954
Family Size	4.966	1.464	4.953	4.994
Han	0.939	0.239	0.936	0.938
Obs.	231891		90117	70210
Quarter One	56547		20502	18045
Quarter Two	53279		21042	16031
Quarter Three	57479		22545	17412
Quarter Four	64586		26028	18722
	Child's Characteristics			
Age	18.517	1.888	19.12	17.83
Girl	0.478	0.500	0.476	0.479
Senior Secondary Attendance	0.315	0.465	0.373	0.243
Junior Secondary Completion	0.663	0.473	0.722	0.585
Han	0.939	0.239	0.936	0.938
Obs.	231891		90117	70210
Quarter One	59470		22737	18402
Quarter Two	55210		21146	16851
Quarter Three	52337		21568	14878
Quarter Four	64874		24666	20079

Note: 1. Sample: mothers at ages of 12-26 in 1966 with kids aged 16-22 in 1990; 2. marriage status is a dummy representing whether were married with spouse. The comparisons between a clear control group at ages of 22-26 in 1966 and a clear treated group at ages of 14-18 in 1966 are presented.

Table 2.1.2: Statistics Summary

Panel A	Mean	Std. Dev.	Control Cohorts (22-26)	Treated Cohorts (14-18)
	Father's Characteristics			
Age	45.168	3.344	47.884	40.494
Senior Secondary Attainment	0.201	0.401	0.251	0.114
Marriage Status	0.980	0.141	0.982	0.978
Numbers of Children	2.709	1.064	2.644	2.857
Family Size	5.032	1.415	4.985	5.162
Han	0.937	0.242	0.938	0.934
Obs.	169716		87378	34646
Quarter One	41385		21097	8316
Quarter Two	36753		19441	7099
Quarter Three	41299		21407	8380
Quarter Four	50279		25433	10851
	Child's Characteristics			
Age	18.331	1.840	18.796	17.507
Girl	0.478	0.500	0.476	0.481
Senior Secondary Attendance	0.301	0.459	0.358	0.186
Junior Secondary Completion	0.643	0.479	0.701	0.520
Han	0.930	0.254	0.927	0.931
Obs.	169716		87378	34646
Quarter One	43792		22737	18402
Quarter Two	40740		21146	16851
Quarter Three	37666		21568	14878
Quarter Four	47518		24666	20079

Note: 1. Sample: fathers at ages of 12-26 in 1966 with kids aged 16-22 in 1990; 2. marriage status is a dummy representing whether were married with spouse. The comparisons between a clear control group at ages of 22-26 in 1966 and a clear treated group at ages of 14-18 in 1966 are presented

Table 2.2: Evaluating the Effects of School Closure

Education Attainment		Maternal	Paternal		
Residential* Age in 1966		Age 12-26	Age 14-18&22-26	Age 12-26	Age 14-18&22-26
δ_{12}	City*age_12	-0.101*** (0.017)	--	-0.152*** (0.038)	--
δ_{13}	City*age_13	-0.122*** (0.013)	--	-0.178*** (0.028)	--
δ_{14}	City*age_14	-0.129*** (0.010)	-0.128*** (0.009)	-0.154*** (0.021)	-0.154*** (0.020)
δ_{15}	City*age_15	-0.133*** (0.008)	-0.132*** (0.008)	-0.162*** (0.017)	-0.161*** (0.016)
δ_{16}	City*age_16	-0.125*** (0.007)	-0.123*** (0.007)	-0.151*** (0.013)	-0.150*** (0.013)
δ_{17}	City*age_17	-0.087*** (0.007)	-0.086*** (0.008)	-0.116*** (0.011)	-0.115*** (0.011)
δ_{18}	City*age_18	-0.065*** (0.006)	-0.064*** (0.007)	-0.082*** (0.010)	-0.082*** (0.011)
δ_{19}	City*age_19	-0.049*** (0.006)	--	-0.084*** (0.009)	--
δ_{20}	City*age_20	-0.044*** (0.006)	--	-0.054*** (0.009)	--
δ_{21}	City*age_21	-0.018*** (0.006)	--	-0.041*** (0.009)	--
δ_{22}	City*age_22	0.007 (0.006)	0.007 (0.006)	-0.002 (0.008)	-0.002 (0.010)
δ_{23}	City*age_23	-0.001 (0.006)	-0.0005 (0.008)	-0.017** (0.008)	-0.017* (0.009)
δ_{24}	City*age_24	-0.001 (0.006)	-0.0003 (0.008)	-0.026*** (0.008)	-0.026*** (0.010)
δ_{25}	City*age_25	0.007 (0.006)	0.008 (0.008)	-0.017** (0.008)	-0.017* (0.010)
Obs.		231891	160327	169716	122024
R-squared		0.11	0.12	0.11	0.12
F-Statistic					
Wald-Test①		87.55	124.44	34.07	42.00
Wald-Test②		91.90	82.89	54.47	52.26
Wald-Test③		0.93(P=0.44)	0.56(P=0.69)	3.61	3.61

①The null hypothesis: $\delta_{12}=\delta_{13}=\delta_{14}=\delta_{15}=...=\delta_{24}=\delta_{25}=0$

②The null hypothesis: $\delta_{14}=\delta_{15}=\delta_{16}=\delta_{17}=\delta_{18}=0$

③The null hypothesis: $\delta_{22}=\delta_{23}=\delta_{24}=\delta_{25}=0$

Note: 1. Empirical sample includes parents' aged 12-26 in 1966 adjusted for school calendar with children aged 16-22 in 1990; 2. The reference cohort is the group for parents aged 26 born in towns in 1966; 3. Other controls: age cohort dummies, residential dummy, province fixed effects, ethnicity fixed effects and quarter fixed patterns for parents. 4. *** represents significance at 1%,* *represents significance at 5% and * represents significance at 10%.

Table 2.3.1: Difference-in-Difference (Mothers-and-Children)

Panel A:	Senior Secondary Completion of Mothers		
	Treated Group (age 14-18 in 1966)	Control Group (age 22-26 in 1966)	Difference
City	0.120	0.268	-0.147***
			(0.003)
Town	0.024	0.066	-0.042***
			(0.001)
Difference	0.096***	0.202 ***	-0.105***
	(0.002)	(0.002)	(0.003)
Panel B:	Senior Secondary Attendance of Children		
	Treated Group (age 14-18 in 1966)	Control Group (age 22-26 in 1966)	Difference
City	0.445	0.583	-0.138***
			(0.004)
Town	0.162	0.218	-0.055***
			(0.002)
Difference	0.283***	0.365***	-0.082***
	(0.003)	(0.003)	(0.005)

Table 2.3.2: Difference-in-Difference (Fathers-and-Children)

Panel A:	Senior Secondary Completion of Fathers		
	Treated Group (age 14-18 in 1966)	Control Group (age 22-26 in 1966)	Difference
City	0.226	0.398	-0.171***
			(0.006)
Town	0.083	0.146	-0.063***
			(0.002)
Difference	0.143***	0.251***	-0.108***
	(0.004)	(0.003)	(0.006)
Panel B:	Senior Secondary Attendance of Children		
	Treated Group (age 14-18 in 1966)	Control Group (age 22-26 in 1966)	Difference
City	0.390	0.566	-0.176***
			(0.006)
Town	0.130	0.209	-0.078***
			(0.003)
Difference	0.260***	0.358***	-0.098***
	(0.005)	(0.003)	(0.007)

Table 2.4: Intergenerational Transmission of Senior Secondary Education

Dependent Variable	Senior Secondary Attendance of Children				
	(1) OLS	(2) IV		(3) OLS	(4) IV
Mother-All	0.337***	0.788***	Father-All	0.310***	0.709***
	(0.07)	(0.07)		(0.03)	(0.076)
R-Square	0.24	0.16	R-Square	0.26	0.20
Obs.	231891	231891	Obs.	169716	169716
F-statistics of the First Stage		216.47			173.52
Mother-Daughter	0.336***	0.882***	Father-Daughter	0.304***	0.749***
	(0.003)	(0.087)		(0.025)	(0.057)
R-Square	0.26	0.14	R-Square	0.285	0.22
Obs.	110891	110891	Obs.	81185	81185
F-statistics of the First Stage		105.76			86.87
Mother-Son	0.337***	0.659***	Father-Son	0.316***	0.640***
	(0.07)	(0.082)		(0.035)	(0.102)
R-Square	0.21	0.175	R-Square	0.24	0.176
Obs.	121000	121000	Obs.	88531	88531
F-statistics of the First Stage		123.52			99.42

Note: 1.Other independent variables include family-size, marital status of parents, number of kids own by the parent in household, kids' age cohort dummies, parents' age cohort dummies (adjusted by school calendar), a residential region dummy, ethnicity fixed effects for parents and children, birth province fixed effects for parents and children, and quarter fixed effects for parents and children. Only the estimates of interest, the coefficients of parents' senior high completion, are presented and each coefficient represents one single regression in the table; 2. Cluster standard errors are reported in brackets clustering for parents' ages and residential locations. *** represents significance at 1%,* *represents significance at 5% and * represents significance at 10%.

Table 2.5: Examination within Samples of Different Age-Spans

Dependent Variable	Senior Secondary Attendance of Children							
Sample	Mothers' Senior Secondary Completion				Fathers' Senior Secondary Completion			
Parents	12-26 in 1966		14-18&22-26 in 1966		12-26 in 1966		14-18&22-26 in 1966	
Children	Age 16-20 in 1990		Age 16-22 in 1990		Age 16-20 in 1990		Age 16-22 in 1990	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Parent-All	0.337***	0.801***	0.339***	0.793***	0.308***	0.651***	0.311***	0.736***
	(0.070)	(0.089)	(0.060)	(0.073)	(0.027)	(0.087)	(0.071)	(0.098)
R-Square	0.24	0.17	0.24	0.16	0.26	0.20	0.27	0.20
Obs.	188156	188156	160327	160327	143098	143098	122024	122024
F-statistic at first stage		187.46		182.01		154.52		147.54
Parent-Daughter	0.339***	0.870***	0.335***	0.874***	0.304***	0.753***	0.304***	0.736***
	(0.070)	(0.081)	(0.050)	(0.092)	(0.02)	(0.054)	(0.022)	(0.064)
R-Square	0.28	0.156	0.27	0.13	0.29	0.23	0.29	0.23
Obs.	92070	92070	76557	76557	69892	69892	58208	58208
F-statistic at first stage		93.40		89.90		78.46		73.84
Parent-Son	0.336***	0.628***	0.344***	0.686***	0.312***	0.534***	0.317***	0.709***
	(0.070)	(0.078)	(0.080)	(0.083)	(0.033)	(0.095)	(0.032)	(0..131)
R-Square	0.22	0.188	0.22	0.14	0.25	0.18	0.25	0.103
Obs.	96086	96086	83770	83770	73206	73206	63816	63816
F-statistic at first stage		106.26		102.11		87.66		84.67

Note: 1.Other independent variables include family-size, marital status of parents, number of kids own by the parent in household, kids' age cohort dummies, parents' age cohort dummies (adjusted by school calendar), a residential region dummy, ethnicity fixed effects for parents and children, birth province fixed effects for parents and children, and quarter fixed effects for parents and children; 2. Each estimate represents a single regression. (1) and (2) represent different samples. R-squared at the first stage ranges from 0.11 to 0.16; 3. Standard errors are adjusted for clustering reported in brackets. *** represents significance at 1%,* *represents significance at 5% and * represents significance at 10%.

