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Fertility Expectations and Educational Attainment: Evidence from the Mothers of China's Sibling-less Generation

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Abstract

The speed at which women's educational attainment has caught up with men's is probably one of the greatest social changes in the late 20 century. What explains this impressive increase in female's education? This paper exploits China's One-Child Policy as a natural experiment that exogenously reduced fertility to study the relationship between fertility and educational attainment of the mothers of the sibling-less generation. I use two difference-in-differences approaches to estimate the education changes in the post-policy Han women cohorts. My estimates suggest that the policy increased the education of women younger than 19 when the policy was implemented by up to 1.3 years of schooling, which counts for up to 54.5% of increase in education improvement of women born between 1960-1980. Females under age 15 experienced the strongest effect compared to other teenagers. In addition, the policy increased the likelihood of women completing high school by up to 8.10 percentage points, but has not much effect on college completion. Further analysis on post-school outcomes provides evidence for the potential mechanisms, such as delaying entry to motherhood and increasing labor force participation, through which the policy increased women's education.

JEL Classification: I20, J13, J16, J18

Keywords: China's One-Child Policy, women, mothers, educational attainment

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1 Introduction

Women's educational attainment has been increasing remarkably relative to men's in both western and eastern countries in the late 20 century. For example, the share of women holding a bachelor's degrees in the U.S. increased from 43.1 percent to 57.1 percent (U.S. Department of Education, 2011) from 1970 to 2010. Figure 1 shows the pattern of women's education catching up with men's in China. The systemic shift has been labeled as a "quiet revolution" that began in the late 1970s and is still ongoing (Goldin, 2006).

Economists have been trying to explain this impressive improvement in women's education levels by looking at the channels of changes in labor force participation, increasing returns to schooling, changes of women's economic role, etc. Goldin et al. (2006) suggest that in the late 1960s and the early 1970s young women in the U.S. expected an increase in their future labor force participation. However, starting later 1980s the change in the female labor force participation rate is trivial (Bureau of Labor Statistics: labor force participation for female age 25-34.). If the expectation of returns to schooling did not keep increasing, why did women's educational attainment did?

Evidence that changes in women's educational attainment is correlated to trends in fertility and marriage is well documented in the literature. Women who become mothers at an early age tend to accumulate fewer years of schooling compared to those who delay their entry to motherhood (Waite and Moore, 1978). Rindfuss et al. (1980) suggest that increase in women's educational attainment will delay the age of first birth, so that total fertility in life is reduced. Goldin (2006) argue that "marriage delay enabled women to take formal education more seriously and led to changes in their relationship to work." Childbearing reduces women's expected pay

or limits their career development (Waldfogel, 1997; Budig, 2014). Pritchett (1994) demonstrates Becker (1991)'s "desired children" view that birth control methods are mainly an induced response to the reducing demand for children rather than an essential cause of the decreased demand, and points out that one way to lower people's fertility desire is to improve people's education. The possible causal connection between fertility and education is exceedingly complex. It is difficult for empirical research to show the causal effect of total fertility on woman's education as usually the demand for children and educational attainment are endogenously chosen. Without an exogenous variation in fertility, identifying the causal relationship is not possible.

In this study, I exploit China's One-Child Policy (henceforth OCP) as an exogenously negative shock to fertility to estimate the causal effect of birth control policy on educational attainment of women who are mothers of the sibling-less generation. Extensive literature has shown that China's family planning policies explained a sizable portion of fertility decline (Lavelly and Freedman, 1990; McElroy and Yang, 2000; Wang et al., 2012; Li et al., 2005), although the size of the reduction is debatable due to different measures of the policies. OCP's effect on human capital investment to children (the sibling-less generation) has attracted lots attention as well (Qian, 2004; Angrist et al., 2005; Black et al., 2005; Li et al., 2008; Rosenzweig and Zhang, 2009; Lee, 2012). However, OCP's effect on educational attainment of mothers of the sibling-less generation has received little attention from economists.

Why should we expect mothers of the sibling-less generation increased their human capital investment responding to the birth control policy? Upon observing OCP implementation, Chinese women would expect that their future childbearing responsibility to be exogenously reduced. On one hand, their expected labor force participation and option value for the future career would be increased, which to-

gether lead to increase in return to schooling. On the other hand, women may delay their entry to motherhood or even to marriage considering a much relaxed timetable for fertility. All those forces would lead women to pursue more education. Thus the question of this paper is whether women who observed OCP before dropping out of school changed their educational choices; if yes, then how. Furthermore, among those who changed their dropout decision due to the policy, which birth cohort were affected the most.

I use two difference-in-differences (DD) approaches to identify the impact of OCP on mothers of the sibling-less generation. My first DD model estimates the differences in the educational attainment between the ethnic majority (Han) women and the ethnic majority (Han) men, both for birth cohorts that are affected by the policy (post-policy group) and birth cohorts that are unaffected by the policy (pre-policy group). I use men as my control group because compared to women, men are much less likely to change education decision due to changes in expected fertility of their partners in the future. The opportunity cost of motherhood is also much higher than that of fatherhood (Budig and England, 2001; Budig, 2014; Adda et al., 2015). Thus men's educational attainment is less likely to be affected by the exogenous shock on future fertility. My second DD model estimates the differences in the educational attainment between Han women and the ethnic minority (non-Han) women, both for the post-policy group and the pre-policy group. I exploit the difference in birth quota restricted by OCP between Han and non-Han couples to capture the difference in expected fertility between Han women and non-Han women.

I use individual level data from China Family Panel Studies (CFPS). My sample includes cohorts born between 1950-1980. I define birth cohorts 1950-1960 (age 20-30 when the policy was implemented) as my pre-policy group, as 20 year-olds prob-

ably had already made dropout decision or finished schooling. The birth cohorts 1961-1980 (younger than 19 when the policy was implemented) are the post-policy cohorts in my basic set-up.

To the best of my knowledge, the only study that exploits OCP to address the relation between fertility and schooling is one by Huang et al. (2015, working paper) where they adopt cross-sectional and temporal variation on fine rate on unplanned pregnancy as a measure of intensity of OCP¹ to estimate the reduced-form effect on girls' high school completion rate. They find an increase in OCP fines by one-year household income predicts 2 percentage points increase in high school completion among female teenagers of Han. They also investigate marriage outcomes, labor market outcomes and subjective attitudes towards gender equality and children to shed light on potential mechanisms. However, using variation in monetary penalty as an exogenous measure of OCP is problematic because local governments may set the amount of fines according to local financial situations and local fertility demand(Zhang, 2017). Additionally, monetary penalty is neither the only or the harshest enforcement of OCP as well as the previous Family Planning Policy (1963-1979). Losing track of the other enforcement like excluding unauthorized child from public education, discharging parents from social services, compulsory use of abortion, etc.(Banister, 1991) may overestimate the increase in women's educational attainment due to the changes in fine rates.

My paper uses a more straightforward measure of OCP, the policy itself, to estimate its impact on women's educational attainment. It is easy to interpret of the point estimates in my paper as they map cleanly to policy implications. The further novelty of my paper is to explore the different patterns of the policy's effect on different birth cohorts as well. This helps understand the ages at which people

¹The same approach is used in McElroy and Yang (2000).

make important education decisions. I find that OCP significantly increased Han women's years of schooling by up to 1.3 years, which counts for up to 54.6% of increase in women's education improvement in birth cohorts between 1950-1980. By investigating the pattern of the OCP's effect on different birth cohorts, I show that women aged 14-15 when the policy was implemented experienced the greatest shock. In addition, I find that the OCP significantly increased women's likelihood of completing high school. However, there is not much evidence showing the policy's effect on college completion.

