Scarring Effects of Deprived College Education during China's Cultural Revolution*

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Abstract

China's college enrollment system came to a sudden halt as the Cultural Revolution (1966-1976) started. Virtually no students were admitted to colleges from 1966 to 1969. We estimate a marked downward shift in college completion rate for the affected cohorts, i.e., those born in or after 1947, relative to the older cohorts. Using a regression discontinuity approach, we show that these individuals experienced a sizable reduction in labor supply, earnings, and wealth after some 30 years, which can be attributed to the loss of opportunities to access college education. We also find that the disruption of college education made the relevant cohorts less attractive in the marriage market.

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1 Introduction

Prior literature has shown that exposure to adverse conditions in early life can have large and persistent impacts on adult outcomes. People have long-term losses in education, health, labor supply and income, after experiencing negative shocks in utero or during childhood such as epidemics (Almond, 2006; Barreca, 2010; Lin and Liu, 2014), famines (Almond et al., 2010; Chen and Zhou, 2007; Gørgens et al., 2012; Lindeboom et al., 2010), natural and environmental disasters (Almond et al., 2009; Dinkelman, 2016), economic recessions (Adhvaryu et al., 2014;Banerjee et al., 2010; Berg et al., 2006), or wars (Akbulut-Yuksel, 2014; Ichino and Winter-Ebmer, 2004; Leon, 2012). Can adverse shock to education at adolescence also have a lasting negative effect? To what extent can people make up for the loss of education later in life?

In this study, we investigate how the suspension of college admission during China's Cultural Revolution (1966-1976) affected people's lives. In June 1966, the Chinese central government decided to abolish the college entrance examinations and postponed the admission process for half a year. As the Revolution unfolded, the half-year delay eventually extended into a four-year suspension of college enrollment. There were virtually no new entrants to China's universities during the period 1966-1969 (Figure 1). Because of this radical policy change, many young people were deprived of the opportunities for higher education, and their life courses derailed.

We implement a regression discontinuity (RD) approach to examine how the abrupt suspension of college admission affected the lives of these cohorts. For those who were just about to finish high school in 1966, the sudden, unexpected suspension of college admission imposed a significant barrier for them to go to college during 1966-1976. Their slightly older counterparts (some are merely one month older), however, would have had a better chance of going to college in 1965, when colleges were still open to new recruits. As illustrated in Figure 2, people who were born in January 1947 had a lower probability of going to college than their lucky counterparts who were born just a month earlier. If the unobserved characteristics of

people born on either side of this birth date cutoff are similar on average, then the observed difference in corresponding later-life outcomes between these two cohorts reflects the true damage of the policy that disrupted the progression toward college education. This RD design also allows us to single out the effect of college enrollment suspension from other contemporaneous social and policy changes that took place in the midst of the decade-long Cultural Revolution, which involved a sweeping series of social upheavals and radical reforms that have long-lasting confounding effects.

Our empirical analysis shows that the suspension of college admission indeed had a large impact on college education. In the 2000 Population Census, which captures the relevant cohorts in their fifties, 11.1% of the high school graduates in the pre-Culturual Revolution control group had college education. Our RD estimate using data from the same Census shows that the college suspension led to a 4.7 percentage points (more than 40% of the mean of the pre-Cultural Revolution cohort) reduction in the probability of having college education among those who completed high school. A number of validity tests suggest the identification assumptions of our RD design are quite convincing, as there are neither discrete changes of baseline covariates nor endogenous sorting around the cutoff.

Comparing results from the 2000 Census to those from the 1990 Census, we are also able to see whether and by how much people can make up for their educational loss earlier in life. In fact, the fraction of people with college education does not go to zero for the affected cohorts. Other than being able to get into college before the Cultural Revolution through earlier school entry or grade skipping, most of the college graduates in affected cohorts either got into colleges after admission resumed in 1970 or were able to get college education as part-time adult students later in life. The RD estimate for college education from the 2000 Census is 0.6 percentage points smaller in magnitude than that estimated using the 1990 Census, which suggests that the affected generation could make up for their loss by 11.3% over the decade (1990-2000) when they were already in their forties and fifties.[1] However,

[1]Han et al. (2016) systematically explores people's remedial efforts for their educational loss during the Cultural Revolution.

we observe that there was still a large gap between their education level and that of the earlier cohorts, which implies that they were unable to fully remedy the loss even by 2000, when the affected cohorts were approaching the retirement age.

Unsurprisingly, this policy shock had long-term negative impacts on people's labor market outcomes and economic well-being in general as shown by the 2000 Census. The labor force participation of the affected people were reduced in their fifties. People in the affected cohort were 4.7 percentage points less likely to work. Our RD estimations indicate a 3.2% drop in earnings as a result of the policy. The enrollment suspension is also found to have reduced a person's house size, a proxy for wealth, by 3.5% around the birth date cutoff.

The suspension of college admission is also found to have negatively affected a person's marriage market outcomes, especially spousal quality. Both males and females from the affected cohorts tended to marry someone with less education because of this policy change. However, we do not find any significant effect on fertility for women.

This article is closely related to previous studies that evaluate important educational interventions (for example, Duflo, 2001; Currie and Moretti, 2003; Chou et al., 2010). In contrast to most other policies that expanded the opportunities of education, the policy experiment we study worked in the opposite direction by imposing impediments to further education. The associated loss in numerous dimensions estimated with an RD design underscores the importance of college education, and achieving it at the right age.

Our study contributes to a large body of literature on the long-term effects of early-life shocks. Much of the previous literature focuses on growth disturbances in the fetal period, infancy, and early childhood (see reviews by Almond and Currie, 2011, Currie and Almond, 2011, and Currie et al., 2013). In this article, we investigate an intervention at a much later stage in life, the deprivation of access to college education in early adulthood. Our empirical analysis shows that the associated scarring effects are large, multi-dimensional, and can be felt over the life cycle. Our results suggest that negative shocks to human capital during early adulthood can also have significant detrimental effects that are difficult remedy.

Our work also contributes to a small but growing literature that assesses the adverse effects of China's Cultural Revolution. Cultural Revolution is one of this country's major transformative events in the last half century. This nationwide crisis lasted a decade, involved violence, social unrest and radical reforms, all of which had widespread consequences in numerous dimensions and at all levels of society. Nevertheless, there have been few quantitative evaluations so far of this major historical event. A few previous studies have shown that formal education is adversely affected, from elementary school to college, throughout this period (Deng and Treiman, 1997; Meng and Gregory, 2002; Meng and Gregory, 2007; Giles et al., 2015; Zhang et al., 2007). We add to this literature by systematically investigating the causal effects of the deprivation of college education, an optional final stage of formal learning, during the Cultural Revolution.

The remainder of this paper is organized as follows. In the next section, we briefly describe the Cultural Revolution and China's higher education since 1949. In Section 3 we illustrate our empirical strategy. We describe the data in Section 4 and report our RD estimation results in Section 5. In Section 6, we examine the validity of our RD design. Finally, we provide our concluding remarks in Section 7.

2 The Cultural Revolution and China's Higher Education

This section provides a brief account of China's higher education in three phases, namely before, during, and after the Cultural Revolution.[2] For the pre-Cultural Revolution period, we will focus on how colleges selected students, as those who were admitted to colleges right before the Cultural Revolution are of the greatest interest in this study. We will then describe the Cultural Revolution (1966-76), and illustrate how it has affected China's culture, education and the society. Finally, China resumed a normal education system after Mao died in 1976, which will be briefly discussed toward the end of the section.

[2]This section draws heavily on MacFarquhar and Fairbank (1987), MacFarquhar and Fairbank (1991), and Meisner (1999).

2.1 Higher Education before 1966

When the Chinese Communist Party (CCP) came into power and founded the People's Republic of China in October 1949, the new government took over all 205 colleges from the previous regime. A reorganization of the entire system of higher education was soon under way. New forms of education would have to be devised appropriate for the immediate needs of building an industrialized nation. In order to train enough technical personnel for China's economic development, the system of higher education was gradually transformed along Soviet lines.

The national unified entrance examinations were first introduced in 1952 as an integral part of China's first Five-Year Plan to industrialize the newly-founded republic. Enrollment was centralized and standardized. Every college was given an enrollment quota, and candidates would win admission to their preferred institution based on their performance on the national examinations that were given annually. From 1952 until 1958, the enrollment system was gradually perfected.

However, during the Great Leap Forward (1958-1961), the system that selects students purely based on academic achievements was questioned and eventually derailed. A new form of college enrollment was adopted in 1958. The unified national entrance examinations were not held that year, and instead, universities gave their own examinations. 1958 also marked the start of using more political criteria in college admissions. Young people with certain family backgrounds, mainly those from the capitalist and landlord families were discriminated against. Individuals could be denied access to higher education altogether if their families have serious political problems, regardless of their own academic standing. In contrast, candidates of worker-peasant origins were given priority in admission. In fact, in 1958, many workers and peasants were admitted to universities on the basis of recommendations, without having to take any written examinations. Although the national unified entrance examinations were restored in 1959 and held every year thereafter until the beginning of the Cultural Revolution in 1966, students from lower SES families (workers and peasants) could

still be admitted to colleges on the basis of recommendations without having to sit in the entrance examinations. From the 1950s until the early 1960s, the fraction of college students from worker-peasant families steadily increased as a result of the change in admission priorities. In 1951, 19% of the college students were from worker-peasant backgrounds. The figure rose to 48% in 1958 (NBS, 1959). For the period of 1960-1961, college students from worker-peasant background accounted for 67% of the total enrollment (Lee, 1980).

2.2 The Cultural Revolution in 1966-1976

The Cultural Revolution, which erupted in the summer of 1966, was largely the result of the decisions of Chairman Mao Zedong, for reasons of both power and policy. Before launching the Cultural Revolution, Mao felt shut out by his more conservative colleagues in power. Meanwhile, he was concerned that the extant bureaucracy was dominated by bourgeois ideology and the country was in danger of a regression to capitalism. Mao made use of his unique charismatic standing and resorted to mass mobilization for political support. A spontaneous organization, the "Red Guard", was established by college, middle school, and high school students, who answered Mao's call to rebel against the existing political order.

