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Women's Education and Fertility in China

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Abstract

Using data from the China Family Panel Studies, this paper exploits the Compulsory Education Law of China implemented in the 1980s to empirically examine the causal impact of women's education on fertility in rural China by difference-in-differences methods. The results show that an additional year of schooling lowered the number of children a woman would have by approximately 0.09 children, postponed the age of first childbirth by 0.7 years, and reduced the probability of having a second child or more children by 0.18 among those mothers whose first child was a girl. In addition to the income effect, these results are also partly explained by more educated women preferring quality to quantity of children, placing a greater value on leisure and no longer perceiving children as the sole focus in their lives.

Keywords: Women's education; Fertility; Demographic transition; Compulsory education law; Quality and quantity of children

JEL Codes: I25; J11; J13

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1. Introduction

China has experienced a dramatic and consistent fertility decline since the beginning of the 1970s, which was noted as China's demographic transition (Cai 2010), and this trend was accelerated by the country's family planning policy.[1] According to the World Bank, the total fertility rate (TFR) dropped from more than six in the 1960s to approximately 2.5 in the late 1970s, then fell below the replacement rate in the early 1990s, and has remained at approximately 1.6 since the 2000s.

There are two strands of literature on the explanation of the fertility decline in China. One attributes the decline of the fertility rate to the intervention of family planning policy (see Wang et al. 2017 for a review). Another emphasizes the essential role of socioeconomic factors, such as education improvement and urbanization (Lavely and Freedman 1990; Zhao and Zhang 2018).

One pronounced social phenomenon coincident with the decline in the fertility rate is the increase in the education level, especially after the Compulsory Education Law of China (CELC) was enacted in 1986.[2] Figure 1 shows that the decline in the fertility rate and the increase in women's education have occurred simultaneously since the 1980s.

<Figure 1>

This paper is closely related to the second strand of research, and we are interested in estimating the causal effect of women's education on their fertility behavior, such as fertility number, the timing of childbirth and marriage, using the exposure to the CELC as an instrumental variable.

We find that an additional year of schooling lowered the number of children a woman would have by approximately 0.09 children, postponed the age of first childbirth by 0.7 years, and reduced the probability of having a second child or more children by 0.18 among those mothers whose first child was a girl.

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[1] Family planning policy in 1960-70s is known as "later, longer and fewer" policy. Some research argued that the decline of the fertility rate in China began even before the implementation of the family planning policy (Lavely and Freedman 1990).

[2] Calculating using China census data, the average years of schooling of population aged 15 and older increased from 5.33 years in 1982 before the CELC to 9.36 years in 2015 after 30 years since the CELC enacted.

Then we explore channels from increased women's education to the decline of the fertility rate. We go beyond the existing literature which mainly attributed the fertility decline to the rising opportunity costs associated with the improved educational level, and show that in addition to the income channel, education-induced value shift, e.g. more educated women preferring quality to quantity of children, placing a greater value on leisure, and no longer perceiving children as the sole focus in their lives, has also played an important role.

First, we investigate women's income and labor market participation as channels driving fertility decline. In a recent review paper (Doepke et al. 2022), they concluded that the focus on traditional negative relationships between income and fertility as well as labor supply and fertility has changed. Theoretical models (Galor 2012; Greenwood et al. 2017) and empirical evidence (Hazan and Zoabi 2015) show that the relationship between income and fertility rate does not necessarily always negative.

Indeed, we find a U shape of women's income on the fertility rate, which suggests that the impact of the income channel could be either positive or negative depending on the quantile of income.

Second, we investigate the role of social norms, such as preference for children (e.g., David and Sanderson 1987, Zheng et al. 2009), on fertility rate, as highlighted by Doepke et al. (2022) that social norms are among the key determinants of fertility behavior. We are among the first ones to empirically examine whether more education leads to different preferences on the quality and quantity of children and the implication of this preference shift on fertility.[3]

Our results suggest that women with more education prefer the quality to the quantity of children: better-educated women spend more on children's education, and care more about children's education, ceteris paribus. Moreover, women with more education tend to report a smaller ideal number of children and are less likely to regard children as the sole focus of their lives. The role of preference shifts on the fertility rate could partly explain why an increase in the total fertility rate is not

[3] Norms are considered to be stable but could change due to temporary social factors through learning (Munshi and Myaux 2006; Kohler 2000).

observed even after the Chinese two- and three-child policy.

Our study complements the existing literature in several ways. The previous studies using compulsory schooling laws as instrumental variables are mostly on developed countries; our study is among the few to focus on a developing country.

One study which is also on China and worth noting is Chen (2022), which found a positive relationship between women's education and fertility rate using the college expansion in the 1990s in China. Our study mainly differs from Chen (2022) in the source of exogenous variation in education and the results. In China throughout the 1990s, only 1% to 3.5% of the population has a higher education. In contrast, our exogenous shock is the CELC, which requires a 9-year compulsory schooling for school-age children, including 6 years of primary school and 3 years of junior high school. The CELC was enacted in 1986 but implemented between 1986 and 1991 in different provinces, which allows us to exploit both within birth cohort and within birth region variations in years of schooling. In the 1980s, more than 70 percent of the Chinese population did not complete junior high school. Using CELC as an exogenous shock, we reach different conclusions, and our results apply to the broader population.

This paper also enriches the policy evaluation literature on the CELC in China. Previous studies have exploited the CELC to examine the effect of education on health and cognition (Huang 2015), the outcomes of the next generation (Cui et al. 2019), and the effect on parents (Ma 2019). The dimension of fertility behavior is still unexplored.

The remainder of the paper is organized as follows. Section 2 discusses theories and channels on education and fertility, and introduces the institutional background. Section 3 presents the data set, describes variables, and outlines the empirical strategy. Section 4 reports the main empirical findings. Section 5 is on channels and mechanisms. Section 6 concludes the paper.

2. Literature, Theories, and Institutional Background

2.1 Review of the related literature

The relationship between female education and the fertility rate is among the top interests of economists and other social scientists. The relationship between women's education and fertility has been widely examined. Previous studies adopted several approaches to estimate the causal effect of additional female education on their fertility behavior and led to different conclusions.

The vast majority of empirical studies on the causal impact of female education on their fertility were conducted in developed countries. The instrumental variables (IV) approach is the most prevalent method. For instance, studies using compulsory educational laws as instrumental variables found that female education reduces fertility in Germany (Cygan-Rehm and Maeder 2013) and in England (Fort et al., 2016), but a none impact or positive impact in other countries, e.g., in the UK (Geruso and Royer 2018; Braakmann 2011), Norway (Monstad et al. 2008), and the US (Leon 2004). Other sources of IVs include school extension programs in Germany (Kamhöfer and Westphal 2019) and in Korea (Sohn and Lee 2019), and both studies have found a negative impact; school entrance policies in the US (McCrary and Royer 2011), by which a none causal impact has been demonstrated; and migration policies, by which a negative impact was suggested among Israeli Arabs (Lavy and Zablotsky 2015).

Monozygotic twin data were utilized as a second method. This line of research finds a positive effect in the US (Amin and Behrman 2014), but no significant effect in Sweden (Kramarz et al. 2021).

In comparison, studies in developing countries are far less common. Breierova and Duflo (2004) used school construction in Indonesia to address the endogeneity of female education and found little impact on fertility. Osili and Long (2008) used a similar identification strategy and demonstrated a negative impact on fertility in Nigeria. Ali and Gurmu (2018) exploited the reduction in the length of primary school in Egypt and found a negative impact on fertility.

In the Chinese context, the fertility decline was due to a more complicated mixture of socioeconomic changes, public policies, and family planning policies. In a very recent study, Chen (2022) exploited China's college expansion in the 1990s and found that women's additional education induced by the college expansion increases their fertility and reduces the probability of having no child. The main differences between Chen's study and ours are the source of variations in women's exogenous education improvement, the compliers, and the results. In Chen (2022) the compliers were those who got the opportunity to go to college thanks to the expansion policy. In China throughout the 1990s, only 1% to 3.5% of the population has a higher education, and women affected by the college expansion took up only a very small proportion of the population. In contrast, our exogenous shock is the CELC implemented since 1986, and in the 1980s, more than 70 percent of the population did not complete junior high school.

2.2 Theories

2.2.1 Opportunity costs

Opportunity costs are one of the most important theoretical channels from education to the fertility rate emphasized in the literature.

In neoclassical economics and new home economics, both the quantity and quality of children bring direct utility to women or households, and children are consumed as a normal good (Becker 1960, 1965, 1983; Willis 1973). Since it costs time to raise children, women who have a higher wage rate as a result of improved education would earn more income but also face a higher opportunity cost of raising a child. Beckerian theory predicts that the substitution effect due to higher opportunity costs dominates the income effect; hence, women choose to have fewer children.[4]

However, the dominance of the substitution effect was challenged in later studies. Whether this channel exhibits a negative or a positive effect depends largely on the form of the budget constraint and expenditure function on bearing and educating a

[4] The intuition behind the dominance of the substitute effect is that investing in children becomes relatively cheaper because children quality could be obtained from the market, however, bearing a child costs more due to the time-consuming nature of childbirth.

child. Galor (2012) showed that the substitution effect does not necessarily dominate. The theoretical prediction of Greenwood et al. (2017) on the effect of women's earnings on the fertility rate is mixed. Hazan and Zoabi (2015) predicted and empirically tested that the effect of mothers' education on the fertility rate is U-shaped.

Since more educated women realize their improved earning ability in the labor market, if the fertility rate decreases with the improvement of women's education, it might be observed that women participated more in the labor market after their educational level improves. Both theoretical models (Hazan and Zoabi 2015) and empirical studies (Kan and Lee 2018) support this argument.

The opportunity costs discussed above, together with the channel of improving women's health knowledge, are the main mechanisms mentioned in the literature, as argued by Michael (1973) that education may affect women's fertility through either income or learning.[5] However, in a recent review paper (Doepke et al. 2022), they concluded that the traditional focuses in fertility models on the negative relationship between income and fertility, the negative relationship between labor supply and fertility, and the mechanism of opportunity costs and Q-Q tradeoffs have shifted in the new era.