I also analyze OCP's effect on women's post-school outcomes. My findings show OCP at schooling ages led to delayed entry to first marriage and motherhood, decreased number of births and increased labor force participation. These findings provide evidence, though not direct, for the potential mechanisms, through which OCP increased women's educational attainment. Namely, the paper contributes to literature on explaining the shrinking of the educational attainment gap between women and men. It also sheds light on the literature on linkages between fertility and human capital accumulation in general.

The paper proceeds as follows. Section 2 provides some history background of OCP. After describing the data in Section 3, I layout the estimation strategy in Section 4. Section 5 presents the main empirical results of the OCP's effect on educational attainment and Section 6 provides additional results for later outcomes and discusses possible mechanisms. Finally, Section 7 concludes by discussing the policy implications and suggesting direction for future research.

2 History Background of One-Child Policy

Being a populous country, controlling the population size has been a fundamental policy of China since it was founded. There are basically 3 periods in the history of Chinese Family Planning Policy (henceforth FPP). Period 1: Mild and narrowly implemented family planning policy (1963–1971); Period 2: Strong and widely implemented family planning policy (1971–1979); Period 3: One-child policy (1979–2015) (Li et al., 2005; Wang et al., 2012). The One-Child Policy was formally conceived in 1979 and rapidly established across the country in 1980 (Banister, 1991; Huang et al., 2015, working paper). In my identification, I take 1980 as the OCP implementation year for the whole country. It was the strictest FPP as it restricted each couple to have only one child, as its name suggested. Note this strict requirement was only among the Han, the ethnic majority². The policy allowed many exceptions for ethnic minorities³. An urban non-Han couple could conditionally have two children and a rural non-Han couple was conditionally allowed to have three or even more children. For an ethnic group with a small population size, the policy was even further relaxed (Wang et al., 2012). There are also some exceptions for rural Han couples, considering the fact that most of the rural families live by labor-intensive agriculture activities. For example, a rural Han couple could apply for a permit to have a second child 4 years after their first birth, if the first child is a daughter or disabled. Thus the intensity of OCP could be roughly ordered from high to low as urban Han, rural Han, urban non-Han and rural non-Han.

The provincial governments gradually issued detailed regulations to guarantee the enforcement. Population and Family Planning Commissions were set up at every

²The 2010 Census of China indicated that 91.51% of Chinese were Hans.

³There is only one ethnic majority in China, Han. The other 55 ethnic groups count as minorities, non-Han

level (province, city, county, etc.) to make sure the enforcement of the policy. OCP was enforced through monetary penalties on unauthorized child, denial of public service, required abortion of subsequent pregnancy, sterilization etc. (Banister, 1991; McElroy and Yang, 2000; Li and Zhang, 2007). The government also encouraged people to comply the policy by rewarding couples who had only one child with a “one child certificate”, which entitled them to a variety of benefits (Arnold and Zhaoxiang, 1986). Meanwhile the government tightened the registration and inspection work and raised the awareness by campaigns and posters.

Note that I do not intend to capture the total effect of the Family Planing Policy on women’s education. As mentioned above, there are several stages of FPP representing different level of birth control restrictions before OCP. Those policies could already have effects on women’s education. But I only study the OCP’s effect, which can be interpreted as the extra effect that OCP added on to the previous policies’.

3 Data

The micro-data I use for the analysis come from the ongoing Chinese Family Panel Studies (henceforth CFPS⁴), a nationally representative, annual longitudinal survey of Chinese communities, families, and individuals. The CFPS is designed to collect individual-, family-, and community-level longitudinal data in contemporary China which reflecting social and economic transformation of Chinese society and how those affecting the economic activities, education outcomes, family relationships, migration, and health status of its population. By now, CFPS has finished two survey waves, 2010 baseline survey and 2012 follow-up survey. All members over

⁴CFPS was launched in 2010 by the Institute of Social Science Survey (ISSS) of Peking University, China. It is funded by the Chinese government through Peking University.

age 9 in a sampled household are interviewed. I use the cross-sectional CFPS 2010 baseline survey data in my analysis. In the 2010 baseline survey, the CFPS successfully interviewed around 15,000 families and about 30,000 individuals within these families, for an approximately response rate of 79%.

The data contains a rich set of individual, household and community information, including demographics, economics, and education information. It is amazing that the survey covers most of the administrative regions⁵ in China: all 4 municipalities⁶ and 21 provinces⁷. The darker shaded regions in Figure 2 are the provinces and municipalities in which the survey has been conducted. Note that the ones left out⁸ except Hainan province, are very distinct from the others in terms of ethnicity composition, language and lifestyles. It would be hard to compare the policy's effect in these regions anyways, had the survey covered them.

The sample I use in the estimation includes cohorts born between 1950 and 1980. Table 1 presents some summary statistics of the sample. The percentage of women versus men is 52.12% versus 47.88%. The percentage of Han and non-Han is 91.89% versus 8.11%. There are 83.83% of rural population. The primary variable I use to represent educational attainment is years of schooling constructed by CFPS. It ranges from 0 to 22. All individuals in my analysis are not in school.

On average, cohorts born between 1950-1980 have 7.373 years of schooling. Men have more years of schooling versus women and Han have more years of schooling compared to non-Han. Specifically, years of schooling of each group are: Han men, 8.156, Han women, 6.331, non-Han men, 6.226, non-Han women, 4.444. Besides

⁵There are 4 municipalities, 28 provinces (including 5 autonomous regions) and 2 special administrative regions (Hongkong and Mocaou) in China.

⁶Beijing, Tianjin, Shanghai and Chongqing.

⁷Hebei, Shanxi, Liaoning, Jilin, Heilongjiang, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Henan, Hubei, Hunan, Guangdong, Guangxi, Sichuan, Guizhou, Yunnan, Shaanxi and Gansu.

⁸Inner Mongolia, Xinjiang, Tibet, Qinghai, Ningxia

years of schooling, I also use completion of school level to illustrate OCP's effect on education. I define "Junior High Completion" as 1 if one's years of schooling is large or equal to 9, 0 otherwise. Similarly, "Senior High Completion" as 1 if one's years of schooling is large or equal to 12, 0 otherwise; "4-yr College Completion" is 1 if one's years of schooling is large or equal to 16. Above 72.5% of the population have completed junior high school, about 22.79% of the population completed senior high school, and very small number of people have finished 4-yr college. Also, Figure 3 shows most of dropouts happen after completing junior high school. Figure 1 shows the increasing trend of years of schooling across cohorts by gender. The graph shows women's cohort-averaged years of schooling has been catching up with men's among the younger cohorts. The gender gap among the 1980 cohorts has been narrowed down compared to the older cohorts.⁹

There are a lot of benefit from using the survey data. First, it provides detailed information on family background that is essential to one's education outcome. Namely, number of siblings, father's level of education, mother's level of education, father's political status and mother's political status¹⁰. Second, the survey provides province of birth, which helps to rule out the potential problem of inter-province migration.

Another data set, China Health and Nutrition Survey (CHNS), is used to estimate the main regressions for robustness check. The main results and some char-

⁹There is an obvious downturn between the mid 1960s to the early 1970s. A possible explanation is that the industrialization after the Cultural Revolution gave a positive employment shock to the labor market. Students dropout of school for the big opportunity, given the fact that education wasn't fully recovered from the Cultural Revolution. I look forward to more researches on this problem.