Probably unexpected by Mao, however, the youth movement quickly spun out of control and degenerated into violence, factionalism, and anarchy. At first, the enthusiastic Red Guards organized mass meetings, posted wall posters in public areas, published their own newspapers to attack their teachers, school administrators and local party officials verbally. Soon, the most radical student rebels began to attack the established authority physically. Homes of the victims were ransacked. Beating and torture were also very common. Later on, the factionalized student rebel groups started to war against one another. In cities like Shanghai, the working class also formed their own organizations and joined the battle. The whole country was thrown into turmoil, and the party bureaucracy to a large extent ceased to function as a national organization. To restore order, the army intervened and even more blood was shed. Eventually, the Red Guards were disbanded and sent down to the

countryside to do agricultural work by May of 1968. Deprived of the opportunities of higher education and urban employment during the Cultural Revolution, the "rusticated youth" eventually see themselves as the "lost generation".[3]

The mass movement indeed helped Mao to regain the reins of political power. His rivals in the core political circle such as President Liu Shaoqi were purged. Conservative officials from all levels of administration were removed from their posts and sent to labor camps. At the same time, Maoist cultural revolutionariests were promoted. The radical episode of the Cultural Revolution came to an anticlimactic end during the Ninth Congress of the Communist Party of China in 1969, which proclaimed the Cultural Revolution a great success and marked the reestablishment of a certain political normalcy. The struggle for power within the top bureaucracy continued, although they had been totally hidden from the public view until the downfall of Lin Biao, the military leader and anointed successor of Mao, in 1971. During the early 1970s, many efforts were made to restore the unity of the party and the pre-Cultural Revolution order. The Maoist policies were entirely dismantled and reverted by reformists led by Deng Xiaoping after Mao's death in 1976.

Inevitably, the national economy also fell victim to the political turmoil during the radical phase of the Cultural Revolution. Industry and transportation were the most affected. In cities, the industrial production was halted due to absenteeism, strikes, and open physical clashes. The transportation system was severely disrupted, as millions of Red Guards were given free use of the railway, buses and trucks wherever they went. As a result, the transport of essential commodities was displaced. Fortunately, the disruption of the economy was largely confined to the period from 1966 to 1968. Agricultural production was much less affected, as the Cultural Revolution was a distinctly urban movement, and a stable food supply was the highest priority by the government.

[3]They returned to the urban areas after the Cultural Revolution ended in 1976.

2.3 Disruption of Culture and Education

A fundamental transformation of culture and the educational system was an essential part of the Cultural Revolution. On June 13, 1966, the Central Committee of the Party released a Circular concerning Reforming the Enrollment and Examination Procedure in Higher Education. The Directive pointed out that the extant enrollment system in higher education was inappropriate and must be changed completely. It also stipulated that admission of new students of 1966 to college be postponed for half a year to allow for a thorough reevaluation and reform of the system of higher education. The entrance examinations were not given in July, as usual, that year. As the Cultural Revolution unfolded, the half-year delay in enrollment stretched into four years before a handful of colleges were permitted to resume enrollment in 1970. As illustrated by Figure 1, college admission literally dropped to zero during the period of 1966-1969.

In October 1970, student recruitment resumed in a few selected universities, but in accordance with the instructions issued by the Central Committee of the Party, the new recruits were not to be chosen directly from fresh high school graduates, but from the ranks of workers, peasants and soldiers. No written examinations were held for student recruitment. To gain admission, the candidates only needed recommendations from the"mass", leadership approval from their production units as well as the approval of the college admission office. The criteria were largely based on political reliability and personal connections. This new form of enrollment was expanded nationwide later on.[4] These new university students are later known as the worker-peasant-soldier college students.

Since the breakout of the Cultural Revolution, classes had been promptly canceled in colleges. A few colleges reportedly reopened after 1969, but intellectuals were replaced by the proletariats in the administration of schools. Many academic courses were replaced with new courses with a practical bent. A hefty fraction of the students' time was allocated to

[4]In 1973, there was a short-lived attempt to reintroduce examinations to improve the academic quality of recruits, which was soon rolled back by Mao's most fervent supporters.

working on farms or in factories. Even these courses could not last long because of continued violence and low attendance. Students were either actively participating in the movement or enjoying their cloistered way of life.

The overall cultural or intellectual life of the Chinese people was dismal during the Cultural Revolution. In the campaign against all symbols of the past ("the four olds"), old books and paintings were burned, museums and homes were ransacked, and historic relics were destroyed. The cult of Mao, however, reached its zenith during the Revolution, with everyone frenetically worshiping Chairman Mao as the deified great leader. The use of library was restricted, whereas Mao's works became the most popular, if not the only available, reading materials for ordinary people. Normal artistic and literary creation was largely forbidden. Only a handful of artists and writers were allowed and worked under supervision only for the purpose of political propaganda.

China's intellectuals were seriously scarred by the mass movement. Their homes were raided, books and manuscripts burned, and they themselves were often subject to painful sessions of "study and criticism". A great many of them were arrested and jailed or sent to labor camps in remote rural areas. Scientific research was paralyzed by the political fear or lack of equipment and supplies while research in social sciences and humanities had all but ceased. For Chinese intellectuals, the period of 1966-1976 was indeed the "ten lost years".

2.4 Post-Mao College Education

In August 1977, only one year after Mao's death, the 11th National Congress of the Party announced the end of the Cultural Revolution. The reinstitution of the national college entrance examinations was announced two months later. Since 1977, all students in colleges have been selected based on their performance on the entrance examinations or some special talents. The admission of worker-peasant-soldier students was terminated accordingly thereafter, although they were allowed to continue their study until graduation.

By the end of 1977, educational policies had been largely reverted to normal ones.

In 1978, the Ministry of Education issued a document with regard to the curriculum and instructional methods for higher education, emphasizing that a major fraction of the college time should be devoted to classroom instruction and learning. Soon colleges were revived and started to function like any college in the rest of the world.

3 Empirical Strategy: the RD Design

Our empirical analysis has two parts. First, we employ a RD framework to quantify the effect of college enrollment suspension on the probability of having college education. In particular, we exploit the fact that the extent to which a person is affected by the policy is a discontinuous function of his or her birth date. Essentially, the discontinuity is created by the abrupt suspension of college enrollment in 1966, for which students below a certain age (typically 19) had not yet completed high school and would miss the last train to college before the Cultural Revolution. People who were born in December 1946 and had followed a typical schooling schedule would have finished high school by the age of 19 in 1965 when the universities were still open to new entrants. In contrast, those who were born in January 1947 and made a normal progress in education had not completed high school until 1966, when colleges stopped admitting new students. Under such a policy, the biological "accident" of a birth just after December 1946 would significantly hurt one's opportunity of getting into college, relative to those born in December 1946. Specifically, we estimate the following equation:

$$C_{ij} = \alpha_0 + \alpha_1 D_{ij} + f(R_j) + X_{ij}\theta + u_{ij}, \tag{1}$$

where the dependent variable C_{ij} is a college education dummy variable for individual i in birth cohort j, $D_{ij}(= 1(R_{ij} \geq 0))$ is an indicator variable that equals one for individuals who belong to the post-change cohort, R_{ij} is an individual's birth cohort (measured in month-year pairs) relative to the birth cohort cutoff at January 1947, and X_{ij} includes predetermined personal characteristics such as gender and ethnicity. The smooth function $f(\cdot)$ captures the underlying relationship between birth cohort and the attainment of higher education.

In parametric specifications, we use lower-order polynomials to model $f(\cdot)$ and allow its functional form to differ on either side of the January 1947 cutoff. The key parameter of interest is α_1, which measures the impact of the policy change on the probability of having college education.

Then we use an equation of a similar form to estimate the effect of the enrollment suspension on a person's socio-economic outcome, Y_{ij}:

$$Y_{ij} = \beta_0 + \beta_1 D_{ij} + g(R_{ij}) + X_{ij}\omega + v_{ij}, \tag{2}$$

where $g(\cdot)$ is a smooth function that captures the relationship between birth cohort and the outcome, and is in practice approximated with flexible lower-order polynomials that have varying slopes on either side of the discontinuity. The key identifying assumption underlying our estimation procedure is that the conditional expectation of potential outcome with respect to birth cohort is smooth through the $R_{ij} = 0$ threshold. In that case, we can attribute any discontinuities at this threshold to the causal effect of the suspension of college enrollment. The estimated β_1 can be interpreted as the discontinuous change in the outcome as a consequence of the enrollment suspension. Because the running variable R_{ij} is discrete by nature, we follow Lee and Card (2008) to obtain robust standard errors by clustering at the birth cohort level.

4 Data

Our main data sets are from the 1990 and 2000 Population Censuses of China. There are two great advantages of the Population Censuses. First, the data have each individual's month and year of birth, based on which we can construct a relatively fine measure of the running variable in our RD design. Second, its sample size is enormous, with more than 11 million records in our 1% sample for each year. For our RD design, the sample of analysis contains over one million observations for each census year. The massive sample size, combined with the information on the year and month of birth, allows us to focus contrasts narrowly around the discontinuity to increase the similarity of the unobservable factors while having

sufficient statistical power for inference. Unfortunately, neither of the Censuses have any direct measure of earnings or wealth. To get a proxy for income, we construct a new variable named occupational score, which is the median annual income for each of the same double-digit occupation in the 2005 National Population Sample Survey. Under the assumption that the relative earnings across occupations are stable over a five-year period, the occupational score calculated from the 2005 data is a good proxy for earnings in 2000. The house size is used as a wealth proxy.

We impose a few sample restrictions. First, we use cohorts born between 1942 and 1951 in our sample, or the neighboring cohorts around January 1947, the birth date cutoff after which people were more affected by the policy. Second, we focus exclusively on individuals with at least high school education, as they were the sub-population "at risk" from the college enrollment suspension. Table 1 provides descriptive statistics for our estimation samples. Among the high school graduates, 8% had college education in 1990. The same figure reached 9% in 2000.