Table 2.6: Examination with Different Outcome Variable

Dependent Variable	Junior Secondary Completion of Children							
Sample	Mothers' Senior Secondary Completion				Fathers' Senior Secondary Completion			
Parents	12-26 in 1966		14-18&22-26 in 1966		12-26 in 1966		14-18&22-26 in 1966	
Children	Age 16-22 in 1990		Age 16-22 in 1990		Age 16-22 in 1990		Age 16-22 in 1990	
	(1) OLS	(1) IV	(2) OLS	(2) IV	(1) OLS	(1) IV	(2) OLS	(2) IV
Parent-All	0.135***	0.230***	0.130***	0.264***	0.158***	0.280***	0.156***	0.303***
	(0.003)	(0.05)	(0.004)	(0.075)	(0.004)	(0.049)	(0.004)	(0.061)
R-Square	0.23	0.22	0.23	0.16	0.24	0.20	0.25	0.23
Obs.	231891	231891	160327	160327	169716	169716	122024	122024
F-statistic at first stage		217.47		182.01		173.52		147.54
Parent-Daughter	0.131***	0.175***	0.127***	0.150***	0.155***	0.184***	0.154***	0.197***
	(0.004)	(0.059)	(0.005)	(0.059)	(0.005)	(0.072)	(0.006)	(0.082)
R-Square	0.25	0.25	0.26	0.26	0.33	0.26	0.28	0.26
Obs.	110891	110891	76557	76557	81185	81185	58208	58208
F-statistic at first stage		105.76		89.90		83.21		73.84
Parent-Son	0.139***	0.238***	0.134***	0.256***	0.161***	0.379***	0.159***	0.403***
	(0.004)	(0.063)	(0.005)	(0.071)	(0.004)	(0.084)	(0.005)	(0.109)
R-Square	0.20	0.20	0.21	0.20	0.22	0.20	0.22	0.21
Obs.	121000	121000	83770	83770	88531	88531	63816	63816
F-statistic at first stage		123.52		102.11		99.42		84.67

Note: 1.Other independent variables include family-size, marital status of parents, number of kids own by parents in household, kids' age cohort dummies, parents' age cohort dummies (adjusted by school calendar), a residential region dummy, ethnicity fixed effects for parents and children, birth province fixed effects for parents and children, and quarter fixed effects for parents and children.; 2. Each estimate represents a single regression. (1) and (2) represent different samples. R-squared at the first stage ranges from 0.11 to 0.16; 3 The standard errors are adjusted by clustering for ages. *** represents significance at 1%,* *represents significance at 5% and * represents significance at 10%.

Table 2.7: Examination with Various Identification Strategies

Dependent Variable	Senior Secondary Attendance of Children								
IV Estimates	IV-1		IV-2			IV-1		IV-2	
Mothers-	(1)	(2)	(1)	(2)	Fathers-	(1)	(2)	(1)	(2)
All	0.768***	0.761***	0.656***	0.646***	All	0.784***	0.850***	0.556***	0.529***
	(0.049)	(0.081)	(0.032)	(0.039)		(0.10)	(0.06)	(0.035)	(0.047)
R-Square	0.19	0.20	0.20	0.20	R-Square	0.19	0.20	0.22	0.24
Obs.	231891	160327	231891	160327	Obs.	169716	122024	169716	122024
F-statistics (First Stage)	233.35	188.31	61.78	64.28		195.23	162.99	48.19	50.70
Daughter	0.870***	0.879***	0.599***	0.608***	Daughter	0.790***	0.860***	0.508***	0.483***
	(0.11)	(0.12)	(0.041)	(0.04)		(0.086)	(0.07)	(0.038)	(0.052)
R-Square	0.22	0.23	0.24	0.24	R-Square	0.21	0.22	0.22	0.27
Obs.	110891	76557	110891	76557	Obs.	81185	58208	81185	58208
F-statistics (First Stage)	114.54	92.76	30.10	31.48		99.47	82.84	24.12	24.83
Son	0.670***	0.648***	0.593***	0.590***	Son	0.733***	0.839***	0.469***	0.425***
	(0.11)	(0.11)	0.040	0.049		(0.13)	(0.09)	0.038	(0.050)
R-Square	0.17	0.17	0.19	0.19	R-Square	0.17	0.18	0.23	0.24
Obs.	121000	83770	121000	83770	Obs.	88531	63816	88531	63816
F-statistics (First Stage)	135.59	106.34	34.48	35.78		111.87	93.25	27.59	28.86

Note: 1.Other independent variables include family-size, marital status of parents, number of kids own by the parent in the household, kids' age cohort dummies, parents' age cohort dummies (adjusted by school calendar), a residential region dummy, ethnicity fixed effects for parents and children, birth province fixed effects for parents and children, and quarter fixed effects for parents and children. Only the estimates of interest, the coefficients of parents' senior high completion, are presented and each coefficient represents one single regression in the table; 2. Robust clustered standard errors are reported in brackets and adjusted by clustering in age. *** represents significance at 1%,* *represents significance at 5% and * represents significance at 10%; 3. Sample (1) includes parents at ages of 12-26 in 1966 with children at ages of 16-22 in 1990. Sample (2) includes parents at ages of 14-18 and 22-26 in 1966 with children at ages of 16-22 in 1990. The dummy IV-1 for sample (1) indicates whether a city resident was at ages of 19 and below in 1966. The dummy IV-1 for sample (2) indicates whether one was at ages of 14-18 and born in city residential in 1966; For the identification strategy of IV-2, instruments are interactions of age indicators (15 age indicators for sample 1 and 10 for sample 2) , residential (city or town) and provinces (30 provinces including 3 municipalities).

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Appendix A

Appendix for Chapter 1

A.1 Evidences for Educational Interruption

Because of limitations in the data, I only obtained the educational statistics after 1971. According to the Table A.1, Figure A.1 and Figure A.2, the rural and urban areas exhibit quiet different experience during the Cultural Revolution.

Figure A.3 shows conditions in 1965. The red bar represents the number of schools and the blue bar represents the new students. The vertical axis represents the ratio of the related information at the given education level to the whole nation. For example, the new enrolled students for junior secondary schools accounted for 7.59% of all the new enrolled students in 1965. The proportion of primary schools was 95.45% of all the schools of China in 1965. Figure A.4 shows the consistent conclusions we have in the context that the senior high completion was seriously affected.

The birth cohorts were affected at different status in 1966, for example being denied when at the first year of junior secondary or the last year of senior secondary schools. Considering their differences and this continuous treatment, I group them together and examine how their incomes have been impacted (see Table A.2). Results are consistent with my identification strategy. Within each classified group in the measure of closure, they were impacted similarly.

Figure A.1: Number of Senior Secondary Schools, by Region

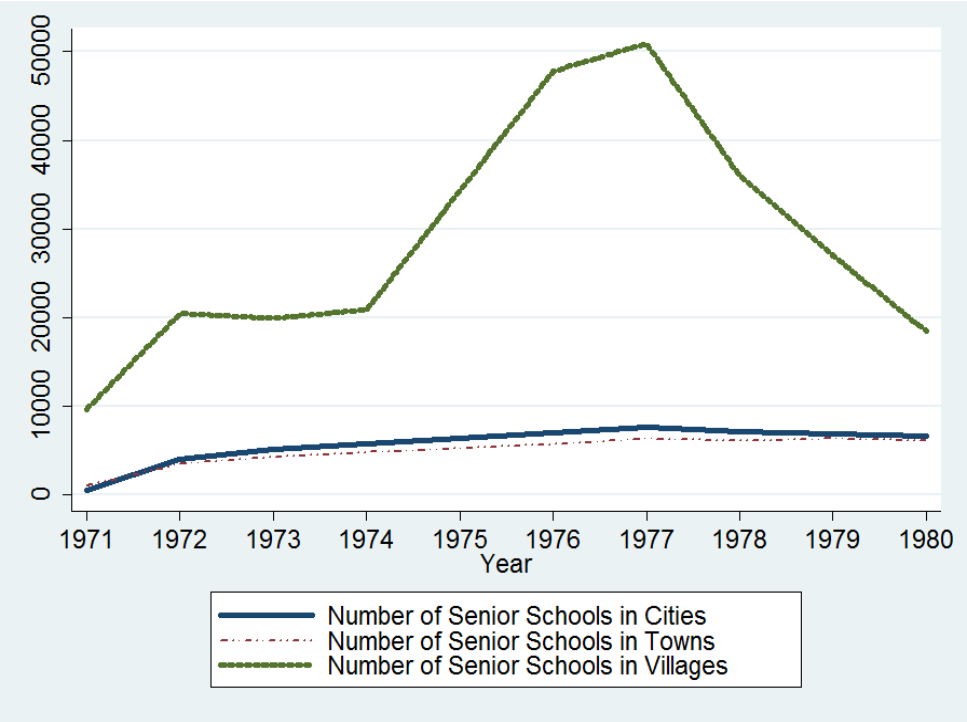


Figure A.2: Number of Junior Secondary Schools, by Region

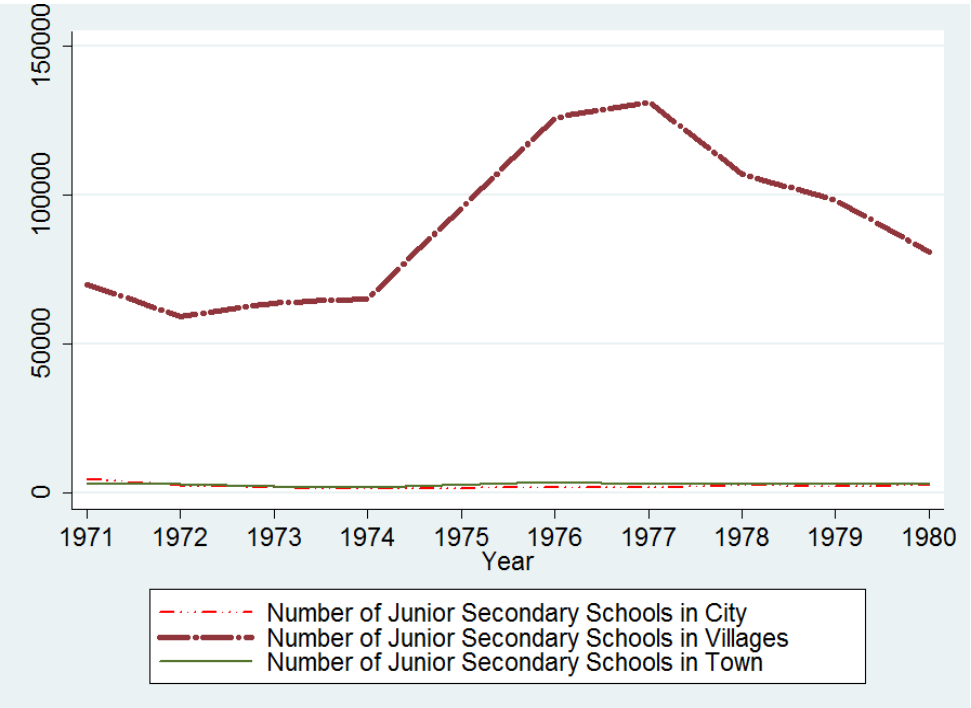


Figure A.3: The Ratios of New Students Enrolled and Number of Schools

Before the Cultural Revolution in 1965 (unit: %)