¹⁰The answers for father/mother's level of education include: "Illiterate", "Primary school", "Junior high school", "Senior high school", "2- or 3-year college", "4-year college/Bachelor's degree", "Master's degree" and "Doctoral degree". The answers for father/mother's political status include: "Member of communist", "Member of democratic", "Member of communist youth league" and "General public". Based on China's particular political environment, being party member of communist means responsible for insuring policies implementation. Therefore, with parent being party member of communist, children are more likely to be well informed of OCP.

acteristics of the data has been discussed in the Appendix A.

4 Method

4.1 Difference-in-Differences

In this section, I introduce my empirical strategy for measuring the effect of OCP at schooling ages on the educational attainment of treated women. I use two standard difference-in-differences (DD) models to do this. Specifically, in the first DD model, I compare Han women relative to Han men; and in the second, I compare Han women relative to non-Han women.

Let's start with the first DD model. I estimate the policy's effect on Han women relative to Han men. I use men as my untreated group because men are not likely to change their dropout decision due to the changes in expected fertility of their partners in the future. The reasoning is that it is woman who give birth and bear most of the child caring burden. The opportunity cost of fatherhood is also much lower than that of motherhood (Budig and England, 2001; Budig, 2014; Adda et al., 2015). Thus men's dropout decision at schooling age is less likely to be affected by the exogenously negative shock on future fertility. In this sense, men are great controls for women. However, men's return to schooling could be affected by their reduced expected fertility induced by OCP as their expected financial support from children declined. We shouldn't overlook this channel, considering men were the primary providers of their families back in that time. Therefore, I would like to take one step back by arguing that men are much less likely to be affected by OCP compared to women. My estimate may be downward biased in this logic.

For the second DD, as discussed above, the "one child" quota constraint is only on Han couples. Family of non-Han had more relaxed OCP restrictions compared to

Han on birth quota. An urban non-Han couple could conditionally have two children and a rural non-Han family was conditionally allowed to have three or even more children. For some minority groups with small population size, the OCP was even further relaxed (Wang et al., 2012). Comparing with the birth constraint for the non-Han families, we can consider that Han people’s fertility demand ($\text{birth} \leq 1$) is binding. Thus the methodology is straightforward, Han women’s expected fertility was exogenously changed by the OCP while non-Han women’s not, or at least not that much. I argue that this difference in expected fertility will cause difference in educational attainment between Han women and non-Han women. Note that I do not distinguish the different policies among minority groups here. I only compare the most restricted group, Han to the others (non-Han).

4.2 Pre-Policy and Post-Policy Groups

There are basically two generations in my sample. The “old generation”, who were older than a certain age (“cut-off age”) when the policy was implemented. They had already made decision between dropping-out of school and staying in school when the policy came into play. Thus the policy should not have affected their education outcome. This “old generation” is the pre-policy group.

Instead, the “young generation” were younger than the “cut-off age” and were still in school when the policy was implemented. Considering that the policy lowered the expected fertility, the lifetime child-caring cost was contemporaneously reduced. Therefore they would expect to devote more time to their own education and career in the incoming future. In other words, exposure to the policy changed their drop-out decision. Thus the “young generation” is the post-policy group.

Based on the sample average years of schooling, most drop-off decision are made after primary school or junior high school. Generally speaking, a normal Chinese

primary school takes 6 years to finish, and a junior high school takes 3 years. Students usually start school at age 6. Hence age 12 will be the earliest potential “cut-off age” and age 15 is likely to be another early dropout age.

My sample includes cohorts born between 1950-1980. I define birth cohorts 1950-1960 (age 20-30 when the policy was implemented) as my pre-policy group, as 20 year-olds probably have already made dropout decision or finished schooling. Including even older cohorts may overestimate the policy’s effect by attributing the contribution of domestic and international social and economic development to the overall education improvement. The birth cohorts 1961-1980 (age 0-19 when the policy was implemented) are the post-policy cohorts.

The regression framework for my first DD can be written as follows:

$$Edu_{isc} = \alpha + \sum_{j=1}^C \gamma_j I_j + \lambda Women_{isc} + \beta_1 Women_{isc} \times Post_{sc} + \Omega X_{isc} + \epsilon_{isc} \quad (1)$$

where i indexes individuals, s indexes provinces, and c indexes birth cohorts. The dependent variable Edu is the years of schooling. I_j is a set of birth cohort dummies, $Women$ is a dummy for Han women (relative to Han men), $Women \times Post$ is a interaction of Han women and post-policy cohorts. X is a vector of observable characteristics. ϵ is the error term. The set of demographic characteristics X_{isc} includes a dummy of rural, a $women \times rural$ interaction term, province fixed effects, parents’ educational attainment, number of siblings, parents’ political status. Regression (1) runs on sample of only Han people.

The interpretation of regression (1) is straightforward. The vector γ_j is the set the cohort fixed effects that represent the policy’s nation wide effects on birth cohorts. λ is the time-invariant gap between Han women and Han men. Finally, the coefficient of the interaction term, β_1 , captures all variation in education specific to

Han women (relative to Han men) who were younger than a certain “cut-off age” when the policy was implemented. β_1 is the coefficient of interest for the estimation, indicating the education improvement in the post-policy Han women cohorts.

Similarly, regression for the second DD can be written as regression (2). Again, β_2 is the coefficient of interest, which indicates the education improvement in the post-policy Han women relative to non-Han women. Regression (2) runs on sample of only women.

$$Edu_{isc} = \alpha + \sum_{j=1}^C \gamma_j I_j + \lambda Han_{isc} + \beta_2 Han_{isc} \times Post_{sc} + \Omega X_{isc} + \epsilon_{isc} \quad (2)$$

4.3 Parallel Trend Assumption Tests

Figure 4 shows the parallel trends of years of schooling between the pre-treatment groups, Han women and Han men born between 1950-1960 using raw data. The figure shows clear parallel trend between the two pre-treatment groups. I run a linear time trend test on Han population born between 1950-1960¹¹ to confirm that no pre-treatment trend in men’s education compared to women (See Table 2).

Similarly, Figure 5 shows no pre-treatment trend in non-Han women’s educational attainment compared to Han women by using raw data of years of schooling. I also run a linear time trend test on the sample of women born between 1950-1960¹². Table 2 shows that there is no different trend between pre-treatment Han

¹¹

$$Edu_{isc} = \theta + \sum_{j=1}^C \psi_j I_j + \tau Women_{isc} + \eta t + \delta Women_{isc} \times t + \Lambda X_{isc} + \epsilon_{isc}$$

where t is a linear time trend. Other notations are the same as ones in my main regressions. I test if δ is significantly different from zero.

¹²

$$Edu_{isc} = \theta + \sum_{j=1}^C \psi_j I_j + \tau Han_{isc} + \eta t + \delta Han_{isc} \times t + \Lambda X_{isc} + \epsilon_{isc}$$

I test if δ is significantly different from zero.

women and non-Han women.

5 OCP's Effect on Educational Attainment

5.1 OCP's Effect on Years of Schooling

To begin, I estimate the average effect of OCP at schooling ages on treated women's years of schooling, which is my primary interest of this paper. Panel A in Table 3 presents the OLS point estimates of β_1 in Regression (1). Column (1) shows estimate from regression including women dummy, interaction of women and policy dummy, birth year fixed effects and province fixed effects. Estimate in column (1) indicates that Han women obtained 1.1 more years of schooling relative to Han men, when exposed to the shock of OCP. The standard errors in brackets are clustered at province-cohort level. The estimate is statistically significant at the 1 percent level.