5 Main Results

In this section, we report our main RD results. We begin by reporting estimates of the impact of the suspension of college enrollment on the attainment of college education. We then report estimates of the policy's impacts on income, wealth, and marriage market outcomes. Our RD samples, if not otherwise mentioned, are restricted to individuals born between 1942 and 1951 with at least high school education. Standard errors are clustered at the cohort (month-year of birth) level for the RD analysis.

5.1 College Education

To the extent that the enrollment suspension indeed matters, we should observe a break in college attainment as a function of birth cohort close to the birth date cutoff. In Figure 3, we use data from the 1990 Population Census to plot the relationship between birth cohort and

the attainment of college education (here, those who were born in 1942-1946 are referred to as the pre-CR cohorts, while those who were born in 1947-1951 are referred to as the post-CR cohorts). People with community college[5] or high school education are take as the base group. The relevant cohorts are observed in their forties or late thirties. Open circles represent the share of cohorts having college education for each month-year of birth. The vertical bar denotes January of 1947, the month of birth after which cohorts were affected by the college enrollment suspension. Superimposed on the graph are the fitted values from a regression that includes a quadratic polynomial of month of birth, and an indicator for whether or not the cohort was affected by the enrollment suspension. Visually, there is a stark change in the fraction of people with college education around the January 1947 threshold. The quadratic fit predicts a decline in the probability of having college education, between December 1946 and January 1947, by 5.3 percentage points, which is about a third of the mean for the pre-CR cohorts. The probability of having college education does not drop to zero at the birth date cutoff because some people started school at an earlier age or skipped grades, and were able to go to college before 1966, and some others entered college after the admission resumed a few years later.

The formal regression results using the same data (Table 2) confirm the visual impression conveyed in Figure 3. In column 1, we report the most parsimonious specification, with only the indicator for being born after the January 1947 cutoff, and a second-order polynomial in birth cohorts as independent variables. The coefficient of the discontinuity indicator is negative and statistically significant at the 1% level. The estimate suggests that the cessation of enrollment led to a 5.3 percentage points reduction in the probability of having college education. Adjusting for individual characteristics (column 2) hardly changes the estimate and its precision.

These baseline results are robust to different choices of bandwidth. Specifically, we limit our sample within increasingly narrower intervals around the cohort cutoff. In column

[5]Community college was non-existent during the Cultural Revolution. Community college diplomas were often awarded through adult education programs after the Cultural Revolution.

3 of Table 2, we focus on individuals born within 48 months around the cutoff. The estimate is relatively insensitive to the narrowing of estimation window and remain statistically significant. The last column shows the results from a local linear regression with a bandwidth of 24. This non-parametric approach produces a statistically significant point estimate that is quantitatively similar to the parametric estimates.

We repeat the graphical and regression analysis using data from the 2000 Population Census, which captures the relevant cohorts in their fifties or late forties. Similarly, Figure 4 shows a significant downward shift in the college completion rate around the 1947 birth date cutoff. Interestingly, however, the fractions of college graduates are slightly larger than their 1990 levels, both for the pre-CR cohorts and the post-CR cohorts. It seems that people had been investing in college education in their middle ages. Perhaps less obvious in the graph is how the size of the discontinuity changes over the same period. As is evident from columns 1 and 2 in Table 3, the absolute value of the estimated discontinuity in college education is 0.047, about 11% smaller than the 1990 estimate, which suggests that the post-1947 cohorts had put in more effort to make up for their educational loss relative to the older cohorts. Similar to the 1990 results, the 2000 results are robust to the choice of bandwidth or functional forms (columns 3 and 4 in Table 3).[6]

Figure 5 shows how college attainment changes over the life cycle for the relevant cohorts based on data from the 1982, 1990 and 2000 Population Censuses. The 1982 Census captures the cohorts of interest in their thirties, which enables us to observe their education at a relatively young age. Unfortunately, the 1982 Census only reports age in years as of July 1980 in stead of the exact year of birth, which prevents us from doing a rigorous RD analysis. Moreover, the 1982 Census does not distinguish between college and community college, so college education refers to college and community college in Figure 5. We plot the fraction of people with college education for each age with the 1982 data in Figure 5. Note here that those who were 35 years old were born either in the second half of 1946 or

[6]We also estimate a similar effect of the college suspension on college education for the same cohorts with data from the Urban Household Survey (UHS). The results are reported in the Appendix.

the first half of 1947, which straddle the threshold of January, 1947. Those aged 36 or older belong to the pre-CR cohorts, while those age 34 or younger belong to the post-CR cohorts. There is an obvious downward shift in college education for the post-CR cohorts relative to the pre-CR cohorts observed in the 1982 Census, as we should expect from the college enrollment suspension.

In order to make meaningful comparisons across different Censuses, we calculate the college completion rate for each birth cohort represented by ages as of July 1982 using the 1990 and 2000 Censuses. The college completion rates observed in 1990 and 2000 Censuses are apparently higher for any of the given cohorts, which suggests that people had been making efforts to get more college education, regardless of their exposure to the 1966 policy change. However, the age profile of college completion rates seem to be flatter in 1990 and 2000 Censuses, which indicates that people who were more affected by the policy tried harder to make up for their educational loss.

5.2 Income

We now turn to an analysis of the effect of the enrollment suspension on our personal income measure, the occupational income score. Figure 6 shows the raw mean log occupational scores by birth cohort using data from the 2000 Population Census. Once again, open circles represent means for each month of birth. The polynomial fit, which includes second-order cohort trends with different slopes on either side of the January 1947 cutoff, predicts that the average occupational income scores decreased by approximately 3% for the cohorts who turned 19 during or after 1966, when college enrollment was first suspended.

Consistent with the graphical evidence, estimates from regressions of different specifications (Table 4) all suggest that the suspension had a large impact on our income measure. The simplest specification in column 1 shows that being born in January 1947 or later leads to a drop in occupational income score by 3.3% (statistically significant at the 1% level). As shown in columns 2 and 3, controlling for more co-variates and limiting the sample to a

narrower interval around the threshold do not affect the estimate much. This finding is also robust to the use of a local-linear specification with a 24-month bandwidth, the results of which are displayed in column 4.

5.3 Wealth

The suspension of college admission also seemed to have a large negative effect on household wealth, as proxied by the house size. As our estimates reported in Table 5 suggest, being born in or after the January 1947 cutoff leads to a large reduction in house size (around 3%), relative to those born on the other side of the threshold.[7] The estimate is largely insensitive to the inclusion of covariates and the use of smaller bandwidths.

5.4 Labor Market Participation

The detrimental effect of the enrollment suspension is also observed on labor market outcomes in the 2000 Census. As Table 6 reveals, people who were born in or after January 1947 are 4.7 percentage points less likely to work, compared to people born right before that birth date cutoff. No effect is found for a person being disabled or supported financially by other household members. Further, as column 4 in the same table shows, the policy is estimated to have no significant effect on labor supply on the intensive margin, conditional on working. In summary, the suspension of college enrollment decreases the labor supply of the affected cohort at the extensive margin, while no effect is found at the intensive margin.

5.5 Marriage Market Outcomes

Aside from income and wealth, the suspension of college enrollment also affected people's marriage market outcomes through its effect on education. As evident from the results shown in Table 7, the college enrollment suspension did not seem to have any effect on the chance of getting married, both for men and for women. This is not surprising because we are focusing on people with at least high school education, for whom marriage is nearly

[7] The corresponding graphic pattern of the relationship between log house size and birth cohort is shown in Appendix Figure A1.

universal.[8] As for the timing of marriage, males were hardly affected by the policy (column 3). Interestingly, however, women were married at earlier ages (around 2.2 months) because of the same policy (based on the estimate shown in column 3).

The marriage market outcomes could also have been affected by the policy through assortative mating. We measure spousal quality over the dimensions of education and income. In particular, we examine whether the enrollment suspension affected spousal education and income (conditional on working). Using the same RD strategy, we estimate a large impact of the policy on spousal education. As reported in the first two columns of Table 8, for married men, the college suspension led to a 1.5 percentage points decrease in the probability of wife having college education (47% of the mean).

The enrollment suspension is also found to have adverse effects on the spouse's labor market outcomes. As column 3 of Table 8 shows, men who were born in or after January 1947 tend to marry someone 2.3 percentage points less likely to work, compared to men born right before that birth date cutoff. As shown in the last column of Panel A of the same table, men affected by the suspension of college enrollment ended up marrying women earning 5% less, for wives who were working at all.

Similar marriage market results are found for females (Table 9). We estimate a substantial impact of the policy on a woman's spousal quality measured by education. Women who were born in or after January 1947 were married to men who were 4.7 percentage points less likely to have college education (25% of the mean). No significant effects are found for the husband's probability of working. The estimates for husband's earnings (measured with log occupational scores) are not precise enough for any meaningful inference, which is not surprising given a smaller sample size for women, coupled with the fact that many of their husbands already left the labor force.

[8] In our sample of analysis, less than 0.6% of the men or women have never been married.

5.6 Fertility

Finally, we examine the policy's potential effect on fertility. We fit similar RD models with the sample of women from the 1990 Population Census, which captures the affected cohorts in their forties. As Table 10 shows, there are no significant impacts of the policy of college enrollment suspension on fertility at both the extensive and intensive margins.

6 Validity of the RD Design

For a first check, we examine the validity of the continuity assumption of the RD design, i.e., whether people endogenously sort themselves around the cutoff line (McCrary, 2008). Hypothetically, fully anticipating the college enrollment suspension in 1966, people (or their parents) born in January 1947 would have had the incentive to go to school at an younger age by misreporting their ages in order to enter college right before the enrollment cessation in 1966. Although manipulation of this kind seems very unlikely, we provide a visual check of its possibility. Panel A of Figure 7 plots the number of high school graduates by month of birth for cohorts born between 1942 and 1951, and Panel B presents a magnified view for cohorts between 1945 and 1948. Despite systematic seasonal fluctuations from year to year, there seems to be no indication of any discontinuous change in the density at the January 1947 cutoff.