2.2.2 Preferences for quality and quantity of children

Changes in preferences could have a vital impact on fertility choice but are seldom mentioned in the empirical literature because they are largely unobservable. Galor (2012) showed that an increase in preference for child quality has a clear negative effect on the fertility rate, while an increase in preference for child quantity has exerted a clear positive effect.

Contrary to the usual assumption that preferences are held constant, they are sensitive to changes in socioeconomic factors, e.g., education. A mother's education could have influenced her preference for the quality and quantity of children. In recent

[5] There are several ways of health knowledge working to reduce fertility. Better-educated women would have a better ability to use modern contraception methods, which has been examined in early literature (Rosenzweig et al. 1989) and the case of China (Lavely and Freedman 1990). Additionally, more educated women improve infant health in several ways (see McCrary and Royer 2011 for detail), such as changing smoking behavior (Currie et al. 2003) and improving household productivity for health (Grossman 1972).

papers on China, Chen et al. (2020a, 2020b) found a spillover effect of urban talent education on the education of the local rural population and the historical human capital stock on today's educational level. Both papers regard the education level as a value, i.e., better-educated individuals think more highly of education. As such, better-educated parents emphasize education more and, hence, invest more in the quality of children and choose to have fewer children.

A shift in the preference regarding the quantity of children also has important implications for the fertility rate. Becker (1960) described the preference for children as "tastes", which are determined by demographic characteristics. Although few economic studies focus on how education shifts taste for the number of children and the effect on fertility, sociologists and demographers regard shifts in values and taste for children as the main reason for the fertility decline, e.g., the second demographic transition theory (see Lesthaeghe 1995). Along with economic and social development, people value their personal lives more than offsprings and a children-centered life.[6] This theory suggests that the preference for the quantity of children has weakened as women's education has increased (Gottard et al. 2015). Changes in preferences among more educated women indicate a shift in social norms, which has become one of the key drivers of fertility decisions (Doepke et al. 2022).

2.3 Institutional Background: Compulsory Education Law of China

This paper exploits the implementation of the compulsory education law in China in the 1980s as a natural experiment to estimate the effect of the additional education of women on their fertility behaviors. In the 1980s, the Chinese central government started systematic educational reform, aiming to guarantee the right of school-age students to receive education and to improve the quality of the population (Ma 2019). As an essential part of educational reform, the Compulsory Education Law of China (CELC) was passed in 1986 and took effect on July 1, 1986. The CELC is also known as the 9-year compulsory educational law, since, according to the law,

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6 Researchers regard Becker's new home economics theory and the second demographic transition theory as the two prominent theoretical perspectives on fertility decline in the socioeconomic and demographic literature (Gottard et al. 2015).

all children aged 6 must be enrolled in school for 9 years until they finish junior high school. A typical child would start school at age 6, complete the nine-year compulsory education by age 15, and then decide whether to pursue further education or enter the labor market (Cui et al. 2019).

One important feature of the implementation of the CELC is that each province was allowed to arrange the specific time of enforcement of the CELC. Therefore, there are differences in the effective year of the CELC across provinces. The earliest provinces that implemented the CELC were Beijing, Hebei, Shanxi, Liaoning, Heilongjiang, Zhejiang, Jiangxi, Chongqing, and Sichuan provinces in 1986, and the last ones were Hunan, Guangxi, and Gansu provinces in 1991. Appendix Table 1 lists the effective year of each province adopted by Huang (2015).

It is possible that unobserved factors of different birth cohorts could influence both education and fertility; for instance, with economic and social development, different birth cohorts would form different norms toward both education and the number of children. These unobserved factors could not be fully controlled even using the exogenous policy, such as the CELC we used here. The variation in the CELC implementation year across provinces allows us to control for the birth cohort of women and obtain a within-cohort estimation, which could solve this endogenous issue.

However, when exploiting the variations in the CELC enforcement year, one possible concern is that the implementation date of the CELC in each province is not random but rather due to the level of economic and educational development in each province. Huang (2015) argues that the effective year and educational level before the CELC are relatively unrelated. We also show in the next section that reform years across regions are not correlated with pre-reform regional characteristics.

3. Data, variables, and empirical strategies

3.1 Main Data

The main data used in the paper is the 2018 wave of the China Family Panel

Studies (CFPS). The CFPS 2010–2016 adult survey and the CFPS 2010–2018 child survey are also used to complement the information of the main sample.

The CFPS is a nationally representative, biannual longitudinal survey of Chinese communities, families, and individuals launched in 2010 by the Institute of Social Science Survey (ISSS) of Peking University, China. The nationwide CFPS baseline survey in 2010 successfully interviewed 14,798 households from 635 communities, including 33,600 adults and 8,990 children in 25 designated provinces, for a response rate of 81%, with the majority of the nonresponse due to noncontact (Xu and Xie 2015). The stratified multistage sampling strategy ensures that the CFPS sample represents 95% of the total population in China (Xie 2012).

Each wave of the CFPS contains a survey for adults aged 16 and above, and a survey for children under 16. The child survey has two parts: one is answered by children aged 10–15, and the other is answered by their parents.

We are interested in understanding the impact of women's education improvement on their fertility rate; and focus on the rural population since after 1984, rural households were allowed to have a second child if the first one were a girl. This policy allows this group of households to make the fertility decision more freely, and this freedom in fertility choice is helpful to identify the effect of education on fertility.

Since both completed years of schooling and complete fertility are observed only once, we form our main sample from the 2018 CFPS adult survey, and restrict our analyzed sample to women aged 35–50 in 2018, i.e., aged 3 to 18 in the year 1986 when CELC was enacted, who are most likely to complete childbirth and still be in the labor market in the survey year of 2018. This sample selection allows us to obtain completed fertility information, completed education information, and labor market information.

Education, fertility behavior, and demographic information were obtained from the 2018 CFPS adult survey. Income and other labor market variables might face transitory shocks, which make a single observation insufficient to represent the lifelong situation. We use repeated income in different waves to mitigate this measurement error and to smooth the possible transitory income shock (Black and

Devereux 2011), and obtained the personal income, labor market working hours, and home-producing hours of sampled females from five waves of the CFPS adult survey (namely, CFPS 2010, 2012, 2014, 2016, and 2018). Information on maternal attitudes and behavior toward children is from the CFPS 2010–2018 child surveys. We match the child data to the adult female data; in total, we obtain 2,880 rural females in the sample.

3.2 Variables

3.2.1 Outcome variables

We use three indicators to measure the fertility behavior of women. The first variable is the number of children which measures the complete fertility of women. The second one is whether to have a second child when the first child is a girl.[7] The third one is the age at first childbirth.

3.2.2 Key independent variable of interest

The key independent variable of interest is the education level of women, measured by years of schooling.

3.2.3 Instrumental variables

Since education is endogenous, we exploit the CELC as a natural experiment to correct the possible bias as in Huang (2015), Ma (2019), and Cui et al. (2019), and instrument it by exposure to the CELC and the interaction of exposure to the CELC and the proportion of people with fewer than 9 years of schooling prior to the CELC at the provincial level.[8]

In the spirit of Duflo (2001), one instrumental variable for endogenous education is the extent of exposure to the CELC. Following Huang (2015) and Ma (2019), we measure the exposure as a continuous variable according to the comparison of women's birth years with the CELC effective year in women's birth province.[9] As

[7] Since women were not allowed to have a second child under the One-child Policy (OCP) when the first child was a boy (Ebenstein 2010), if we included the women whose first child is a boy in the study sample, the impacts would be under-estimated because of the restriction of the OCP, and the estimates would be also contaminated by the variation in the severity of the penalty for violation of the OCP across regions.

[8] The enforcement year of the CELC and the proportion of people with fewer than 9 years of schooling prior to the CELC in each province are obtained from Huang (2015).

[9] The CELC first went public in April 1986, and went into effect in the same year, so households were hardly able to prepare for moving to different regions before the implementation. In addition, inter-regional mobility was quite rare in China in the 1980s due to the restriction of the *hukou* policy. In our sample, 98% of individuals lived in

mentioned in Section 2, the CELC affects primary and junior high school age children, i.e., children aged 6 to 15. As such, women who had reached 16 when the CELC was implemented in their provinces were not exposed to it, and their exposure takes the value of zero. Women aged six and below when the CELC was implemented in their provinces were fully exposed and their exposure is equal to 10, and exposure of those aged in the middle takes the value of 1 to 9.[10]

The program intensity is another source of variation utilized to generate instrumental variables. We follow Huang (2015) and use the proportion of people having completed less than 9 years of schooling at the province level prior to the implementation of the CELC to measure the program intensity. The basic idea behind this is that the impact of educational policy varies among regions with different levels of educational development prior to the policy (Duflo 2001). According to Huang (2015), the average impact of the CELC on education varies by province, with various proportions of people having completed less than 9 years of schooling prior to the CELC. This measurement is out of the control of an individual household and is arguably exogenous (Huang 2015; Ma 2019). We use the interaction between exposure to the CELC and program intensity as another instrumental variable.

3.2.4 Other control variables

To control for other confounding factors, we include women's demographic and economic characteristics, such as marriage status, number of marriages, ethnicity, self-reported health status, birth cohort dummy, and birth region dummy, as controls. We also control for household and spouse information, including household income per person, family size, and age and education of the spouse. we also control important variables at the provincial level, including GDP per capita, one-child policy fines, and sex ratio.[11] Table 1 shows the descriptive statistics of the variables.

<Table 1>

their birthplace at the age of 12.

[10] For instance, a woman born in 1976 in a province where the CELC got in effect in 1986 was 10 years old then her exposure equals 6.

[11] Province GDP is obtained from China Statistic Yearbook. The OCP fine in each province is from Ebenstein (2010). The sex ratio of children aged 1–5 at women's first childbirth is calculated using China 2010 census.