Regression in column (2) adds in other controls, including rural dummy, interaction of rural and women dummy, numbers of siblings, both parents' highest level of education, and both parents' political status. Controlling for rural factors are essential to the estimation, because there are around 84% population are rural residents in the 1960s (World Bank), and education outcome in rural areas are significantly lower than that in the urban areas. Also, the tradition of big family and son preference has been more deep-rooted in rural areas relative to urban areas. Thus the policy's effect on rural women could be different compared to urban women. Number of siblings reflects one's educational resources. Women and men may face different education opportunities based on the number of siblings in household, again because of son preferences in some areas. Controlling parents education might further control for the gender bias. Based on China's particular political environment, being party member of communist means responsible for insuring policies

implementation. Therefore, with parent being party member of communist, girls are more likely to be well informed of OCP. Estimate in column (2) implies that the average effect of OCP at schooling ages on Han women relative to Han men is 1.304 more years of schooling. This counts for almost 54.6% of education improvement of women born during 1960-1980 relative to women born between 1950-1960.

Panel B in Table 3 presents the OLS point estimate of β_2 in Regression (2). Similar as discussed above, estimate in column (1) is from regression including Han dummy, the interaction term of Han and policy dummy, birth cohort fixed effects and province fixed effects. Column (1) shows OCP increased Han women's years of schooling by 0.949 year, compared to non-Han women. The estimate is statistically significant at the 5 percent level. After controlling for the rural factors, sibling factor and parents' education and political background, the point estimate changes to 0.809 and is still significantly different from zero at the 5 percent level. This point estimate is not significantly different from the point estimate of β_1 in Regression (1), 1.304 though.

As discussed in the identification strategy section, the post-policy cohorts are the ones who were still in school and had not made dropout decisions when the policy was implemented. Table 3 shows the policy's average effects on all birth cohorts younger than 19 at 1980. Are the policy's effects different across birth cohorts? Which cohorts were impacted the most? Table 4 shows this difference in policy's effect on different post-policy cohorts. Each column in Table 4 represents result from regression with different post-policy group. Basically, I fixed the pre-policy group (1950-1960 birth cohorts), and change the post-policy group from cohorts who were below 19 when the OCP was implemented (1961-1980 birth cohorts, column (1)) to cohorts who were below 12 (1968-1980 birth cohorts, column (8)) across regressions. The estimates in column (1) are the same as in column (4) of Table 3.

In Panel A of Table 4, estimates across columns consistently show positive effect of OCP on women's education. All estimates are strongly significant at the 1% level. It indicates that the post-policy Han women end up with up to 1.474 more years of schooling compared to Han men. The point estimate in column (5) has the largest magnitude, indicating Han women who were younger than 15 at 1980 experienced the strongest policy's effect. This is also confirmed by dynamic difference-in-differences regression results presented in Figure 6. Cohorts below 15 had more years of schooling compared to older cohorts between 16-19. It is not difficult to see why. From Figure 3, we can tell most of students dropout of school at the 6th and 9th grades, indicating that age 12 and age 15 were the most likely dropout ages (assuming students start schooling around age 6). If a woman observed OCP (by information from family, neighbors, school, teachers, or even posters and slogans) before she dropped-out of school, she may change her mind and stay in school. The later she was informed of the policy, the less likely she would change her mind as she either had made the decision or had left school.

Similarly, Panel B in Table 4 shows that OCP has positive and significant effect across all birth cohorts among Han women relative to non-Han women. The point estimates show a very similar relationship as the one in Panel A. Specifically, birth cohorts younger than 14 (column (6)) were impacted by the policy the most. Again, dynamic DD results presented in Figure 7 confirms that cohorts born after 1966 experienced stronger policy's effect than the older cohorts. This is a little different than the most impacted age indicated in Panel A, age 15. The difference may be due to the different identification: Han women relative to Han men versus Han women relative to non-Han women. But I do not think we can draw any conclusion out of it.

To sum up, my estimates imply that OCP had a positive and significant effect

on women's years of schooling. By constraining the quota of birth per couple, OCP reduced the number of birth for women who were exposed to the policy. Among those women, cohorts at schooling ages saw the opportunity of pursuing higher education and ended up getting about one more years of schooling on average.

It is worthwhile noticing that the policy's average effects on Han women relative to Han men are consistently larger than the average effects on Han women relative to non-Han women, across different specifications. However, the point estimates of β_1 is significantly different from the point estimate of β_1 while the point estimates of β_2 is not significantly different from the point estimate of β_1 due to the relatively large standard error of β_2 . Thus it is debatable that if two estimates are fundamentally different.

5.2 OCP's Effect on High School/College Completion

The results above imply that OCP improved women's educational attainment in terms of years of schooling. Now, how likely that OCP pushed women to get a higher level of education? It is obvious that the distribution of highest level of education is concentrated at primary school and junior high school based on Figure 3. It is interesting and worthwhile to check whether the policy pushes women to complete a higher level of education, senior high school or college. I now estimate the impact of OCP at schooling ages on women's senior high school completion by using a linear probability model and a probit model. The specification of controls are the same as the OLS estimation.

Table 5 shows the LPM point estimates and the marginal effects of probit regression for OCP's effect on completion of a certain level of education. Column (1) and (2) presents the policy's effect on senior high school completion. The base outcome is dropping-out before finishing high school (i.e. years of schooling < 12). In Panel

A, the point estimate from LPM in column (1) shows that that OCP increased Han women's probability of finishing high school by 4.22 percentage points relative to Han men. This effect is statistically significant at the 5% level. The marginal effect from the probit model is highly consistent with the LPM estimate. That is, relative to Han men, Han women's probability of finishing high school was increased by 6.37 percentage points due to OCP. The marginal effect is significant at the 1% level. Estimates in column (1) and (2) of Panel B confirm OCP's positive effect on senior high school completion. Specifically, the LPM shows that the policy increased Han women's probability of finishing high school by 7.34 percentage points relative to non-Han women. Consistently, the probit model indicates the Han women's probability of finishing high school was raised by 8.1 percentage points compared to non-Han women.

Results above clearly show that OCP had a positive and significant effect on Han women's high school completion, both by comparing to Han men and by comparing to non-Han women. Would the policy have any similar effect on college completion? Column (3) and (4) in Table 5 presents the impact of OCP on 4-year college completion. The base outcome here is dropping out before finishing college (i.e. years of schooling < 16). In Panel A, both the LPM estimate and the probit marginal effect indicate that the policy had no effect on Han women's college attainment relative to Han men. In Panel B, the marginal effect of the probit regression shows the policy significantly increased Han women's likelihood of completing college by 1.21 percentage points, compared to non-Han women. The LPM estimate is consistent with the probit marginal effect in terms of magnitude, though is not statistically significant.

6 Post-school Outcomes

The analysis above shows that OCP at schooling ages had a positive and statistically significant effect on Han women's educational attainment. This explains a large part of education improvement for women born during 1960-1980 compared to women born between 1950-1960. In this section, I will estimate the policy's effect on women's later outcome after finishing school and link the later outcome results to the potential mechanism of increase in educational attainment.

