# Intergenerational Impact of Birth-Control Policies on Fertility: The Role of Norms

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# Intergenerational Impact of Birth-Control Policies on Fertility: The Role of Norms

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**Abstract**

We study the intergenerational impact of birth-control policies on fertility and examine whether and how these policies persistently reduce fertility even after their abolition. We develop a model that integrates the endogeneous evolution of fertility norms. Birth-control policies, through the reduction of mothers' fertility, establish new norms that shape the fertility decisions of subsequent generations. Consequently, daughters' fertility is lower due to these new norms, even when the policies are no longer in force. To test the model's implications, we leverage a quasi-experimental setting provided by China's One-Child Policy, which was implemented from 1979 in a staggered manner and abolished in 2016. Based on the recently released 2020 population census, our results reveal that the policy has a persistent impact on reducing fertility and affects generations no longer subject to its regulations. This study is the first to provide causal evidence of birth-control policies from an intergenerational perspective, and highlights the role of norms in shaping fertility outcomes.

**JEL Classification:** D1,J11,J13

**Key words:** Birth-control Policies; Fertility; Norms; Intergenerational Spillovers

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# 1 Introduction

Fertility rates have decreased across countries and regions at all income levels worldwide over the past half-century, as shown in Fig. 1a. By 2021, the total fertility rate (TFR) for 110 out of 217 countries fell to or below the replacement level of 2.1.[1] This trend of low fertility presents a significant challenge for policymakers globally and has sparked extensive academic interest in exploring the causes of this long-term decline (Doepke et al., 2023). Beyond shifts in social, economic, and cultural conditions, birth-control policies have also played a role in this global fertility decline. Between 1976 and 2013, 160 out of 217 countries implemented such policies in various forms (De Silva and Tenreyro, 2017). Fig. 1b shows the share of countries that implemented such policies by income level over the past half-century. This share has decreased for upper-middle-income countries and increased for low-income countries.[2]

We ask: Have these policies continued to persistently decrease fertility even after their abolition? If so, what are the underlying reasons for this persistence? Understanding the answers to these questions is crucial for countries that had formerly implemented such policies. In Fig. 1c, we categorize upper-middle-income countries into two groups: those that never adopted birth-control policies and those that adopted and later abandoned such policies before 2007. The never-adopted group saw a TFR decrease from 4.4 in 1960 to 1.7 in 2021, while the ever-adopted group experienced a drop from 6.2 in 1960 to 1.3 in 2021. This pattern is consistent with a persistent effect of birth-control policies on fertility.

Our analysis begins with a model that integrates the endogeneous evolution of fertility norms. It examines how birth-control policies for mothers impact the fertility of their daughters and persist even after the policies are no longer in effect for daughters. In our model, a women's fertility is determined not just by the economic costs and benefits of childbearing, but also by social norms for fertility. Following the "conformity" framework (Akerlof, 1997), we assume that a mother's fertility establishes a norm for her daughter. A daughter's fertility level deviates from the "intrinsic" optimal level, which is determined solely by economic costs and benefits, and moves closer to the fertility level of her mother. In an economy with initially high fertility rates, daughters' fertility tends to surpass the

[1] Data sources: World Development Indicator Database. The TFR is defined as the average number of children born to a woman over her lifetime.

[2] We categorized countries into income levels based on the earliest standard released by the World Bank.

"intrinsic" optimal level. However, birth-control policies that reduce mothers' fertility levels can establish new norms of lower fertility, and thereby lead to lower fertility rates in their daughters.

To empirically test our theoretical predictions, we require a one-shot birth control policy that impacts a single generation and is subsequently lifted for following generations. China's One-Child Policy (OCP), and its unexpected abolition, offers an ideal context for such analysis. The OCP's rollout across provinces in the late 1970s and early 1980s offers a quasi-experimental setting by directly imposing a fertility restriction on mothers of those born in the 1970s, and thereby reducing sibling sizes for the 1970s birth cohort. Easing of the OCP began in 2014 with implementation of the "Selective Two-Child Policy," which allowed couples to have a second child if either spouse was an only child. This relaxation culminated on December 27, 2015, with a proposed amendment to the Law of Population and Family Planning. This led to the unexpected introduction of a universal two-child policy on January 1, 2016, and thereby ended the OCP era. Importantly, those born in the 1970s cohort remained within their reproductive years post-abolition.

Our empirical analyses are based on multiple datasets. The recently released 2020 population census provides valuable data on the fertility behavior of the 1970s cohort following termination of the OCP. We also use the 2010 population census, 2005 and 2015 mini-censuses, China Family Panel Studies (CFPS) for 2012 to 2018, and 1987 Fertility In-Depth Survey (FIDS).

We employ a cohort event-study design to identify the causal effect of maternal exposure to the OCP on the fertility of women born in the 1970s, leveraging the rollout of the OCP across provinces in the late 1970s and early 1980s. We carefully measure and validate the timing of the OCP's rollout across provinces using a variety of sources, including government documents, *Population Chronicles*, and the *Encyclopedia of Chinese Family Planning*. In this setup, a mother's exposure to the OCP within a province is determined by her daughter's birth year relative to the year the policy was implemented: Mothers of daughters born post-implementation were more exposed to the OCP, compared with those whose daughters were born prior to the OCP.

We find that maternal exposure to the OCP lowers her daughter's fertility. Conditional on birth-province and birth-year fixed effects, fertility is up to 0.22 lower for daughters born 1 year after OCP implementation, compared with daughters born before the OCP.

This effect is substantial, especially given the notably low TFR of 1.06 in China in 2022.[3] Because the OCP lowers maternal fertility by 0.33, a Wald estimator suggests that a one-unit decrease in maternal fertility leads to a 0.67 (0.22/0.33) reduction in daughters' fertility.

We conduct a battery of robustness checks. First, the event-study design requires the absence of an anticipation effect. We detect no pre-trend in fertility outcomes before the year of OCP implementation. Second, the key identifying assumption of our event-study design is parallel trends in potential fertility outcomes. We control for three contemporaneous events that may correlate with OCP timing and fertility outcomes, and further add interactions between birth-cohort dummies and a series of pre-OCP socioeconomic, cultural, and political conditions. Third, we address concern regarding potential correlation of OCP exposure across generations, since all daughters in our main analytic sample were also subject to the OCP before 2014. We directly examine intergenerational correlation in OCP exposure, and conduct a placebo test by replacing our main dependent variable with daughters' fertility before the OCP relaxation. Fourth, our theory assumes an absence of birth control for the daughters, while in reality the OCP was abolished only after 2016, leaving a 5-year window before we observe fertility in the 2020 census. We carefully examine whether our empirical analysis informs the hypothetical fertility behavior without birth control for the daughters. Last, we use heterogeneity-robust estimators in the recent event-study literature (Sun and Abraham, 2021; Callaway and Sant'Anna, 2021). Our empirical results remain robust to all of these identification concerns.

In our theoretical model, intergenerational fertility persistence comes from the evolution of fertility norms. We examine three alternative explanations that attribute intergenerational fertility persistence to changes in daughters' childbearing costs. Specifically, maternal OCP exposure may result in (i) an increase in daughters' human capital via the child quantity-quality trade-off (Becker and Lewis, 1973); (ii) an increase in maternal labor supply, which potentially influences daughters' labor market engagement via the intergenerational transmission of cultural traits (Fernández and Fogli, 2006, 2009); and (iii) an increase in coresidence between daughters and their parents (Rosenzweig and Zhang, 2014). We do not detect significant effects of maternal OCP exposure on daughters' educational attainment, labor-market outcomes, or coresidence behavior.

[3]Data source: Qiao (2023).

Our study provides the first causal evidence on the intergenerational effects of birth-control policies, and complements the macro-level analysis by De Silva and Tenreyro (2020), who evaluate the role of these policies in the global fertility decline. Using microdata, we leverage the phased implementation and subsequent repeal of China's OCP as a quasi-experimental setting. Both our findings and those of De Silva and Tenreyro (2020) show a lasting reduction in fertility due to birth-control policies.

Our research contributes to the burgeoning literature on the diffusion of fertility norms. The literature has explored such diffusion through religious groups (Munshi and Myaux, 2006); migrant networks (Daudin et al., 2019); and cultural lineages (Beach and Hanlon, 2023; Spolaore and Wacziarg, 2022). Notably, Rossi and Xiao (2023) observe a spillover effect of China's "Later, Longer, and Fewer" (LLF) Campaign on fertility among non-targeted minorities. These studies explore variations in fertility norms that result from shifts in culture or policy and analyze how these changes are disseminated within peer groups, with a specific emphasis on the diffusion of fertility norms among peers of the same generation. We add to the literature by studying the intergenerational spillovers in fertility behavior and highlight the role of maternal fertility in shaping fertility norms.

Inspired by this literature, we further incorporate the peer effect on fertility in our model. In this expanded framework, the fertility norm for a daughter is a weighted average of her mother's fertility and the (expected) average fertility of her peer group. This extension yields two novel insights. First, although the peer effect facilitates further diffusion of the low fertility norm among the daughter's generation, it alone cannot generate the intergenerational effects of birth-control policies. Second, the peer effect on its own leads to multiple equilibria, as shown by Akerlof (1997); however, maternal fertility acts as a focal point, and thereby pins down a unique equilibrium for the daughter's generation.

Our main event-study estimates potentially reflect both maternal and peer effects on fertility behavior, if the OCP differentially affected the fertility of mothers of women born in the same province and year. Fortunately, our extended model enables us to derive a lower bound for the component of maternal effect in our main estimates. This is feasible if we can estimate the parameter that represents the peer effect alone. We estimate this parameter by adopting the strategy of Li and Zhang (2009) and Rossi and Xiao (2023). By integrating the model with these estimates, we demonstrate that at least 35% of our estimated effect of maternal OCP exposure on daughters' fertility is due to the maternal

effect alone.

Our study serves as a bridge between two strands of the literature. The first examines the impact of public policies on cultural practices, as exemplified by Bau (2021), who demonstrates that pension policies influence post-marriage residences in societies with matrilocal or patrilocal customs. The second strand explores intergenerational cultural persistence, with studies such as those by Blau et al. (1992); Fernández et al. (2004); Fernández and Fogli (2009); and Giuliano (2007), who demonstrate how source-country traits determine fertility rates, labor force participation, and the living arrangements of second-generation immigrants in the U.S. These two strands of the literature jointly imply that a one-shot policy can have enduring effects through its influence on culture and the persistence of cultural values across generations. This implication is theoretically and empirically explored in our study.

Our study highlights two major policy implications. First, Fig. 1b shows that many less developed countries have recently implemented birth-control policies to reduce fertility (Rossi and Godard, 2022). While initially effective, our research points to their lasting impact on fertility norms by leading to sustained low fertility rates even after policy removal. This necessitates ongoing policy adjustments to prevent irreversible changes in demographic trends. Second, as shown in Fig. 1c, countries that previously employed such policies now face fertility rates below replacement level, which persist even after policy abolition. Traditional measures such as childcare subsidies and extended maternal leave are less effective under these altered norms. Revitalizing fertility rates may thus require new public campaigns to reshape fertility norms.

# 2 Theory

This section begins by constructing a model in which maternal fertility serves as a social norm that influences the daughter's fertility choice. It then derives the implications of this model for the lasting impact of birth-control policies. Finally, the model is extended to include peer effect on fertility.

## 2.1 A Model of the Evolution of Fertility Norms

Consider a woman in generation $t$ who chooses her consumption ($c_t$) and fertility ($n_t$) to maximize her utility:

$$\begin{aligned} \max_{c_t, n_t} \; U_t = \; & \ln(c_t) + \gamma \ln(n_t) - \sigma |\ln(n_t) - \ln(n_{t-1})|, \\ \text{s.t.} \quad & c_t + p_t n_t = y_t, \end{aligned} \tag{P1}$$

where $\gamma$ represents the degree of maternal altruism toward children, $p_t$ is childbearing cost, $y_t$ is her income, and $n_{t-1}$ denotes the fertility of her mother or the number of her siblings. The price of consumption is normalized to 1. In this model (P1), the mother's fertility serves as a norm that influences the daughter's fertility choices. The penalty term ($-\sigma|\ln(n_t) - \ln(n_{t-1})|$) captures the utility loss at a rate of $\sigma$ for every log point deviation of the woman's fertility from her mother's fertility ($n_{t-1}$).

Our model's formulation is analogous to those of Akerlof (1997); De Silva and Tenreyro (2020); and Spolaore and Wacziarg (2022). In Akerlof (1997) and Spolaore and Wacziarg (2022), the norm is defined as the expected mean fertility for her generation ($\bar{n}_t$), whereas De Silva and Tenreyro (2020) define it as a weighted average of the replacement level of fertility (2.1) and the woman's mother's fertility. By contrast, we define the norm as $n_{t-1}$, which emphasizes the evolution of fertility norms over generations. We also consider the norm to be the weighted average of $n_{t-1}$ and $\bar{n}_t$ when allowing for the peer effect on fertility in later sections.[4]

In the special case in which $\sigma = 0$, the fertility norm $n_{t-1}$ does not influence the woman's fertility $n_t$. The optimal fertility $n_t^*$ is only determined by the "intrinsic" economic costs and benefits, given by $n_t^* = \frac{\gamma}{1+\gamma}\frac{y_t}{p_t}$. This intrinsic optimal fertility declines when (i) the childbearing cost $p_t$ rises relative to income $y_t$ (i.e., higher $p_t/y_t$) or (ii) the preference for children diminishes (i.e., lower $\gamma$).

Generally, we derive the optimal fertility ($n_t^*$) through the following proposition, under the assumption that $n_{t-1}$ is exogenous to the current generation:[5]

[4] De Silva and Tenreyro (2020) include the squared difference between $n_t$ and the norm in their penalty term, while Akerlof (1997) and Spolaore and Wacziarg (2022) use the absolute value of the difference. We follow the latter, as discussed by Akerlof (1997).