3.3 Empirical Strategies

The baseline regression model to estimate the effect of women's education on fertility behavior is as follows:

$$y_{ipt} = \alpha_0 + \beta_1 Eduy_{ipt} + \boldsymbol{X_{ipt}^1 \beta_2} + \boldsymbol{X_p^2 \beta_3} + Cohort_t + Region_p + u_{ipt}$$

where y_{ipt} is the outcome variable of fertility behavior of woman i born in province p and born in year t. $Eduy_{ipt}$ is the key variable of interest, the educational level measured by years of schooling. $\boldsymbol{X_{ipt}^1}$ represents a vector of women's demographic, socioeconomic, and family characteristics, and $\boldsymbol{X_p^2}$ is a vector of economic and social conditions of women's birth province p. $Cohort_t$ is the women's birth year fixed effect, and $Region_p$ is the fixed effect of the region to which women's birthplace belongs.[12]

The OLS estimation of the effect of women's education on their fertility is most likely to be biased since the level of education is potentially endogenous, and there might be unobserved individual fixed factors that influence both the choice of the education level and the fertility decision.

The first stage of our empirical strategy is to utilize the exogenous variation of exposure of the CELC to control for the endogenous part of the education variable through a difference-in-differences (DID) framework as in Duflo (2001):

$$Eduy_{ipt} = \beta_0 + \alpha_1 Exposure_{pt} + \alpha_2 Exposure_{pt} \times PreProp_p + \boldsymbol{X_{ipt}^1 \alpha_3} + \boldsymbol{X_p^2 \alpha_4} + Cohort_t + Region_p + u_{ipt}.$$

$Exposure_{pt}$ is the measure of exposure to the CELC of individuals born in province p and born in year t, which takes the value of 0 to10 as discussed in Section 3.2; those aged 6–15 are partially exposed and their $Exposure_{pt}$ takes the value of 1 to 9, and those aged 16 and above are nonexposed and their $Exposure_{pt}$ take the value of zero. $PreProp_p$ is the proportion of people with fewer than 9 years of schooling in the population born prior to the CELC in province p, and the interaction of $Exposure_{pt}$ and $PreProp_p$ is incorporated in the equation.

[12] There are four regions in total, eastern, middle, western, and northeastern China, which are divided based on geographic areas and economic development.

The variation in the enforcement year of the CELC across provinces allows us to control for birth cohort fixed effects $Cohort_t$, which addresses unobserved birth cohort effects.

The time of implementation of the CELC across provinces may be not random. In order to address this concern, in the main equation, we control for birth region dummies $Region_p$, and the GDP per capita in each province in 1985, one year prior to the implementation of the CELC.

Furthermore, we conduct a test to check the exogeneity of reform year across provinces by regressing the effective year of CELC on pre-reform characteristics including local GDP, average wage, unemployment rate, birth rate, population density, literacy proportion, the proportion of the population with less than 9 years schooling, dropout rate, gender gaps in schooling years, the proportion of female employees, and one-child policy fine. The pre-reform data are obtained in the 1985 China statistics yearbook and 1982 population census. The results in Table 2 indicate that the reform year is unrelated to these pre-reform characteristics.

<Table 2>

It is also possible that the implementation of the one-child policy might simultaneously affect women's education and fertility behavior. To address this concern, we control for the fines of additional births in each province using the data from Ebenstein (2010). To capture the preference for a son in different areas, which may simultaneously affect women's education and fertility behavior, we control for the sex ratio of children aged 1–5 when women have their first child at the provincial level.

In the second stage, the following equation is used to estimate the effect of women's education on fertility:

$$y_{ipt} = \alpha_0 + \beta_1 \widehat{Eduy_{ipt}} + \boldsymbol{X^1_{ipt}\beta_2} + \boldsymbol{X^2_p\beta_3} + Cohort_t + Region_p + u_{ipt}$$

where $\widehat{Eduy_{ipt}}$ is the predicted value of education from the first stage. The coefficient of β_1 is the parameter of interest, which captures the effect of an additional year of schooling on fertility behavior. More specifically, it is the estimated local average treatment effect (LATE) for compliers, i.e., those women who have changed their level of education because of the implementation of the CELC (Imbens and Angrist 1994).

4. Main Results

4.1 The Effect of Education on Fertility Behavior

Table 3 presents the results of the first-stage regression. In Column (1) we show the effect of a simple Exposure dummy variable (equals one if exposure is more than zero, and equals zero if non-exposed) on years of schooling, and find that exposure to the reform on average increases schooling by 0.93 years. In Column (3) we show that length of exposure to the CELC significantly improves years of schooling; one more year of exposure improves women's schooling by 0.36 years. The F-statistics are more than 60 indicating that the instrumental variable is not a weak IV (Stock and Yogo 2005). Furthermore, estimates suggest that the CELC significantly improves the schooling of women and is more effective in highly educated areas.[13]

<Table 3>

Table 4 is the results from the second stage: an additional year of schooling has reduced the number of children a woman would have by approximately 0.09 children, lowered the probability of having a second child or more children by 0.18 among those mothers whose first child was a girl, and postponed the age of first childbirth by 0.7 years.

<Table 4>

The postponement of fertility timing might be attributable to the direct impact of prolonged schooling on marriage timing. In Appendix Table 2, we present results from three specifications. First, we find that an additional year of schooling postponed the age of marriage by 0.33 years, while an additional year of schooling postponed the age of first childbirth by 0.7 years, indicating that the postponement of fertility among

[13] One possible explanation is that in higher-educated provinces before the CELC, the enforcement of the CELC is more strict, which results in a stronger effect. There is another working paper by the authors which discusses the enforcement of the CELC in more detail and is available upon request.

more educated women is not totally attributed to the postponement of marriage. Second, we control for marriage age in the main regression, and the result remains unchanged. Last, we drop the individuals with high school or more education, whose marriage timing might be directly affected by attending school; we find that the result of education on the age of first childbirth is similar.

It is worth noting that the effect of education on the fertility rate is underestimated by OLS, which is consistent with previous studies using compulsory schooling to estimate the relationship between education and the fertility rate (Leon 2004; Cygan-Rehm and Maeder 2013; Dinçer et al. 2014). Leon (2004) attributes the downward bias of OLS to heterogeneity across individuals and the nonlinearity of fertility to the return to schooling. Cygan-Rehm and Maeder (2013) argue that IV estimates the LATE effects, which does not reflect the effect among other stages of education.

In our context, one possibility is that the unobserved differences that encourage schooling, such as ability or access to credit, exert a positive impact on the fertility rate, e.g., persons with greater abilities or more access to credit are more likely to have better education, higher income, and more children. However, this argument depends largely on whether the pure income effect dominates the substitution effect.

Another plausible explanation is that in the context of China, the son preference is severe in rural areas, so before the CELC, girls had fewer opportunities than boys to receive an education. At that time, educated women were likely from relatively rich families, who shared the value of larger families and more off-springs. The effect of women’s education was offset by this positive bias.

A third explanation is that in comparison to the OLS estimates, the IV estimates are the LATE for compliers, i.e., those who would receive more education because of the implementation of the CELC (Imbens and Angrist 1994). Women’s education would affect fertility through the shift of views, values, and preferences; thus, those who are more willing to accept the education policy are more likely to be those who are willing to lead a different lifestyle after receiving more education. Therefore, those affected by CELC would become more affected by education.

Besides the baseline model, we also adopt several additional specifications as robustness checks. We employ the CELC exposure as the single instrumental variable as a robustness check. In terms of the number of children and incidence of having more than one child, the results in Appendix Table 3 are similar to the main results but insignificant in terms of childbearing age.[14] We also estimate the intention-to-treat (ITT) effects of the CELC exposure by directly regressing women's fertility outcomes on IVs. Results in Appendix Table 4 show that the ITT estimates are qualitatively similar to the LATE estimates from the 2SLS models.

Furthermore, instead of using the length of exposure to the CELC as an IV, we also construct a binary instrumental variable which equals one if the individual was affected by the CELC (aged 15 and below at the reform) and zero otherwise. The results using the binary IV are qualitatively similar to the ones using the continuous IV but the coefficients are not surprisingly larger.

Last, we use three educational levels, i.e., primary school or lower, junior high school, high school or beyond, instead of years of schooling to measure one's education outcome. In regression, primary school and below is the baseline group, and the other two groups are instrumented by two exposure level dummy variables, i.e., partial exposure and full exposure (following Cui et al. (2019), and their interactions with regional pre-reform education level as in the main analysis. The results are listed in Appendix Table 5 and are qualitatively similar to the main results.

4.2 Validity of Identification

We conduct two placebo tests to ensure that our findings are due to the CELC exposure rather than spurious correlations in the data or simply due to random statistical results.

The first test is based on the control experiment of Duflo (2001), in which she employed a sample of older cohorts to test the validity of treatment. As the CELC has actually impacted individuals aged 15 and under at the time it was enacted, In this placebo test we restrict the sample to women aged 21 to 36 in 1986 who were not

[14] We also used policy intensity as a single instrumental variable and found that the effects of years of schooling on fertility behavior are significant at the 1% level for all three outcome variables.

affected by the law actually.[15] Accordingly, we calculate the artificial exposure to the law using this placebo sample of older cohorts who were 53 to 68 years old in the survey year of 2018 in the same way as the actual exposure was calculated.[16] We expect that the artificial exposure will have no significant effect on the fertility outcomes of the older cohorts. Table 5 is the first and second stage estimations using the artificial exposure, and shows that estimates from both the first and second stages are not significant.[17] We also use the interaction between the artificial exposure and the intensity of the artificial program as the second instrumental variable; the intensity of the artificial program is measured by the proportion of people with fewer than nine years of schooling prior to the implementation of the artificial law.[18] Again we find that the results are not significant, as shown in Appendix Table 6.

<Table 5>

The second test is a permutation test, in which we use the same sample as the main analysis but randomly assign an effective year of the CELC to each province to examine whether the simulated policy has an impact on education (Rosenbaum 2007). In particular, for each province, we choose a random implementation year for the law between 1976 and 1996 and create the "random" exposure to the law based on the random implementation year and the women's birth year in the same way as we construct the actual exposure. We also create the simulated policy intensity by assigning the actual policy intensity values of all provinces to each province at random. We evaluate the effect of simulated policy on women's years of schooling using the simulated "random" CELC exposure and its interaction with the simulated "random" policy intensity, similar to the first stage regression in the main analysis.