As discussed above, women would expect more time on labor market since OCP exogenously reduced their expected time spent on child-caring. With fewer children in the future, women should also expect less financial support from children and to rely on her own. Meanwhile, the policy probably improved women's social status and awakened feminist consciousness. Thus the return to schooling would increase correspondingly. Additionally, anticipating fewer children to have, women may delay their entry to motherhood and even delay entry to their first marriage, which ends up with more time to be devoted in education and career. Theoretically, I should show the impact of OCP on changes of women's expectation on education, career, marriage and fertility. However, there is no contemporaneous data of expectation on those aspects in the survey, or any other surveys with the same time frame. Instead, I will estimate the policy's effect on later outcomes such as marriage (i.e. age at first marriage), fertility (i.e. number of birth, age at first birth), and labor force participation, assuming that the expectation on the later outcomes is highly correlated with the realized outcomes. If the channel of OCP affecting women's educational attainment is through changes in expectation of later outcomes, we should be able to observe the changes in later outcomes reacting to the policy.

Again, I use difference-in-differences estimation with the same specification of controls as above. I will begin the analysis with comparing Han women versus Han men. Assuming that men were much less impacted by OCP due to their small share of child-bearing burden, we should expect Han men had little change in labor force participation (measured by whether ever have had a formal job). However, men's labor force participation could be affected, in the sense that their expected financial support from children declined. If that this the case, I assume women and men had the same effect from this channel. Column (1) in Panel A of Table 6 shows that relative to Han men, the policy increased Han women's likelihood of having a formal job by 10.4 percentage points. This is significant at 1 percent level. Also, I compare Han and non-Han women's labor force participation impacted by OCP. Column (2) shows that relative to non-Han women, Han women's likelihood of having a formal job was increased by OCP by 4.32 percentage points, which is consistent in direction with the estimate in column (1), regardless of the different magnitudes and significance. As I do not expect sufficiently different marriage and fertility outcomes between Han women and Han men (considering most of Han women are married to Han men), I will not estimate the policy's effect on marriage and fertility by using the Han women and Han men difference-in-differences.

Now, let's see the differences in marriage and fertility outcomes between Han women and non-Han women. Since non-Han women had much relaxed birth control policy, the changes in their expectations on marriage and fertility are much less compared to Han women's. First, Han women and non-Han women differ in fertility. To estimate the fertility outcomes, I expand my sample to birth cohorts 1940-1980. In my previous analysis on education outcome, the sample only includes birth cohorts between 1950-1980. I use 1950-1960 as pre-policy group because whoever above 20 when OCP was implemented in 1980 would have made their educational decision.

However, 20 year-olds may not enter marriage or motherhood¹³ yet. Thus I need to expand my control group to older cohorts, 1940-1960, who had probably entered their marriage or motherhood by 1980. In Panel A, Table 6, column (3) shows that Han women had 0.191 fewer child relative to non-Han women on average. This confirms that OCP successfully differed the number of birth between Han and non-Han ethnic minorities. Moreover, this suggests that Han women had significantly lower expected number of birth compared to non-Han women. Column (4) shows the difference in age at first birth between Han and non-Han women. It implies OCP delayed Han women's entry into motherhood by 1.217 years. Note this point estimate is statistically significant at 5 percent level. Unfortunately, Column (5) shows there is not much policy's effect on delay of entry into the first marriage. Specifically, the point estimate is 0.102 but is not statistically significant. This implies that the policy made women postponed their fertility but not their marriage.

In summary, results above show causal effects of OCP on post-school outcomes of Han women relative to the control groups. Specifically, OCP decreased Han women's fertility, delayed their entry to the first marriage and motherhood, and increased their labor force participation. However, these causal effects may not be direct, as the post-school outcomes could be directly caused by the increased educational attainment. Thus there may be two channels of OCP affecting the later outcomes, one is direct, the other is through increased education. In case of the second channel biasing the estimate, I control for years of schooling and re-estimate the OCP's effect on the post-school outcomes. Panel B in Table 6 shows the new estimates of the policy's effects. Generally speaking, all policy's effects are highly consistent with ones in Panel A. It is not surprising that a considerable amount of effect is caused by the increased education and the estimates in Panel A

¹³Women have to be married to give birth in China. This is part of the family planning policy.

are biased due to the increased education's effect on the same outcomes.

Analysis in this section presents marriage, fertility and labor market consequences caused by the OCP. More importantly, it supports the hypothesis that women increased their education due to expectation of decreased fertility, delayed entry to first marriage, delayed entry to motherhood and increased labor market participation. However, again, analysis above is not a direct proof but a support of the mechanism.

7 Conclusion

Women's educational attainment has been increasing tremendously compared to men's all over the world. This paper exploits China's One-Child Policy's which was implemented national wide in 1980 as an exogenous shock to fertility to estimate its effect on educational attainment of women, who are the mothers of the sibling-less generation. The hypothesis is that the women's expected fertility was reduced by OCP at schooling ages. Then the reduced expected fertility increased return to schooling, which leads to higher educational attainment. I use two difference-in-differences approaches to estimate this effect. The first DD is Han women versus Han men. I use men as my untreated group because men are much less likely to change their education decision due to the changes in expected fertility of their partners in the future. The second DD is between Han women and non-Han women. As non-Han women have much relaxed OCP restrictions compared to Han in terms of birth quota, non-Han women's expected fertility were less reduced due to the policy.

I find that OCP significantly increased Han women's years of schooling by up to 1.304 years, which counts for up to 54.6% of increase in women's education im-

provement in birth cohorts between 1960-1980. By investigating the pattern of the OCP's effect on different birth cohorts, I show that women below age 15 when the policy was implemented experienced the greatest shock. I also find that the policy significantly increased women's likelihood of completing high school. However, there is not much evidence showing policy's effect on college completion. By analyzing post-school outcomes, I provide evidence of OCP's effect on women's delayed entry to first marriage and motherhood, decreased number of birth and increased labor force participation, which helps explain the mechanism of OCP's effect on educational attainment. The paper shows OCP's positive externality on education and explains the enlarging gap of educational attainment between women and men. It sheds light on the literature of linkages between fertility and human capital accumulation in general.

There are some limitations in this study. First, both of my untreated groups are not perfect. Han men and non-Han women are somehow affected by the policy, even though much less compared to Han women. There might be some characteristics in these two groups that I do not observe contribute to their reaction to the policy. There also might be some contemporaneous social changes affecting those two groups differently relative to Han women. Second, in this reduced form estimation, I cannot directly prove the mechanism behind OCP's effect on Han women's education. I only provide evidence of links between the policy and women's later outcomes, which supports the potential mechanism. I hope future researches may explore these questions.