[5] We exclude any dynastic interactions except for the evolution of fertility norms over generations. This assumption is justified in our empirical context, given that the birth-control policy exogenously changes the fertility of the woman's mother.

**Proposition 1** *When* $\sigma \geq 0$,

$$n_t^* = \begin{cases} n_t^u, & \text{if} \quad n_{t-1} > n_t^u, \\ n_{t-1}, & \text{if} \quad n_t^l \leq n_{t-1} \leq n_t^u, \\ n_t^l, & \text{if} \quad n_{t-1} < n_t^l, \end{cases}$$

*where* $[n_t^l, n_t^u] = [\frac{\gamma-\sigma}{1+\gamma-\sigma}\frac{y_t}{p_t}, \frac{\gamma+\sigma}{1+\gamma+\sigma}\frac{y_t}{p_t}]$.

*Proof.* See Appendix Section A.1.

The proposition demonstrates how maternal fertility serves as a norm that influences the daughter's fertility. Specifically, the daughter fully mimics her mother's fertility $n_{t-1}$ when $n_{t-1} \in [n_t^l, n_t^u]$, such that $n_t^* = n_{t-1}$. When $n_{t-1} \notin [n_t^l, n_t^u]$, she partially mimics the norm. If the mother's fertility is sufficiently high (low), such that $n_{t-1} > n_t^u$ ($n_{t-1} < n_t^l$), the daughter's optimal fertility is $n_t^u$ ($n_t^l$), which is larger (smaller) than the intrinsic optimal fertility.

## 2.2 Model Implications for the Lasting Effect of Birth-control Policies

Fig. 2 illustrates the lasting effect of birth-control policies. Our model explains this effect. For illustration, consider a sequence of four generations, indexed by 0, 1, 2, and 3, in a society. Based on Proposition 1, we define the fertility interval for each generation as $[n_t^l, n_t^u] = [\frac{\gamma-\sigma}{1+\gamma-\sigma}\frac{y_t}{p_t}, \frac{\gamma+\sigma}{1+\gamma+\sigma}\frac{y_t}{p_t}]$. We make the following assumption:

**Assumption 1**

*(a) All model parameters remain stable except that the price of childbearing,* $p_t$*, consistently increases from generations 0 to 3,*

$$p_0 < p_1 < p_2 < p_3;$$

*(b) the fertility of generation 0 starts at the equilibrium level, such that* $n_0^* \in [n_0^l, n_0^u]$*; and*

*(c) the price change from generation 0 to 1 is large enough, such that* $p_1 > \frac{\gamma-\sigma}{1+\gamma-\sigma}\frac{y_1}{n_0^l}$.

The solid line, OABC in Fig. 2, represents the "natural" equilibrium fertility rates without birth-control policies. Point O denotes $n_0^*$ for generation 0. By Assumption 1a, the

fertility interval $[n_t^l, n_t^u]$, where $t = 1, 2, 3$, shifts downward. By Assumption 1c, Proposition 1 states that the equilibrium fertility rates for generations 1, 2, and 3 land on the upper bounds of the fertility intervals, represented by points A, B, and C.

The dashed line, OA'B'C', represents the equilibrium fertility rates with a one-shot birth-control policy on generation 1. Comparing the dashed line with the solid line, we observe a lasting effect of the policy. Because of the policy, we assume that the fertility of generation 1 is constrained to be $n^p$ such that $n^p < n_1^l$ (point A'). When the policy is removed after this generation, the fertility of generation 2 does not bounce back to point B, the natural equilibrium fertility rate. This is because the constrained low fertility of generation 1 establishes a new norm for generation 2. The equilibrium fertility is $n_l^2$ for both generations 2 and 3. Fig. 2 shows that $n_2^l$ is smaller than both $n_2^u$ and $n_3^u$.

We summarize the long-lasting impact of the birth-control policies in the following proposition:

**Proposition 2** *Under Assumption 1,*

*(a) Without a birth-control policy, the equilibrium fertility rates are*

$$n_0^* > n_1^* = n_1^u > n_2^* = n_2^u > n_3^* = n_3^u.$$

*(b) When a birth-control policy restricts the fertility of generation 1 at $n^p < n_2^l$, but is removed afterward, the equilibrium fertility rates are*

$$n_0^* > n_1^* = n^p < n_2^* = n_3^* = n_2^l.$$

*Proof.* See Appendix Section A.3.

Because $\sigma > 0$, $n_2^l < n_2^u$: The one-shot birth-control policy at generation 1 lowers fertility for generation 2. If we assume $n_2^l < n_3^u$, the policy further lowers fertility for generation 3. Note that the theoretical prediction of Proposition 2 does not hinge on the assumption $n^p < n_2^l$. As long as $n^p < n_2^u$, the policy for generation 1 reduces equilibrium fertility for subsequent generations.

Our model is adaptable to include parental investment in child human capital, and thereby incorporates a mechanism of the child quantity-quality (QQ) trade-off (Becker

and Lewis, 1973).[6] If this mechanism is at work, a birth-control policy could lead to reduced fertility in the first generation, increased investment per child, enhanced human capital in the second generation, and subsequently lower fertility in the second generation. In Section 5.4, we analyze this mechanism within our empirical setting but find no significant effect of the birth-control policy on the human capital of the second generation. This aligns with other studies that investigate the QQ trade-off in the Chinese context (Rosenzweig and Zhang, 2009), which indicates that this mechanism does not drive our empirical findings. For the sake of simplicity, our theoretical model abstracts from child human capital investment.

## 2.3 Model Extension: Incorporating Peer Effect

We now extend our model to incorporate the peer effect in shaping fertility norms, which has been extensively investigated in the literature (Richerson and Boyd, 2008; Li and Zhang, 2009; Spolaore and Wacziarg, 2022; Beach and Hanlon, 2023; Rossi and Xiao, 2023). Specifically, the utility maximization problem for woman $i$ in generation $t$ becomes

$$\begin{aligned} \max_{c_{i,t},n_{i,t}} \; & U_{i,t} = \ln(c_{i,t}) + \gamma \ln(n_{i,t}) - \sigma |\ln(n_{i,t}) - \ln(N_{i,t})|, \\ \text{s.t.} \quad & c_{i,t} + p_t n_{i,t} = y_t, \end{aligned} \tag{P2}$$

where the fertility norm ($N_{i,t}$) is a weighted average of the mother's fertility ($n_{i,t-1}$) and the (expected) fertility of peers ($\bar{n}_t$), such that

$$N_{i,t} = \alpha n_{i,t-1} + (1-\alpha)\bar{n}_t, \tag{1}$$

where $\alpha \in [0,1]$ represents the strength of maternal relative to the peer effect on the fertility norm. The solution to P2 is identical to that to P1, stated in Proposition 1, when a society starts at the steady state for generation $t-1$. Because of the peer effect, $n_{i,t} = \bar{n}_t$ in the steady state.[7]

We consider a case in which the society does not start at the steady state for generation $t-1$. For simplicity, we assume that a birth-control policy restricts the fertility rate of a proportion $\lambda \in (0,1)$ of women at generation 1 to $n^p < n_2^l$.[8] The policy does not restrict

[6] For a comprehensive review of the child QQ trade-off, see Guo et al. (2022) and Doepke (2015).
[7] See Appendix Sections A.4 and A.5 for the formal proof.
[8] If the birth-control policy restricts every women in generation 1 to $n^p$, incorporating the peer effect does

the remaining $1-\lambda$ proportion of women.

In this case, two fertility norms emerge for women in generation 2. For those who are daughters of mothers treated by the policy, the norm is $N_{r,2} = \alpha n^p + (1-\alpha)\bar{n}_2$. For the remaining women, it is $N_{ur,2} = \alpha n_1^u + (1-\alpha)\bar{n}_2$. As $n^p < n_1^u$, $N_{r,2} < N_{ur,2}$. Because they have different norms, the optimal fertility differs between these two types of women. The solution to P2 now becomes a Bayesian Nash equilibrium (Blume et al., 2011), in which women in generation 2 have rational expectations that the ex-ante expected average fertility of their peers ($\bar{n}_2$) coincides with the ex-post realized average fertility, such that

$$\bar{n}_2 = \lambda n_{r,2}^* + (1-\lambda) n_{ur,2}^*,$$

and $n_{r,2}^*$ ($n_{ur,2}^*$) is the equilibrium fertility for women whose mothers' fertility was (not) constrained by the policy.

The proposition below characterizes, and Fig. 3 plots, equilibrium fertility for generation 2 in this case.

**Proposition 3** *(a) When $\alpha = 0$, the maternal effect does not exist (Fig. 3a). The equilibrium fertility for generation 2, $n_{r,2}^* = n_{ur,2}^* \in [n_t^l, n_t^u]$. Multiple equilibria exist.*

*(b) When $\alpha = 1$, the peer effect does not exist (Fig. 3b). $n_{r,2}^* = n_2^l < n_{ur,2}^* = n_2^u$.*

*(c) When $\alpha \in (0, \alpha_1)$, $n_{r,2}^*$ decreases with $\lambda$ when $\lambda < \lambda_1$, then stays constant at $n_2^l$; $n_{ur,2}^*$ stays constant at $n_2^u$ when $\lambda < \lambda_2$, then decreases with $\lambda$ (Fig. 3c).*

*(d) When $\alpha \in [\alpha_1, 1)$, $n_{r,2}^*$ decreases with $\lambda$ when $\lambda < \lambda_3$, then stays constant at $n_2^l$; $n_{ur,2}^*$ stays constant at $n_2^u$ when $\lambda < \lambda_4$, then decreases with $\lambda$ (Fig. 3d).*

*We have $\alpha_1 = \frac{n_2^u - n_2^l}{n_1^u - n^p}$, $\lambda_1 = 1 - \frac{n_2^l - n^p}{(1-\alpha)(n_1^u - n^p)}$, $\lambda_2 = \frac{n_1^u - n_2^u}{(1-\alpha)(n_1^u - n^p)}$, $\lambda_3 = 1 - \frac{\alpha(n_2^l - n^p)}{(1-\alpha)(n_2^u - n_2^l)}$, $\lambda_4 = \frac{\alpha(n_1^u - n_2^u)}{(1-\alpha)(n_2^u - n_2^l)}$, where $\lambda_1 > \lambda_3$, and $\lambda_2 < \lambda_4$.*

*Proof.* See Appendix Sections A.4–A.7.

Based on the proposition, we have five observations. (1) The average fertility rate of generation 2 decreases with a one-shot birth-control policy that constrains fertility for $\lambda$ proportion of women at generation 1, as long as the maternal effect exists ($\alpha > 0$). This holds true irrespective of the existence of the peer effect. (2) The policy does not affect the average fertility rate of generation 2 when only the peer effect exists ($\alpha = 0$). (3) The

not affect our analysis in the above section.

optimal fertility for those whose mothers are untreated ($n^*_{ur,2}$) decreases with the policy as long as the share of women whose mothers are treated ($\lambda$) is sufficiently large. (4) The effect of the one-shot birth-control policy extends naturally beyond generation 2, since the decreased fertility for generation 2 reduces the norms for generation 3 through the maternal effect. (5) Our results for multiple equilibria when the peer effect exists only echo those of Akerlof (1997). However, when $\alpha > 0$, maternal fertility serves as a focal point that pins down a unique equilibrium in our extended model.

In exploring the unique institutional context characterized by the staggered rollout of the OCP among Han Chinese in the late 1970s and early 1980s, followed by its termination in 2016, our main empirical analysis below tests the prediction based on Proposition 2. We also use the differential implementation between Han and ethnic minorities to test some predictions based on Proposition 3. Finally, we use Proposition 3 to quantitatively separate maternal and peer effects in accounting for the long-lasting effect of the OCP on women whose mothers' fertility was directly constrained by the policy, but they themselves are no longer constrained by the policy after 2016.

# 3 Institutional Background

To test our theoretical prediction, a one-shot birth-control policy is required—one that affects a single generation and is removed for subsequent generations. China's OCP, followed by its sudden abolition in 2016, provides a unique context for such an analysis. This section first describes the rollout of the OCP in the late 1970s and early 1980s, measures the implementation timing of the policy across provinces, and finally describes its nationwide termination in 2016.

## 3.1 History of the Birth-control Policy in China

China launched its family planning campaign, the "Later, Longer, Fewer" Campaign, in 1971 (Zhang, 2017).[9] In response to fears of an overpopulation crisis, Xiaoping Deng, then the new leader of China, initiated a more stringent family planning program in 1979. This radical initiative, aimed at restricting most families to a single child, was one of the

[9]This slogan advocated for late marriage and childbearing, extended birth spacing (at least 3 years between two births), and limiting the number of children to no more than two. The program began with the State Council's Document 51, "Report on Better Implementing Family Planning Policy," released in 1971.

most extreme birth-control measures in recorded history. It encompassed a comprehensive approach that involved widespread propaganda, regulatory measures, incentives for compliance, and punitive actions, including financial and employment-related penalties. Despite its intent, the program did not fully achieve a universal one-child norm across the country. However, the collective set of these radical population control policies since 1979 has been commonly referred to as the OCP.

The OCP, since its inception, faced significant public resistance. To mitigate this, the government, starting in the 1980s, relaxed the policy for rural residents and ethnic minorities. The central committee's 1984 Document No. 7 allowed rural families, especially those with a first-born daughter, to have a second child, and ethnic minorities were generally permitted more than one child (Scharping, 2013). Despite these relaxations, the policy remained strict for urban populations. Prime Minister Li Peng in 1989 reaffirmed a population target of 1.2 billion by the end of the century, aiming to limit the natural growth rate to below 1.25%. The 2002 Law of Population and Family Planning further legalized the OCP and maintained the stringent one-child rule in urban areas through the 1990s and 2000s.[10]

## 3.2 Measuring the Rollout Timing of the OCP across Provinces

The phased implementation of the OCP across provinces offers a quasi-experimental setting to examine our theoretical predictions on the evolution of fertility norms. Although the initiative was formally announced in 1979, the central government only enacted general guidance for implementing the policy. The timing of OCP implementation varied significantly across provinces, since it depended on the Communist Party's political decision process and enforcement at the local level.