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[15] In this sample of placebo test we exclude those aged 16 to 20 in 1986, the year CELC was enacted. Although they were not targeted by the law, they were still at school age when it went into effect, and they might have been affected as a result of grade repetition, delayed school entry, and spillover effect of younger siblings within a household. But even if these individuals are included in the placebo test, the results are similar.

[16] In line with the calculation of actual exposure, in this placebo sample, those aged 21 to 24 in the 1986 CELC enacted year are fully exposed with the value of 10, those aged 24 to 33 are partially exposed, and those aged 33 to 36 are nonexposed with the value of zero.

[17] The second stage coefficients are large in absolute value (Columns (2) to (4)) because the insignificant effect of exposure to the placebo policy on the education of older cohorts indicates a weak IV in the first stage (Column (1)).

[18] We calculate the proportion of people with fewer than nine years of schooling prior in each province in 1964 to measure the intensity of the artificial policy using the 1964 population census data, in correspond to the age of individuals in the placebo sample.

We then repeat this procedure 2,000 times, expecting there is no significant effect of the simulated "random" exposure on the women's education.

Figure 2 depicts the distribution of 2,000 "random" exposure coefficients, which we compare to the actual impact of CELC exposure on women's education from Table 3. The p-value of the permutation test is the fraction of "random" exposure coefficients that are bigger in absolute value than the actual coefficients. All of the p-values in the permutation test are less than 0.01, indicating that the effects of exposure on women's education in the main analysis are not attributable to random incidence.

<Figure 2>

5. Mechanisms

In this section, we further investigate the channels through which women's education exerts a negative causal impact on fertility.

5.1 Income, Labor Supply, and Leisure

Becker's fertility choice models serve as canonical models in family economics and fertility analysis. In their models, increasing women's education improves women's wages, which causes higher opportunity costs for having children; thus, fertility declines.

To investigate the mechanism between education and fertility outlined in Becker's fertility choice models, we first use the IV framework to examine the causal impact of women's education on their income.

We use the average of repeated income observed from 2010 to 2018 to smooth the possible transitory income shock. Columns (1) and (2) in Table 6 report the effects of women's education on women's income. The results show that an additional year of schooling significantly improves women's income by 2.2 thousand yuan per year on average. We also estimate the returns on education, and the results are listed in Columns (3) and (4). The return on education due to the implementation of the CELC is 0.45 for rural women aged 35–50, higher than the overall estimations in Fang et al.

(2012), who find the return to education using the CELC as an IV to be 0.2 for the total sample.

Columns (5) and (6) show the impact of income on complete fertility after controlling for the endogeneity of education. To emphasize the main point of potential channels, we focus on the number of children as the dependent variable in mechanism analyses, which is the most direct measurement of complete fertility. Increasing income reduces the number of children, but the square term is significantly positive, indicating that the impact of income on fertility is a "U" shape, which is in line with the findings of Hazan and Zoabi (2015). The coefficient of schooling years on fertility is no longer significant after controlling for income, indicating that education affects fertility through income.

<Table 6>

Additionally, we examine whether women's education affects their labor supply. Hazan and Zoabi (2015) constructed a structural framework in which women's education, fertility, and labor supply were considered simultaneously. If the income channel holds, it implies that more education will increase the women's labor supply, and they will have less time to raise children and less time on home production.

Table 7 shows the impact of women's education on labor supply, including both the agricultural and nonagricultural labor supply, participation in nonagricultural work, and nonagricultural working time of those who participate in nonagricultural work. In the estimation, we measure the working hours as the average of different waves from 2010 to 2018 to reduce the measurement error. The results show that women tend to reduce their labor market supply as years of schooling increase. Meanwhile, more educated women are more likely to participate in nonagricultural work, but when conditional on those who participated in nonagricultural work, nonagricultural working hours decreased along with the increase in education. However, it is worth noting that women with less education might be older cohorts who had worked for more years, and working hours have an accumulative effect. In addition, nonagricultural working might include more hours spent outside of the workplace. So the effect of schooling on working hours might be underestimated.[19]

<Table 7>

We further add the variable of working hours and nonagricultural work as well as nonagricultural working hours as controls in the regression. The results are robust when we add these three variables. The results in Table 8 show that only total working hours show significant negative effects on completed fertility, i.e., women who work longer in the labor market tend to have fewer children, which is in line with the opportunity cost story. However, more educated women tend to work slightly less in the labor market, indicating that labor market participation is not a leading reason for the fertility decline. Nonagricultural work participation does not show any significant impact on fertility, which is consistent with the arguments of Doepke et al. (2022).[20]

<Table 8>

We further examine the relationship between women's education and home production time as well as leisure, which reflects the importance of personal life. We use repeated observations for weekly housework hours to measure time spent on home production and weekly hours spent watching TV and movies to measure leisure time. The results shown in Appendix Table 7 indicate that more educated women tend to spend less time on home production and more time enjoying leisure. We also restrict the sample to women with at least one child under 16, among whom the home-producing time includes a large part of parenting time, and the results remain unchanged.

In summary, we find that women's increased income due to education improvement has an important effect on fertility. But we did not find consistent results in terms of labor supply. More educated women spend less time working in the labor market. Meanwhile, women with more education spend less time on home production but more time on leisure, suggesting a changing preference from a family-and-children-centered life to enjoying one's personal life. These findings

[19] We controlled for cohort fixed effects and used repeated working hours, which could alleviate the problem of the bias in working hours between older and younger cohorts.

[20] Related to nonagricultural work participation, previous studies found that urbanization was an important factor in fertility decline, both in the developed economy (Sato and Yamamoto, 2005) and in China's context (Lavely and Freedman, 1990; Guo et al., 2012).

motivate us to further investigate women's attitudes toward the quality and quantity of children.

5.2 Preferences for Quality of Children

In the theoretical analysis, both women's increased preference for the quality of children and decreased preference for the quantity of children can lead them to reduce the fertility (Galor 2012). As a way of learning and transmitting values, receiving an education is a plausible explanation of women valuing more the education of their children and their personal life instead of obtaining utility from having more children and child-centered family life.

Two variables are used to measure women's preference for the quality of children. One is education expenditure on children conditional on women's income and family income, measured by family yearly costs on all kinds of children's education-related fees. After controlling for women's and family income, spending more on children's education indicates that women or parents attach more importance to children's education.

The other indicator measures whether parents care about their children's education.[21] We use the 5-rank indicator and generate a binary variable with 0 representing indifferent, disagree, and strongly disagree and 1 representing agree and strongly agree. The data on education expenditures and care about children's education are from the CFPS 2010–2018 child survey. We match children's data to women's data. we control for characteristics of children, such as age, gender, education, height, and weight in the regressions. Therefore, the sample used in this section consists of matched child-mother observations. The results are listed in Table 9. Women with higher levels of education tend to value children's education more, hence reducing fertility.

<Table 9>

We add the variables of preferences for the quality of children, represented by

[21] The indicator is from the interviewer's question, "the environment in the family indicates that parents care about children's education." The answer is from 1 to 5: 1, strongly disagree; 2, disagree; 3, indifferent; 4, agree; 5, strongly agree.

educational expenditure on children and concern for children's education, to the main regression. Columns (1) and (2) in Table 10 show the impact of women's preferences for the quality of children on fertility. The estimates show that an increase in preference for the quality of children exerts a negative impact on women's fertility, and the coefficient of education decreases in the absolute level and is insignificant after controlling for preferences for the quality of children, which indicates that women's preferences for the quality of children are one of the important channels through which education reduces fertility.

<Table 10>

5.3 Preferences for Quantity of Children

To measure women's preference for the number of children, we use the ideal number of children as the dependent variable.[22] The larger the ideal number of children, the more women value the quantity of the offspring. Appendix Figure 1 shows the relation between women's years of schooling and the ideal number of children, which indicates a downward trend. The results in Table 11 show that with an additional year of schooling, women tend to reduce the ideal number of children by 0.1, indicating that more educated women prefer fewer children.

<Table 11>

Again, we add the preference for the quantity of children to the main regression. Columns (3) and (4) in Table 11 show that women's preference for the quantity of children is significantly positively related to the number of children, and the coefficient of years of schooling decreases in the absolute level and is insignificant after controlling for preferences for the quantity of children, indicating that the reducing preference for the quantity of children is another important channel through which education plays a negative role in fertility decline.

[22] This variable is based on the question "how many children do you think is ideal for you?" in the CFPS 2018 adult survey. As there are only less than 5% of women reported an ideal number of children greater than three, we construct a scale variable to measure women's ideal number of children, which equals 0 if the answer to the question is zero, equals 1 if the answer is one, equals 2 if the answer is two, equals 3 if the answer is three or more to correct the skewness of the true number.

5.4 Preference for Children- and Family-centered Life

The second demographic transition theory suggests that economic and social development, such as education improvement, help women develop a lifestyle in which they value their personal lives more, and they no longer regard children as the sole focus of their lives (Lesthaeghe 1995).

We use three variables to check this preference shift as women's education improved. The three variables are from three questions in the CFPS 2018 child survey evaluating the subject importance of "having a happy and harmonious family", "having children to carry on the family line", and "children being promising". The answers to each question are ranked on a scale from 1 to 5, indicating importance from "not important" to "very important".

Appendix Figure 2 shows slight downward relation between women's years of schooling and these three subjective indicators. In Appendix Table 8, after controlling for endogeneity, more educated women tend to attach less importance to having a happy family, having children to carry on the family line, and children being promising. The value shift indicates that with more schooling, women place less value on a child- and family-centered life, which is in line with the second demographic transition theory. The findings also demonstrate the role of social norms in determining fertility (Doepke et al. 2022).