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Table 1: Descriptive Statistics of CFPS, by Demographic Groups

Variable	Han		non-Han		All
	Men	Women	Men	Women	
Observations	8597	9334	747	836	19514
Education					
Year of Schooling	8.156 (4.081)	6.331 (4.683)	6.226 (4.628)	4.444 (4.745)	7.373 (4.552)
≥Junior High Completed	62.04% (0.485)	45.35% (0.498)	42.84% (0.495)	29.67% (0.457)	51.88%(0.500)
≥Senior High Completed	25.11%(0.434)	17.61%(0.381)	14.59%(0.353)	10.52%(0.307)	20.47%(0.403)
≥4-yr College Completed	2.90%(0.168)	1.80%(0.133)	1.87%(0.136)	1.675%(0.128)	2.28%(0.149)
Family					
# of Siblings	3.09(1.908)	3.256(1.939)	3.325(1.842)	3.459(1.856)	3.195(1.921)
<i>Father's Edu</i>					
≥Junior high school	32.5%(0.469)	34.52%(0.475)	32.13%(0.467)	33.97%(0.474)	33.53%(0.472)
<i>Mother's Edu</i>					
≥Junior high school	18.06%(0.385)	18.63%(0.389)	17.40%(0.379)	20.45%(0.404)	18.42%(0.388)
Father: Member of Communist	0.169(0.375)	0.174(0.379)	0.146(0.353)	0.141(0.349)	0.169(0.375)
Mother: Member of Communist	0.022(0.147)	0.025(0.157)	0.030(0.170)	0.014(0.119)	0.024(0.152)
Rural	0.827(0.378)	0.834(0.372)	0.923(0.266)	0.921(0.270)	0.838(0.368)
Later Outcome					
Labor Force Participation	0.682(0.466)	0.511(0.500)	0.707(0.456)	0.590(0.492)	0.600 (0.490)
# of Birth	1.688(0.919)	1.810(0.908)	1.963(1.037)	2.138(1.000)	1.776(0.927)
Age at First Marriage	1988.8(8.582)	1987.4(8.470)	1989.6(8.853)	1988.7(9.062)	1988.1(8.593)
Age at First Birth	1990.5(8.214)	1989.2(8.196)	1991.6(8.206)	1990.9(8.301)	1989.9(8.242)

Notes: Data is from CFPS. Sample includes cohorts born 1950-1980.

Standard errors are in the parentheses.

Table 2: Pre-Trend Assumption Test

	(1)	(2)	(3)
	CFPS (1950-1959)	CFPS (1950-1960)	CFPS (1950-1961)
<i>Panel A. Han Women VS. Han Men</i>			
$t \times Women$	-0.040 (0.046)	-0.035 (0.043)	-0.038 (0.038)
N	4303	4650	4900
<i>Panel B. Han Women VS. non-Han Women</i>			
$t \times Han$	0.005 (0.108)	0.149 (0.102)	0.079 (0.089)
N	2283	2470	2619

Note: Sample in column (1) includes birth cohorts from 1950-1959, sample in column (2) includes birth cohorts from 1950-1960, and sample in column (3) includes birth cohorts from 1950-1961. Dependent variable is years of schooling. Independent variables include women dummy/Han dummy, interaction of women and time/interaction of Han and time, province fixed effects and birth year fixed effects. Other controls include rural dummy, interaction term of rural and women dummy/interaction term of rural and Han dummy, number of siblings, father and mother's level of education and father and mother's political status.

Standard errors in parentheses are clustered at province-cohort level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$.

Table 3: OCP's Effect on Years of Schooling, Average Effect

Dependent Var.	Years of Schooling	
	(1)	(2)
<i>Panel A. Han Women VS. Han Men</i>		
<i>Women × Policy</i>	1.100*** (0.181)	1.304*** (0.172)
<i>N</i>	17879	13317
<i>Panel B. Han Women VS. non-Han Women</i>		
<i>Han × Policy</i>	0.949** (0.377)	0.809** (0.405)
<i>N</i>	10142	7437
State FE	YES	YES
Other Controls	NO	YES

Note: Data is from CFPS. Sample includes birth cohorts 1950-1980. Dependent variable is years of schooling. Independent variables include women dummy/Han dummy, policy dummy, interaction of women and policy/interaction of Han and policy, province fixed effects and birth year fixed effects. Policy dummy equals one for post-policy cohorts born between 1961-1980, and equals zero for everyone else. Other controls include rural dummy, interaction term of rural and women dummy/interaction term of rural and Han dummy, number of siblings, father and mother's level of education and father and mother's political status. Each column presents results from a separate regression with a different specification.

Standard errors in parentheses are clustered at province-cohort level.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$.

Table 4: OCP's Effect on Years of Schooling, Moving Treatment Group

Dependent Var.	Years of Schooling							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment Group	<i>Age</i> ≤ 19	<i>Age</i> ≤ 18	<i>Age</i> ≤ 17	<i>Age</i> ≤ 16	<i>Age</i> ≤ 15	<i>Age</i> ≤ 14	<i>Age</i> ≤ 13	<i>Age</i> ≤ 12
Panel A. Han Women VS. Han Men								
<i>Women</i> × <i>Policy</i>	1.304*** (0.172)	1.349*** (0.173)	1.423*** (0.170)	1.436*** (0.172)	1.474*** (0.175)	1.439*** (0.176)	1.405*** (0.179)	1.407*** (0.181)
<i>N</i>	13317	13067	12506	11867	11324	7040	10204	9712
Panel B. Han Women VS. non-Han Women								
<i>Han</i> × <i>Policy</i>	0.809** (0.405)	0.855** (0.408)	0.848** (0.411)	0.851** (0.412)	0.909** (0.419)	0.991** (0.424)	0.942** (0.430)	0.948** (0.438)
<i>N</i>	7437	7288	6952	6596	6293	5993	5666	5384

Note: Data is from CFPS. Sample includes birth cohorts 1950-1980. Dependent variable is years of schooling. Independent variables include women dummy/Han dummy, policy dummy, interaction of women and policy/interaction of Han and policy, province fixed effects and birth year fixed effects. Other controls include rural dummy, interaction term of rural and women dummy/interaction term of rural and Han dummy, number of siblings, father and mother's level of education and father and mother's political status. Each column presents results from a separate regression with a different post-policy group. For instance, post-policy cohort in Column (1) are born between 1961-1980 while cohort in column (8) are born between 1968-1980.

Standard errors in parentheses are clustered at province level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$.

Table 5: OCP's effects on Women's Senior High School/College Completion

Dependent Variable	Senior High School Completion		College Completion	
	(1) LPM	(2) Probit	(3) LPM	(4) Probit
Panel A. Han Women VS. Han Men				
<i>Women × Policy</i>	0.0422** (0.0144)	0.0637*** (0.0158)	-0.00486 (0.00413)	0.00560 (0.00388)
<i>N</i>	13309	13309	13309	12860
Panel B. Han Women VS. non-Han Women				
<i>Han × Policy</i>	0.0734** (0.0304)	0.0810** (0.0401)	0.0151 (0.0109)	0.0121** (0.00529)
<i>N</i>	7430	7430	7430	6061

Note: Sample includes birth cohorts 1950-1980. Dependent variable in column (1) and (2) is dummy of senior high school completion. Dependent variable in column (3) and (4) is dummy of 4-yr college completion. Column (1) and (3) show estimates from the linear probability models; while column (2) and (4) show estimates from probit models. Independent variables include women dummy/Han dummy, policy dummy, interaction of women and policy/interaction of Han and policy, province fixed effects and birth year fixed effects. Policy dummy equals one for post-policy cohorts born between 1961-1980, and equals zero for everyone else. Other controls include rural dummy, interaction term of rural and women dummy/interaction term of rural and Han dummy, number of siblings, father and mother's level of education and father and mother's political status. .

Standard errors in parentheses are clustered at province cohort level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$.