To measure the timing of OCP rollout across provinces, we first collected numerous government documents, the *Population Chronicles*, and the *Encyclopedia of Chinese Family Planning*. From these, we compiled a timeline for issuing key legal documents—documents, approvals, notices, regulations, and provisions—pertaining to the OCP for each province. The final step is identifying the date each provincial government officially mandated one child per family and imposed heavy penalties on families with excess second-order births. These official issuance dates, along with comprehensive timelines, are presented in Ap-

[10]See Appendix B.1 for more details on the OCP rollout across China.

pendix C Table C1, which reports the start of the OCP in each province. This table shows significant variation in OCP timing across provinces.

We then validate our measure. Appendix C Fig. C1 shows that TFR declined in a province right after our identified OCP implementation year in the event study framework.[11]

We investigate the determinants of implementation timing at provincial level. We regress the timing against a set of socioeconomic and demographic variables measured in the year prior to the implementation, along with the geographic distance between the provincial capital and Beijing. This distance variable serves as a proxy for political proximity to the central government. Appendix C Table C2 reveals that estimates of socioeconomic and demographic variables are minimal and statistically insignificant. However, as expected, the distance from Beijing shows a positive and statistically significant correlation, which suggests that provinces farther from Beijing tend to implement the OCP later. These findings affirm that the timing of the rollout was determined by political decisions of the Communist Party at provincial level.[12] We carefully control for distance to Beijing interacted with birth cohort dummies in our empirical analysis, as discussed in Section 5.4.

### 3.3 Abolition of the OCP and the Short-lived Fertility Rebound

The central government began to ease the OCP in 2014 with the "Selective Two-child Policy," which allowed couples to have a second child if either spouse was an only child. This policy had limited impact, however, because the targeted population did not seem to respond to the policy. On December 27, 2015, a proposal to amend the Law of Population and Family Planning was submitted to the National People's Congress, and by January 1, 2016, the universal two-child policy was unexpectedly enacted, effectively ending the OCP (He et al., 2023).

This abrupt policy shift in 2016 led to a temporary increase in fertility rates, predominantly due to a rise in second-child births, which particularly benefited the 1970s cohort. Birth rates per 1,000 women aged 15-49 climbed from 25.9 in 2015 to 44.2 in 2017, then gradually fell back to 28.9 by 2021 (Fig. 4a). This fertility spike was driven by second-child births, which surged from 8.9 per 1,000 women in 2015 to 22.1 in 2017, before decreasing to 12.1 in 2021. Meanwhile, the rate of first-child births remained stable, hovering around

[11] See Appendix Section B.2 for details on the event-study estimation.
[12] See Appendix Section B.3 for details on the regression analysis.

16 during 2015-2021.[13]

In 2021, China lifted all remaining fertility restrictions and began encouraging families to have up to three children. Despite these measures, the TFR continued to decline, falling from 1.16 in 2021 to 1.06 in 2022.[14] This indicates that the post-2016 fertility rebound was transient. In response to ongoing low fertility rates, the Chinese government is now formulating and enacting a range of pro-natalist policies, though the effectiveness of these policies remains to be seen.

### 3.4 Defining Generations

In light of the institutional context, we define women born between 1969 and 1980 as the second generation ($t = 2$ in Fig. 2), their mothers as the first generation, and their children as the third throughout our empirical analysis below. This will align our empirical analysis with the theoretical model. We chose the 1969-1980 range because women born before 1969 were largely unable to give birth after the 2016 OCP abolition, and those born after 1980 saw minimal variation in their mothers' OCP exposure across provinces. Further justification for these thresholds is detailed later.

## 4 Data Sources

This section outlines our data sources. We draw on the most extensive datasets that contain information on fertility in China: the 2010 and 2020 population censuses, 2005 and 2015 mini-censuses, China Family Panel Studies (CFPS) from 2012 to 2018, and 1987 Fertility In-Depth Survey (FIDS). The 2020 census has particular significance because it marks the first census conducted after the abolition of the OCP, and thus allows for the analysis of fertility behavior in the post-policy era. Together, these datasets provide a unique opportunity to examine both desired and actual fertility across multiple generations, before and after the OCP's termination.

### 4.1 Population Censuses

[13]Data source: *China Labor and Population Statistical Yearbook*, published by the National Bureau of Statistics: 2007-2021.
[14]Data source: Qiao (2023).

The National Bureau of Statistics (NBS) of China has conducted a population census every 10 years and a 1% population survey (mini-census) midway between each census since 1990. Both the census and mini-census provide nationally representative data that contain rich demographic and socioeconomic information. This includes age, gender, birthplace, ethnicity, fertility (for women aged 15 to 64), education, and labor market outcomes.

Our main dataset draws on the 2020 census. It offers up-to-date, nationally representative data on the actual fertility of women aged 15 to 64 following the OCP's termination. We analyze a 1‰ random sample from this census, accessed through the Peking University Development Research Center portal under NBS authorization.[15] We also use a 20% random sample from the 2005 mini-census, a 0.35% random sample from the 2010 census, and a 20% random sample from the 2015 mini-census for robustness and mechanism analyses. Table 1 reports summary statistics for samples constructed using the census data.

## 4.2 The Chinese Family Panel Studies

The CFPS is a biennial survey that captures China's societal, economic, educational, and health conditions (Xie, 2012). The baseline was launched in 2010 and includes 33,600 adults and 8,990 children from 14,960 households across 25 provinces. Its probability-proportional-to-size sampling ensures the survey's national representativeness. The CFPS conducted follow-ups in 2012, 2014, 2016, 2018, and 2020. A distinctive feature of the CFPS is its collection of data on desired fertility or fertility intention. In the 2012 and 2018 waves, children aged 10-15 were asked how many children they would like to have in a hypothetical scenario without birth-control restrictions.[16] This question was also posed to adults aged 16 and above in the 2014 and 2018 waves.[17] We use data from these three waves to examine the impact of the OCP on desired fertility for the second and third generations.[18]

## 4.3 China Fertility In-Depth Survey

[15] Data analysis was conducted in a secure lab at the NBS-Peking University Development Research Center.
[16] Question KA202 in the individual (youth) module.
[17] Question M501 in the individual (adult) module. This question was also designated as 'inquiry regarding the ideal number of children' in the questionnaire. In 2018, the adults were directly asked how many children they would like to have.
[18] The sample, variables, and summary statistics for analysis based on the CFPS are detailed in Appendix Section D.1.

The 1987 FIDS complements the CFPS in our analysis by offering insights into desired fertility for the first generation whose fertility was directly constrained by the OCP, some of whom had died prior to the CFPS baseline survey in 2010. The NBS conducted the FIDS in April 1987 across several provinces. The 1987 FIDS gathered detailed data on female respondents' characteristics, marriage, fertility, breastfeeding history, contraception knowledge and usage, and basic information on their husbands. Notably, it included a question on desired fertility in the absence of the OCP—similar to the CFPS—that targeted all adults.[19]

# 5 Empirical Analysis

This section outlines our empirical strategy, defines the analytic sample, presents main results, conducts robustness checks, and explores potential mechanisms.

## 5.1 A Cohort Event-study Design and Analytic Sample

Our main analysis focuses on the effect of OCP exposure of the first generation on fertility of the second generation, as defined in Section 3.4, in the post-policy era. We exploit the staggered rollout of the OCP in an event-study specification:

$$Y_{icp} = \alpha_p + \theta_c + \delta_p \cdot c + \sum_{l \neq -1} \beta_l \cdot D_{cp}^{l} \cdot Early_p + \epsilon_{icp}, \tag{2}$$

where $Y_{icp}$ measures fertility in the 2020 census for a woman $i$ in the second generation, who was born in province $p$ and year (cohort) $c$; $\alpha_p$, $\theta_c$, and $\delta_p \cdot c$ capture, respectively, province fixed effects, cohort fixed effects, and province-specific cohort linear trends; $D_{cp}^{l}$ are relative year indicators; $Early_p$ indicates that province $p$ adopted the OCP before 1984; and $\epsilon_{icp}$ is the error term. Standard errors are clustered at province level in the estimation of Eq. 2.

We define the relative year indicator, $D_{cp}^{l}$, to measure the degree of OCP exposure as follows:

$$D_{cp}^{l} = \mathbb{I}[l = c + s - T_p], \tag{3}$$

where $l$ denotes the relative year in our event-study design and represents the OCP exposure

[19] The sample, variables, and summary statistics for analysis based on the 1987 FIDS are detailed in Appendix Section D.2.

level for a woman's mother. Here, $T_p$ is the year a province first implemented the OCP, and $s$ represents the typical spacing between births. In our main analysis, we adopt $s = 4$ years, because over 90% of first-generation mothers experienced birth intervals of up to 4 years.[20] For example, consider women born in a province $p$ in which the OCP was enacted in 1980 ($T_p = 1980$). A woman born in 1976 ($c = 1976$) in this province would be positioned to expect a younger sibling by 1980 ($s = 4$) if her mother planned further childbirths. For such a woman born in 1976, we calculate $c + s - T_p = 1976 + 4 - 1980 = 0$; her relative year equals zero ($l = 0$), making $D^0_{cp} = 1$. Conversely, for women born in years other than 1976 in this scenario, $c + s - T_p \neq 0$; thus, $l \neq 0$ and $D^0_{cp} = 0$. Following this logic, for a woman born in 1977, $D^1_{cp} = 1$, and for one born in 1978, $D^2_{cp} = 1$. This method allows us to assess the varying levels of policy exposure across different cohorts within each province. We designate $l = -1$ as the reference period and bin relative years $\leq -4$ to prevent multicollinearity concerns.

Following Bailey et al. (2021) and Goodman-Bacon (2021), we interact $Early_p$ with $D^l_{cp}$ in Eq. 2. This interaction sets $D^l_{cp}$ to 0 for provinces that adopted the policy after 1984, and thus includes these last-treated provinces in the control group. This approach improves the efficiency of our event-study estimators.[21]

To address cross-provincial heterogeneities in life-cycle fecundity patterns, we include province-specific cohort trends. This is crucial, because although the OCP was uniformly terminated in 2016 across all provinces, women of varying ages, whose mothers experienced different degrees of OCP exposure, may have exhibited distinct fertility behaviors between 2016 and 2020. While cohort fixed effects capture common life-cycle fecundity patterns, our addition of province-specific linear trends accounts for any heterogeneities across provinces.[22]

The estimation sample includes urban Han Chinese women born in 1969-1980 in the 2020 census. First, as discussed in Section 3, the restriction to one child per family is largely exempted for ethnic minorities and rural residents. Second, based on the fertility history between 2015 and 2020 by province and birth cohort, our statistical analysis shows that

[20] For a detailed justification of setting $s = 4$ and sensitivity analyses for alternative $s$ values, refer to Appendix Section E.1.

[21] Appendix Section E.2 shows that our estimation remains similar but less precise without interacting $D^l_{cp}$ with $Early_p$.

[22] Appendix Section E.3 presents more discussion and robustness analysis of the specification of the province-specific cohort linear trend.

there is a structural break in cohort 1969:[23] Women born before 1969 seldom experienced childbirth after 2016. Third, we use 1980 as the cutoff year for our sample to account for the policy's latest implementation in 1984 across provinces and align with the 4-year birth spacing ($s = 4$).

Table 1 Panel A reports summary statistics for the sample constructed using the 202 census, which comprises 75,438 women. The average number of children by 2020 for these women is 1.46.

## 5.2 Identifying Assumptions

We are interested in the estimates of $\beta_l's$ ($l \geq 0$) in Eq. 2, which are used to measure the effects of OCP exposure of the women's mothers (first generation) on the fertility of the women themselves (second generation). To assess the mothers' exposure to the OCP, we leverage variations in both the birth years of the women and the timing of OCP implementation across provinces. These two factors jointly influence the likelihood of these women having younger siblings, and thereby capture the fertility constraint imposed by the OCP on their mothers. Mothers of women born after implementation of the OCP were more exposed, whereas mothers of those before the OCP were less exposed, depending on the years between the OCP timing and the woman's birth year.

Consistent estimation of $\beta_l$ in our event-study framework requires two key assumptions, as outlined by Sun and Abraham (2021) and Miller (2023). The first is the absence of anticipation effects, which means that mothers should not have altered their fertility prior to the OCP's implementation in anticipation of the policy. The second assumption is parallel trends in potential fertility outcomes. This assumes that in the absence of the OCP, fertility changes across birth cohorts should be the same between provinces that implemented the policy early and those that implemented it later. The second assumption is subtle in our study context, because we estimate the effect of OCP exposure of the mothers' generations on the fertility of the women's generation. This requires that the timing of OCP implementation does not correlate with factors that vary by province and birth cohort and that could influence fertility rates across both generations, conditional on covariates. These two assumptions will be thoroughly examined in Section 5.4.

[23] Appendix C Fig. C2 shows that births in 2016-2020 are nearly 0 for cohorts born before 1969, but they surge for later cohorts born after 1969. We further conduct a formal test on structural breaks following Bailey et al. (2021), and details are presented in Appendix E.4. We also conduct sensitivity analysis of an alternative range of birth cohorts in Appendix E.4.