6. Conclusions

Using the CFPS data, this paper exploits the implementation of compulsory education laws in the 1980s in China to empirically examine the impact of women's education on their fertility behavior. The results show that an additional year of schooling has reduced the number of children a woman would have by approximately 0.09 children, postponed the age of first childbirth by 0.7 years, and lowered the probability of having a second child or more children by 0.18 among those mothers whose first child was a girl.

The impact of income on fertility is a "U" shape, i.e., it reduces fertility at first but then increases fertility as income improves. But we do not find consistent results in terms of labor supply, we find that more years of schooling increases the probability of participation in nonagricultural work, but reduces women's labor market hours.

In line with the second demographic transition theory, in which fertility decline is considered to be a value shift, we find that more education reduces women's time on home production in addition to labor market hours while increasing women's leisure time.

The theoretical Q-Q tradeoff model implies that both increasing preferences for the quality of children and decreasing preferences for the quantity of children reduce fertility. However, in economic empirical studies, few studies focus on preference shifts. From the perspective of the second demographic transition theory, we examine the changes in preferences for the quality and quantity of children induced by the improvement of women's education. The empirical results suggest that women who are better educated prefer the quality to the quantity of children. Specifically, women spend more on children's education, care more about children's education, tend to report a smaller ideal number of children, and are less likely to regard children as the sole focus of their lives when they have more education.

As suggested by Doepke et al. (2022), social norms have become one of the key determinants in fertility decisions. This paper sheds light on the explanation of the decline in the fertility rate by exploring shifting preferences among better-educated women. In a rapidly aging economy such as China, fertility declines will be a major threat to economic growth and social development. Although China has been taking several steps to encourage fertility in the 2010s, a fertility rebound was not observed. An important policy implication of this study is that to promote fertility, re-shifting preferences to having more children and promoting a social norm of valuing a child- and family-centered life are equally important as other policies.

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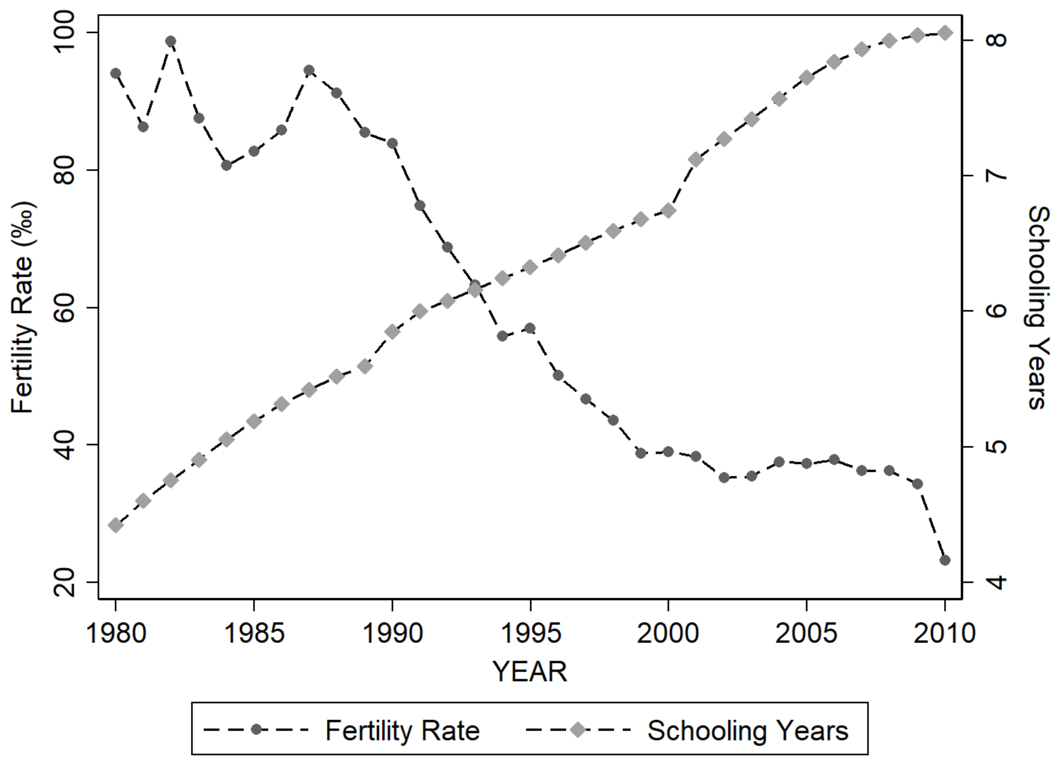


Figure 1: Fertility Rate and Years of Schooling of Birth-Aged Women in Rural China, 1980–2010

Data Sources: Calculated by authors. The China Census 1990 is used for the women's fertility rate and years of schooling of the 1980s, Census 2000 for data from the 1990s, and Census 2010 for data from the 2000s.

Notes: The fertility rate is the ratio of all births to the birth-aged women population in rural areas, i.e., *the Fertility rate in year t* equals *All Resident Births in year t* divided by *the Female Population aged 15–49 in year t*; Years of schooling is the average number of years of schooling of women aged 15–49 in rural areas.

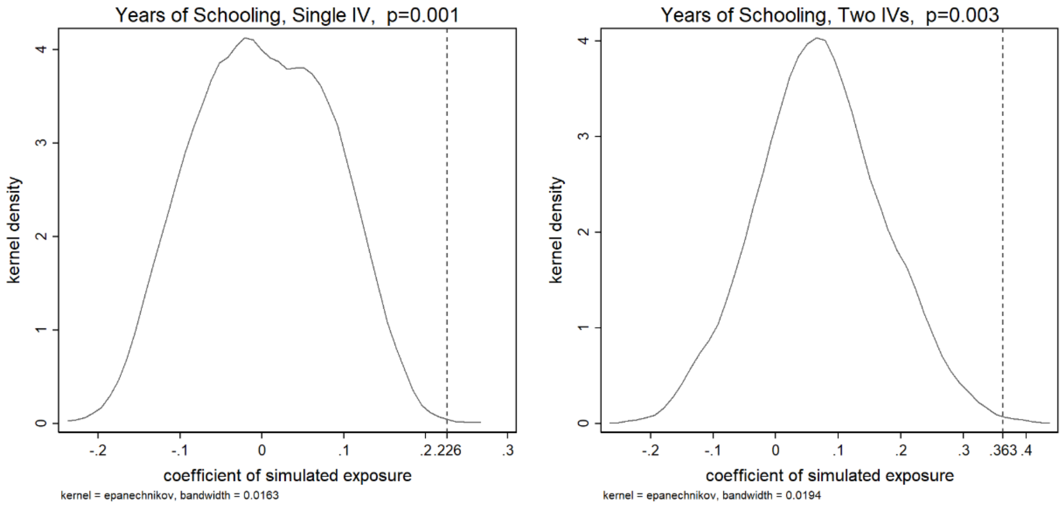


Figure 2: Women's education and fertility behavior: Permutation test

Data Sources: CFPS 2018

Notes: In the permutation test, we randomly assign an implementation year of CELC between 1976 and 1996 to each province. The "random" exposure to the policy is then constructed based on the randomly assigned effective year and birth year, and we randomly assign the actual values of policy intensity of all provinces to each province as the "random" policy intensity. The effect of simulated policy exposure on years of schooling is estimated based on two simulated instrumental variables, the simulated "random" CELC exposure and its interaction with the "random" policy intensity. We repeat the procedure 2,000 times and the p-value is the proportion of simulated coefficients of the "random" exposure greater than the actual coefficients in absolute value.

Table 1: Descriptive Statistics

Variable	Obs	Mean	Sd	Min	Max
Number of children	2880	1.952	0.794	1.000	7.000
Have a second (or more) birth	1411	0.815	0.388	0.000	1.000
Age at first childbirth[a]	2872	23.390	3.357	14.000	45.000
Years of schooling	2880	6.015	4.042	0.000	19.000
Exposure	2880	3.491	3.715	0.000	10.000
Age	2880	43.588	4.686	35.000	50.000
Marriage status (1=married)[b]	2880	0.996	0.062	0.000	1.000
Number of marriages	2880	0.998	0.0493	0.000	2.000
Ethnicity (1=Han)	2880	0.887	0.316	0.000	1.000
Health	2880	2.889	1.252	1.000	5.000
Family income per person (in thousand *yuan*)	2880	20.745	71.766	0.000	3300.00
Age of spouse	2880	45.430	5.430	29.000	69.000
Years of schooling of spouse	2880	7.036	3.983	0.000	16.000
OCP fine (times of annual salary)	2880	2.548	1.219	0.300	5.000
GDP per capita before CSLs (in *yuan*)	2880	772.200	393.800	420.000	3811.00
Province sex ratio before CSLs (%)	2880	52.156	2.545	45.738	60.920

Notes: [a] Approximately 1.8% of the sample women had their first child when they had not reached 18, and 8.1% had their first child when they had not reached 20, which is the legal age of marriage. However, our empirical results are similar when excluding these observations.

[b] Among our sample, 99.6% (2,869 of 2,880) are currently married, and the remainder are unmarried (2 observations), cohabit (6 observations), divorced (1 observation), or widowed (2 observations).

Table 2: Pre-reform Characteristics and Reform Years

VARIABLES	CELC implementation years
GDP per capita	-0.002
	(0.002)
Average wage	0.005
	(0.006)
Unemployment rate	0.350
	(0.424)
Birth rate	0.135
	(0.111)
Population density	0.002
	(0.002)
Proportion of illiteracy	-0.013
	(0.083)
Proportion of below 9-years education	0.530
	(2.474)
Gender gap in years of schooling	0.216
	(3.879)
Proportion of female employees	0.076
	(0.133)
Observations	25
p-value of F-statistics	0.254
R-squared	0.349

Source： 1985 China statistical yearbook and 1982 Population Census.

Notes: Robust standard errors are in parentheses; *Gender gap in years of schooling* are measured in 1982, other variable are measured in 1985.