For a second validity check, we test for potential discontinuities in a few predetermined individual attributes around the cutoff. For a valid RD design, the treatment variable should have no influence over the variables determined prior to the realization of the treatment. As a partial test of this assumption, we examine if the observable pre-treatment covariates are "locally" balanced around the threshold. Figure 8 plots the mean of some personal demographic characteristics, namely gender and ethnicity, against the year and month of birth. Also plotted are the predicted values from regressions that include a second-order polynomial in the cohort, and an indicator for observations above the threshold for both predetermined covariates. In general, the figures indicate that the difference at the January

1947 threshold is small and statistically indistinguishable from zero.

As a final check, we examine if the suspension of college education has a similar discontinuous effect on people's sent-down experience around the same birth cohort cutoff. In fact, many high school students who lost their last chance to attend college during the Cultural Revolution were sent down to rural areas for manual labor (Li et al., 2010). To test if someone's sent-down experience also changes discontinuously around birth cohort cutoff in 1947, we resort to another data set, the China Household Income Project, which contains the information on whether the person has ever participated in the rustication movement. Figure 9 plots the fraction of high school graduates who were sent to rural areas during the movement against the year of birth. It appears that the probability of having any sent-down experience is fairly smooth around the 1947 birth cohort, which lends more credence to the assumption that the unobserved characteristics of people born above and below the cutoff are largely comparable.

7 Conclusion

This paper evaluates the long-term detrimental effects of educational loss during the Cultural Revolution in China. The sudden suspension of college enrollment in 1966 deprived the opportunity of college education for individuals who just completed high school. We use the discrete change in college education as a function of birth cohort to identify the disruption of college education in Cultural Revolution. We find that this policy change led to a 5.3 percentage points decline in the chance of having college education (observed in 1990) among those who finished high school.

Using the same RD strategy, we find that the educational loss hurts the affected cohort along a wide array of dimensions. Most notably, the enrollment suspension decreased labor supply and reduced earnings for those who worked. The size of the house, which we use a wealth proxy, was smaller for those who failed to achieve college education because of this policy. Apart from its economic impacts, we find that the disruption of education also made

people less attractive in the mating market. The magnitude of the aforementioned effects are large, easily detectable in more than 30 years after the policy.

The Cultural Revolution has been widely considered as playing a transformative role in the Chinese history, but there has been little quantitative analysis of its broad social and economic effects. Our study finds large enduring detrimental effects through its manipulation of high education policies alone. More work is needed to fully evaluate the longer-term effects of the Cultural Revolution.

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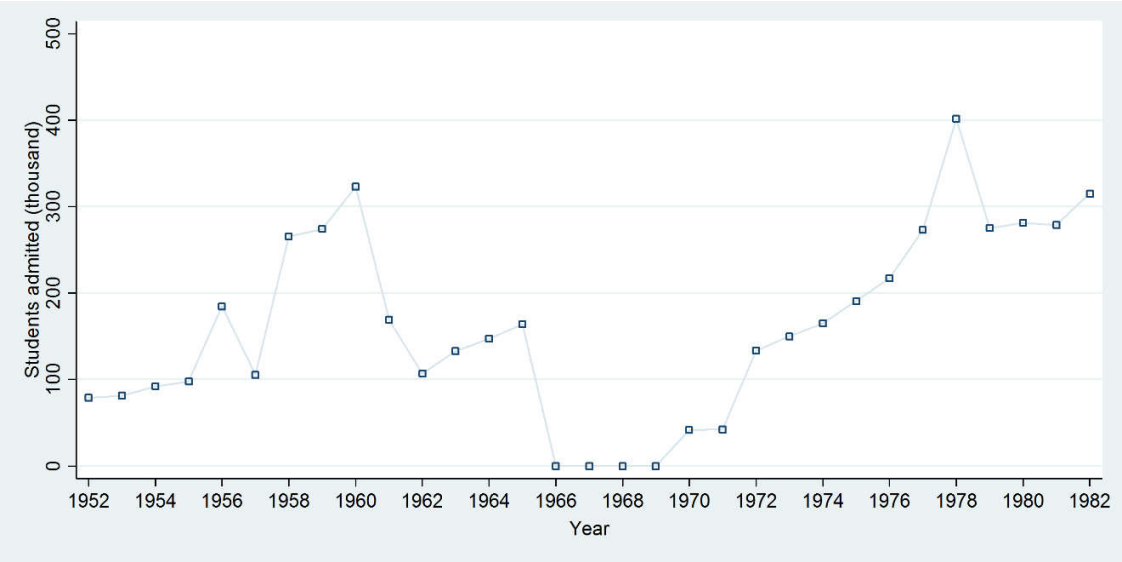
Appendix: Urban Household Survey Results

Apart from the Population Censuses, we also make use of another data set, which is derived from combining 14 rounds of the Urban Household Surveys (UHS) to estimate the effect of the suspension of college admission. The surveys were conducted on an annual basis by the National Bureau of Statistics (NBS) of China. We have access to data from nine (out of 31) provinces for the years 1988-2001. The summary statistics for the sample of individuals born between 1942 and 1951 and with at least high school education are provided in Appendix Table A1. The UHS data set has better and more accurate income measures that are absent in the Population Censuses. However, we do not use the UHS data in our main analysis for three reasons. First, the UHS data have a much smaller sample size. Second, the UHS does not report the month of birth. Third, its survey questions on education do not distinguish between college and community college.

The regression results using the UHS data are contained in Appendix Table A2. First-stage regressions reported in Panel A suggest that being born in or after 1947 is associated with an approximated 10 percentage points drop in the probability of having college education (including community college). The estimates are largely robust to the inclusion of different set of controls. Results of the reduced-form income equation, contained in Panel B, show a drop in log around the 1947 birth year cutoff by almost 9 percent. This discontinuity estimate is not sensitive to adjustment of covariates.

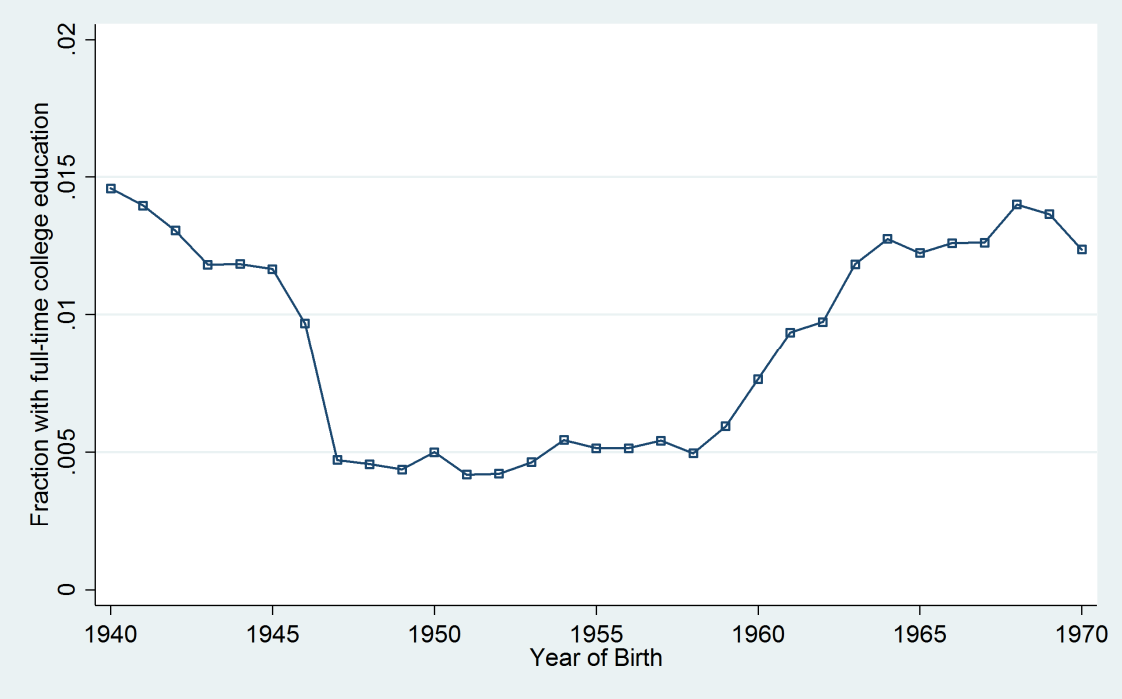
Figure 1: Admitted college students by year



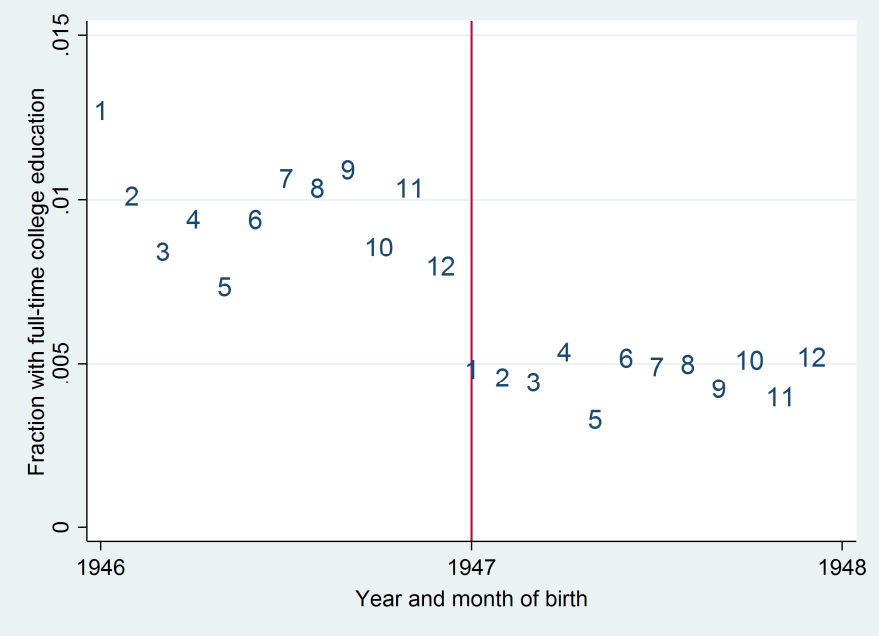
Source: *Achievement of Education in China: Statistics 1949-1983*