A particularly important concern in our context is the intergenerational correlation in OCP exposure. In particular, provinces that implemented the OCP earlier may tend to enforce the policy more strictly in subsequent years. This could trigger two challenges. First, if the timing of the OCP rollout correlates with subsequent over-time changes in OCP enforcement within the same province, the common trend hypothesis is violated. Second, if the timing of the OCP rollout correlates with cross-province variations in OCP enforcement, the treatment effect of OCP rollout on second-generation fertility could be heterogeneous across provinces, and thus introduces a misspecification in Eq. 2. In Section 5.4, we directly examine intergenerational correlation in OCP exposure, conduct a placebo test using second-generation fertility before OCP relaxation, and implement heterogeneity-robust estimators in the recent event-study literature (Sun and Abraham, 2021; Callaway and Sant'Anna, 2021).

## 5.3 Main Results

Before presenting our main results for the fertility of women in the second generation, we first estimate the OCP's impact on their mothers' fertility. This impact corresponds to the effect of birth-control policies on the first generation ($t = 1$ shown in Fig. 5) in our model. Using urban Han Chinese women born in 1975-1980 from the mini-census 2005, we estimate Eq. 2 with the number of siblings as the dependent variable to proxy for the mothers' fertility.[24] Fig. 5 reports that estimates of $\beta_l$ are near 0 for $l < -1$, which indicates no significant pre-trend. The $\beta_l$ estimate decreases from -0.07 for $l = 1$ to -0.33 for $l = 5$, consistent with the literature (Qin et al., 2017). This suggests that the OCP significantly reduced fertility in the first generation. Table 2 reports estimates and the corresponding standard errors.

We now present our main results. Based on our main analytic sample of urban Han Chinese women born during 1969-1980 in the 2020 census, Fig. 6 plots our estimates of $\beta_l$'s. The figure shows no pre-trend, since the estimates of $\beta_l$'s are nearly zero when $l < -1$. The $\beta_l$ estimate decreases from -0.05 for $l = 1$ to -0.22 for $l = 5$, which are both significant at the 10% level. Women whose mothers were exposed to the OCP had between 0.05 and 0.22 fewer children compared to those whose mothers were not exposed. The result

[24] Table 1 Panel B provides summary statistics for this sample. We include women born after 1974, since the mini-census 2005 requires only those aged 30 or below to report their sibling size. Mini-census 2005 is the only census wave that requires individuals to report their sibling size.

is consistent with our prediction by Proposition 2. The estimated effect is substantial, especially considering a TFR of 1.06 in 2022.

By combining the findings from Figs. 5 and 6, we calculate the intergenerational persistence in fertility, as implied by Proposition 1. Within a local average treatment effect framework (Imbens and Angrist, 1994), the estimates from Fig. 5 serve as first-stage results that show the OCP's impact on mothers' fertility. Fig. 6 provides reduced-form estimates of the OCP's influence on women's fertility. The ratio of these estimates offers a causal interpretation of how changes in mothers' fertility affect their daughters' fertility (Angrist and Krueger, 1992). Consequently, we infer that for a long-term horizon ($l = 5$), a one-unit decrease in mothers' fertility reduces daughters' fertility by 0.67 (0.22/0.33).

## 5.4 Robustness

**Anticipatory effects.** Figs. 5 and 6 show that the estimates of $\beta_l$ for $l < -1$ are small and statistically insignificant, which suggests no anticipatory effects on fertility in both generations. This result is confirmed by Appendix C Fig. C1, which demonstrates no pre-trend in the TFR preceding the year of OCP implementation. We further assess anticipatory effects by analyzing birth spacing among mothers in provinces that implemented the OCP after 1981. These mothers are grouped based on their daughters' birth dates: Group 1 (pre-1975 births) and Group 2 (1975-1978 births). Mothers in Group 1 were not influenced by the policy. We aimed to discern whether mothers in Group 2 adjusted their birth intervals in anticipation of the policy change. Upon comparing birth-spacing distributions in Appendix C Fig. C3, we observe similar patterns for mothers in both groups, which indicates no anticipatory behavior.

**Common trends for potential outcomes.** This is the most important identifying assumption for our event-study design. We comprehensively investigate the robustness of our results to this assumption by conducting three sets of analyses.

First, we control for four socioeconomic and policy shocks in our regression: the Great Famine (1959-1961), the Cultural Revolution (1966-1976), the "Later, Longer, and Fewer" Campaign during the 1970s, and implementation of the Compulsory Education Law (around 1986).[25] These shocks varied in intensity across provinces, and exposure to these

[25] We do not consider the rural household responsibility system reform in the late 1970s, because we focus on urban women. The construction of measurements for different policy shocks is detailed in Appendix E.5.

events also differed among the cohorts we are studying. Our estimate might capture the effects of these shocks if they correlate with both fertility and our measured OCP exposure simultaneously.

Second, we control for interactions between the cohort dummies and a series of variables that measure pre-OCP socioeconomic and political conditions in the regression. Our event-study framework has well accounted for any cohort-invariant and linearly evolved cross-province heterogeneity. Nonetheless, the heterogeneity in these conditions could impact not only the level and linear changes, but also nonlinear changes in fertility across cohorts of different provinces. As shown in Appendix Section C Table C2, whereas OCP timing does not significantly correlate with pre-OCP socioeconomic conditions, it indeed correlates with the geographic distance between the provincial capital and Beijing. Therefore, it is necessary to control for interactions between the cohort dummies and distance to Beijing.

Third, we control for a set of variables that measure socioeconomic conditions to account for potential macroeconomic impacts of the OCP rollout (Li and Zhang, 2007). The OCP may have distinctively influenced the socioeconomic environment for women of the second generation, particularly during their developmental years, with potential cumulative effects over time. Notably, 1970s cohorts, who experienced varied OCP intensities during ages 0-5, likely faced diverse socioeconomic conditions. Such heterogeneities might bias our estimations, given recent findings such as Cotofan et al. (2023), which suggest that socioeconomic conditions, particularly in early adulthood, can shape individual preferences and, consequently, fertility choices. Consequently, we follow Cotofan et al. (2023) and use regional GDP growth and per capita GDP data to construct cohort- and province-specific socioeconomic variables. These variables are measured during the women's impressionable years, typically ages 18-25.[26] Appendix E.5 shows that our main finding remains robust in these three sets of sensitivity analyses.

**Early-life OCP exposure of the second generation.** One concern with our estimation is that all women in our estimation sample were subject to the OCP before 2014. Provinces that implemented the OCP earlier may tend to enforce the policy more strictly in subsequent years. This may lead to a violation of the common trend hypothesis if the timing of the OCP rollout correlates with subsequent over-time changes in OCP en-

[26]The "impressionable years hypothesis" suggests that ages 18 to 25 are crucial for establishing enduring attitudes, beliefs, and values, and highlights this period's significance due to increased cognitive adaptability (Krosnick and Alwin, 1989; Cotofan et al., 2023).

forcement intensity that directly influence second-generation fertility. Specifically, if OCP exposure for women in the first generation in the 1970s and 1980s, net of province and cohort fixed effects and province-specific linear trends, correlates with the intensity of the OCP for women in the second generation in the 1990s and 2000s, our negative estimates of $\beta_l$ ($l > 0$) would mechanically reflect the OCP effect in early life for women in the second generation. However, this is unlikely for two reasons. First, policy enforcement has remained stable since the mid-1990s (Section 3.1), leaving little room for cross-cohort variations in OCP exposure for second-generation women. Second, we find no reason to expect a correlation between the timing of OCP implementation for women in the first generation and changes in OCP intensity for their daughters across birth cohorts.

To further alleviate this concern, we conduct two analyses. First, we examine the correlation between OCP exposure of the mothers and intensity of the OCP experienced by their daughters. Specifically, we re-estimate Eq. 2, using the daughters' OCP intensity as the dependent variable. Intensity is measured by the average fine rate the daughter experienced during her early life (6–20) and reproductive ages (20–45) based on her birth province and cohort.[27] Appendix C Fig. C4 shows that the estimates of $\beta_l$ ($l > 0$) are statistically insignificant.[28]

Second, we examine the correlation between the mothers' OCP exposure and their daughters' fertility before OCP termination. We re-estimate Eq. 2 using the same birth cohorts as in our main sample, but measure their fertility in 2013 based on the mini-census 2015.[29] If there is a significant correlation between the mothers' OCP exposure and their daughters' OCP intensity, estimates of $\beta_l$ ($l > 0$) will be negatively significant. Our estimates reported in Appendix C Fig. C5 contradict this prediction.

**A short window of childbearing after OCP abolition.** A key challenge arises from the fact that the OCP was only fully repealed in 2016, which limits our observation of fertility to a 5-year window until the 2020 census. Cohorts born between 1969 and 1980 were already in their mid-30s to late-40s by 2016, and thus entering later reproductive stages. This short window raises concerns about the ability of these cohorts to reflect

[27] Under the OCP, parents in China who exceed their fertility limit are forced to pay a fine, which varies across provinces. See Appendix E.6 for the details of this policy.

[28] Appendix E.6 reports the details.

[29] Table 1 Panel C reports the average fertility of these women before policy relaxation in mini-census 2015, which shows an average of 1.37 children by 2013. We measure the fertility of these women in 2013, which corresponds to the period before the central government initiated relaxation of the OCP in 2014 and introduced the "Selective Two-child Policy," as outlined in Section 3.3.

changes in fertility in the post-OCP era. Also, post-abolition fecundity likely varied across these cohorts. To mitigate these concerns, our main analysis includes province-specific trends for each cohort to address heterogeneous life-cycle fertility patterns. Despite these efforts, uncertainty persists regarding the adequacy of the 5-year observation period to capture genuine fertility behavior in the absence of birth-control policies.

We conduct three analyses to address this concern. First, analyzing national aggregate fertility data reveals a notable trend in second-child birth rates in our study period, as depicted in Fig. 4b. There was a significant rise from 5.7 in 2015 to 10.2 in 2017, with a subsequent decline to almost zero by 2021. The peak in 2017, when rates hit 10.2—approximately half the average for fertile women aged 15-49, as detailed in Fig. 4a—suggests that women in our sample were actively seizing the last chance to fulfill their fertility desires.

Second, we use desired fertility of the second generation as a proxy for their hypothetical fertility in the absence of birth control.[30] The results, depicted in Fig. 7a, show that the estimates of $\beta_l$'s are significantly negative. Compared with Fig. 6, the impact of maternal OCP exposure on the women's desired fertility appears larger than that on their realized fertility. This difference likely reflects the OCP's restriction on the second generation's fertility for a substantial portion of their fecundity window.[31]

Third, we extend our analysis of desired fertility to third-generation women, who are daughters of second-generation women. Our theory predicts that the OCP affects fertility beyond the second generation. The third generation are teenagers during the survey years and will not be affected by the OCP during their entire reproductive lifespan, which offers an alternative context to test our theoretical prediction. We re-estimate Eq. 2 using desired fertility of the third generation as the dependent variable.[32] Results presented in Fig. 7b show that grandmothers' OCP exposure decreases desired fertility for their grandchildren.

**Heterogeneous treatment effects.** Even though the timing of the OCP rollout doesn't predict cross-cohort variations in OCP exposure among second-generation women in the

[30] Data regarding desired fertility for second- and third- generation women draw on the CFPS. We provide detailed information on sample construction and summary statistics in Appendix Section D.1.

[31] Using data from the 1987 FIDS, we re-estimate Equation 2 using the desired fertility of first-generation women as the dependent variable. The estimates of $\beta_l$'s ($l > 0$) are presented in Appendix C, Figure C7a, and are found to be near zero and statistically insignificant. This result aligns with our theoretical prediction, which suggests that it is the actual fertility behavior of mothers—rather than their fertility intentions—that establishes the fertility norms for the succeeding generation.

[32] Appendix Section D.1 provides details on sample construction and summary statistics.

same province, these women on average experienced greater exposure to the OCP during their early lives. If early-life OCP experience alters the responsiveness of second-generation fertility to fertility norms, Eq. 2 would be misspecified by not allowing for heterogeneous treatment effects across provinces.

To address this issue, we employ the estimators proposed by Sun and Abraham (2021) and Callaway and Sant'Anna (2021). If provinces that implemented the OCP at different times exhibit distinct treatment effects given the same relative year, the coefficients obtained using these two estimators would no longer exhibit the same pattern as those estimated using Eq. 2. Appendix C Fig. C6 shows that our results remain robust.[33]

## 5.5 Mechanism

This section explores the mechanism through which mothers' exposure to the OCP influences their daughters' fertility. In the theoretical analysis, we derive the evolution of fertility norms as the driving force behind the lasting impact of the OCP, assuming similar changes in childbearing costs for women across generations. However, the OCP itself could have altered these costs, dependent on the extent of the mothers' exposure to the policy. If this is true, our main findings could be attributed to these OCP-induced shifts in childbearing costs, rather than to the evolution of fertility norms.

**Alternative mechanisms.** The literature suggests three alternative mechanisms. The first relates to the theory of the child QQ trade-off (Becker and Lewis, 1973), which we discussed in Section 2.2. The QQ theory predicts that the OCP's role in reducing the first generation's fertility might lead to more investment per child, and consequently enhance the human capital of women in the second generation. This increase in human capital could, in turn, affect the fertility of these women. The second relates to women's labor supply: The OCP-induced decrease in fertility may increase the labor supply of women in the first generation. This may alter the labor supply of their daughters in the second generation through the intergenerational transmission of cultural traits that affects female labor supply (Fernández and Fogli, 2006, 2009). In addition, if the OCP increases the human capital of women in the second generation through the child QQ trade-off, the OCP will also change their labor supply. The potential change in the women's labor supply may

[33]The observed uniformity in behavioral responses across various provinces may stem from a widespread reluctance among women to limit their family to a single child during that period. This interpretation is supported by the empirical analysis presented in Section 5.4 using the 1987 FIDS.

affect their fertility. Third, the literature in economics, sociology, and demography suggests that the OCP would change the living arrangements of the first and second generations (Rosenzweig and Zhang, 2014). Because fertility decreases, mothers in the first generation are more likely to coreside with their daughters. Since mothers can assist in caring for children, the cost of childbearing might decrease for women in the second generation. All three factors may influence women's fertility in the second generation through the change in childbearing cost in our theoretical model.