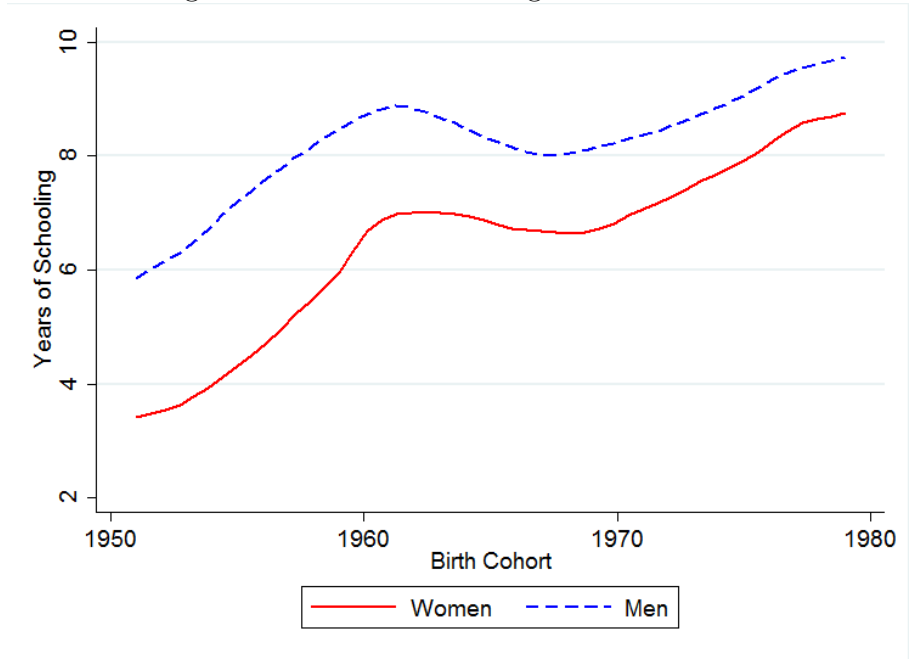
Table 6: OCP's effects on Women's Post-School Outcomes

Treated vs. Untreated	Han Women vs. Han Men		Han Women vs. non-Han Women		
	(1) (LFP)	(2) (LFP)	(3) (Number of Birth)	(4) (Age at 1st Birth)	(5) (Age at 1st Marr)
Panel A. No Control for Education					
Policy's Effect	0.104*** (0.020)	0.043 (0.054)	-0.191* (0.100)	1.217** (0.458)	0.102 (0.334)
Panel B. Control for Education (Years of Schooling)					
Policy's Effect	0.094*** (0.020)	0.037 (0.055)	-0.170* (0.0983)	1.133** (0.462)	-0.092 (0.323)
Education	0.008*** (0.001)	0.007*** (0.002)	-0.033*** (0.003)	0.127*** (0.011)	0.173*** (0.010)
<i>N</i>	13312	7433	7982	7981	7634

Note: Sample includes birth cohorts 1950-1980 for column (1) and (2). Sample includes birth cohorts 1940-1980 for column (3) to (5). Dependent variables in column (1) and (2) is dummy of ever have had a formal job. Dependent variable in column (3) to (5) are number of birth, age at the first birth and age at the first marriage. Independent variables include women dummy/Han dummy, policy dummy, interaction of women and policy/interaction of Han and policy, province fixed effects and birth year fixed effects. Policy dummy equals one for post-policy cohorts born between 1961-1980, and equals zero for everyone else. Other controls include rural dummy, interaction term of rural and women dummy/interaction term of rural and Han dummy, number of siblings, father and mother's level of education and father and mother's political status.

Standard errors in parentheses are clustered at province-cohort level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$.

Figure 1: Years of Schooling Across Cohorts



Notes: The gender-cohort averaged years of schooling is weighted by individual weight.

Figure 2: CFPS Covers 21 Provinces and 4 Municipalities

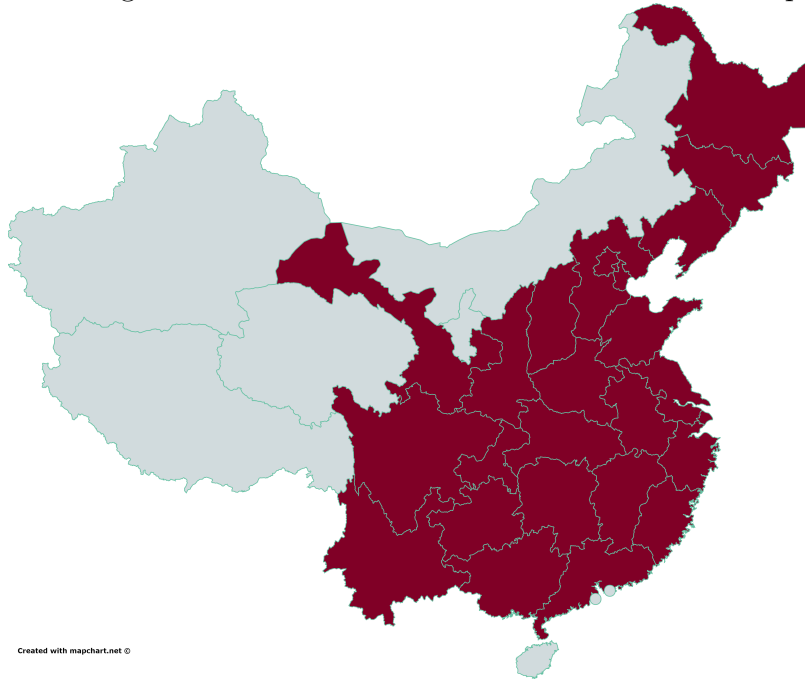
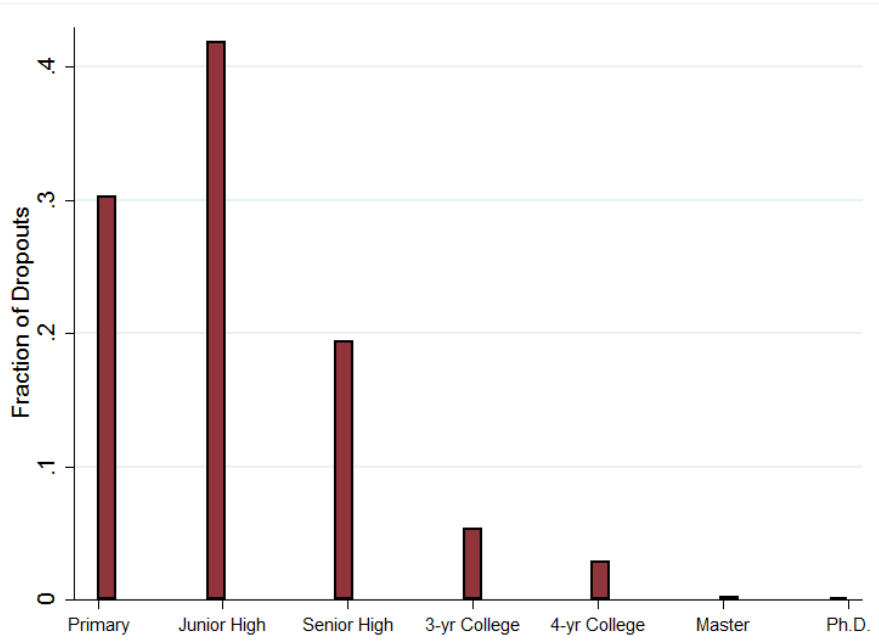
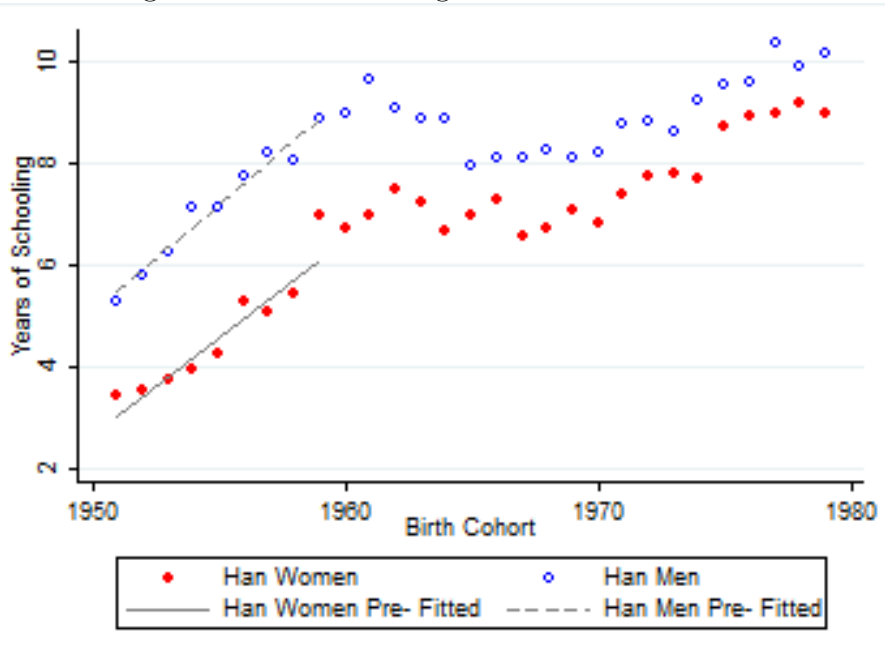