Figure 2

Panel A: Fraction of population with full-time college education by year of birth

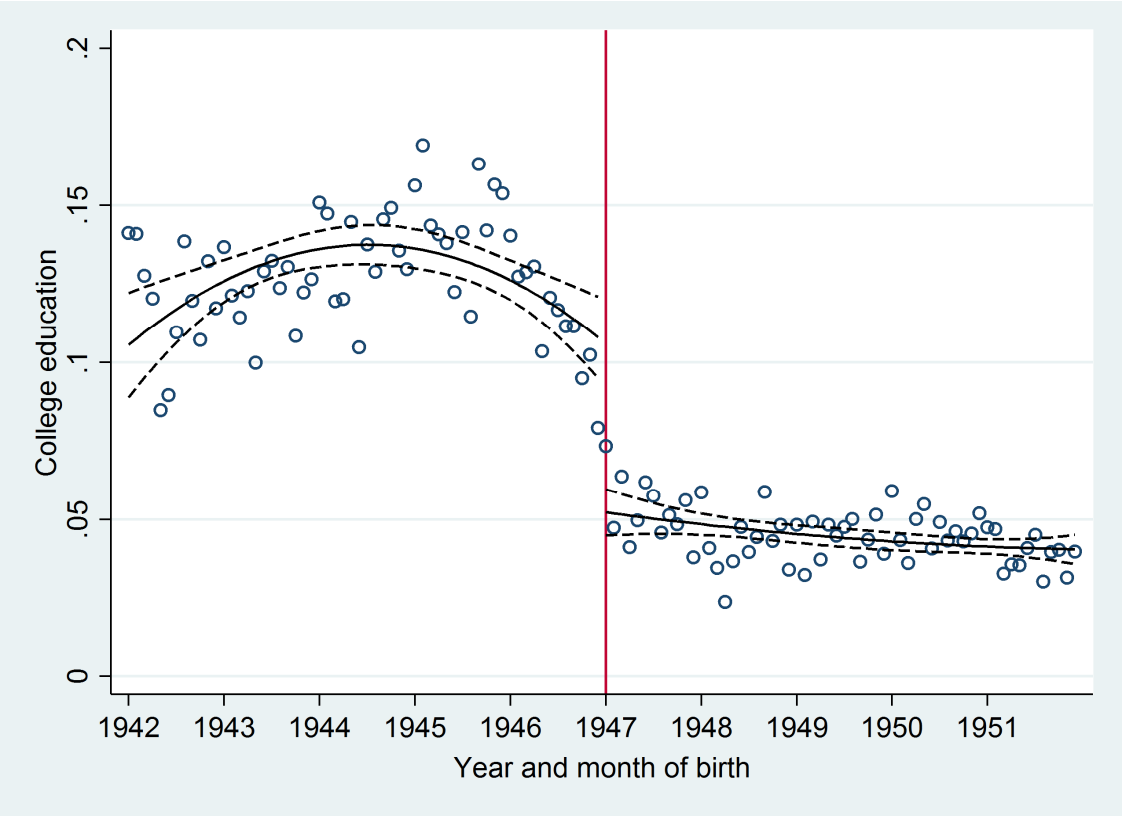


Panel B: Fraction of population with full-time college education by month of birth



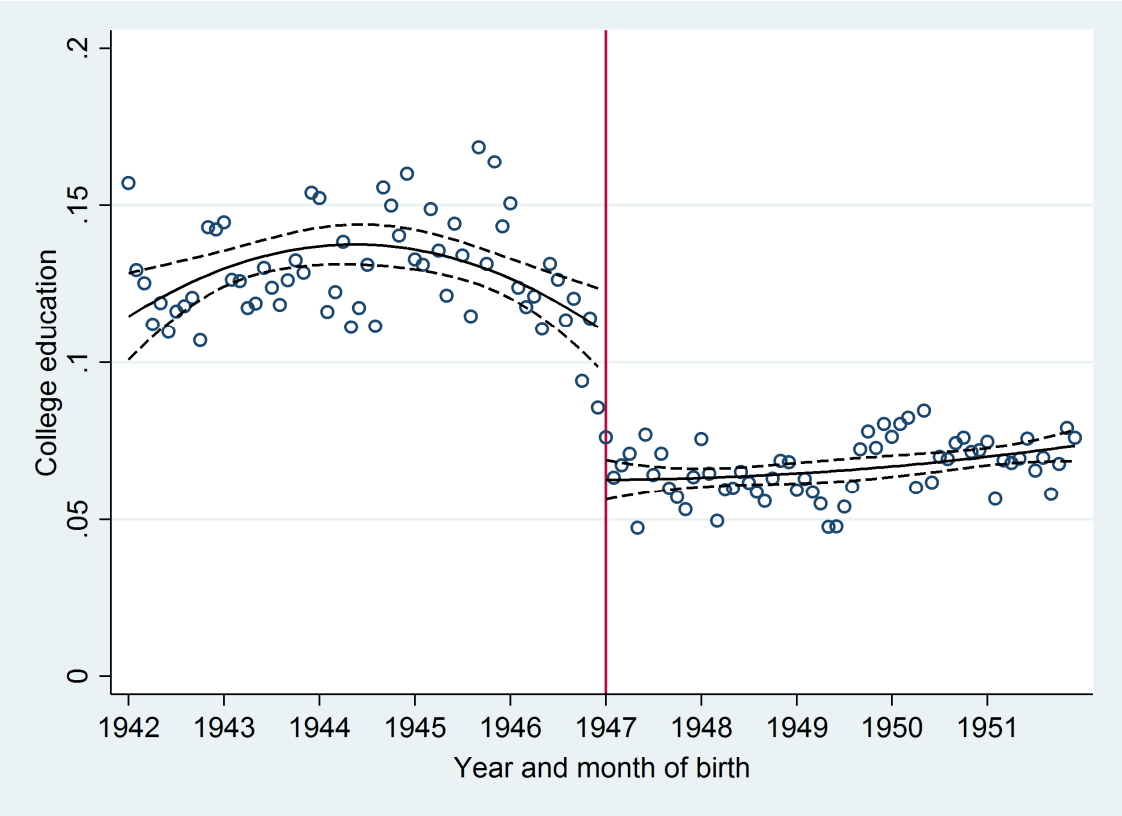
Data source: 2000 Population Census of China

Figure 3: The impact of college enrollment suspension on college education (1990 Population Census)



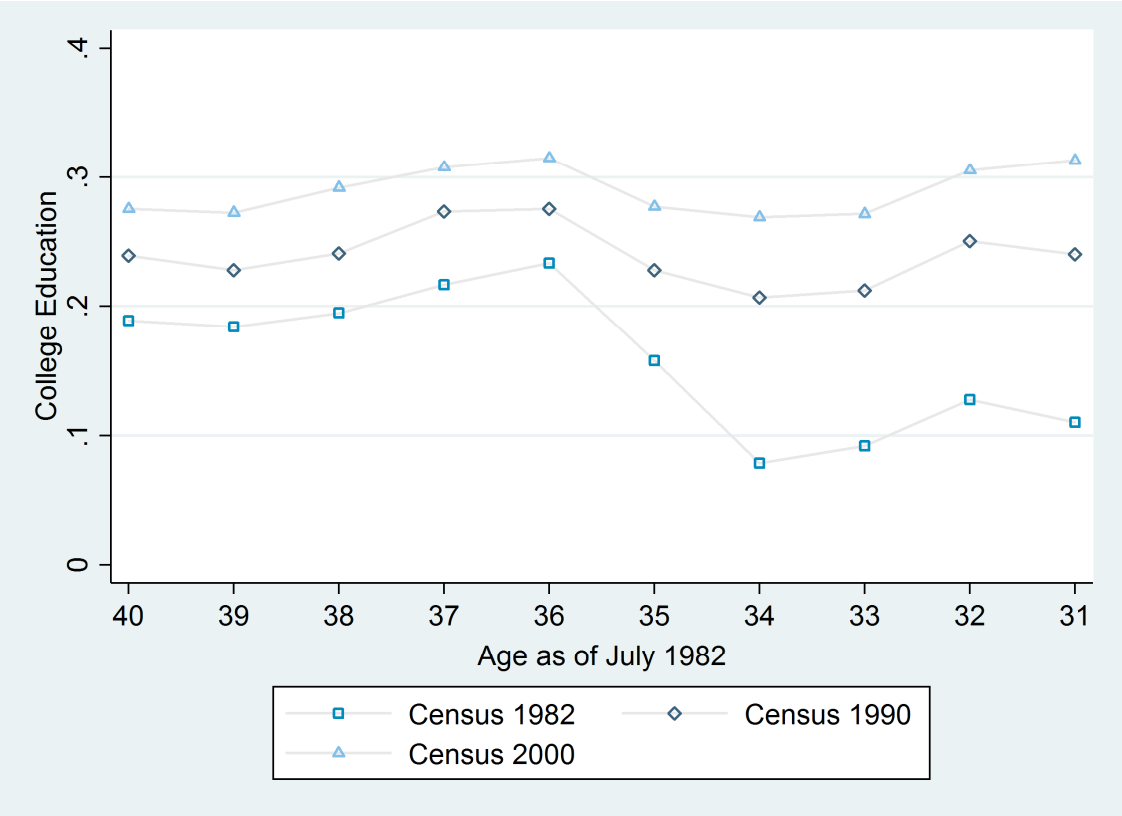
Notes: The sample is from the 1990 Population Census of China, restricted to individuals born between 1942 and 1951 and with high school education. Open circles represent means in each month of birth cells. The continuous line is the predicted outcome from a regression that includes a second order polynomial in the running variable, and a dummy for observations above the cutoff. Dashed lines are the 95 percent confidence intervals.