We empirically examine the three potential mechanisms. We re-estimate Eq. 2 using women's education, labor market outcomes, and coresidence status with parents or parents-in-law as dependent variables.[34] Appendix C Figs. C8-C10 show that the estimates of $\beta_l$'s ($l > 0$) are all small and statistically insignificant.[35] Our results regarding women's education align with prior research. Comprehensive studies examining the OCP in China have concluded that its effect on children's human capital is minimal (Rosenzweig and Zhang, 2009; Liu, 2014; Li and Zhang, 2017). These results suggest that our main finding is less likely to be driven by the three alternative mechanisms.

**Discussions of the fertility norm mechanism.** Our model suggests that the OCP restricts mothers' fertility and thus establishes a new fertility norm for future generations. This norm influences the fertility of these subsequent generations by modifying the utility function, rather than through changes to the costs and benefits in the budget constraint. Direct evidence on fertility norm evolution has not yet been provided. However, using desired fertility as a measure of fertility norm[36], our analysis of desired fertility—illustrated in Fig. 7—supports the notion of a fertility norm mechanism.

It's essential to recognize that, theoretically, the fertility norm mechanism is largely unaffected by OCP-induced changes in childbearing costs, as long as these alterations are not substantial. While we have examined three alternative mechanisms influenced by changes in childbearing costs due to the OCP, the potential variations in these costs are vast and often challenging to measure. Nevertheless, the assumption regarding common

[34] To address potential behavioral changes stemming from relaxation of the OCP, we measure the dependent variables—education, labor market performance, and living arrangements of second-generation women—using 2010 census data. Summary statistics are presented in Table 1, Panel D. The results remain robust when dependent variables are replaced by those measured in the 2015 mini-census and and 2020 census.

[35] Appendix C Table C3 reports estimates and corresponding standard errors.

[36] The CFPS solicits desired fertility based on inquiries on "the ideal number of children." If respondents interpret the "ideal number of children" as the number of children they desire under the hypothetically scenario of zero childbearing cost, then this measure of desired fertility would capture the fertility norm. Please see Appendix Section A.2 for a formal proof.

price changes (Assumption 1a) can be adjusted to accommodate variations in childbearing costs based on OCP treatment status.[37] The strength of the fertility norm mechanism roots in Akerlof (1997), which suggests that within a context of "conformity," a "marginal change" in the cost of childbearing would have "literally no effect" on fertility behavior, highlighting the mechanism's robustness.

# 6 Maternal vs Peer Effects

We have established robust evidence that mothers' exposure to the OCP influences their daughters' fertility in the post-OCP era. As outlined in Proposition 2, we've interpreted these findings to mean that the restricted maternal fertility by the OCP establishes a new norm for daughters. This interpretation assumes the OCP had a uniform effect on the fertility of all mothers for daughters born in the same province and year. Yet, this assumption might not always hold. For example, imagine two women born in 1978 in a province where the OCP was implemented in 1979. If one woman's mother was past childbearing age by 1979, while the other's was not, the OCP's fertility restrictions would only apply to the latter. This variation implies that the OCP's impact on mothers' fertility—and consequently on the daughters' perceived fertility norms—can differ even within the same province and cohort. Under such circumstances, peer influences might also shape fertility norms, meaning that our estimates of $\beta_l$'s ($l > 0$) capture both maternal and peer effects, as Proposition 3 suggests.[38] In this section, we aim to distinguish quantitatively between maternal and peer influences on the lasting effect of the OCP.

For simplicity, we assume that the proportion of mothers affected by the OCP is $\lambda$ for a given relative year $l$ across all provinces, which is not observed by researchers. Our estimate of $\beta_l$ is thus represented as

$$\beta_l = \lambda(n^*_{r,2} - n^u_2) + (1-\lambda)(n^*_{ur,2} - n^u_2), \tag{4}$$

[37] In our model, the upper fertility bound for second-generation women is given by $u^u_2 = \frac{\gamma+\sigma}{1+\gamma+\sigma}\frac{y_2}{p_2}$. The OCP may lead to an increase in $p_2$ and a corresponding decrease in $n^u_2$. However, if the OCP-induced rise in $p_2$ is modest such that $n^u_2 \geq n_1$, the fertility of second-generation women will mirror that of the first generation ($n^*_2 = n_1$), indicating that the fertility norm mechanism continues to operate effectively.

[38] It is important to note that the maternal effect is a prerequisite. By Proposition 3, mothers' OCP exposure would not impact daughters' fertility in the absence of the maternal effect, regardless of the peer effect's presence.

where $n_2^u$ denotes the hypothetical fertility of urban Han Chinese women in the second generation in the absence of the OCP, and $n_{r,2}^*$ and $n_{ur,2}^*$ represent the realized fertility of women whose mothers were and were not, respectively, affected by the OCP.

Our objective is to establish a lower bound (in absolute terms) for the impact of a mother's OCP exposure on her daughter's fertility through the maternal effect *alone*, denoted by $n_2^l - n_2^u$, where $n_2^l$ represents the hypothetical fertility of Han Chinese women whose mothers were restricted by the policy but in the absence of the peer effect, as suggested by Proposition 2:

$$\begin{aligned} n_2^l - n_2^u &\leq n_{r,2}^* - n_2^u \\ &\leq \lambda(n_{r,2}^* - n_2^u) \\ &= \beta_l - (1-\lambda)(n_{ur,2}^* - n_2^u) \\ &\leq \beta_l - (n_{ur,2}^* - n_2^u), \end{aligned} \tag{5}$$

where the first inequality is due to $n_2^l \leq n_{r,2}^*$, as implied by Proposition 3; the second and third inequalities follow from $0 < \lambda < 1$; and the equality is based on Eq. 4. Therefore, $\beta_l - (n_{ur,2}^* - n_2^u)$ serves as a lower bound for $n_2^l - n_2^h$ in absolute value, since both terms are negative.

We have estimated $\beta_l$ but not $n_{ur,2}^* - n_2^u$, which represents the effect that arises from the diffusion of low fertility norms within the second generation *alone*. Whereas extensive literature focuses on the diffusion of low fertility norms in peer groups (Spolaore and Wacziarg, 2022; Rossi and Xiao, 2023), estimating its impact on urban Han Chinese women is infeasible. This is due to the limitations of census data, which, for a given birth cohort within the same province, do not differentiate between women whose mothers were and were not treated by the OCP.

In the following analysis, we estimate the peer effect, $n_{ur,2}^* - n_2^h$, using minority women. This analysis presupposes that, were it not for the OCP, fertility preferences between the Han and ethnic minorities would be similar. While the credibility of this assumption remains an open question, it is a premise frequently adopted in existing research (Li and Zhang, 2009; Rossi and Xiao, 2023; Li and Zhang, 2007; Wang and Zhang, 2018; Zhang, 2017). Accepting this assumption enables us to estimate a lower bound for the maternal effect's contribution to the lasting effect of the OCP. Specifically, we re-estimate Eq. 2, this time focusing on urban minority women born from 1969 to 1980 in the 2020 census.

Their fertility is used as the dependent variable. For these women, we assign the same policy exposure values to their mothers as we did for the mothers of urban Han women born in corresponding provinces and years.[39]

The results in Appendix C Table C4 inform the peer effect. Minority women, whose Han counterparts' mothers were impacted by the OCP, have lower fertility than those whose peers' mothers were not under the OCP. The $\beta_3$ estimate reveals that in 2020, fertility among minority women in provinces that implemented the policy 3 years earlier was 0.053 lower than in women born the same year in provinces that adopted the policy later.[40] Our results align with those of Rossi and Xiao (2023).

We apply Eq. 5 to compute the lower bound of the maternal effect using estimates from the ethnic minority sample. For example, considering the relative year 3 ($l = 3$), the absolute lower bound for $n_2^l - n_2^h$ is $0.03 (= 0.08 - 0.05)$, which constitutes 35% of the total effect ($\beta_3$). It is important to note that the estimated coefficient of 0.05 may overestimate the peer effect within the second generation.[41] This coefficient encompasses two elements: the direct peer effect from Han Chinese to minorities within the second generation, and an indirect effect that combines the peer effect from Han Chinese to ethnic minorities in the first generation and the maternal effect from minority mothers to their daughters. The latter component includes a maternal effect. Therefore, the estimate of 0.05 based on minority women may overestimate the peer effect.[42]

# 7 Future Extensions

We suggest two potential extensions for future research. First, our model assumes that a mother's fertility influences her daughter's only through the modification of fertility norms. Future studies could expand this framework by incorporating additional pathways, such as changes in the daughter's education and labor force participation. While our robustness

[39] For more details on the empirical analysis using the ethnic minority sample, who are culturally similar to the Han Chinese, see Appendix F.1.

[40] Due to the small sample size of urban minority women in the 2020 census, the coefficients of $\beta$'s are not estimated with precision; this limitation also hinders our investigation of heterogeneous effects based on the share of Han Chinese across regions, as implied by Proposition 3.

[41] This overestimation may not be of great concern, since it could result in an underestimation of the component of maternal influence in the overall effect.

[42] The above analysis quantifies a lower bound on the contribution of the maternal effect to the OCP effect on daughters' fertility. Interestingly, we are also able to establish a lower bound for a structural parameter: the strength of the maternal effect relative to the peer effect, $\alpha$, in the woman's utility function (Eq. 1). See Appendix F.2 for more details.

analyses did not substantiate these alternate channels in this specific context, they could be significant in other scenarios. Second, there is potential to apply our theoretical framework to study the intergenerational effects of diverse socioeconomic policies that may alter social norms. Such research could yield deeper understanding of the broader implications of policy interventions on societal dynamics.

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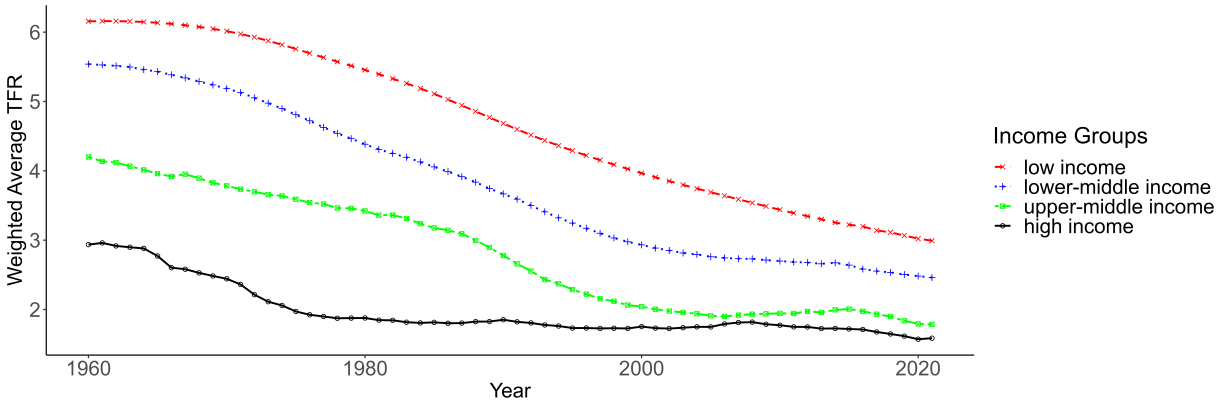
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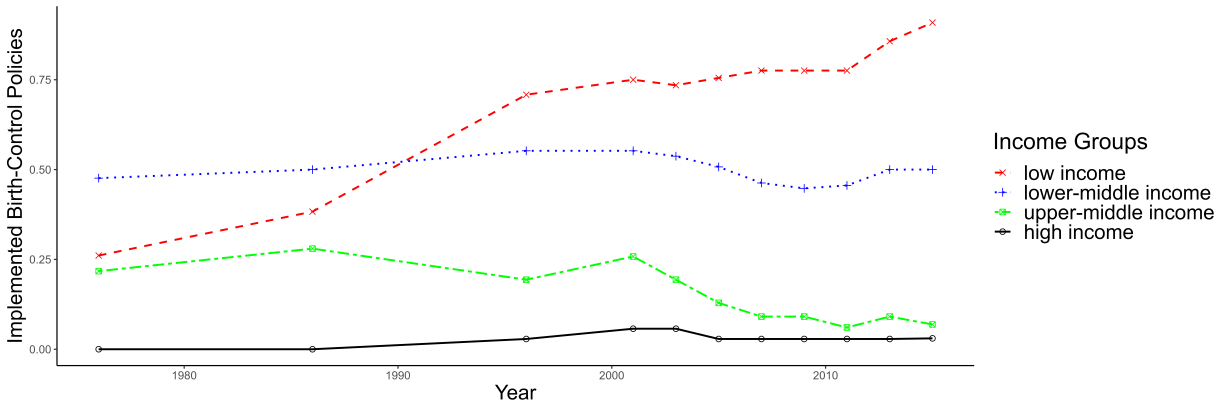
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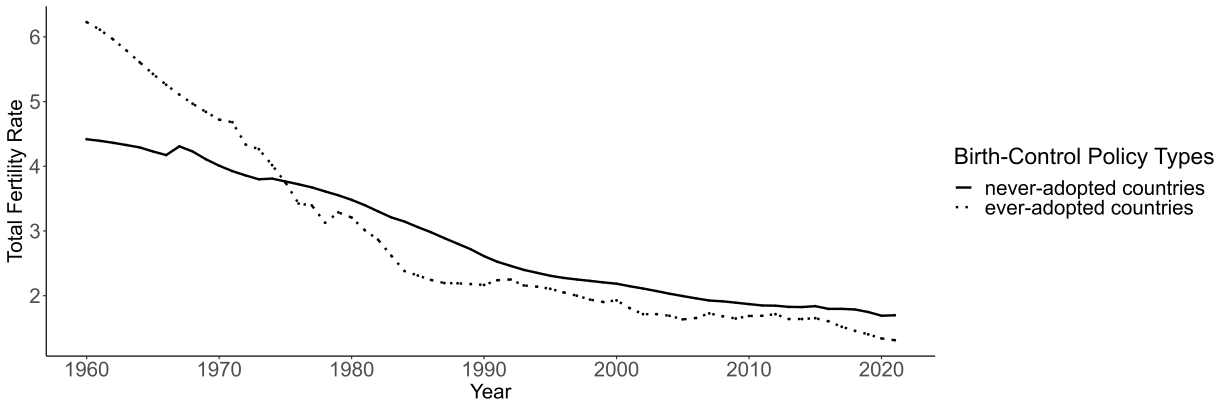
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(a) Total Fertility Rate of Countries, by Income Group