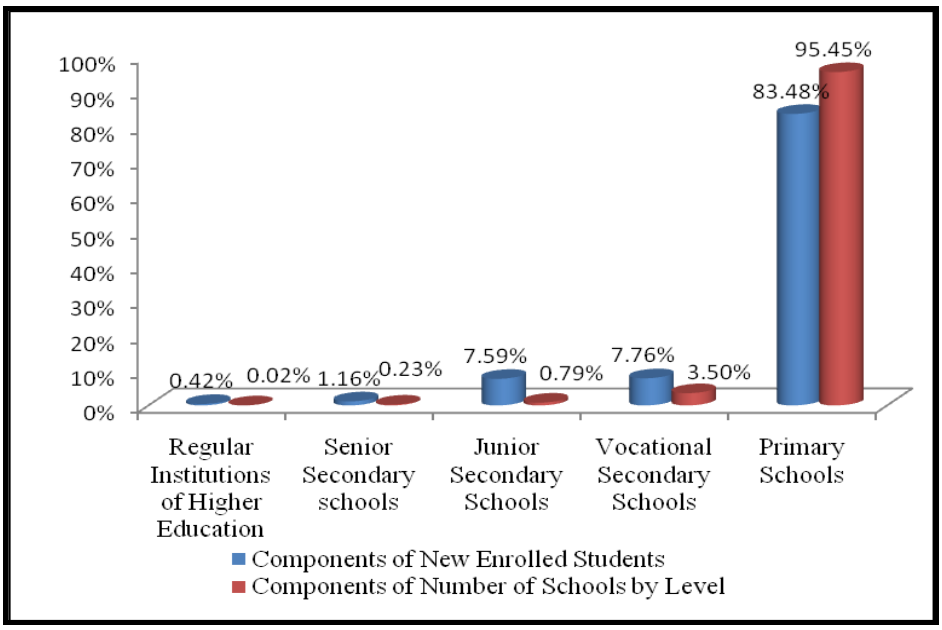


Figure A.4: Education Attainments in 2002, by Birth Cohort and School Level

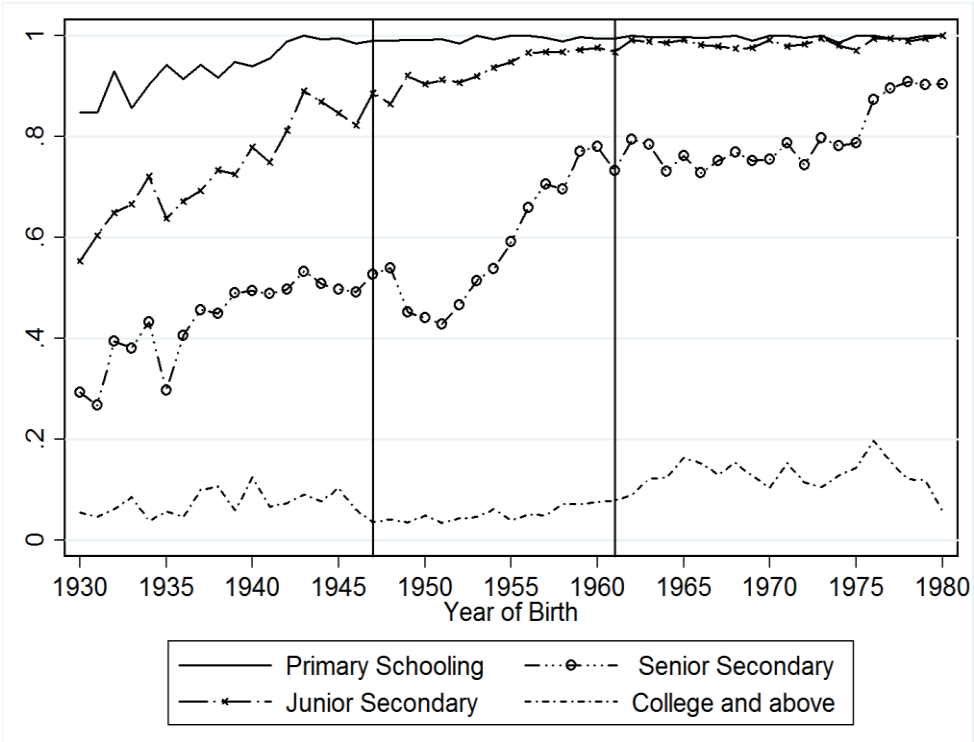


Table A.1: The Changes between 1971 and 1972 for Senior High Education, by Region

Senior High Education		1971	1972
No. of Schools	Urban	500	4000
	Rural	9690	20485
Full-time Teachers (10,000)	Urban	7.29	15.9
	Rural	25.88	26.5
Students (10,000)	Urban	126.38	228
	Rural	344.85	474.6
Students per full-time teacher	Urban	17.34	14.34
	Rural	13.32	17.91
New Students Enrolled (10,000)	Urban	54.51	127.9
	Rural	212.11	262.5

Data Resources: Chinese Statistics Yearbook: 1949-2008

Table A.2: Robustness for the Classification in the Measure of Closure

	Dependent Variables	
Groups Regressoins	Schooling Years Obtained in 2002	Log (Average Annual Income)
Closure	Base Group Closure=0	
0.5	0.154	0.010
	(0.12)	(0.048)
1	-0.318***	-0.042*
	(0.09)	(0.02)
4	-0.540***	-0.085***
	(0.15)	(0.02)
6	-0.751***	-0.106***
	(0.12)	(0.02)
Other independent variables: constant, age, age squared, gender, famine and province fixed effects		

Data source: CHIPS 2002(empirical samples); Robustness standard errors are reported and clustering by ages.

A. 2 The Send-Down Movement and Determinantes of Being Sent-down

A.2.1 Variations over Birth Cohorts and Regions

In Figure A.5, each scatter represents the proportion of the sample being rusticated at specific cohort level. The patterns over birth cohorts are consistent based on datasets of CHIPS 1995 and CHIPS 2002. The bumps indicate that the interested birth cohorts, 1946-1961, were more likely to be rusticated during the Cultural Revolution. Figure A.6 shows us that the older cohorts stayed in the rural areas longer than the younger cohorts.

Figure A.7 and Figure A.8 Show us facts that there existed provincial level variations for the Send-Down Movement. Some provinces and big cities were highly exposed. Figure A.9 and Figure A.10 give us the statistics for the timing the sent-down youth to be sent and return.

A.2.2 the Selection Problem

In Table A.3, I examine determinants of being sent-down for the interested cohorts 1946-1961. They were graduates or current students during the Cultural Revolution. The results show that predetermined factors, for example: parents' social status ("Cheng fen") and parents' education attainments, played significant role in determining the probability of being sent-down for those children. Firstly, if parents were with higher education background, their kids were more likely to be sent-down. Secondly, if parents belonged to some particular social status ("chengfen"), for example, rich peasants, office workers, petty proprietor and revolutionary cadre, their children were more likely to be sent-down to the rural areas. Thirdly, some regions have higher probabilities to send the youth to the rural areas. Additionally, I also explore their length of stay as the dependent variable. And their length of stay also to some extent significantly correlated with some characteristics of their family backgrounds. During the 1960s to 1980s, China was a planned economy and family income differences were trivial. Therefore without controlling family income will not bias our estimation. As discussed in the section 2, selection problem and heterogeneities among sent-down youth both cast doubts on the liability of the positive effects of the Send-Down Movement through simply comparing the sent-down and non-sent-down youth in the existing literature.

Figure A.5: The Prob. of Being Sent-Down, by Birth Cohort

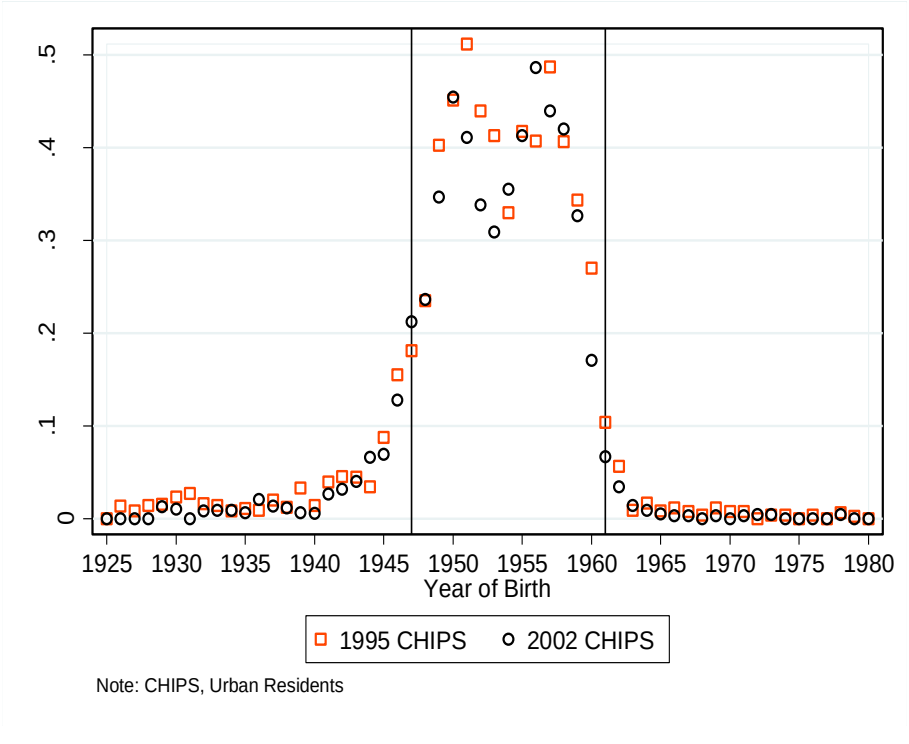


Figure A.6: The Length of Stay in the Rural, by Cohort (CHIPS 2002)