Table 3: IV Estimation of Impact of Schooling on Fertility Behavior: First Stage

	(1)	(2)	(3)
VARIABLES		Years of schooling	
Exposure		**0.226*****	**0.363*****
		(0.059)	**(0.069)**
Exposure*Preprop			**-0.471*****
			(0.132)
Exposure_Dummy	0.927***		
	(0.255)		
Marriage status	-0.813	-0.717	-0.703
	(1.448)	(1.418)	(1.428)
Number of marriages	-2.729**	-2.699**	-2.686**
	(1.209)	(1.191)	(1.217)
Ethnicity	1.175***	1.270***	1.290***
	(0.223)	(0.228)	(0.229)
Health	0.124**	0.120**	0.113**
	(0.053)	(0.053)	(0.052)
Family income per capita	0.002**	0.002**	0.002**
(in thousand *yuan*)	(0.001)	(0.001)	(0.001)
Age of spouse	-0.065***	-0.063***	-0.061***
	(0.021)	(0.021)	(0.021)
Years of schooling of spouse	0.340***	0.338***	0.333***
	(0.018)	(0.018)	(0.018)
OCP fine	0.068	0.073	0.081
	(0.059)	(0.060)	(0.059)
GDP per capita	0.596***	0.560***	0.340**
(in thousand *yuan*)	(0.152)	(0.153)	(0.162)
Province Sex ratio	13.638***	15.057***	15.866***
	(3.352)	(3.308)	(3.311)
Birth cohort dummy	YES	YES	YES
Region dummy	YES	YES	YES
Observations	2,880	2,880	2,880
R-squared	0.341	0.341	0.344

Data Source： CFPS 2018

Notes: Robust standard errors are in parentheses
* p<0.1; ** p<0.05; *** p<0.01

Table 4: IV Estimation of Impact of Schooling on Fertility Behavior: Second Stage

	(1)	(2)	(3)	(4)	(5)	(6)
	Number of children		Have a second birth		Age at first childbirth	
VARIABLES	OLS	IV	OLS	IV	OLS	IV
Years of schooling	-0.032***	**-0.092****	-0.016***	**-0.177*****	0.068***	**0.712*****
	(0.004)	**(0.043)**	(0.003)	**(0.056)**	(0.015)	**(0.200)**
Marriage status	0.178	0.127	-0.110	-0.125	0.851	1.294
	(0.114)	(0.178)	(0.133)	(0.493)	(0.538)	(1.341)
Number of marriages	0.293*	0.127	0.385	0.023	-2.035	-0.640
	(0.167)	(0.226)	(0.377)	(0.720)	(1.846)	(2.172)
Ethnicity	-0.170***	-0.104	0.016	0.163*	-0.317*	-1.017***
	(0.056)	(0.082)	(0.033)	(0.086)	(0.193)	(0.336)
Health	0.021*	0.029**	0.017**	0.039**	0.008	-0.074
	(0.012)	(0.013)	(0.008)	(0.015)	(0.046)	(0.061)
Family income	-0.001**	-0.000*	-0.000***	-0.000	-0.002**	-0.003**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Age of spouse	-0.011**	-0.015**	-0.007**	-0.016**	-0.273***	-0.229***
	(0.005)	(0.006)	(0.003)	(0.007)	(0.020)	(0.028)
Education of spouse	-0.016***	0.005	-0.002	0.054***	0.025	-0.197***
	(0.004)	(0.016)	(0.003)	(0.019)	(0.016)	(0.071)
OCP fine	0.102***	0.106***	0.038***	0.042**	-0.237***	-0.273***
	(0.013)	(0.014)	(0.011)	(0.018)	(0.055)	(0.066)
GDP per capital	-0.166***	-0.132***	-0.187***	-0.119*	-0.342	-0.707**
	(0.039)	(0.046)	(0.041)	(0.061)	(0.284)	(0.320)
Province sex ratio	-4.470***	-3.547***	-2.178***	0.814	80.029***	69.929***
	(0.754)	(1.012)	(0.572)	(1.360)	(3.639)	(5.173)
Birth cohort dummy	YES	YES	YES	YES	YES	YES
Region dummy	YES	YES	YES	YES	YES	YES
Observations	2,880	2,880	1,411	1,411	2,872	2,872
R-squared	0.152	-	0.164	-	0.351	-

Data Source：CFPS 2018

Notes: Robust standard errors are in parentheses;

The instrumental variables are exposure to the CELC and interaction between exposure and program intensity measured by proportion of people with fewer than 9 years of schooling prior to CELC at province level;

* p<0.1; ** p<0.05; *** p<0.01

Table 5: Schooling on Fertility Behavior: Placebo test

VARIABLES	(1) Years of schooling First stage	(2) Number of children IV	(3) Have a second birth IV	(4) Age at first childbirth IV
Exposure	0.049			
	(0.069)			
Years of schooling		-0.657	0.635	2.561
		(0.967)	(1.175)	(3.355)
Control variables	YES	YES	YES	YES
Birth cohort dummy	YES	YES	YES	YES
Region dummy	YES	YES	YES	YES
Observations	2,480	2,480	1,068	2,472
R-squared	0.217	-	-	-

Data Sources: CFPS 2018;

Notes: Robust standard errors are in parentheses;

Sample in this placebo test consists of women aged 21 to 36 in 1986, the year when CELC was enacted, assuming that the law affected these older cohorts. Instrumental variable used in Column (2) to (4) is the artificial exposure to the policy;

Other control variables include the following: 1) women's information: *Marriage status*, *Number of marriages*, *Ethnicity*, *Health*; 2) spouse and family information: spouse's *Age*, *Years of schooling*, *Household income per capita*; and 3) province information: *OCP fine*, *GDP per capita*, *Province sex ratio*;

* p<0.1; ** p<0.05; *** p<0.01

Table 6: Schooling on Fertility Rate: Income Channel

VARIABLES	Personal income		Ln (Personal income+1)		Number of children	
	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Years of schooling	0.526***	**2.225*** **	0.140***	**0.447** **	-0.027***	**-0.066**
	(0.075)	**(0.619)**	(0.019)	**(0.193)**	(0.005)	**(0.046)**
Personal income					-0.013***	-0.011***
					(0.002)	(0.004)
Personal income squared					0.062***	0.055***
					(0.011)	(0.014)
Control variables	YES	YES	YES	YES	YES	YES
Birth cohort dummy	YES	YES	YES	YES	YES	YES
Region dummy	YES	YES	YES	YES	YES	YES
Observations	2,849	2,849	2,849	2,849	2,849	2,849
R-squared	0.147	-	0.085	-	0.170	-

Data Sources: CFPS 2018 and CFPS 2010, 2012, 2014, 2016 are used for repeated *personal income.*

Notes: Robust standard errors are in parentheses;

The instrumental variables are exposure to the CELC and interaction between exposure and program intensity measured by proportion of people with fewer than 9 years of schooling prior to CELC at province level;

Other control variables include the following: 1) women's information: *Marriage status*, *Number of marriages*, *Ethnicity*, *Health*; 2) spouse and family information: spouse's *Age*, *Years of schooling*, *Household income per capita*; and 3) province information: *OCP fine*, *GDP per capita*, *Province sex ratio*;

* p<0.1; ** p<0.05; *** p<0.01

Table 7: Schooling on Labor Market Participation

VARIABLES	Weekly hours in labor market		Nonagri work		Nonagri working hours	
	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Years of schooling	0.456***	**-0.252**	0.025***	**0.085*** **	-0.638***	**-1.407**
	(0.104)	**(1.047)**	(0.003)	**(0.024)**	(0.230)	**(1.829)**
Control variables	YES	YES	YES	YES	YES	YES
Birth cohort dummy	YES	YES	YES	YES	YES	YES
Region dummy	YES	YES	YES	YES	YES	YES
Observations	2,859	2,859	2,558	2,558	1,004	1,004
R-squared	0.052	-	0.178	-	0.040	-

Data Sources: CFPS 2018 and CFPS 2010, 2012, 2014, 2016 are used for repeated *working hours.*

Notes: Robust standard errors are in parentheses;

The instrumental variables are exposure to the CELC and interaction between exposure and program intensity measured by proportion of people with fewer than 9 years of schooling prior to CELC at province level;

Other control variables include the following: 1) women's information: *Marriage status*, *Number of marriages*, *Ethnicity*, *Health*; 2) spouse and family information: spouse's *Age, Years of schooling*, *Household income per capita*; and 3) province information: *OCP fine, GDP per capita*, *Province sex ratio*;

* p<0.1; ** p<0.05; *** p<0.01

Table 8: Schooling on Fertility Rate: Labor Market Participation Channel

VARIABLES	Dependent variable: Number of children							
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Years of schooling	-0.031***	**-0.081****	-0.031***	**-0.093****	-0.033***	**-0.089****	-0.031***	**-0.090****
	(0.005)	**(0.041)**	(0.005)	**(0.044)**	(0.005)	**(0.039)**	(0.005)	**(0.042)**
Weekly hours in labor market	-0.003***	**-0.002****					-0.002**	**-0.002****
	(0.001)	**(0.001)**					(0.001)	**(0.001)**
Nonagri work			-0.113***	**-0.032**			-0.180***	**-0.059**
			(0.031)	**(0.068)**			(0.069)	**(0.114)**
Nonagri working hours					-0.001***	**-0.000**	0.002	**0.001**
					(0.000)	**(0.001)**	(0.001)	**(0.001)**
Control variables	YES	YES	YES	YES	YES	YES	YES	YES
Birth cohort dummy	YES	YES	YES	YES	YES	YES	YES	YES
Region dummy	YES	YES	YES	YES	YES	YES	YES	YES
Observations	2,859	2,859	2,558	2,558	2,477	2,477	2,476	2,476
R-squared	0.159	-	0.160	-	0.160	-	0.164	-

Data Sources: CFPS 2018 and CFPS 2010, 2012, 2014, 2016 are used for repeated *working hours.*

Notes: Robust standard errors are in parentheses;

The instrumental variables are exposure to the CELC and interaction between exposure and program intensity measured by proportion of people with fewer than 9 years of schooling prior to CELC at province level;

Other control variables include the following: 1) women's information: *Marriage status*, *Number of marriages*, *Ethnicity*, *Health*; 2) spouse and family information: spouse's *Age*, *Years of schooling*, *Household income per capita*; and 3) province information: *OCP fine*, *GDP per capita*, *Province sex ratio*;

* p<0.1; ** p<0.05; *** p<0.01

Table 9: Schooling on Preference for Quality of Children

VARIABLES	Education expenditure on children		Care about children's education		Care about children's education-Binary	
	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Years of schooling	0.079***	**0.823*** **	0.021***	**0.076*** **	0.012***	**0.041** **
	(0.009)	**(0.150)**	(0.002)	**(0.029)**	(0.001)	**(0.018)**
Personal income	0.181***	-0.208***	0.007	-0.022	0.004	-0.012
(logged)	(0.033)	(0.081)	(0.007)	(0.017)	(0.004)	(0.011)
Control variables	YES	YES	YES	YES	YES	YES
Birth cohort dummy	YES	YES	YES	YES	YES	YES
Region dummy	YES	YES	YES	YES	YES	YES
Observations	11,223	11,223	10,978	10,978	10,978	10,978
R-squared	0.140	-	0.054	-	0.042	-

Data Sources: CFPS 2018 for women, spouse and household information, CFPS 2010, 2012, 2014, 2016 are used for repeated *personal income*, CFPS 2010–2018 for child information.