(b) Share of Countries That Implemented Birth-control Policies, by Income Group




(c) Trends in Total Fertility Rates by the Type of Past Birth-Control Policy

Figure 1: Global Patterns of Total Fertility Rates and Birth-control Policies. Figure (a) illustrates weighted average total fertility rates within each income group across time. Figure (b) shows the share of countries implementing birth-control policies within each income group across time. Figure (c) presents the total fertility rates of countries within the upper-middle-income group categorized by birth-control policy type. Fertility data are from the World Bank's World Development Indicators, and countries are classified into four income groups based on their earliest available income classification data from the World Bank. Population policy types are extracted from the United Nations World Population Policies Database. In Figure (b) and Figure (c), we define countries implementing policies to lower fertility as "implementing birth-control policies." In Figure (c), among the 37 identified upper-middle-income countries, birth-control policy information is available for 26. We define an "ever-adopted" group to include countries that have ever adopted birth-control policies but abolished them after 2007. Conversely, a "never-adopted" group includes countries that never implemented birth-control policies during our observation window.

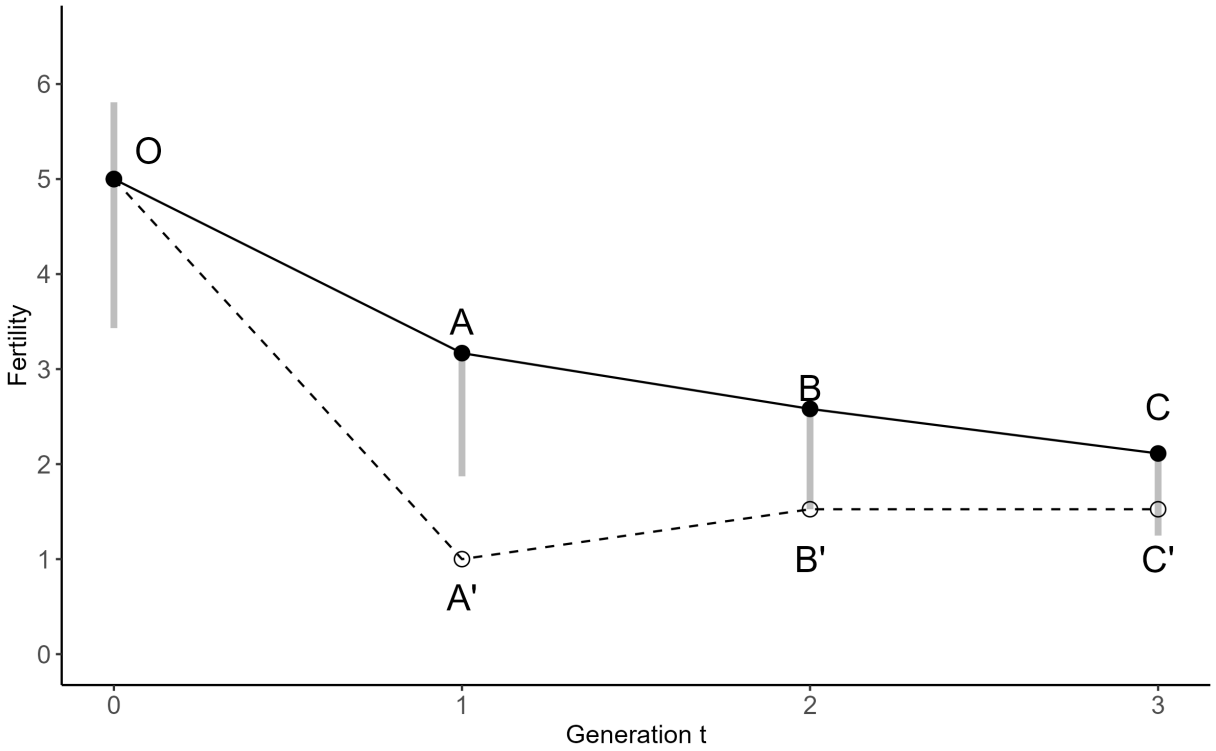
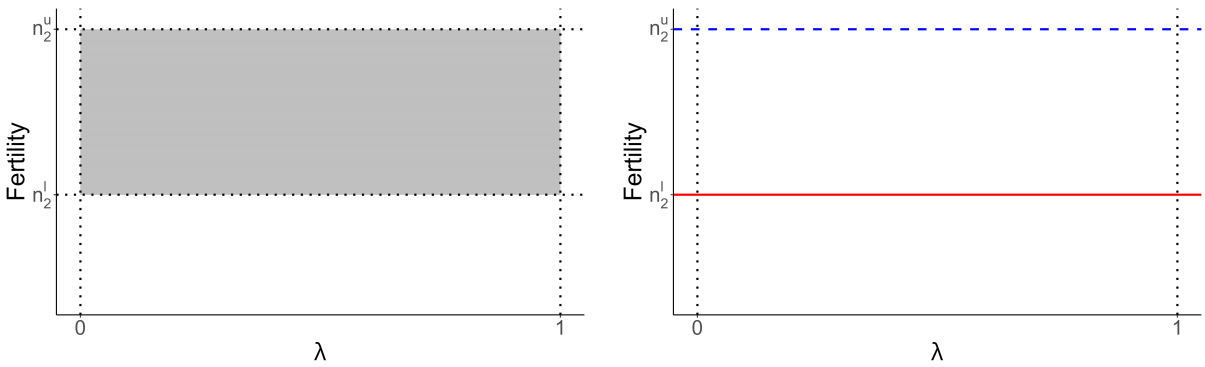


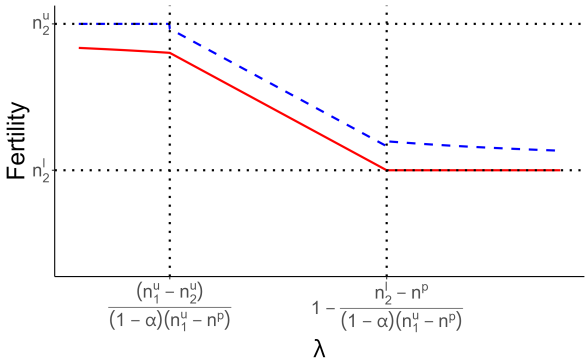

Figure 2: Theoretical Predictions of the Intergenerational Effects of One-shot Birth-control Policies for Generation 1, without Peer Effect. The $x$-axis denotes generations, the $y$-axis shows fertility levels, and vertical gray lines represent the fertility interval $[n_t^l, n_t^u]$ for each generation $t$. The solid line OABC denotes the fertility trend when the birth-control policy never comes into existence. The dashed line OA'B'C' depicts the fertility trend when a mandatory birth-control policy restricts fertility for generation 1, but not for other generations.



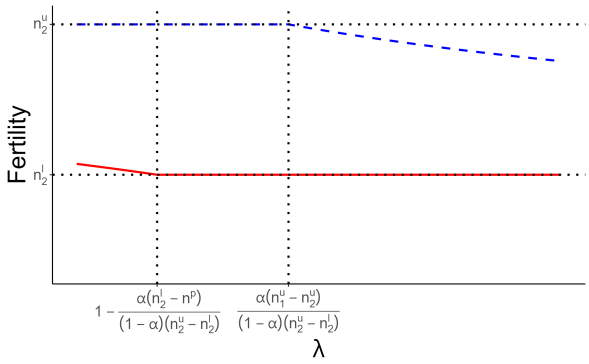

(a) $\alpha = 0$




(b) $\alpha = 1$

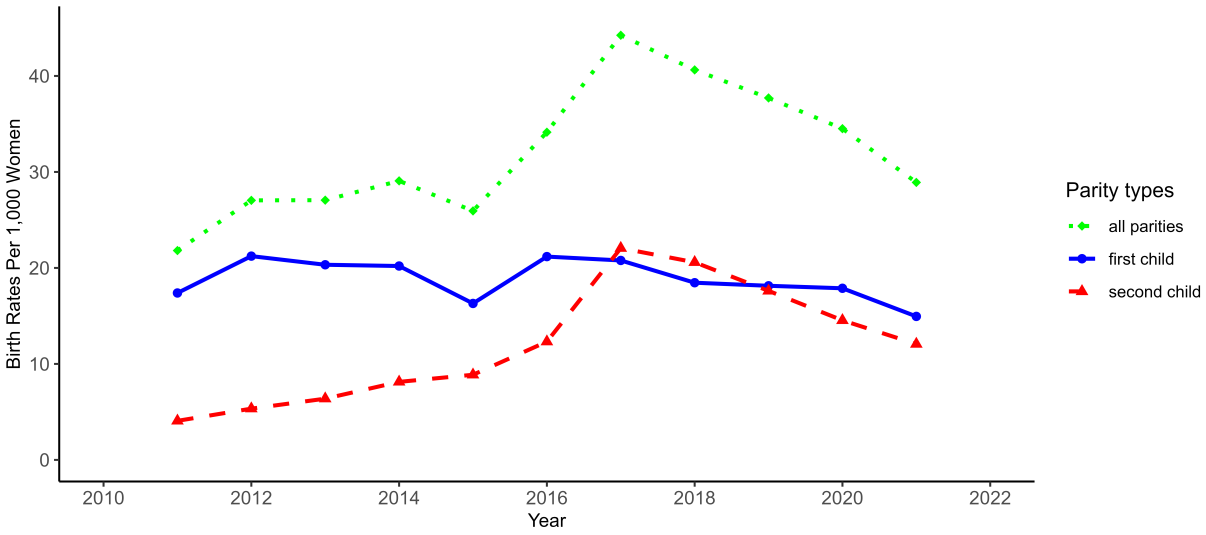



(c) $\alpha \in (0, \frac{n_2^u - n_2^l}{n_1^u - \underline{n}})$

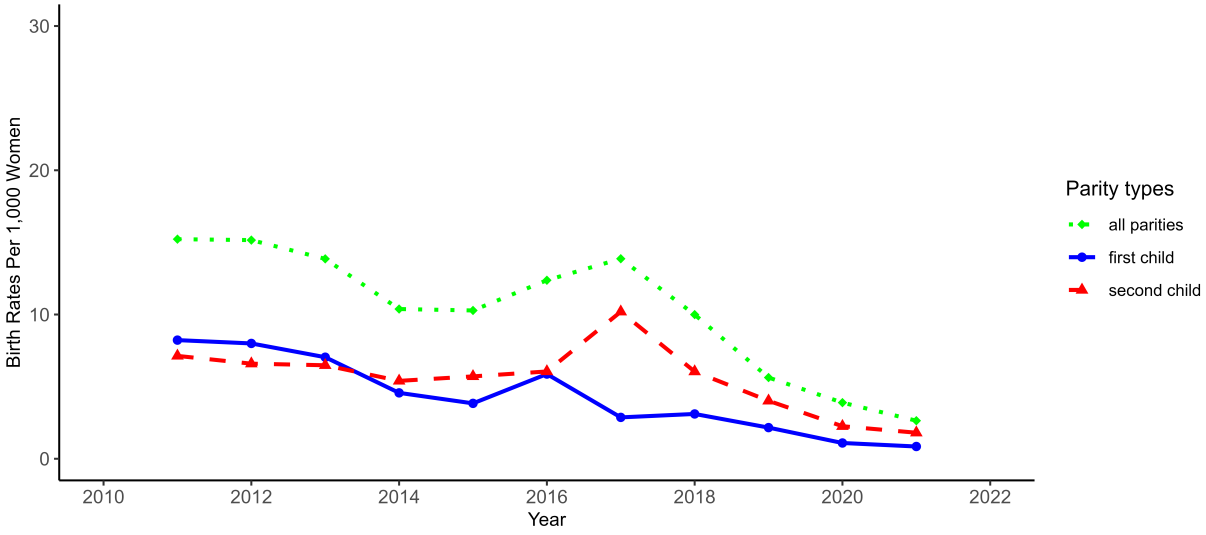



(d) $\alpha \in [\frac{n_2^u - n_2^l}{n_1^u - \underline{n}}, 1)$

Figure 3: Equilibrium Fertility of Generation 2, with both Maternal and Peer Effects. These figures show how the equilibrium fertility of different types of women in generation 2 changes with varying shares of constrained women in generation 1 ($\lambda$). Figures (a)–(d) show various circumstances corresponding to different ranges of $\alpha$, where $\alpha$ denotes the weight of mother's fertility ($n_{i,t-1}$) in determining the fertility norm. The x-axis represents the value of $\lambda$ ranging from 0 to 1, and the y-axis represents fertility levels ranging from $n_2^l$ to $n_2^u$. In Figure (a), as $\alpha = 0$, the peer effect results in the same fertility level for all individuals in generation 2. Multiple equilibria exist, and the equilibrium fertility level can take any value between $n_2^l$ and $n_2^u$. The shaded area represents all possible equilibrium fertility for $\lambda$ ranging from 0 to 1. In Figures (b), (c), and (d), the equilibrium is unique for given values of $\alpha$ and $\lambda$; solid red lines represent equilibrium fertility for individuals with restricted mothers, while dashed blue lines represent equilibrium fertility for those with unrestricted mothers.