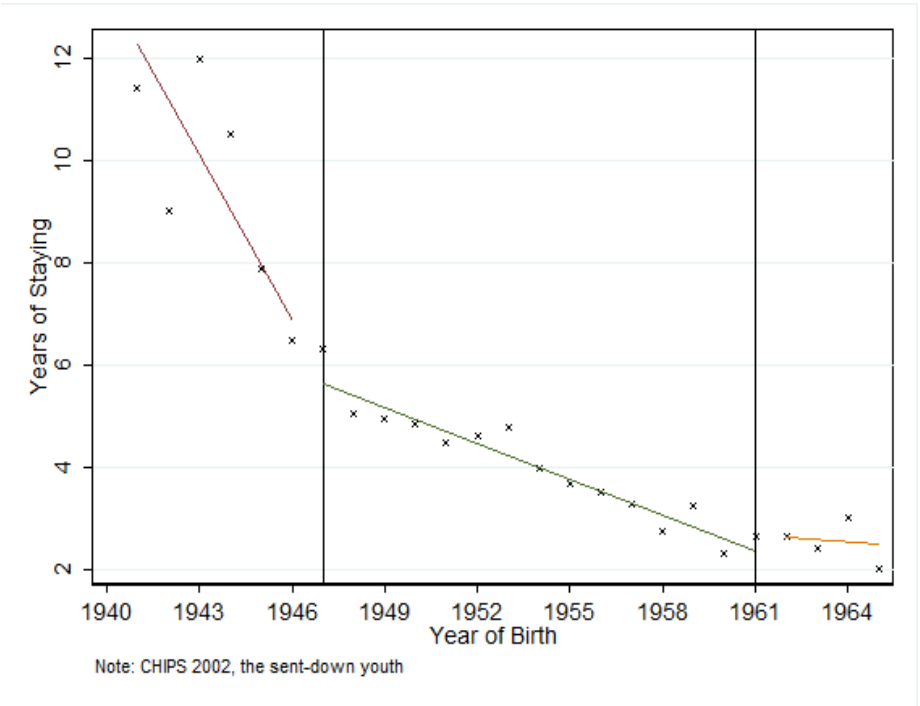


Figure A.7: The Probability of Being Sent-Down, by Region (CHIPS 2002)

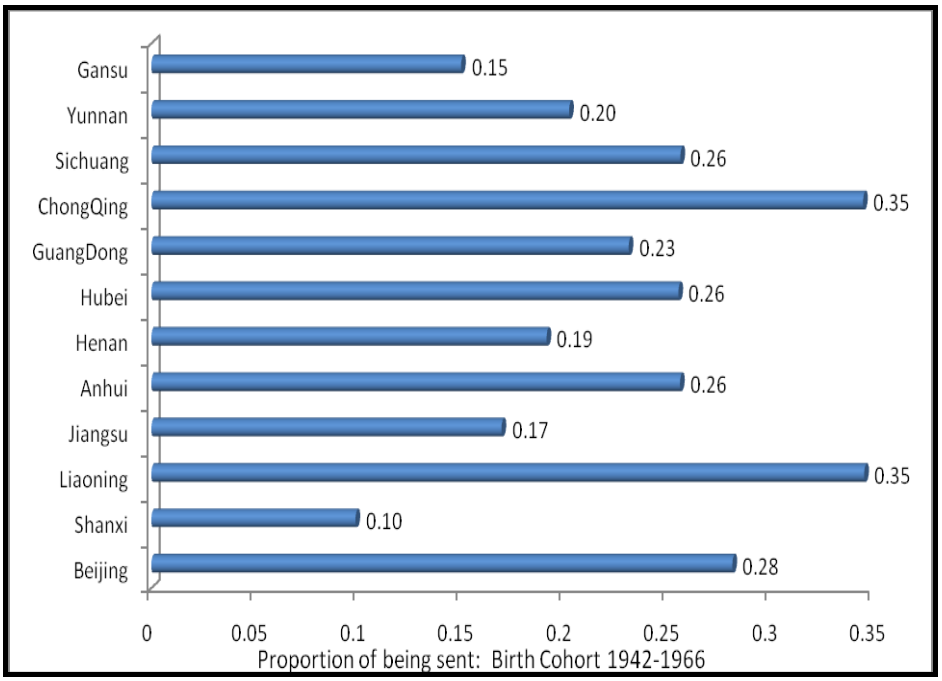


Figure A.8: The Probability of Being Sent-Down over regions and cohorts

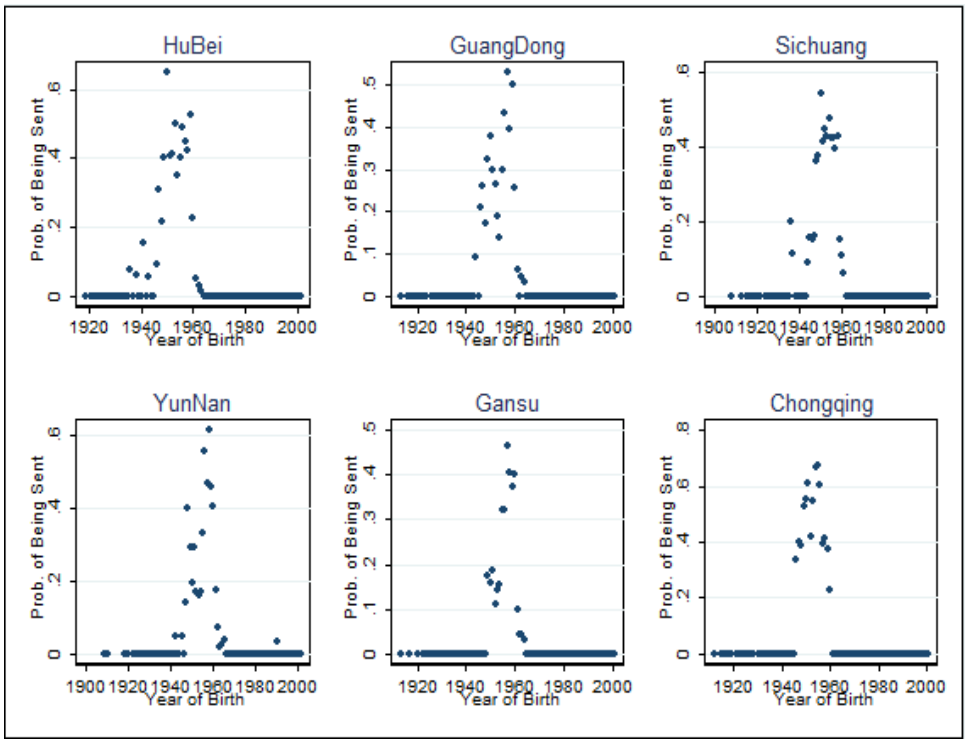


Figure A.9: The Year of Being Sent to Rural Areas, by Birth Cohort

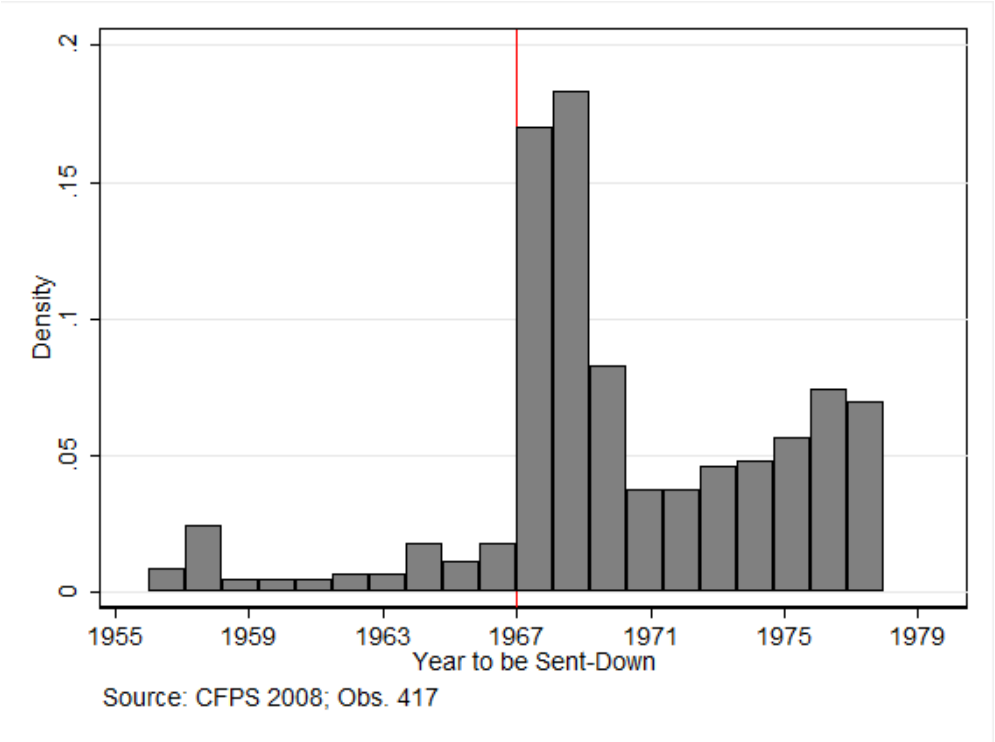


Figure A.10: The Year of Returning to Urban Areas

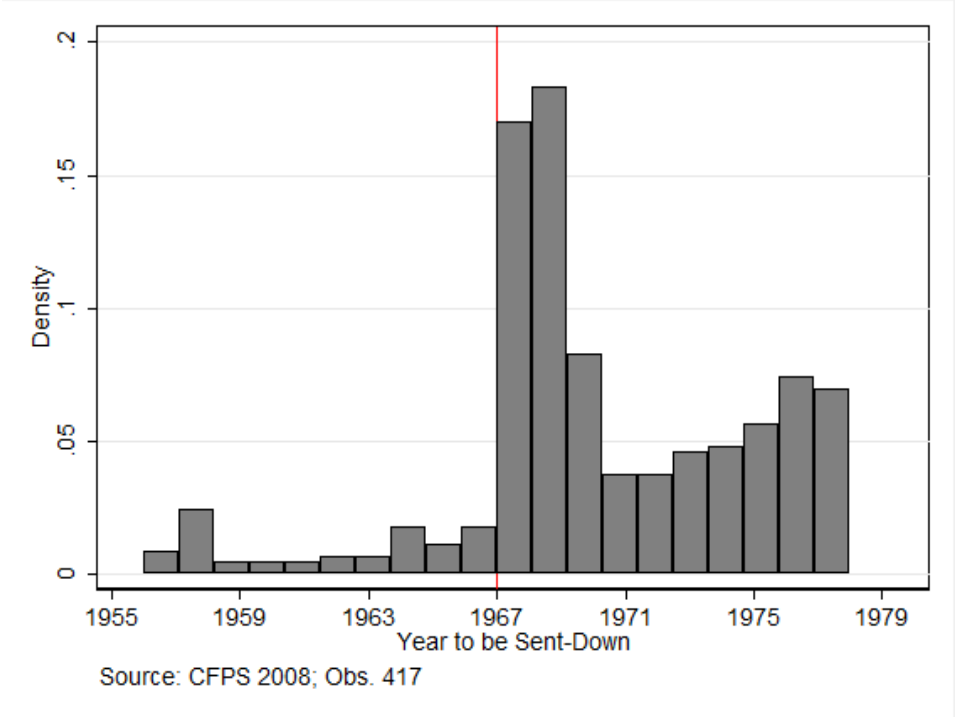


Table A.3: Determinants for Being Sent-Down

Dependent Variable	Sent-Down	
	Father's Education	Mother's Education
Base Group: Below Primary		
Primary	0.062***	-0.0081
	(0.02)	(0.021)
Junior high	0.057**	0.064*
	(0.025)	(0.033)
Senior high	-0.033	0.133***
	(0.037)	(0.042)
College and above	0.074*	0.167***
	(0.044)	(0.077)
Father's "Cheng Fen"	Base Group: poor peasant or landless	
Lower-middle peasant	-0.079*	
	(0.034)	
rich-middle peasant	0.083 *	
	(0.048)	
manual worker	0.131***	
	(0.043)	
office worker	0.139***	
	(0.051)	
petty proprietor	0.269***	
	(0.05)	
revolutionary cadre	0.163**	
	(0.065)	
Parents' Occupations	NO/Yes	
Mother's "Cheng Fen"	Yes	
R-Square	0.1	