Figure 4: The impact of college enrollment suspension on college education (2000 Population Census)



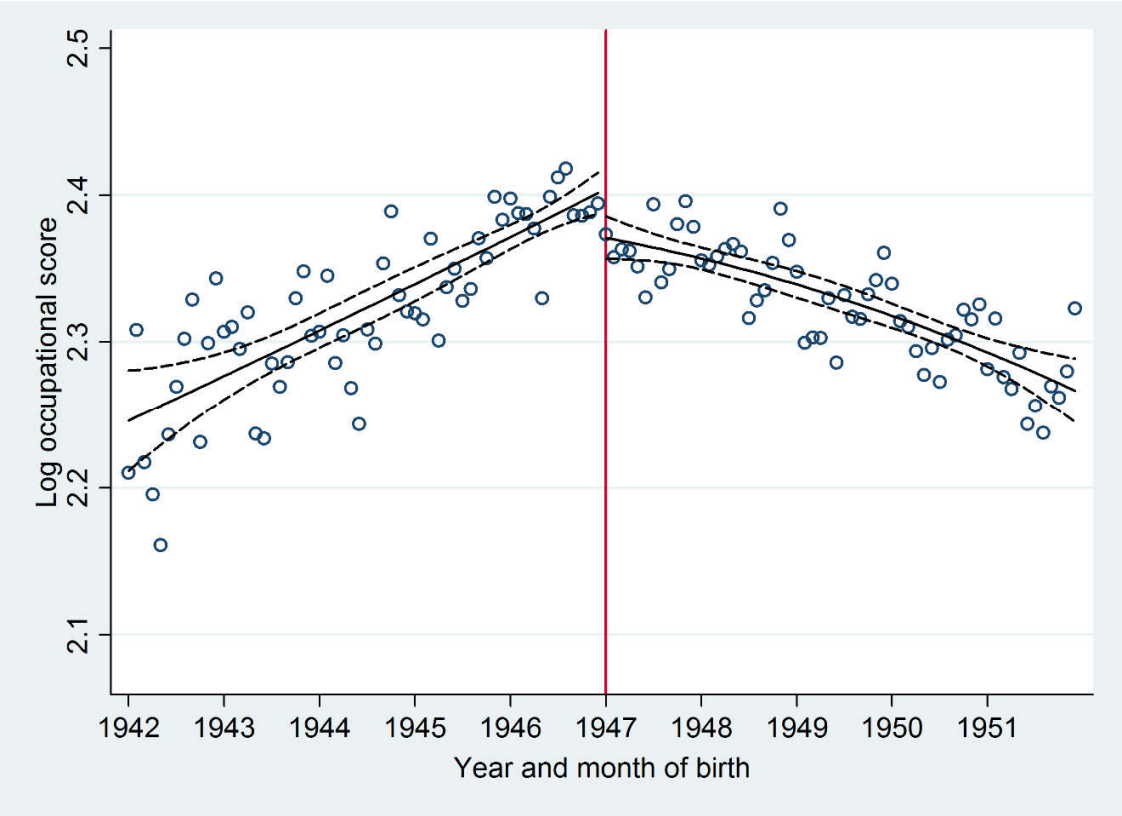
Notes: The sample is from the 2000 Population Census of China, restricted to individuals born between 1942 and 1951 and with high school education. Open circles represent means in each month of birth cells. The continuous line is the predicted outcome from a regression that includes a second order polynomial in the running variable, and a dummy for observations above the cutoff. Dashed lines are the 95 percent confidence intervals.

Figure 5: The college education attainment over the life cycle (Population Censuses 1982, 1990 and 2000)



Notes: The sample is from the 1982, 1990, and 2000 Population Censuses of China, restricted to individuals aged 31-40 as of July 1982 and with high school education. College education includes both college and community college, because the 1982 Census does not distinguish between these two types of education.

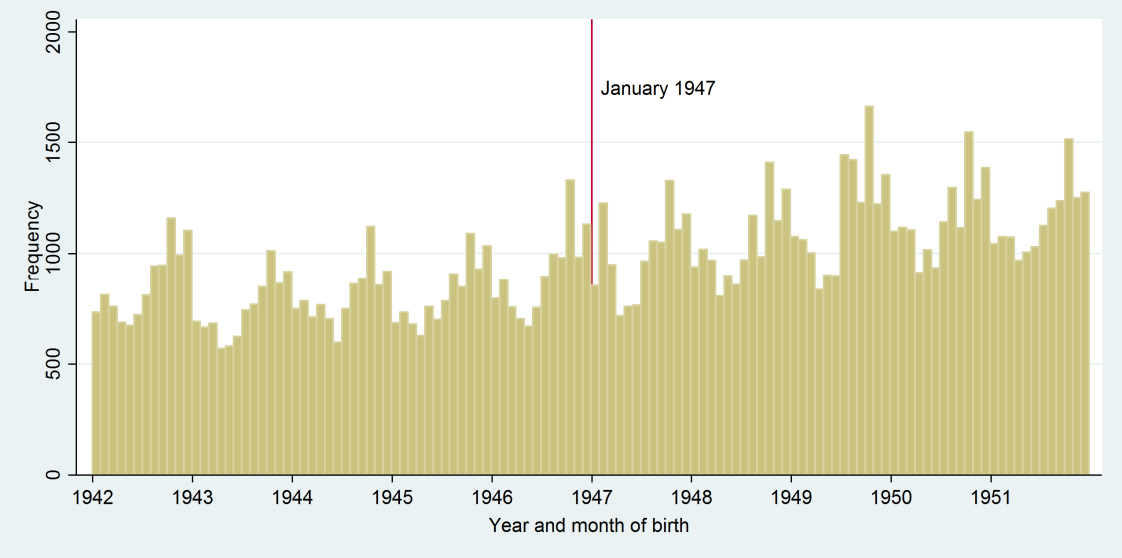
Figure 6: The impact of college enrollment suspension on log occupational score (2000 Population Census)



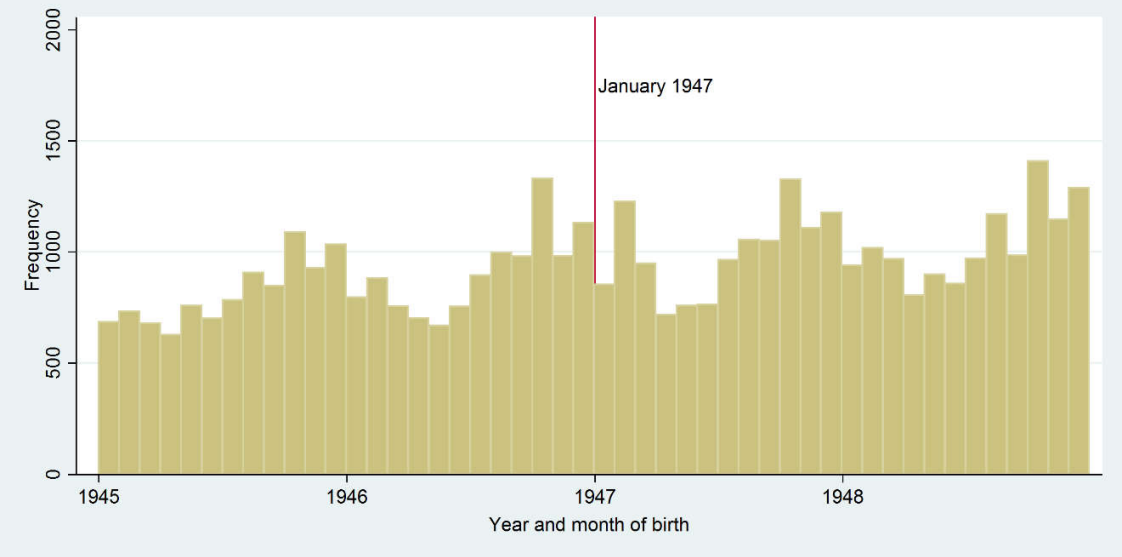
Notes: The sample is from the 2000 Population Census of China, restricted to individuals born between 1942 and 1951 and with high school education. Occupational score is the median income for each occupation in the 2005 National Population Sample Survey. Open circles represent means in each month of birth cells. The continuous line is the predicted outcome from a regression that includes a second order polynomial in the running variable, and a dummy for observations above the cutoff. Dashed lines are the 95 percent confidence intervals.