(a) Overall Trends




(b) Birth Cohorts Born during 1969-1980

Figure 4: Birth Rates among Urban Chinese Women, by Birth Parity. These two figures depict the birth rates among urban Chinese women for first-born and second-born children from 2011 to 2021. Figures (a) and (b) illustrate the trends in birth rates per 1,000 urban women aged 15-49 during survey years and per 1,000 urban women born during 1969-1980, respectively. Data are from *China Population and Employment Statistical Yearbook 2008-2022*.

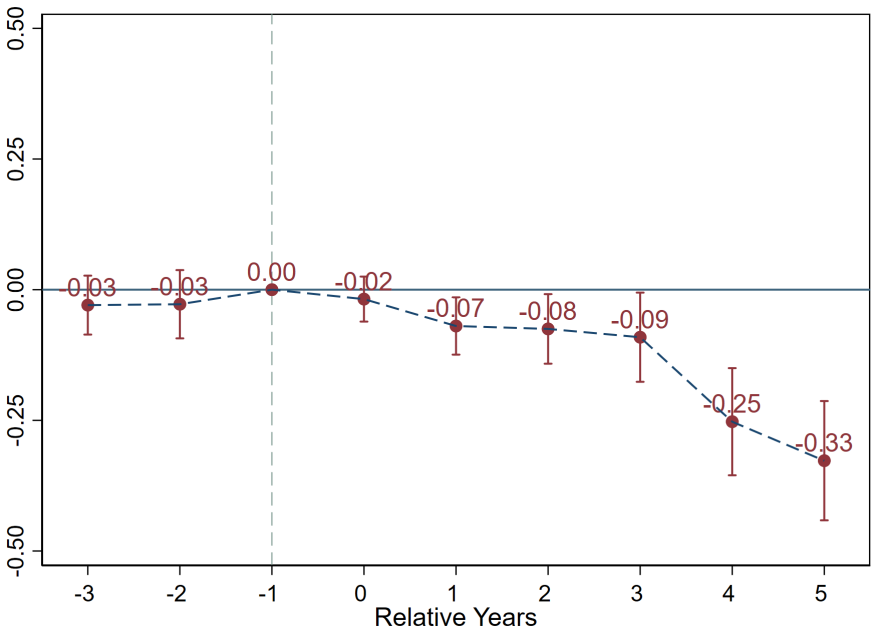



Figure 5: Impact of the OCP Rollout on Second-generation Women's Sibling Size. This figure plots the coefficients estimated using Eq. 2. The dependent variable is second-generation women's sibling size. Data are from the 2005 mini-census and the sample includes urban Han women born during 1975-1980. Control variables include province fixed effects and cohort fixed effects. Robust standard errors are clustered at province level. Vertical bars represent confidence intervals at the 90% level.

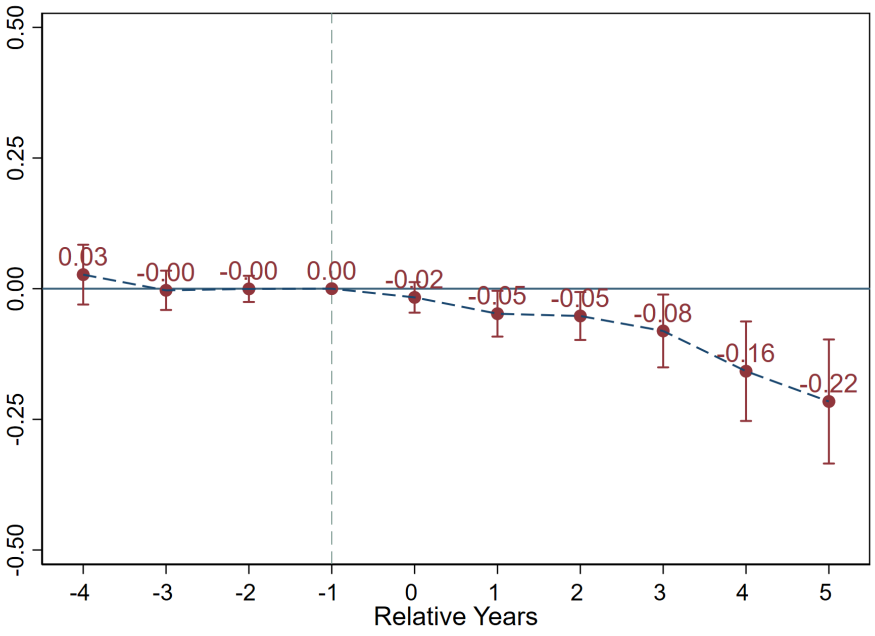
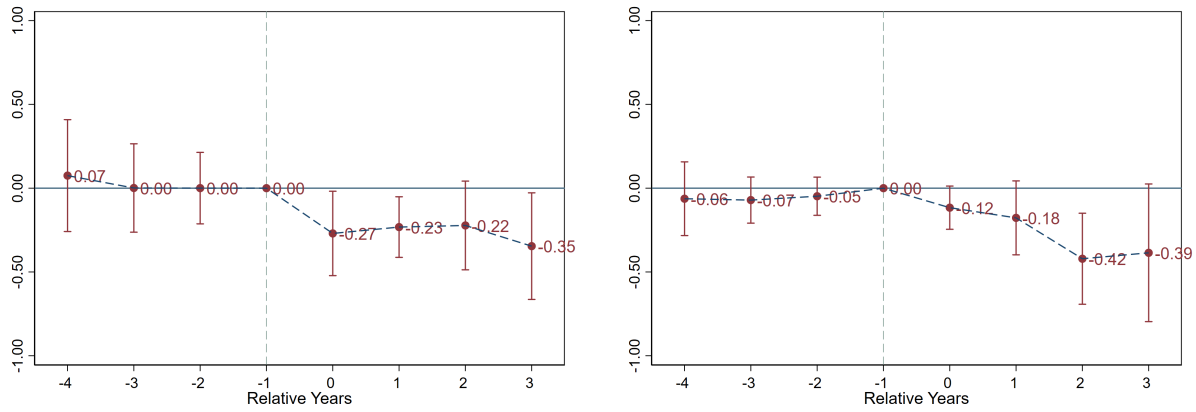



Figure 6: Impact of the OCP Rollout on Second-generation Women's Fertility. This figure plots the coefficients estimated using Eq. 2. The dependent variable is the number of children ever born by 2020. Data are from the 2020 census and the sample includes urban Han women born during 1969 -1980. Control variables include province fixed effects, cohort fixed effects, and province-specific cohort linear trends. Robust standard errors are clustered at the province level. Vertical bars represent confidence intervals at the 90% level.




(a) Second Generation

(b) Third Generation

Figure 7: Impact of the OCP Rollout on Desired Fertility for the Second Generation and Third Generation. These figures plot coefficients estimated using Eq. 2. The dependent variable is desired fertility. Figure (a) shows the impact of the OCP rollout on desired fertility for the second generation. Figure (b) shows the impact of the OCP rollout on desired fertility for the third generation. Data are from CFPS 2012, 2014, and 2018, and samples are restricted to urban Han mothers born during 1969 - 1980. Control variables include province fixed effects, cohort fixed effects, and province-specific cohort linear trends. Robust standard errors are clustered at province level. Vertical bars represent confidence intervals at the 90% level.

Table 1: Summary Statistics of Censuses

| *Variables* | (1) *Mean* | (2) *Std.Dev.* | (3) *N* |
|---|---|---|---|
| *Panel A: Second-generation Fertility in Census 2020* | | | |
| Number of children ever born by 2020 | 1.456 | 0.220 | 75,438 |
| *Panel B: First-generation Fertility in Mini-Census 2005* | | | |
| Sibling size of second-generation women | 1.357 | 0.440 | 32,636 |
| *Panel C: Second-generation Fertility before OCP Relaxation in Mini-census 2015* | | | |
| Number of children ever born by 2013 | 1.374 | 0.136 | 59,561 |
| *Panel D: Second-generation Variables before OCP Relaxation in Census 2010* | | | |
| *Human capital accumulation* | | | |
| Primary school completion (Yes = 1) | 0.994 | 0.009 | 198,203 |
| Junior high school completion (Yes = 1) | 0.876 | 0.083 | 198,203 |
| Senior high school completion (Yes = 1) | 0.389 | 0.123 | 198,203 |
| College completion (Yes = 1) | 0.077 | 0.051 | 198,203 |
| *Labor market performance* | | | |
| Working at least one hour in the past week (Yes = 1) | 0.758 | 0.055 | 198,203 |
| Participating in the labor market (Yes = 1) | 0.810 | 0.053 | 198,203 |
| Total working hours in the past week | 36.350 | 3.217 | 189,414 |
| *Living arrangement* | | | |
| Coresiding with parents or parents-in-law (Yes = 1) | 0.164 | 0.068 | 189,431 |

*Notes:* This table presents summary statistics for fertility outcomes and related variables in China population censuses. Panel A shows the number of children ever born to second-generation women in the 2020 census. Panel B shows second-generation women's sibling size, which represents first-generation women's fertility. Sibling size data are only available in the 2005 mini-census. Panel C shows the number of children born to second-generation women before the OCP relaxation in 2013, as observed in the 2015 mini-census. Panel D shows before-relaxation outcomes of second-generation women, including human capital accumulation, labor market performance, and living arrangements in the 2010 census. Panels A, C, and D include urban Han women born during 1969–1980. Panel B include urban Han women born during 1975–1980, because individuals born before 1975 do not report sibling size in the 2005 mini-census.

Table 2: Impact of the OCP Rollout on Fertility Outcomes

| | (1) | (2) | (3) |
|---|---|---|---|
| *Sample* | *mini-Census 2005* | *Census 2020* | *mini-Census 2015* |
| *Dependent Variable* | *First-generation Fertility (Second-generation Sibling Size)* | *Second-generation Fertility by 2020* | *Second-generation Fertility by 2013 before OCP Relaxation* |
| Relative Year -4 | - | 0.027 | -0.028 |
| | - | (0.035) | (0.043) |
| Relative Year -3 | -0.030 | -0.003 | 0.006 |
| | (0.034) | (0.023) | (0.033) |
| Relative Year -2 | -0.028 | -0.000 | -0.041 |
| | (0.040) | (0.015) | (0.031) |
| Relative Year -1 | - | - | - |
| | - | - | - |
| Relative Year 0 | -0.018 | -0.017 | -0.026 |
| | (0.026) | (0.018) | (0.041) |
| Relative Year 1 | -0.070** | -0.048* | -0.018 |
| | (0.033) | (0.027) | (0.045) |
| Relative Year 2 | -0.075* | -0.052* | -0.013 |
| | (0.040) | (0.028) | (0.062) |
| Relative Year 3 | -0.091* | -0.081* | -0.022 |
| | (0.052) | (0.042) | (0.073) |
| Relative Year 4 | -0.253*** | -0.158** | -0.049 |
| | (0.062) | (0.058) | (0.098) |
| Relative Year 5 | -0.327*** | -0.216*** | -0.043 |
| | (0.069) | (0.072) | (0.134) |
| Observations | 32,636 | 75,438 | 59,561 |
| Mean of dep. var. | 1.357 | 1.456 | 1.374 |

*Notes:* This table shows the coefficients estimated using Eq. 2. Column (1) shows the impact of the OCP rollout on the sibling size of second-generation women. Data are from the mini-census 2005. Samples are restricted to second-generation Han women with urban Hukou born during 1975–1980, because individuals born before 1975 do not report the number of siblings in the 2005 mini census. Control variables include province and cohort fixed effects. Column (2) shows the impact of the OCP rollout on the number of children ever born to second-generation women in the 2020 census. Column (3) shows the impact of the OCP rollout on the number of children born to second-generation women before the OCP relaxation in 2013, as observed in the 2015 mini-census. Samples in Columns (2) and (3) are restricted to urban Han women born between 1969 and 1980. Control variables include province fixed effects, cohort fixed effects, and province-specific linear cohort trends. Robust standard errors clustered at province level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

# Online Appendix for "Intergenerational Impact of Birth-Control Policies on Fertility: The Role of Norms"

Rufei Guo* Lin Lin† Junjian Yi‡ Hanyu Zhu§

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# A Full Derivation of the Theory

## A.1 Proof of Proposition 1

The utility maximization problem of generation $t$ is

$$\begin{aligned} U_t = &\ \ln(c_t) + \gamma \ln(n_t) - \sigma |\ln(n_t) - \ln(n_{t-1})|, \\ s.t. \quad &\ c_t + p_t n_t = y_t, \end{aligned}$$

where $\gamma$ represents the degree of maternal altruism toward children, $p_t$ is the cost of child-bearing, $y_t$ is income of generation $t$ in adulthood, and $\sigma \geq 0$ measures the utility loss for every log point deviation of the women' s fertility from her mother's fertility. Actually, the utility function is a piecewise function:

$$U_t = \begin{cases} \ln(c_t) + \gamma \ln(n_t) - \sigma[\ln(n_{t-1}) - \ln(n_t)], & \text{if} \quad n_t < n_{t-1} \\ \ln(c_t) + \gamma \ln(n_t) - \sigma[\ln(n_t) - \ln(n_{t-1})], & \text{if} \quad n_t \geq n_{t-1}. \end{cases}$$

We will arrive at the optimal solution via a case-by-case discussion.