Note: 1. The sample includes the urban residents born between 1946 and 1961; 2. *** and ** represent significance at 1% and 5%, respectively; 3. The standard error is reported in the parenthesis. Only significant coefficients are reported in the table; 6. The dependent variable is a dummy represents whether one had been sent to the rural or not. Independent variables: father's age, mother's age, father's occupation, mother's occupation, father's social status, mother's social status and province fixed effect; 7. considerable models specifications have been applied. The conclusion is consistent. Results of regression are consistent with or without controlling parents' occupations.

A.3 More Evidences on the Channels in the Mechanism

A.3.1 the Channel of Educational Attainment

Comparison across Countries

Since the channel of educational attainment is the most important channel, I further make placebo tests across asian countries to show the causal loss in human capital caused by the Cultural Revolution. In Figure A.11, the average schooling years obtained for different countries are graphed against different birth cohorts on the x-axis. The patterns of education attainment in Indonesia and Malaysia are without such obvious deep as China for birth cohorts from 1947 to 1961. The data resources and samples are urban residents from CHIPS (1995) for China, Census (1991) for Malaysia and Census (1995) for Indonesia.

Comparison across Regions

Compared with Table A.4 in the main context, we can see the rural residents' annual income has increased from 1990s to 2000s which is consistent with urban areas. But the average schooling years of treated group were not affected obviously by the Cultural Revolution. We can even see that the treated cohorts obtained more schooling years in 2002 Compared with the younger and older control cohorts.

A.3.2 Employment Status, Health Habit and Attitudes

Figure A.12 shows that the affected cohorts are more likely to leave the labor market earlier than the older control group. Figure A.13 states that the treated cohorts have more people smoke. Figure A.14 indicates a possible fact that the treated cohorts value the education less.

Figure A.11: Average Schooling Year, by Country

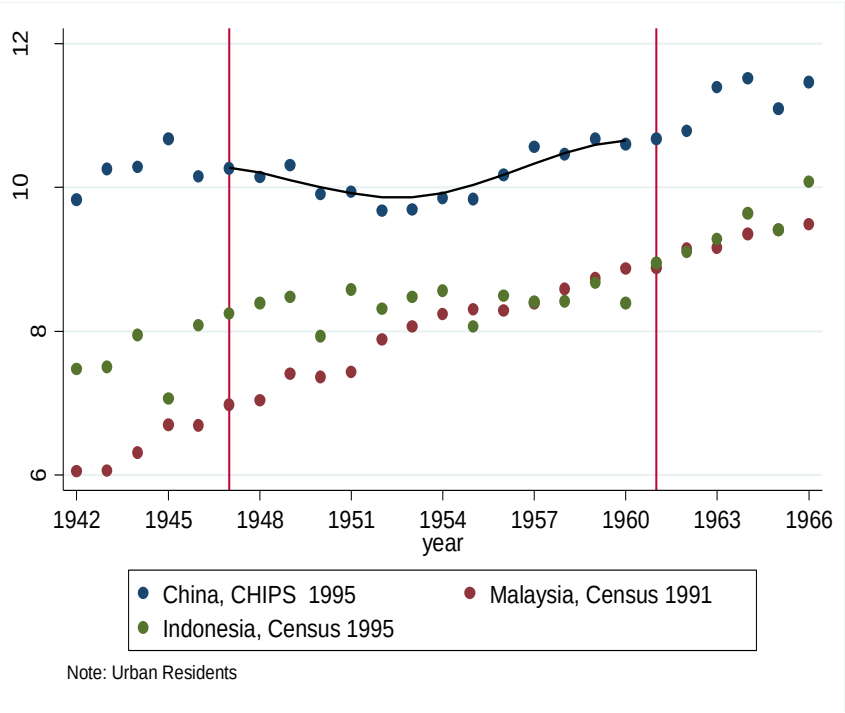
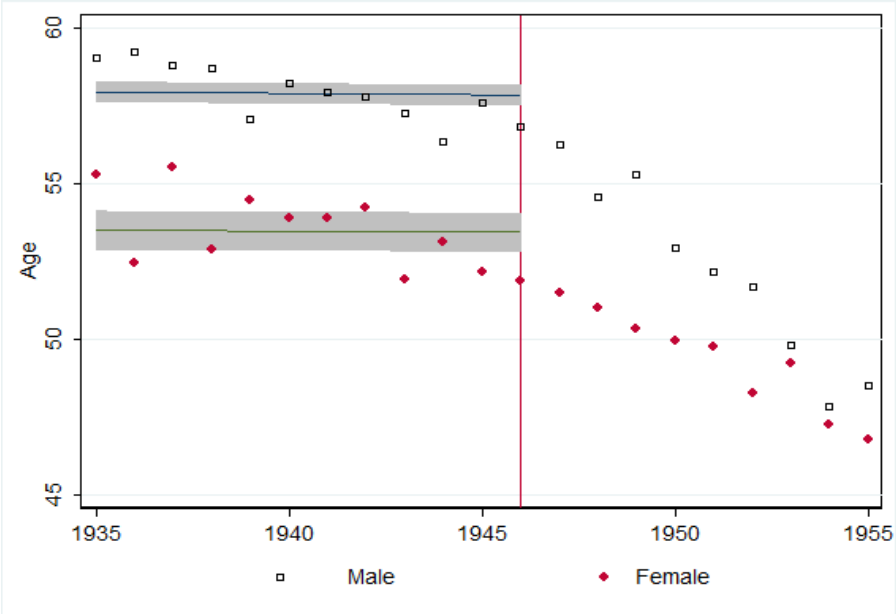
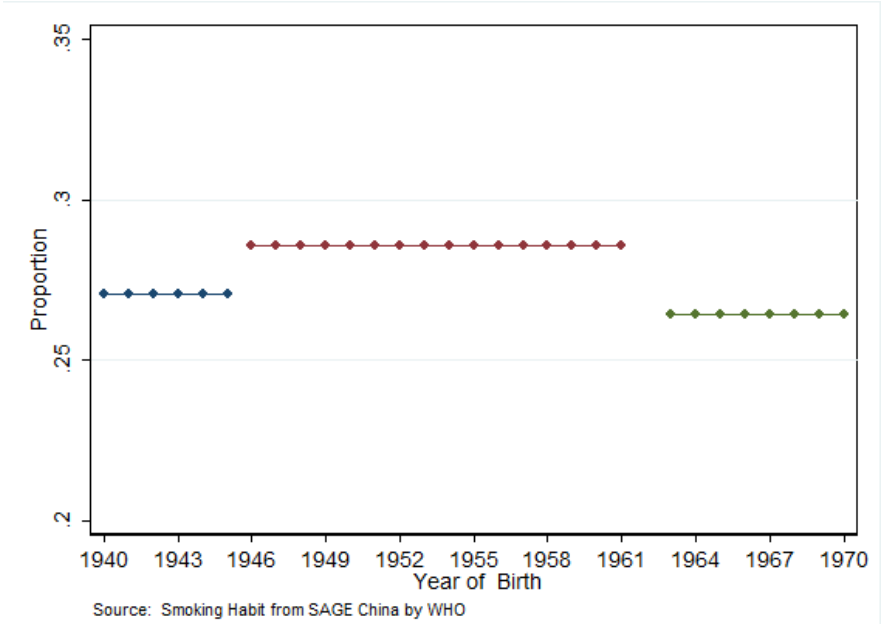


Figure A.12: The Age Out of Labor Force, by Birth Cohort and Gender



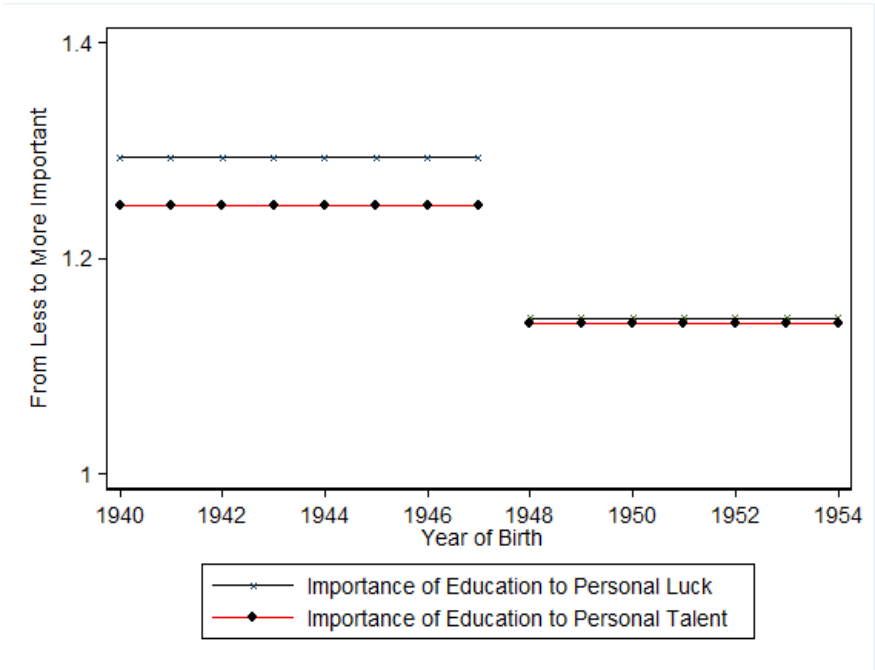
Data resource is from world health organization (WHO) Study on Global Ageing and Adult Health (SAGE) survey 2007-2010.

Figure A.13: The Proportion of Smokers, by Birth Cohort



Data resource is from world health organization (WHO) Study on Global Ageing and Adult Health (SAGE) survey 2007-2010.