Figure 7

Panel A: Cohort size by month of birth: 1942-1951

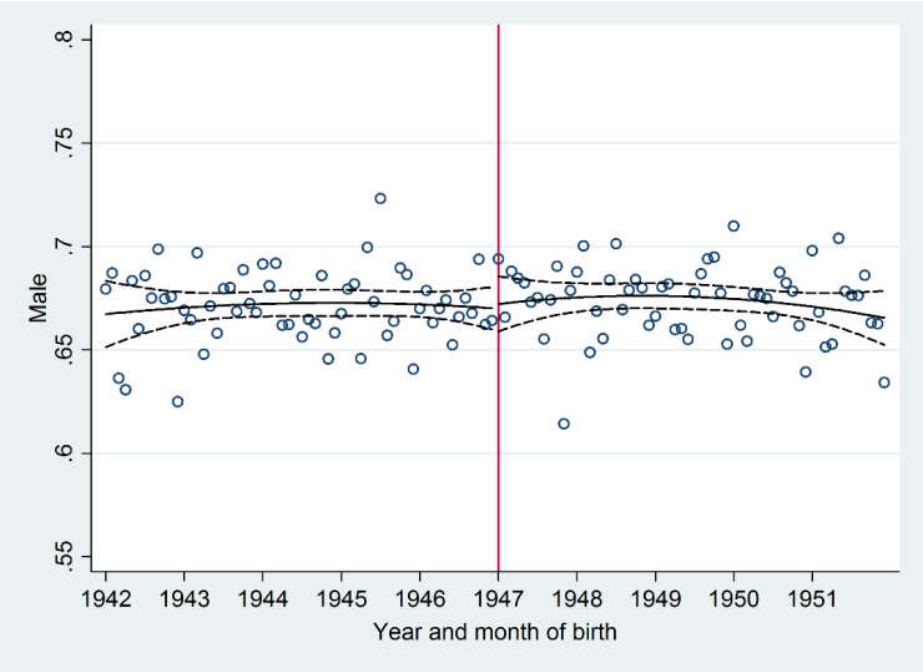


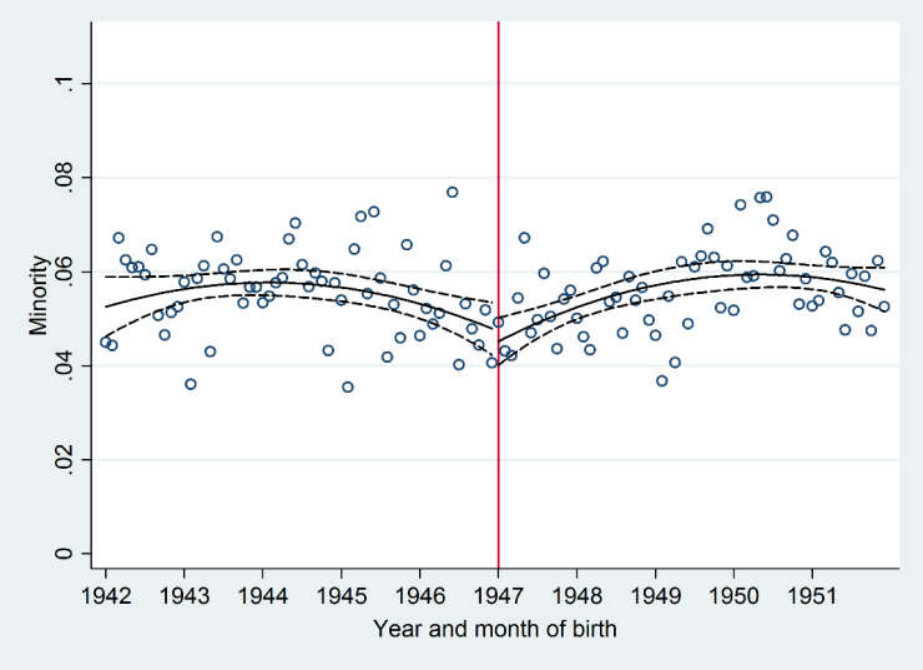
Panel B: Cohort size by month of birth: 1945-1948



Notes: The sample is from the 2000 Population Census of China, restricted to individuals with high school education. Panel B magnifies Panel A to examine cohort size difference around the cutoff.

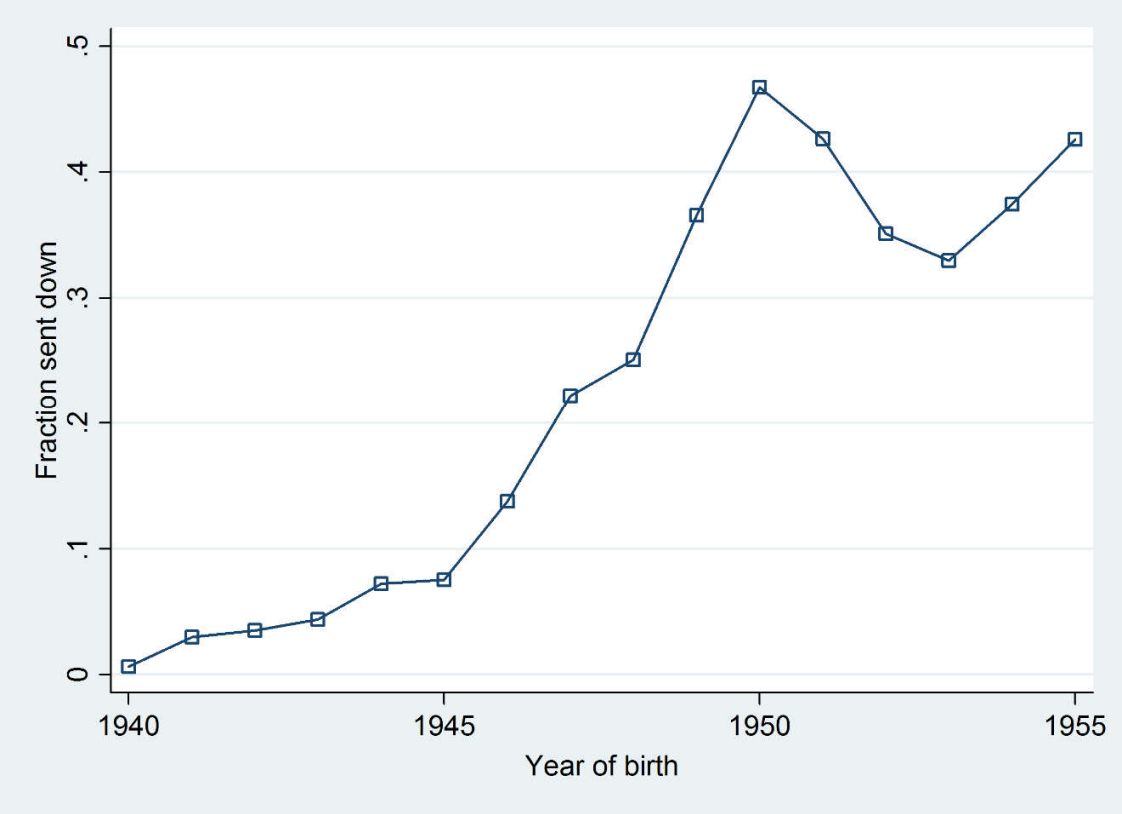
Figure 8: Similarity of individuals' pre-treatment characteristics around the cutoff





Notes: The sample is from the 2000 Population Census of China, restricted to individuals born between 1942 and 1951 and with high school education. Open circles represent means in each month of birth cells. The continuous line is the predicted outcome from a regression that includes a second order polynomial in the running variable, and a dummy for observations above the cutoff. Dashed lines are the 95 percent confidence intervals.

Figure 9: Fraction of cohort with Sent-down experience



Data source: Chinese Household Income Project, 2002

Table 1: Summary Statistics

	1990 Census	2000 Census
Age	43.23	53.08
	(2.86)	(2.87)
Male	0.68	0.67
	(0.47)	(0.47)
Minority	0.05	0.06
	(0.22)	(0.23)
College education	0.08	0.09
	(0.27)	(0.29)
Occupational score		11.60
		(4.82)
House area (m^2)		83.57
		(51.87)

Notes: The 1990 Population Census sample (108,405 observations) contains individuals born between 1942 and 1951 and with at least a high school diploma. The 2000 Population Census sample (115,889 observations) contains individuals born between 1942 and 1951 and with at least a high school diploma. Means are shown for the individual characteristics. Standard deviations are shown below the means in parentheses. Occupational score is the median income (thousand *yuan*) for each occupation in the 2005 National Population Sample Survey.

Table 2: The effects of college enrollment suspension on college education (1990 Population Census results)

	Dependent variable: college education			
	(1)	(2)	(3)	(4)
1(mob ≥ Jan. 1947)	-0.053***	-0.053***	-0.038***	-0.040***
	(0.008)	(0.008)	(0.007)	(0.006)
Order of polynomial in age (measured in months)	2	2	2	1
Bandwidth in months	60	60	48	24
Other demographic controls	No	Yes	Yes	Yes
R^2	0.023	0.024	0.024	0.024
Observations	108,405	108,405	86,238	43,310

Notes: Standard errors, shown in parentheses, are clustered at the month-of-birth level. * denotes statistical significance at the 10% level, ** at the 5% level, *** at the 1% level. The sample includes individuals with at least high school education. 1(mob ≥ Jan. 1947) is an indicator variable that equals one for individuals born in or after January 1947. Other demographic controls include a male indicator and a minority indicator.

Table 3: The effects of college enrollment suspension on college education (2000 Population Census results)

	Dependent variable: college education			
	(1)	(2)	(3)	(4)
1(mob ≥ Jan. 1947)	-0.047***	-0.047***	-0.035***	-0.040***
	(0.008)	(0.008)	(0.007)	(0.007)
Order of polynomial in age (measured in months)	2	2	2	1
Bandwidth in months	60	60	48	24
Other demographic controls	No	Yes	Yes	Yes
R^2	0.016	0.016	0.016	0.016
Observations	115,889	115,889	91,749	45,059

Notes: Standard errors, shown in parentheses, are clustered at the month-of-birth level. * denotes statistical significance at the 10% level, ** at the 5% level, *** at the 1% level. The sample includes individuals with at least high school education. 1(mob ≥ Jan. 1947) is an indicator variable that equals one for individuals born in or after January 1947. Other demographic controls include a male indicator and a minority indicator.

Table 4: The effects of college enrollment suspension on log occupational score (2000 Population Census results)

	Dependent variable: log occupational score			
	(1)	(2)	(3)	(4)
1(mob ≥ Jan. 1947)	-0.033***	-0.032***	-0.035***	-0.042***
	(0.011)	(0.011)	(0.011)	(0.010)
R^2	0.004	0.006	0.005	0.004
Order of polynomial in age (measured in months)	2	2	2	1
Bandwidth in months	60	60	48	24
Other demographic controls	No	Yes	Yes	Yes
Observations	80,598	80,598	63,822	31,428

Notes: Standard errors, shown in parentheses, are clustered at the month-of-birth level. * denotes statistical significance at the 10% level, ** at the 5% level, *** at the 1% level. Occupational score is the median income for each occupation in the 2005 National Population Sample Survey. The sample includes individuals with at least high school education. 1(mob ≥ Jan. 1947) is an indicator variable that equals one for individuals born in or after January 1947. Other demographic controls include a male indicator and a minority indicator.