Notes: Robust standard errors are in parentheses;

The instrumental variables are exposure to the CELC and interaction between exposure and program intensity measured by proportion of people with fewer than 9 years of schooling prior to CELC at province level;

Other control variables include: 1) women's information: *Marriage status*, *Number of marriages*, *Ethnicity*, *Health*; 2) spouse and family information: spouse's *Age*, *Years of schooling*, *Household income per capita*; 3) province information: *OCP fine*, *GDP per capita*, *Province sex ratio*; and 4) child's *Age*, *Gender*, *Years of schooling*, *Weight*, *Height*;

* p<0.1; ** p<0.05; *** p<0.01

Table 10: Schooling on Fertility Rate: Preference Channel

VARIABLES	Number of children			
	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
Years of schooling	-0.031***	**-0.054**	-0.021***	**-0.023**
	(0.005)	**(0.057)**	(0.004)	**(0.042)**
Measures for preference for quality of children				
Education expenditure on children	-0.030***	**-0.026****		
	(0.005)	**(0.013)**		
Care about children's education	-0.030	**-0.005**		
	(0.065)	**(0.090)**		
Care about children's education-Binary	-0.060	**-0.074**		
	(0.097)	**(0.102)**		
Measures for preference for quantity of children				
Ideal number of children			0.659***	**0.657*****
			(0.031)	**(0.047)**
Control variables	YES	YES	YES	YES
Birth cohort dummy	YES	YES	YES	YES
Region dummy	YES	YES	YES	YES
Observations	2,263	2,263	2,871	2,871
R-squared	0.181	-	0.332	-

Data Source: CFPS 2018

Notes: Robust standard errors are in parentheses;

The instrumental variables are exposure to the CELC and interaction between exposure and program intensity measured by proportion of people with fewer than 9 years of schooling prior to CELC at province level;

Other control variables include the following: 1) women's information: *Marriage status, Number of marriages, Ethnicity, Health*; 2) spouse and family information: spouse's *Age, Years of schooling, Household income per capita*; and 3) province information: *OCP fine, GDP per capita, Province sex ratio*;

* p<0.1; ** p<0.05; *** p<0.01

Table 11: Schooling on Preference for Quantity of Children

VARIABLES	Ideal number of children	
	OLS	IV
Years of schooling	-0.017***	**-0.103*** **
	(0.003)	**(0.032)**
Control variables	YES	YES
Birth cohort dummy	YES	YES
Region dummy	YES	YES
Observations	2,871	2,871
R-squared	0.124	-

Source: CFPS 2018

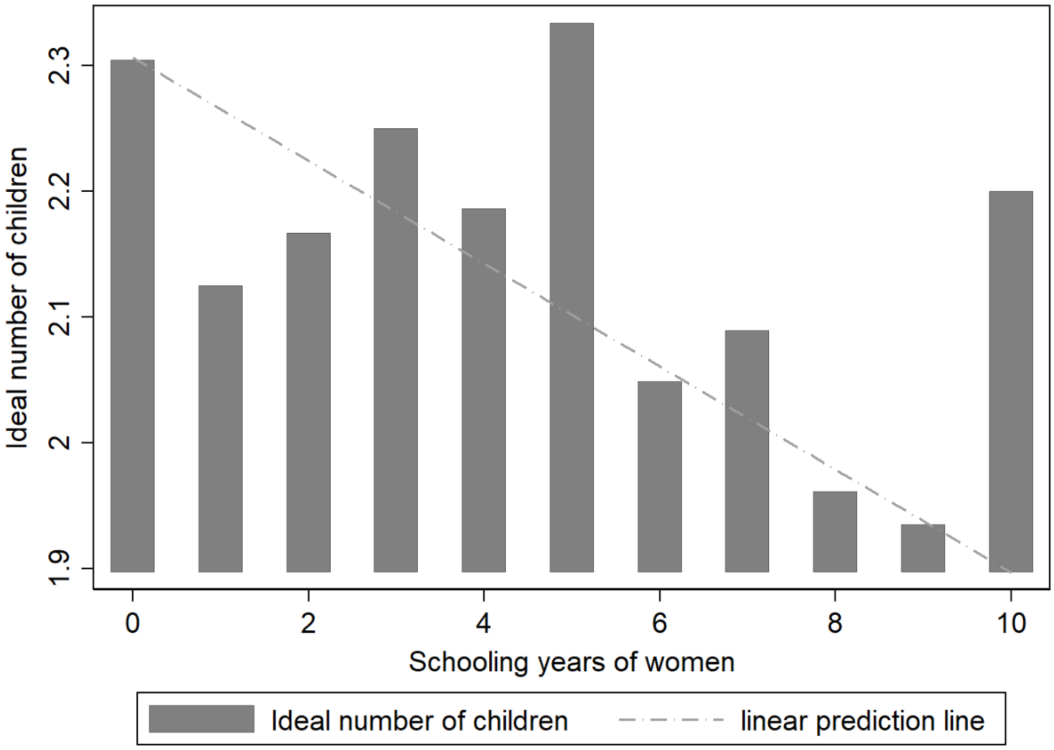
Notes: Robust standard errors are in parentheses;

The instrumental variables are exposure to the CELC and interaction between exposure and program intensity measured by proportion of people with fewer than 9 years of schooling prior to CELC at province level;

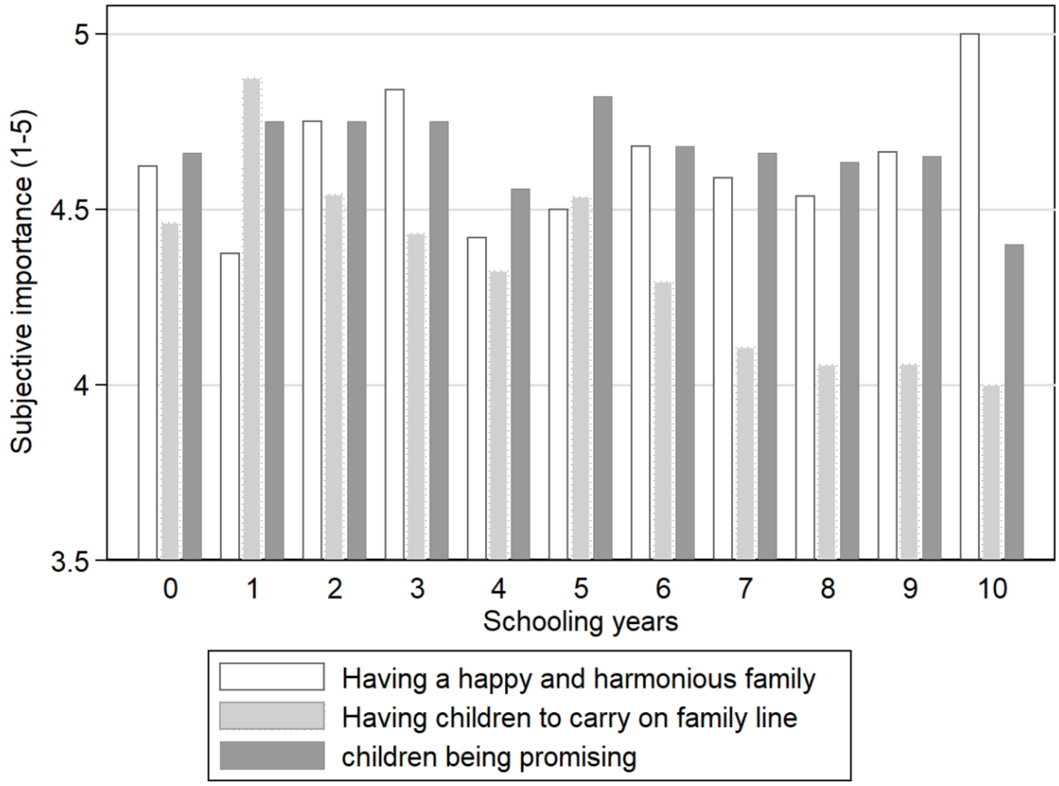
Other control variables include: 1) women's information: *Marriage status*, *Number of marriages*, *Ethnicity*, *Health*; 2) spouse and family information: spouse's *Age*, *Years of schooling*, *Household income per capita*; and 3) province information: *OCP fine*, *GDP per capita, Province sex ratio*;

* p<0.1; ** p<0.05; *** p<0.01

Appendix Figures and Tables



Appendix Figure 1: Schooling and Ideal Number of Children of Women Aged 35–50
Data Source: CFPS 2018.



Appendix Figure 2: Schooling and Subjective Importance of Children, Family Life of Women Aged 35–50

Data Source: CFPS 2018.