Figure A.14: Attitudes for Educational Attainment



Note: The vertical axis labels the relative importance of education to the other factors when observations reveal their attitudes for different determinants in personal success. It is graphed based on the numerical information from CPF studies in 2008.

Table A.4: Income and Education Attainment in Rural Areas

Outcome Variables	Mean	Older Group[a]	Birth Cohorts 1946-1961	Younger Group[b]
Permanent Rural Residents (obs. 3819/the wave of 1995; 7369/ the wave of 2002)				
Average Income (1995)	994.253 (4161.42)	730.651 (3243.73)	1036.981 (4473.56)	1082.03 (4079.10)
Average Income (2002)	1670.721 (3634.72)	1161.642 (3658.62)	1467.783 (3474.78)	1925.508 (3760.21)
Income Growth	68%	60%	41.5%	78%
Schooling Years (1995)	5.757 (3.16)	4.554 (3.19)	5.606 (3.17)	6.846 (2.77)
Schooling Years (2002)	6.846 (2.77)	5.74 (2.86)	7.536 (2.47)	6.78 (2.77)
Rural-urban Migrants (obs. 3407)				
Average Income (2002)	9766.91 (11905.14)	6522.632 (7338.86)	9958.875 (17812.39)	9769.68 (9903.76)
Schooling Years (2002)	7.665 (2.81)	6.615 (3.50)	6.652 (3.16)	7.958 (2.63)

[a] Older group includes birth cohorts of 1935-1945 for the wave of CHIPS 1995 and birth cohorts of 1942-1945 for the wave of CHIPS 2002 respectively.
[b] Younger group includes birth cohorts of 1962-1970 for the wave of CHIPS 1995 and birth cohorts of 1962-1977 for the wave of CHIPS 2002 respectively. Means of variables are shown with the standard deviations reported within the parentheses.

A.4 More Robustness Checks

Table A.5: Robustness of the Mechanism (CHIPS 1995)

Panel A:	Birth Cohorts: 1942-1977				
Measures	(1)	(2)	(3)	(4)	(5)
CR	-0.186***	-0.131***	-0.102**	-0.071**	-0.072**
	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)
Schooling Years		0.041***	0.041***	0.041***	0.025***
		(0.002)	(0.002)	(0.002)	(0.002)
Working-Experience			0.02***	0.021***	0.018***
			(0.002)	(0.002)	(0.001)
Marital Status				0.133***	0.129***
				(0.04)	(0.04)
Occupation	No	No	No	No	Yes
R-squared	0.2	0.22	0.27	0.27	0.29
Obs.	11374	11192	11127	11127	11127
Panel B:	Alternative Measures				
Closure	-0.031***	-0.021***	-0.017***	-0.011**	-0.011**
	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)
Send-Down	-0.114***	-0.079***	-0.059**	-0.04***	-0.04***
	(0.011)	(0.02)	(0.01)	(0.01)	(0.01)
Panel C:	Birth Cohorts: 1935-1970				
CR	-0.107***	-0.047	-0.01	0.013	0.018
	(0.031)	(0.031)	(0.02)	(0.02)	(0.02)
Closure	0.012**	0.001	0.003	0.005	0.004
	(0.01)	(0.005)	(0.004)	(0.004)	(0.003)
Send-Down	-0.088***	-0.048***	-0.01	0.003	0.002
	(0.019)	(0.018)	(0.013)	(0.013)	(0.012)
R-squared	0.1	0.15	0.22	0.22	0.29
Obs.	12626	12625	12424	12424	12308

Note: 1. The sample includes permanent urban residents born between 1942 and 1977 and currently were employed in 1995; 2. *** and ** represent significance at 1% and 5%, respectively. The standard error is reported in the parenthesis and adjusted for 36 clusters in age; 3. Constructions of CR, Send-Down, Closure and Famine are the same as Table 3; Marital Status is a dummy variable and represents whether one is married with spouse in 1995. The missing income is replaced by 0; 4. Other independent variables: gender, age, age square, famine and province fixed effects; 5. For all the empirical models in this paper, I also examine the other construction for Send-Down (see section 2) considering the provincial heterogeneity and consistent estimates are obtained.

Appendix B

Appendix for Chapter 2

B.1 the Educational Policy Changes

Figure B.1 shows the variations of senior secondary schools across city and town residential between 1971 and 1972. An obvious increase can be found in the number of senior secondary schools in city areas. The rural (villages) and urban (cities) areas exhibit quiet different experience during the second half of the Cultural Revolution. We can observe the expansions in junior and senior secondary schools in rural areas which down grade the validity of controlling the rural areas as control groups. Limited by administrative statistics during the Cultural Revolution and before the Cultural Revolution, I only obtain the number of senior high schools in rural area was 20,000 in 1972. In my paper, I only consider the residents in city and town. Table B.1 shows the number of senior secondary schools in town and city residential. In both areas, the numbers of schools exhibit consistent patterns.

Figure B.1: The Supply of Senior Secondary Schools between 1971 and 1972

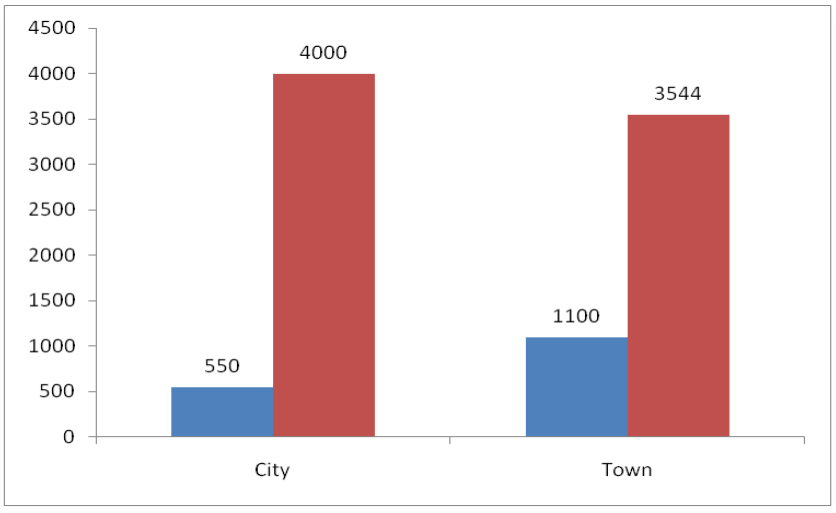


Table B.1: The Number of Senior Secondary Schools across City and Town

Year	City	Town	Year	City	Town
1971	550	1100	1981	6069	5951
1972	4000	3544	1982	5559	5743
1973	5139	4301	1984	5431	5725
1974	5848	4833	1985	5458	5926
1976	7008	5734	1986	5467	6154
1977	7610	6377	1987	5328	5969
1978	7106	6106	1988	5227	5904
1979	6893	6375	1989	5207	5851
1980	6676	6149	1990	5028	5828

B.2 Placebo Tests of the Junior Secondary High Completion

In Figure B.2.1 and Figure B.2.2, I graph the proportions of junior secondary completions against parents' ages in 1966 for all mothers and fathers samples separately. We can compare with graphs of senior secondary completion in section 3. The junior high attainments are not impacted as severely as the senior high completion among the affected population. Overall, both figures show parallel trends with small fluctuations across regions and over time. Regressions same as the Table 2.2 in the main context are applied using the junior secondary completion as the dependent variable for the empirical samples. As shown in Table B.2.1 and B.2.2, the coefficients of interactions and F-statistics for the joint significant tests are consistently supporting the validity of our identification strategy.

Figure B.2.1: Males' Junior Secondary Completion by Region

(Sample: Males of 1990 China Census)

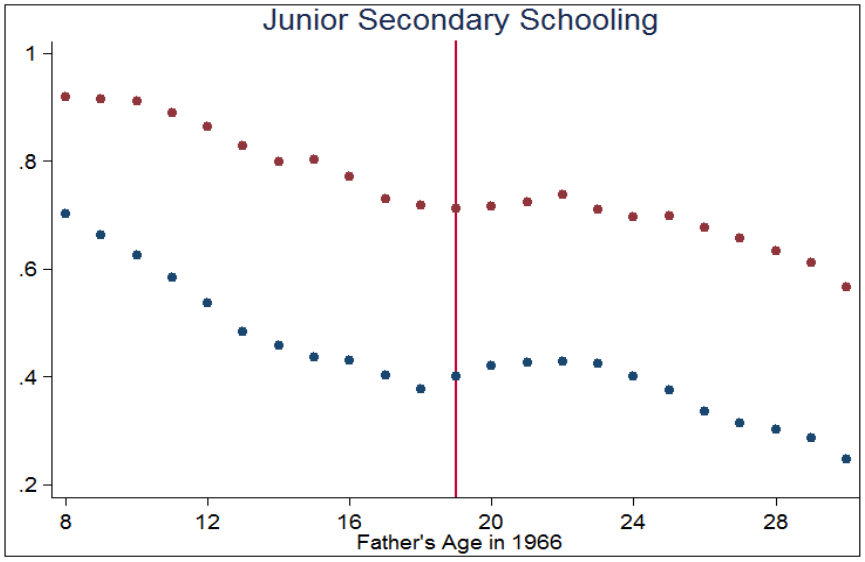


Figure B.2.2: Females' Junior Secondary Completion by Region

(Sample: Females of 1990 China Census)