Figure 3: Distribution of Highest Level of Education among Birth Cohorts 1950-1980



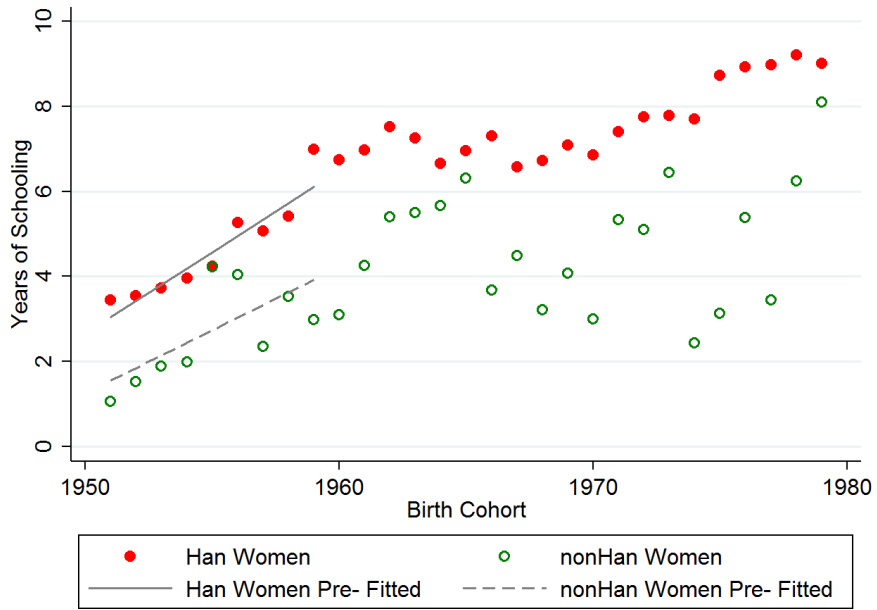
Notes: Sample includes birth cohorts 1950-1980

Figure 4: Averaged Years of Schooling Between Han Women and Han Men



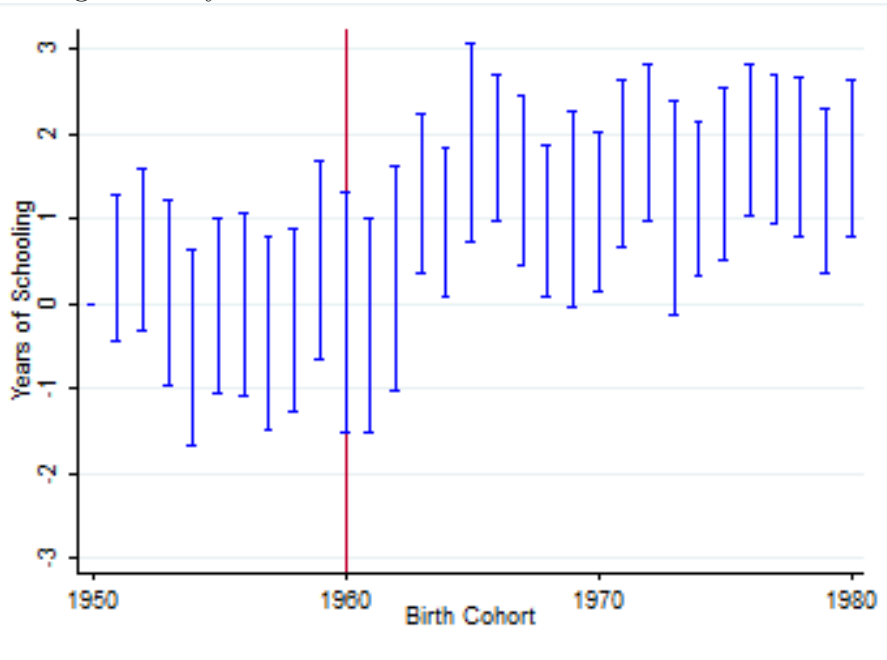
Notes: Sample includes birth cohorts 1950-1980

Figure 5: Averaged Years of Schooling Between Han Women and non-Han Women



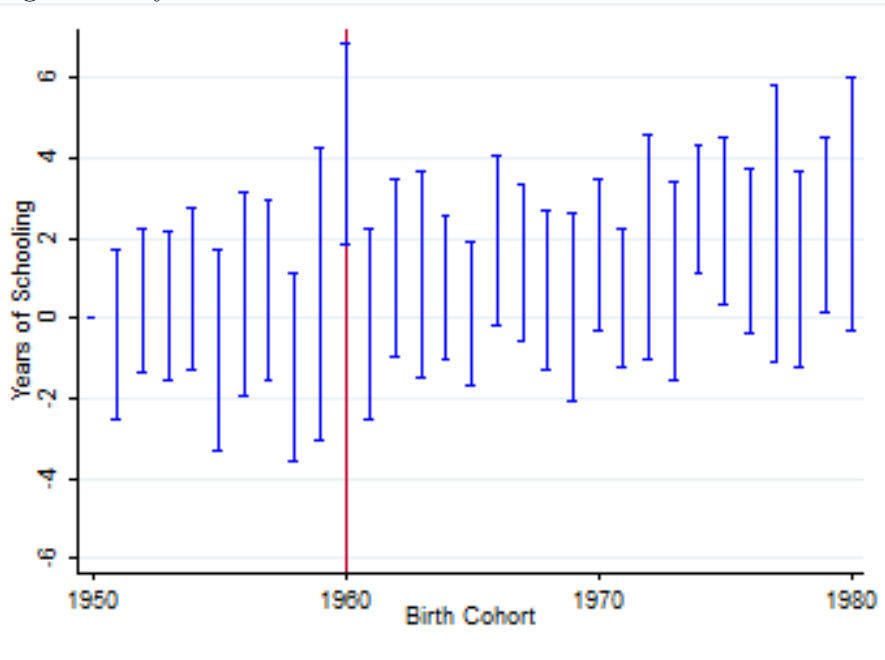
Notes: Sample includes birth cohorts 1950-1980

Figure 6: Dynamic DD between Han Women & Han Men



Notes: Sample includes birth cohorts 1950-1980

Figure 7: Dynamic DD between Han Women & non-Han Women



Notes: Sample includes birth cohorts 1950-1980