Appendix Table 1: Implementation Year of CELC in Each Province

Province	Law effective year
Beijing	1986
Hebei	1986
Shanxi	1986
Liaoning	1986
Heilongjiang	1986
Zhejiang	1986
Jiangxi	1986
Chongqing	1986
Sichuan	1986
Tianjin	1987
Jilin	1987
Shanghai	1987
Jiangsu	1987
Anhui	1987
Shandong	1987
Henan	1987
Hubei	1987
Guangdong	1987
Yunnan	1987
Guizhou	1988
Shaanxi	1988
Xinjiang	1988
Fujian	1989
Hunan	1991
Guangxi	1991
Gansu	1991

Source: Huang (2015)

Appendix Table 2: Schooling on Marriage Timing and Fertility Timing

VARIABLES	Age at marriage	Age at fertility	Age at fertility (excluding high school and above)
	IV	IV	IV
Years of schooling	0.334**	0.427***	0.656***
	(0.169)	(0.161)	(0.247)
Age at marriage		0.632***	
		(0.037)	
Control variables	YES	YES	
Birth cohort dummy	YES	YES	
Region dummy	YES	YES	
Observations	2,777	2,770	2,639
R-squared	-	-	

Source: CFPS 2018

Notes: Robust standard errors are in parentheses;

The instrumental variables are exposure to the CELC and interaction between exposure and program intensity measured by proportion of people with fewer than 9 years of schooling prior to CELC at province level;

Other control variables include: 1) women's information: *Marriage status, Number of marriages*, *Ethnicity*, *Health*; 2) spouse and family information: spouse's *Age*, *Years of schooling*, *Household income per capita*; and 3) province information: *OCP fine*, *GDP per capita, Province sex ratio*;

* p<0.1; ** p<0.05; *** p<0.01.

Appendix Table 3: IV Estimation of Impact of Schooling on Fertility Rate: Single IV

	(1)	(2)	(3)
	Number of children	Have a second birth	Age at first childbirth
VARIABLES	IV	IV	IV
Years of schooling	-0.162**	-0.189**	0.070
	(0.067)	(0.087)	(0.209)
Control variables	YES	YES	YES
Birth cohort dummy	YES	YES	YES
Region dummy	YES	YES	YES
Observations	2,880	1,411	2,872
R-squared	-	-	-

Data Source： CFPS 2018

Notes: Robust standard errors are in parentheses;

The instrumental variable is exposure to the CELC;

Other control variables include the following: 1) women's information: *Marriage status*, *Number of marriages*, *Ethnicity*, *Health*; 2) spouse and family information: spouse's *Age*, *Years of schooling*, *Household income per capita*; and 3) province information: *OCP fine*, *GDP per capita*, *Province sex ratio*;

* p<0.1; ** p<0.05; *** p<0.01

Appendix Table 4: Impact of Schooling on Fertility Rate: Reduced-form estimations

	(1)	(2)	(3)	(4)	(5)	(6)
	Number of children		Have a second birth		Age at first childbirth	
VARIABLES	OLS	OLS	OLS	OLS	OLS	OLS
Exposure	-0.037***	-0.038**	-0.035***	-0.060***	0.016	0.222***
	(0.014)	(0.016)	(0.008)	(0.011)	(0.048)	(0.059)
Exposure*Preprop		0.003		0.081***		-0.705***
		(0.027)		(0.018)		(0.111)
Control variables	YES	YES	YES	YES	YES	YES
Birth cohort dummy	YES	YES	YES	YES	YES	YES
Region dummy	YES	YES	YES	YES	YES	YES
Observations	2,880	2,880	1,411	1,411	2,872	2,872
R-squared	0.137	0.137	0.156	0.165	0.347	0.357

Data Source: CFPS 2018

Notes: Robust standard errors are in parentheses;

Other control variables include the following: 1) women's information: *Marriage status*, *Number of marriages*, *Ethnicity*, *Health*; 2) spouse and family information: spouse's *Age*, *Years of schooling*, *Household income per capita*; and 3) province information: *OCP fine*, *GDP per capita*, *Province sex ratio*;

* p<0.1; ** p<0.05; *** p<0.01

Appendix Table 5: The Effect of Educational Level on Fertility

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Junior high school	High school or beyond	Number of children		Have a second child		Age at first childbirth	
VARIABLES	OLS		OLS	IV	OLS	IV	OLS	IV
(Primary or lower as baseline)								
Junior high school			-0.176***	-0.873**	-0.083***	-0.904***	0.359***	2.660*
			(0.032)	(0.374)	(0.026)	(0.258)	(0.126)	(1.590)
High school or beyond			-0.271***	0.221	-0.161***	-0.966	1.336***	9.817***
			(0.053)	(0.561)	(0.046)	(0.669)	(0.210)	(2.413)
Partial_Exposure	0.318***	-0.004						
	(0.062)	(0.036)						
Full_Exposure	0.151*	0.202***						
	(0.084)	(0.050)						
Partial_Exposure *Preprop	-0.594***	-0.017						
	(0.133)	(0.077)						
Full_Exposure *Preprop	-0.217	-0.469***						
	(0.156)	(0.092)						
Control variables	YES	YES	YES	YES	YES	YES	YES	YES
Birth cohort dummy	YES	YES	YES	YES	YES	YES	YES	YES
Region dummy	YES	YES	YES	YES	YES	YES	YES	YES
Observations	2,880	2,880	2,880	2,880	1,411	1,411	2,872	2,872
R-squared	0.156	0.128	0.145	-	0.158	-	0.356	-

Data Source: CFPS 2018
Notes: Robust standard errors are in parentheses;

Other control variables include: 1) women's information: *Marriage status*, *Number of marriages*, *Ethnicity*, *Health*; 2) spouse and family information: spouse's *Age*, *Years of schooling*, *Household income per capita*; and 3) province information: *OCP fine*, *GDP per capita*, *Province sex ratio*;

* p<0.1; ** p<0.05; *** p<0.01.

Appendix Table 6: Schooling on Fertility Rate: Placebo test using two instrumental variables

	(1)	(2)	(3)	(4)
	Years of schooling	Number of children	Have a second birth	Age at first childbirth
VARIABLES	OLS	IV	IV	IV
Exposure	0.616			
	(0.425)			
Exposure*Preprop	-0.615			
	(0.456)			
Years of schooling		0.168	-0.062	0.433
		(0.170)	(0.089)	(0.540)
Control variables	YES	YES	YES	YES
Birth cohort dummy	YES	YES	YES	YES
Region dummy	YES	YES	YES	YES
Observations	2,480	2,480	1,068	2,472
R-squared	0.217	-	-	-

Data Sources: CFPS 2018;

Notes: Robust standard errors are in parentheses;

Sample in this placebo test consists of women aged 21 to 36 in 1986, the year when CELC was enacted, assuming that the law affected these older cohorts. Instrumental variable used in Column (2) to (4) is the artificial exposure to the policy and the interaction between exposure and intensity of the artificial policy;

Other control variables include the following: 1) women's information: *Marriage status*, *Number of marriages*, *Ethnicity*, *Health*; 2) spouse and family information: spouse's *Age*, *Years of schooling*, *Household income per capita*; and 3) province information: *OCP fine*, *GDP per capita*, *Province sex ratio*;

* p<0.1; ** p<0.05; *** p<0.01

Appendix Table 7: Schooling on Time Allocation

VARIABLES	Time for home production		Time for home production (Conditional on having child(ren) under 16)		Time for leisure	
	OLS	IV	OLS	IV	OLS	IV
Years of schooling	-0.024***	**-0.271*** **	-0.025**	**-0.280** **	0.204***	**1.157*** **
	(0.007)	**(0.087)**	(0.010)	**(0.128)**	(0.047)	**(0.448)**
Control variables	YES	YES	YES	YES	YES	YES
Birth cohort dummy	YES	YES	YES	YES	YES	YES
Region dummy	YES	YES	YES	YES	YES	YES
Observations	2,880	2,880	1,566	1,566	2,873	2,873
R-squared	0.054	-	0.079	-	0.022	-

Data Sources: CFPS 2018 and CFPS 2010, 2012, 2014, 2016 are used for repeated *home producing hours.*

Notes: Robust standard errors are in parentheses;

The instrumental variables are exposure to the CELC and interaction between exposure and program intensity measured by proportion of people with fewer than 9 years of schooling prior to CELC at province level;

Other control variables include the following: 1) women's information: *Marriage status*, *Number of marriages*, *Ethnicity*, *Health*; 2) spouse and family information: spouse's *Age*, *Years of schooling*, *Household income per capita*; and 3) province information: *OCP fine*, *GDP per capita*, *Province sex ratio*;

* p<0.1; ** p<0.05; *** p<0.01

Appendix Table 8: Schooling and Preferences for Children- and Family-Centered Life

VARIABLES	Importance of having a happy family		Importance of having children to carry family line		Importance of children being promising	
	OLS	IV	OLS	IV	OLS	IV
Years of schooling	-0.005	**-0.096****	-0.050***	**-0.306*****	-0.016***	**-0.100****
	(0.004)	**(0.045)**	(0.006)	**(0.076)**	(0.004)	**(0.042)**
Control variables	YES	YES	YES	YES	YES	YES
Birth cohort dummy	YES	YES	YES	YES	YES	YES
Region dummy	YES	YES	YES	YES	YES	YES
Observations	2,880	2,880	2,879	2,879	2,879	2,879
R-squared	0.021	-	0.060	-	0.020	-

Data Sources: CFPS 2018

Notes: Robust standard errors are in parentheses;

The instrumental variables are exposure to the CELC and interaction between exposure and program intensity measured by proportion of people with fewer than 9 years of schooling prior to CELC at province level;

Other control variables include the following: 1) women's information: *Marriage status*, *Number of marriages*, *Ethnicity*, *Health*; 2) spouse and family information: spouse's *Age*, *Years of schooling*, *Household income per capita*; and 3) province information: *OCP fine*, *GDP per capita*, *Province sex ratio*;

* p<0.1; ** p<0.05; *** p<0.01