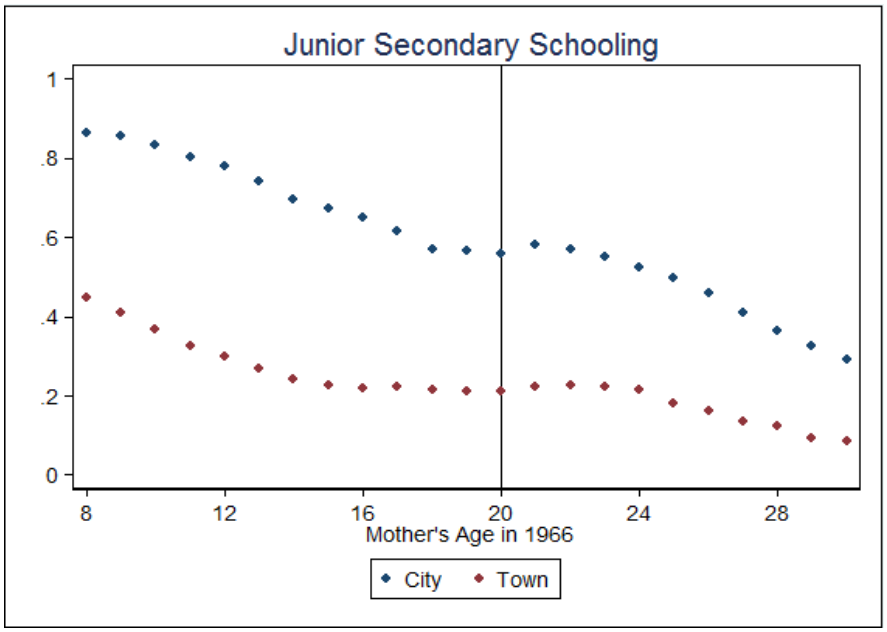


Table B.2.1: Evaluating the Effects of School Closure

		Maternal Education Attainment		Paternal Education Attainment	
Residential* Age in 1966		Senior High	Junior High	Senior High	Junior High
δ_{12}	City*age_12	-0.101***	0.061**	-0.152***	0.040
		(0.017)	(0.025)	(0.038)	(0.047)
δ_{13}	City*age_13	-0.122***	0.046**	-0.178***	-0.074**
		(0.013)	(0.019)	(0.028)	(0.035)
δ_{14}	City*age_14	-0.129***	-0.001	-0.154***	-0.086***
		(0.010)	(0.014)	(0.021)	(0.026)
δ_{15}	City*age_15	-0.133***	0.021	-0.162***	-0.075***
		(0.008)	(0.012)	(0.017)	(0.021)
δ_{16}	City*age_16	-0.125***	0.011	-0.151***	-0.112***
		(0.007)	(0.011)	(0.013)	(0.016)
δ_{17}	City*age_17	-0.087***	0.002	-0.116***	-0.083***
		(0.007)	(0.010)	(0.011)	(0.013)
δ_{18}	City*age_18	-0.065***	-0.001	-0.082***	-0.056***
		(0.006)	(0.009)	(0.010)	(0.012)
δ_{19}	City*age_19	-0.049***	0.007	-0.084***	-0.063***
		(0.006)	(0.009)	(0.009)	(0.011)
δ_{20}	City*age_20	-0.044***	0.019	-0.054***	-0.066***
		(0.006)	(0.009)	(0.009)	(0.11)
δ_{21}	City*age_21	-0.018***	0.028***	-0.041***	-0.071***
		(0.006)	(0.009)	(0.009)	(0.011)
δ_{22}	City*age_22	0.007	0.023**	-0.002	-0.039***
		(0.006)	(0.009)	(0.008)	(0.010)
δ_{23}	City*age_23	-0.001	0.020**	-0.017**	-0.062***
		(0.006)	(0.009)	(0.008)	(0.010)
δ_{24}	City*age_24	-0.001	-0.010	-0.026***	-0.056***
		(0.006)	(0.009)	(0.008)	(0.010)
δ_{25}	City*age_25	0.007	0.009	-0.017**	-0.027***
		(0.006)	(0.009)	(0.008)	(0.010)
Obs.		231891	231891	169716	169716
R-squared		0.11	0.12	0.11	0.12
F-Statistic※					
Wald-Test①		87.55	3.27|3.27※	34.07	8.23|4.41※
Wald-Test②		91.90	0.99|1.13※	54.47	15.79|2.68※
Wald-Test③		0.93(P=0.44)	4.74|5.67※	3.61	12.00|5.15※

①The null hypothesis: $\delta_{12}=\delta_{13}=\delta_{14}=\delta_{15}=...=\delta_{24}=\delta_{25}=0$

②The null hypothesis: $\delta_{14}=\delta_{15}=\delta_{16}=\delta_{17}=\delta_{18}=0$

③The null hypothesis: $\delta_{22}=\delta_{23}=\delta_{24}=\delta_{25}=0$

※ For the regressions of junior secondary completion, F-statistics are also presented for the following null hypothesis: $\delta_{12}=\delta_{13}=\delta_{14}=\delta_{15}=...=\delta_{24}=\delta_{25}$; $\delta_{14}=\delta_{15}=\delta_{16}=\delta_{17}=\delta_{18}$; $\delta_{22}=\delta_{23}=\delta_{24}=\delta_{25}$.

Note: 1. Empirical sample includes parents' aged 12-26 in 1966 adjusted for school calendar with children aged 16-22 in 1990; 2. The reference cohort is the group for parents aged 26 born in towns in 1966; 3. Other controls: age cohort dummies, residential dummy, province fixed effects, ethnicity fixed effects and quarter fixed patterns for parents. 4. *** represents significance at 1%,* *represents significance at 5% and * represents significance at 10%.

Table B.2.2: Evaluating the Effects of School Closure for Restricted Sample

		Maternal Education Attainment		Paternal Education Attainment	
Residential* Age in 1966		Senior High	Junior High	Senior High	Junior High
δ_{14}	City*age_14	-0.128***	-0.001	-0.154***	-0.086***
		(0.009)	(0.015)	(0.020)	(0.025)
δ_{15}	City*age_15	-0.132***	0.021	-0.161***	-0.074***
		(0.008)	(0.013)	(0.016)	(0.021)
δ_{16}	City*age_16	-0.123***	0.011	-0.150***	-0.111***
		(0.007)	(0.011)	(0.013)	(0.016)
δ_{17}	City*age_17	-0.086***	0.003	-0.115***	-0.083***
		(0.008)	(0.010)	(0.011)	(0.013)
δ_{18}	City*age_18	-0.064***	-0.001	-0.082***	-0.056***
		(0.007)	(0.009)	(0.011)	(0.012)
δ_{22}	City*age_22	0.007	0.023**	-0.002	-0.039***
		(0.006)	(0.010)	(0.010)	(0.010)
δ_{23}	City*age_23	-0.0005	0.020**	-0.017*	-0.062***
		(0.008)	(0.010)	(0.009)	(0.010)
δ_{24}	City*age_24	-0.0003	-0.011	-0.026***	-0.056***
		(0.008)	(0.010)	(0.010)	(0.010)
δ_{25}	City*age_25	0.008	0.009	-0.017*	-0.028***
		(0.008)	(0.010)	(0.010)	(0.010)
Obs.		160327	160327	122024	122024
R-squared|F-statistic		0.11|244.8	0.16| 361.48	0.11|184.3	0.12|203.88
F-Statistic※					
Wald-Test①		124.44	2.42|2.57※	42.00	10.63 |5.83※
Wald-Test②		82.89	0.88|0.99※	52.26	15.88|2.61※
Wald-Test③		0.56(P=0.69)	4.33|5.17※	3.61	12.59|5.41※

①The null hypothesis: $\delta_{12}=\delta_{13}=\delta_{14}=\delta_{15}=...=\delta_{24}=\delta_{25}=0$

②The null hypothesis: $\delta_{14}=\delta_{15}=\delta_{16}=\delta_{17}=\delta_{18}=0$

③The null hypothesis: $\delta_{22}=\delta_{23}=\delta_{24}=\delta_{25}=0$

※ For the regressions of junior secondary completion, F-statistics are also presented for the following null hypothesis: $\delta_{12}=\delta_{13}=\delta_{14}=\delta_{15}=...=\delta_{24}=\delta_{25}$; $\delta_{14}=\delta_{15}=\delta_{16}=\delta_{17}=\delta_{18}$; $\delta_{22}=\delta_{23}=\delta_{24}=\delta_{25}$.

Note: 1. Empirical sample includes parents' aged 14-18 and 22-26 in 1966 adjusted for school calendar with children aged 16-22 in 1990; 2. The reference cohort is the group for parents aged 26 born in towns in 1966; 3. Other controls: age cohort dummies, residential dummy, province fixed effects, ethnicity fixed effects and quarter fixed patterns for parents. 4. *** represents significance at 1%,* *represents significance at 5% and * represents significance at 10%.

B.3 Concerns about Data

The first concern is whether the timing of childbearing has been impacted obviously. I examine the average age of children by parents' birth cohorts. As the smoothly increasing trends in both residential locations show, the closure of schools has not caused obvious discontinuity in mothers' decision to choose the timing of giving births in both residential locations (See Figure B.3.1). Secondly, sex selection of children is considered. I gauge the proportion of boy children born and graphed them against mothers' age cohorts in Figure 6. The flat curves indicate that there is no obvious gender selection over time and no significant difference exists between town residents and city residents. I also regress the ratio of number of male children to total number of children born for each female sample on the interactions, age indicators, quarter fixed effect and province fixed effect (see Table B.3.1). All the coefficients of interactions are close to 0. The last concern is that I am not able to follow those adult children having moved out the households (around 30% of the sample). The reason for attrition is mainly related with the facts that the adult kids get married and establish new households. To better understand the problem of attrition, I computed the total number of children missed the number of girls and boys missed within the households at the level of mothers' age cohort. The results are graphed in Figure B.3.3 and Figure B.3.4. Based on the statistics, the missing children are majorly children of parents in control group. They are probably with more education attainment, or it is also possible that more able children are more likely to move out the households and become independent. If they are the case, our estimates might underestimate the effects and constitute lower bounds for the intergenerational transmission. Both graphs show that families with older parents are more likely to have children move out. On average, for birth cohorts who were older than 22 in 1966 (control group), one of their children has left and lost tracking in cities. Meanwhile, there are more children, around 1.5, losing tracking for the town households. For younger cohorts, the number of children having moved out is below 0.5, on average. Hence, most of

the children for the younger mothers were still living within the households in 1990. The analysis of the composition shows that most of the children are girls and in the control group, around one girl has left her parents. By contrast, the proportions of boys moving out were less both in city and town areas. Compared boys and girls, overall most of the boys are still living within the households. Combining both graphs, the probability of missing is more likely a function of their own ages, less likely depends on parents' education attainment and probably is not correlated with the unobserved ability of parents as well as children's education attainment. Also, all the curves show that the moving out patterns of children is similar and consistent across residential regions as well as across genders over time series. With the assumption that the moved out children follow the same structure and determinants are consistent across regions, the sample bias can be alleviated after taking the difference in difference across regions and age cohorts. Therefore, our estimates are sufficient for consistency. The patterns are consistent across town residents and city residents and when the identification strategy is applied, the potential estimation bias is alleviated. If we can have a unique data matching the population, the estimate of interest is perfectly estimated.

The problem of attrition might bias the estimators if the pattern of missing is indeed a function of parent's education and correlated with the unobserved specifics. To further explore the correlation, correlations between variables of interest are studied and presented in Table B.3.1 and Table B.3.2 based on the empirical data. I also apply the regressions of the first stage to explore the attrition problem (see Table B.3.3). How the attrition problem can bias my estimator? The younger parents have less kids moving out and the urban areas have more kids move out. Attrition problem is negative related with the IV and negative related with parents' senior high attainment.