Table 5: The effects of college enrollment suspension on log house size (2000 Population Census results)

	Dependent variable: log house size			
	(1)	(2)	(3)	(4)
1(mob ≥ Jan. 1947)	-0.032***	-0.035***	-0.038***	-0.043***
	(0.009)	(0.008)	(0.010)	(0.010)
R^2	0.001	0.020	0.021	0.019
Order of polynomial in age (measured in months)	2	2	2	1
Bandwidth in months	60	60	48	24
Other demographic controls	No	Yes	Yes	Yes
Observations	114,466	114,466	90,589	44,459

Notes: Standard errors, shown in parentheses, are clustered at the month-of-birth level. * denotes statistical significance at the 10% level, ** at the 5% level, *** at the 1% level. The sample includes individuals with at least high school education. 1(mob ≥ Jan. 1947) is an indicator variable that equals one for individuals born in or after January 1947. Other demographic controls include a male indicator and a minority indicator.

Table 6: The effects of college enrollment suspension on labor market participation (2000 Population Census results)

	Dependent variables			
	Working (1)	Disabled (2)	Dependent (3)	Days worked (4)
1(mob ≥ Jan. 1947)	-0.047***	-0.001	0.001	0.028
	(0.012)	(0.001)	(0.003)	(0.017)
R^2	0.203	0.000	0.010	0.007
Observations	115,889	115,889	115,889	79,147

Notes: Standard errors, shown in parentheses, are clustered at the month-of-birth level. * denotes statistical significance at the 10% level, ** at the 5% level, *** at the 1% level. The sample includes individuals with at least high school education. 1(mob ≥ Jan. 1947) is an indicator variable that equals one for individuals born in or after January 1947. Other demographic controls include a male indicator and a minority indicator.

Table 7: The effects of college enrollment suspension on marriage market outcomes (2000 Population Census results)

	Dependent variables		
	Unmarried	Never married	Marriage age
	(1)	(2)	(3)
Panel A: Men			
1(mob ≥ Jan. 1947)	-0.000	0.000	-0.148
	(0.002)	(0.001)	(0.109)
R^2	0.001	0.000	0.001
Observations	77,933	77,933	77,492
Panel B: Women			
1(mob ≥ Jan. 1947)	-0.002	0.001	-0.183*
	(0.005)	(0.002)	(0.102)
R^2	0.004	0.000	0.025
Observations	37,956	37,956	37,753

Notes: The samples are restricted to married men born between 1942 and 1951 and with high school education. Occupational score is the median income for each occupation in the 2005 National Population Sample Survey. The regressions control for second-order polynomials in age. The IV regressions uses the birth cutoff indicator as an instrument for college education. Standard errors, shown in parentheses, are clustered at the month-of-birth level. * denotes statistical significance at the 10% level, ** at the 5% level, *** at the 1% level.

Table 8: The effects of college enrollment suspension on spouse quality for men (2000 Population Census results)

	Dependent variables			
	Wife has college education	Wife's years of schooling	Wife is working	Wife's log occupational score
	(1)	(2)	(3)	(4)
1(mob ≥ Jan. 1947)	-0.015***	-0.211**	-0.023**	-0.049**
	(0.004)	(0.087)	(0.011)	(0.024)
R^2	0.002	0.002	0.046	0.007
Observations	71,068	71,068	71,068	38,271

Notes: The samples are restricted to married men born between 1942 and 1951 and with high school education. Occupational score is the median income for each occupation in the 2005 National Population Sample Survey. The regressions control for second-order polynomials in age. Standard errors, shown in parentheses, are clustered at the month-of-birth level. * denotes statistical significance at the 10% level, ** at the 5% level, *** at the 1% level.

Table 9: The effects of college enrollment suspension on spouse quality for women (2000 Population Census results)

	Dependent variables			
	Husband has college education	Husband's years of schooling	Husband is working	Husband's log occupational score
	(1)	(2)	(3)	(4)
1(mob ≥ Jan. 1947)	-0.047***	-0.197*	-0.029	0.012
	(0.012)	(0.100)	(0.017)	(0.022)
R^2	0.023	0.008	0.117	0.002
Observations	32,442	32,442	32,442	20,496

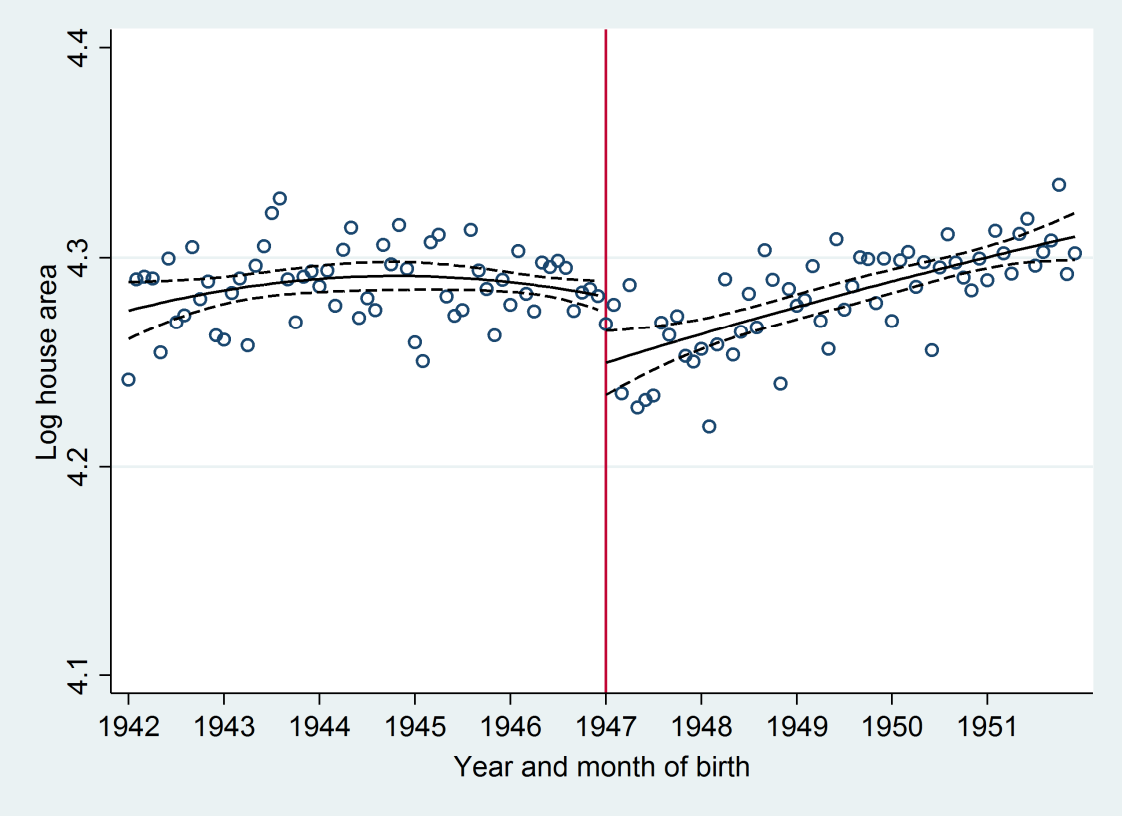
Notes: The samples are restricted to married women born between 1942 and 1951 and with high school education. Occupational score is the median income for each occupation in the 2005 National Population Sample Survey. Standard errors, shown in parentheses, are clustered at the month-of-birth level. * denotes statistical significance at the 10% level, ** at the 5% level, *** at the 1% level.

Table 10: The effects of college enrollment suspension on fertility (1990 Population Census results)

	Dependent variables	
	Births	Childless
	(1)	(2)
1(mob ≥ Jan. 1947)	-0.051	0.005
	(0.043)	(0.006)
R^2	0.172	0.002
Observations	20,011	20,011

Notes: The samples are restricted to women born between 1942 and 1951 and with high school education. The regressions control for second-order polynomials in age. Standard errors, shown in parentheses, are clustered at the month-of-birth level. * denotes statistical significance at the 10% level, ** at the 5% level, *** at the 1% level.

Appendix Figure A1: The impact of college enrollment suspension on log house area (2000 Population Census)



Notes: The sample is from the 2000 Population Census of China, restricted to individuals born between 1942 and 1951 and with high school education. Open circles represent means in each month of birth cells. The continuous line is the predicted outcome from a regression that includes a second order polynomial in the running variable, and a dummy for observations above the cutoff. Dashed lines are the 95 percent confidence intervals.

Appendix Table A1: Summary statistics for the UHS sample

Variables	Observations	Mean	Standard Deviation
Age	17,300	47.38	4.68
Male	17,300	0.59	0.49
College education	17,300	0.36	0.48
Income (*yuan*, 1988 price)	17,300	3542.59	2786.35

Notes: The sample contains wage earners born between 1942 and 1951 and with at least a high school diploma for the survey years 1988-2001. College education includes both college and community college, because the UHS does not distinguish between these two types of education.

Appendix Table A2: The effects of college enrollment suspension on college education and log income (UHS results)

	(1)	(2)	(3)
Panel A: results for college education			
1(yob ≥ 1947)	-0.094***	-0.096***	-0.097***
	(0.007)	(0.004)	(0.004)
R^2			
Panel B: results for log income			
1(yob ≥ 1947)	-0.088**	-0.069**	-0.070**
	(0.031)	(0.030)	(0.030)
R^2	0.002	0.169	0.172
Notes on both panels			
Quadratic in running variable	Yes	Yes	Yes
Other demographic controls	No	Yes	Yes
Survey-year FE	No	No	Yes
Observations	17,300	17,300	17,300

Notes: Each Panel of this table have a similar structure: column (1) reports the results from regressions with a second-order polynomial but no further controls; column (2) controls for individual demographics and column (3) further adds in survey-year fixed effects. Standard errors, shown in parentheses, are clustered at the year-of-birth level. * denotes statistical significance at the 10% level, ** at the 5% level, *** at the 1% level. The sample includes individuals born between 1942 and 1951 and with at least high school education. College education includes both college and community college, because the UHS does not distinguish between these two types of education. 1(yob ≥ 1947) is an indicator variable that equals one for individuals born in or after 1947.Other demographic controls include a male indicator and a quadratic in age.