Figure B.3.1: Children's Age by Parent's Age in 1966

(Sample: 1990 China Census)

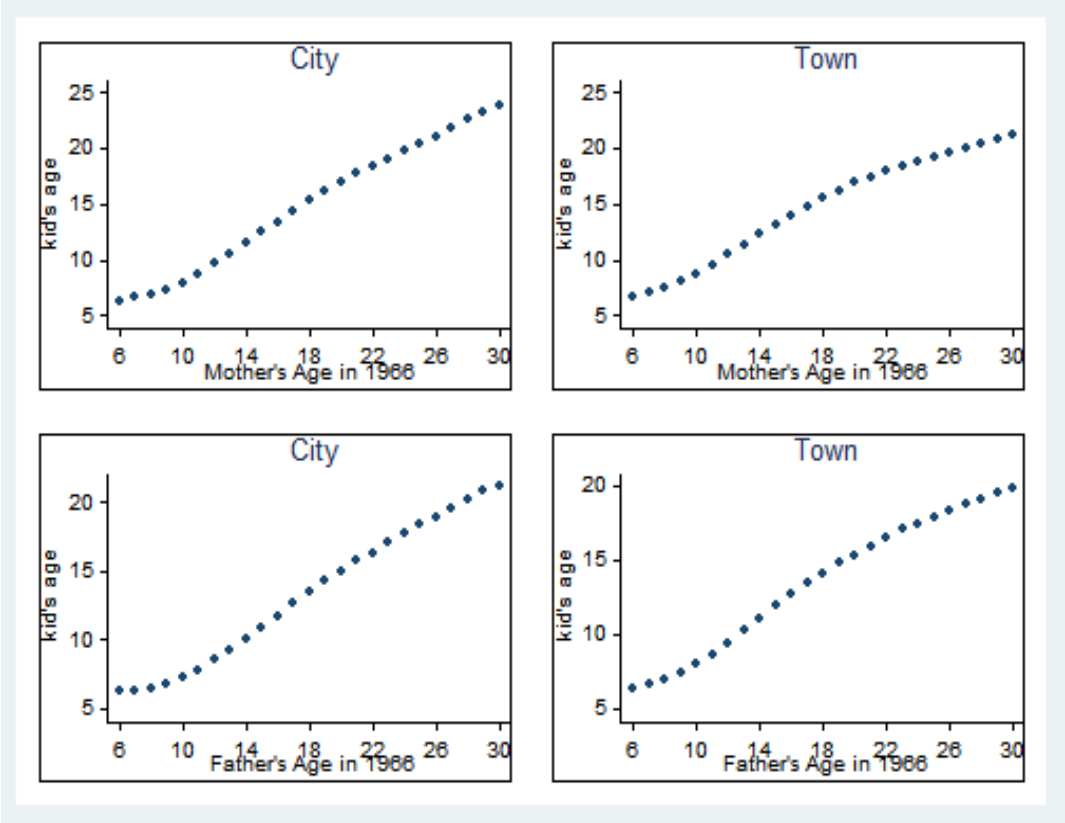


Figure B.3.2: The Proportion of Boy's Births by Mother's Cohort

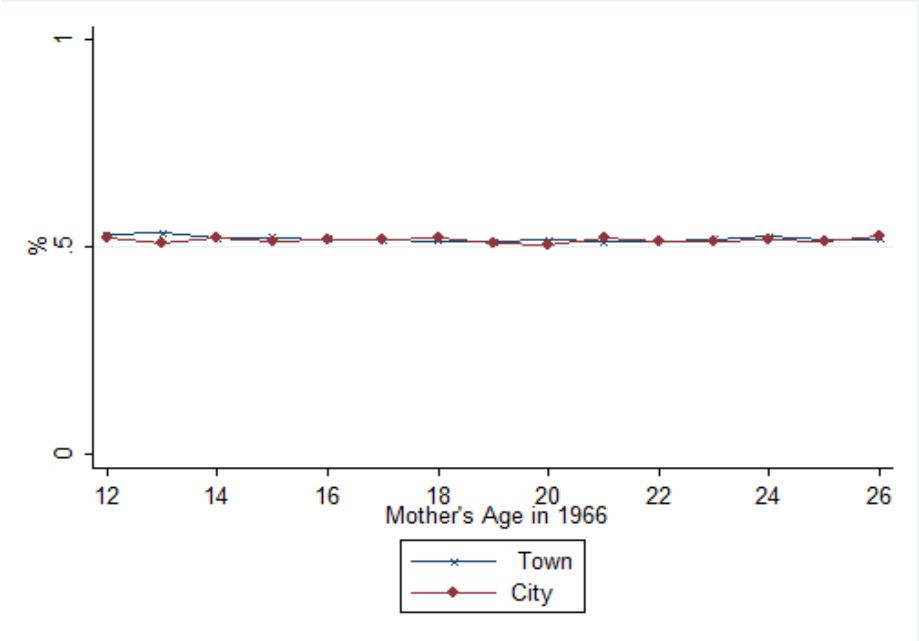


Figure B.3.3: the Children Missed for Households in Cities

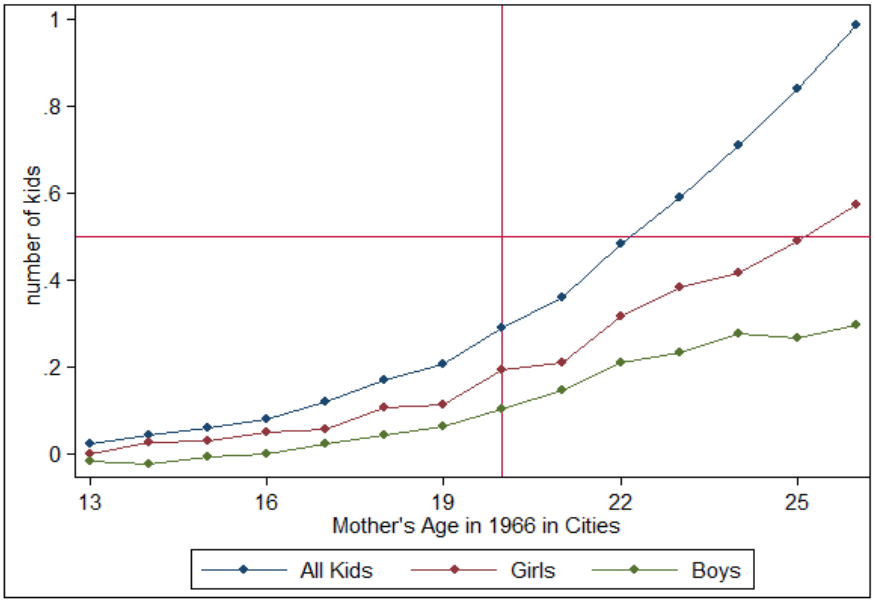


Figure B.3.4: the Children Missed for Households in Towns

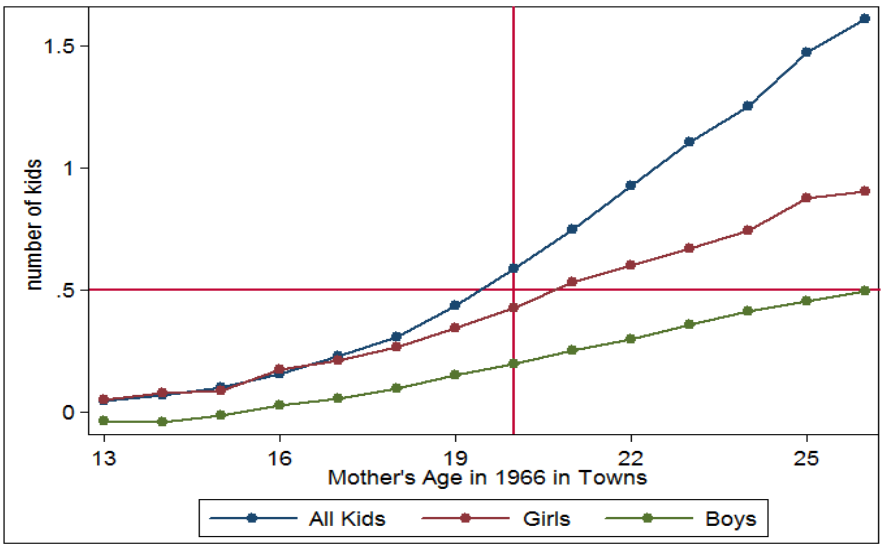


Table B.3.1: Correlation Matrix

Correlation	U	X	Y
Indicator of Attrition (U)	1		
Maternal Senior High Completion(X)	-0.077	1	
Children Senior Attendance (Y)	-0.0686	0.3302	1

Table B.3.2: Correlation between the Instruments and the Indicator of Attrition

IVs	City*age_12	City*age_13	City*age_14	City*age_15	City*age_16	City*age_17	City*age_18
U	-0.0257	-0.0365	-0.0496	-0.0594	-0.0705	-0.0798	-0.08
City*age_19	City*age_20	City*age_21	City*age_22	City*age_23	City*age_24	City*age_25	City*age_26
-0.0821	-0.0644	-0.043	-0.0139	0.0082	0.0352	0.0588	0.0817

Bound the Estimates (Source: Nevo, Aviv and Adam M. Rosen, "Identification with Imperfect Instruments"):

$$\beta^{iv} = \beta + \frac{\sigma_{uz}}{\sigma_{xz}} \,\&\, \beta^{ols} = \beta + \frac{\sigma_{ux}}{\sigma_{x^2}} \,\&\, \sigma_{ux} < 0, \sigma_{uz} < 0, \sigma_{xz} < 0$$

===> we can obtain that $\beta^{ols} < \beta < \beta^{iv}$

Table B.3.3: Regressions

Residential* Age in 1966		Data Issues: Attrition No. of Children> No. of Children within Household	Data Issues: Ratio Male Children/Total Children
δ_{12}	City*age_12	0.162*** 0.007	-0.0003*** 0.0005
δ_{13}	City*age_13	0.149*** 0.007	0.0187 *** 0.0003
δ_{14}	City*age_14	0.138*** 0.007	0.0133 *** 0.0003
δ_{15}	City*age_15	0.104*** 0.008	0.0051*** 0.0003
δ_{16}	City*age_16	0.075*** 0.008	0.0040*** 0.0003
δ_{17}	City*age_17	0.052*** 0.009	0.0018*** 0.0003
δ_{18}	City*age_18	0.022*** 0.009	-0.0019*** 0.0003
δ_{19}	City*age_19	-0.034 *** 0.009	-0.0029*** 0.0003
δ_{20}	City*age_20	-0.059 *** 0.010	0.0084 *** 0.0003
δ_{21}	City*age_21	-0.077 *** 0.010	0.0007 *** 0.0004
δ_{22}	City*age_22	-0.076 *** 0.010	-0.0042 *** 0.0002
δ_{23}	City*age_23	-0.075*** 0.010	-0.0016 *** 0.0003
δ_{24}	City*age_24	-0.057 *** 0.010	0.0082 *** 0.0002
δ_{25}	City*age_25	-0.032*** 0.009	0.0087 *** 0.0002
Obs.		294355	294355
R-squared		0.32	0.01

Note: 1. Empirical sample includes All females' sample aged 12-26 in 1966 adjusted for school calendar; 2. The reference cohort is the group for parents aged 26 born in towns in 1966; 3. Other controls: age cohort dummies, residential dummy, province fixed effects, time trend, ethnicity fixed effects and quarter fixed patterns for parents. 4. *** represents significance at 1%,* *represents significance at 5% and * represents significance at 10%.