**Case 1.** Suppose that mother's fertility is higher than daughter's optimal fertility ($n_{t-1} > n_t^*$); then daughter's utility function takes the form $\ln(c_t) + (\gamma + \sigma)\ln(n_t) - \sigma \ln(n_{t-1})$. When $n_{t-1} > n_t^*$, the utility function is continuously differentiable at $n_t^*$. The first-order conditions (FOCs) determine optimal fertility:

$$n_t^* = \frac{\gamma + \sigma}{1 + \gamma + \sigma} \frac{y_t}{p_t} \equiv n_t^u.$$

This case requires mother's fertility to be sufficiently high ($n_{t-1} > n_t^u$), such that mother's high fertility norm induces daughter's fertility $n_t^*$ to hit an upper bound $n_t^u$.

**Case 2.** Symmetrically, when mother's fertility is sufficiently low ($n_{t-1} < n_t^*$), daughter's utility function becomes $\ln(c_t) + (\gamma - \sigma)\ln(n_t) + \sigma \ln(n_{t-1})$. The FOCs give optimal fertility:

$$n_t^* = \frac{\gamma - \sigma}{1 + \gamma - \sigma} \frac{y_t}{p_t} \equiv n_t^l.$$

This case requires mother's fertility to be sufficiently low ($n_{t-1} < n_t^l$).

**Case 3.** When mother's fertility lies between the lower and upper bounds ($n_t^l \leq n_{t-1} \leq n_t^u$), we will prove $n_t^* = n_{t-1}$ using contradiction. Suppose $n_t^* < n_{t-1}$. By the reasoning in

case 1, we have $n_t^* = n_t^u$. So $n_t^u < n_{t-1}$, contradiction. Suppose $n_t^* > n_{t-1}$. By the reasoning in case 2, we have $n_t^* = n_t^l$. So $n_t^l > n_{t-1}$, contradiction. Thus we must have $n_t^* = n_{t-1}$. In this case, mother's fertility dictates daughter's fertility. When optimal fertility lies strictly within the range ($n_t^l < n_{t-1} < n_t^u$), small changes in intrinsic costs and benefits ($p_t/y_t$, $\gamma$) do not affect daughter's fertility. The "conformity" to social norms arises, because when $n_t$ increases and passes over $n_{t-1}$, the marginal benefit of $n_t$ drops discontinuously (from $\frac{\gamma+\sigma}{n_t}$ to $\frac{\gamma-\sigma}{n_t}$ in our case), but the marginal cost of $n_t$ rises continuously (Akerlof, 1997).

To sum up, the case-by-case discussion gives

$$n_t^* = \begin{cases} n_t^u & \text{if} \quad n_{t-1} > n_t^u, \\ n_{t-1} & \text{if} \quad n_t^l \leq n_{t-1} \leq n_t^u, \\ n_t^l & \text{if} \quad n_{t-1} < n_t^l. \end{cases}$$

$n_{t-1}$ establishes the norm of daughter's fertility, but the impact is limited to a range set by the bounds, which encloses the intrinsic optimum if $\sigma > 0$. This completes the proof of Proposition 1.

## A.2 Desired Fertility under Zero Childbearing Cost

Under the hypothetical scenario of zero childbearing cost, the utility maximization problem for generation $t$ is:

$$\max_{n_t} U_t = \ln(y_t) + \gamma \ln(n_t) - \sigma |\ln(n_t) - \ln(n_{t-1})|,$$

where parents consume all income and freely choose the number of children. When $\sigma > \gamma$, we can show $n_t^* = n_{t-1}$. That is to say, under zero childbearing cost, desired fertility would fully capture the fertility norm.

We prove $n_t^* = n_{t-1}$ by contradiction. (i) Suppose $n_t^* < n_{t-1}$, the utility function for woman $i$ becomes $U_t = \ln(y_t) + (\gamma + \sigma)\ln(n_t) - \sigma \ln(n_{t-1})$. Because $\gamma + \sigma > 0$, the utility function increases with $n_t$. Consider $n_t^* < n_t^* + \epsilon < n_{t-1}$, then $U_t(n_t^*) < U_t(n_t^* + \epsilon)$, which contradicts the assumption that $n_t^*$ is the optimal choice. (ii) Suppose $n_t^* > n_{t-1}$. The utility function becomes $U_t = \ln(y_t) + (\gamma - \sigma)\ln(n_t) - \sigma \ln(n_{t-1})$. Because $\gamma - \sigma < 0$, the utility function decreases with $n_t$. Consider $n_t^* > n_t^* - \epsilon > n_{t-1}$, then $U_t(n_t^*) < U_t(n_t^* - \epsilon)$, which contradicts the assumption that $n_t^*$ is the optimal choice.

## A.3 Proof of Proposition 2

In a more realistic scenario, suppose that the cost of having a child consistently and progressively increases from generations 1 to 3:

$$p_0 < p_1 < p_2 < p_3.$$

Similar to the simple scenario above, the fertility of generation 0 begins at $\tilde{n}_0 \in [n_0^l, n_0^u] = [\frac{\gamma-\sigma}{1+\gamma-\sigma}\frac{y_0}{p_0}, \frac{\gamma+\sigma}{1+\gamma+\sigma}\frac{y_0}{p_0}]$: $n_0^* = \tilde{n}_{-1}$ (points O in Fig. 2). We also assume $p_1 > \frac{\gamma-\sigma}{1+\gamma-\sigma}\frac{y_1}{\tilde{n}_{-0}}$ such that $n_1^u < \tilde{n}_0$.

As marked by the dashed path OABC in Fig. 2, in the absence of birth-control policies, the fertility transition would have followed the upper bounds for generations 1, 2, and 3. A one-shot birth-control policy in generation 1 triggers the fertility transition (the solid path OA'B'C'). When $n^p < n_2^l$, the fertility of generation 2 slightly rebounds but only reaches the lower bound—that is, $n_2^* = n_2^l$.

In reality, a fertility transition results from a combination of rising child prices and declining maternal altruism toward children ($\gamma$). Proposition 2 is robust to variations in $\gamma$ as long as changes in $\gamma$ do not overturn the conditions on the fertility intervals ($n_1^u < \tilde{n}_0, n_2^l < n_3^u, n^p < n_2^l$). The lasting fertility effect of a one-shot birth-control policy does not hinge on the source of fertility decline.

## A.4 Model Extension: Incorporating the Peer Effect

Our theory highlights the evolution of fertility norms behind the persistent fertility-reduction effect of past birth-control policies. The literature has extensively investigated the peer effect in shaping fertility norms, i.e., the spread of new fertility norms within the same generation (Richerson and Boyd, 2008; Spolaore and Wacziarg, 2022; Beach and Hanlon, 2023). There is little doubt that the peer effect serves as an important channel through which new fertility norms spread across time and space. We incorporate the peer effect in our theory, and find a robust prediction of the persistent fertility-reduction effect of past birth-control policies for subsequent generations. Furthermore, the peer effect helps spread the new fertility norm to descendants of initially unrestricted lineages. Importantly, when the maternal effect is absent and the peer effect functions alone, a one-shot birth-control policy that restricts just one generation would have no effect on the fertility of subsequent

generations. Thus, the maternal effect is pivotal for the persistent fertility-reduction effect of one-shot birth-control policies.

To incorporate the peer effect, suppose the fertility norm now consists of the mother's fertility and the expected fertility of peers. The utility maximization problem of lineage $i$ at generation $t$ is

$$\begin{aligned} \max_{c_{i,t},n_{i,t}} \; U_{i,t} = \; & \ln(c_{i,t}) + \gamma \ln(n_{i,t}) - \sigma |\ln(n_{i,t}) - \ln(N_{i,t})|, \\ \text{s.t.} \quad & \alpha n_{i,t-1} + (1-\alpha)\bar{n}_t = N_{i,t}, \\ & c_{i,t} + p_t n_{i,t} = y_t, \end{aligned} \tag{P2}$$

where $N_{i,t}$ denotes the fertility norm, which is a weighted average of mother's fertility ($n_{i,t-1}$) and the expected fertility of peers ($\bar{n}_t$). The weight $\alpha \in [0,1]$ represents the relative strength of maternal versus peer effects. When $\alpha = 1$, the peer effect is absent: P2 collapses to P1. When $\alpha = 0$, the maternal effect is nonexistent, and the peer effect operates in isolation; this particular scenario will be further discussed below. In a typical case of $\alpha \in (0,1)$, both maternal and peer effects are in effect.

**Equilibrium Fertility in the Absence of a Birth-control Policy**

When there is no birth-control policy and $n_{i,t-1}$ is the same for each $i$, the solution of P2 is almost identical to that of P1.

**Lemma 1** *In P2, when $\sigma \geq 0$ and conditional on the same $n_{i,t-1} = n_{t-1}$ for each $i$, the optimal fertility of woman $i$ at generation $t$ is*

$$n^*_{i,t} = \begin{cases} n^u_t & \text{if} \quad n_{t-1} > n^u_t, \\ n_{t-1} & \text{if} \quad n^l_t \leq n_{t-1} \leq n^u_t, \\ n^l_t & \text{if} \quad n_{t-1} < n^l_t. \end{cases}$$

*where* $[n^l_t, n^u_t] = [\frac{\gamma-\sigma}{1+\gamma-\sigma}\frac{y_t}{p_t}, \frac{\gamma+\sigma}{1+\gamma+\sigma}\frac{y_t}{p_t}]$.

*Proof.* See Appendix Section A.5.

**Equilibrium Fertility under a Birth-control Policy**

Suppose that a birth-control policy restricts the fertility level of a proportion $\lambda \in (0,1)$ of mothers in generation 1 to $n^p < n^l_2$.[43] For the remaining $1-\lambda$ proportion of mothers,

[43] If the birth-control policy uniformly restricts every mother in generation 1, introduction of the peer effect

the birth-control policy does not bind. We denote the equilibrium fertility of generation-$t$ individuals in restricted lineages as $n^*_{r,t}$, and those in the unrestricted lineages as $n^*_{ur,t}$.

In generation 2, two sets of fertility norms emerge: Daughters with restricted mothers adhere to a fertility norm $N_{r,2}$:

$$N_{r,2} = \alpha n^p + (1-\alpha)\bar{n}_2,$$

and daughters with unrestricted mothers adopt a fertility norm $N_{ur,2}$:

$$N_{ur,2} = \alpha n_{ur,1} + (1-\alpha)\bar{n}_2.$$

Because $n_{ur,1} \in [n^l_1, n^u_1]$, we must have $n^p < n_{ur,1}$; thus $N_{r,2} < N_{ur,2}$. For simplicity of notation, suppose that the fertility of unrestricted generation-1 mothers stays at the upper bound $n_{ur,1} = n^u_1$. In the face of different fertility norms ($n^p$ vs. $n^u_1$), daughters in generation 2 may opt for different levels of optimal fertility.

Individuals optimize by solving for P2 in the expectation of the optimal fertility choices of others. A Nash equilibrium is sustained by the condition of rational expectation:

$$\bar{n}_t = \lambda n^*_{r,t} + (1-\lambda) n^*_{ur,t}.$$

In the Nash equilibrium, no individual has an incentive to deviate given the optimal fertility of others. Lemmas 2 and 3 characterize the equilibrium fertility of generation 2.

**Lemma 2** *Suppose the maternal effect is moderate relative to the peer effect, $\alpha \in (0, \frac{n^u_2 - n^l_2}{n^u_1 - n^p})$. A birth-control policy restricts the fertility level of a proportion $\lambda \in (0,1)$ of generation-1 mothers to $n_{r,1} = n^p$, which is lower than the lower bound of generation 2, $n^p < n^l_2$. The remaining $1-\lambda$ proportion of unrestricted generation-1 mothers attain $n_{ur,1} = n^u_1$. The strength of $\lambda$ pins down equilibrium fertility for generation 2.*

*If $\lambda \in (0, \frac{n^u_1 - n^u_2}{(1-\alpha)(n^u_1 - n^p)}]$, then*

$$\begin{cases} n^*_{r,2} & = N_{r,2} = \alpha n^p + (1-\alpha)\frac{\alpha\lambda n^p + (1-\lambda) n^u_2}{1-\lambda+\alpha\lambda}, \\ n^*_{ur,2} & = n^u_2, \\ \bar{n}_2 & = \frac{\alpha\lambda n^p + (1-\lambda) n^u_2}{1-\lambda+\alpha\lambda}. \end{cases}$$

would not yield fundamentally different theoretical results.

*If* $\lambda \in (\frac{n_1^u - n_2^u}{(1-\alpha)(n_1^u - n^p)}, 1 - \frac{n_2^l - n^p}{(1-\alpha)(n_1^u - n^p)})$, *then*

$$\begin{cases} n_{r,2}^* & = N_{r,2} = \alpha n^p + (1-\alpha)(\lambda n^p + (1-\lambda) n_1^u, \\ n_{ur,2}^* & = N_{ur,2} = \alpha n_1^u + (1-\alpha)(\lambda n^p + (1-\lambda) n_1^u), \\ \bar{n}_2 & = \lambda n^p + (1-\lambda) n_1^u. \end{cases}$$

*If* $\lambda \in [1 - \frac{n_2^l - n^p}{(1-\alpha)(n_1^u - n^p)}, 1)$, *then*

$$\begin{cases} n_{r,2}^* & = n_2^l, \\ n_{ur,2}^* & = N_{ur,2} = \alpha n_1^u + (1-\alpha)\frac{\lambda n_2^l + (1-\lambda)\alpha n_1^u}{\lambda + \alpha - \lambda\alpha}, \\ \bar{n}_2 & = \frac{\lambda n_2^l + (1-\lambda)\alpha n_1^u}{\lambda + \alpha - \lambda\alpha}. \end{cases}$$

**Lemma 3** *Suppose the maternal effect is strong relative to the peer effect,* $\alpha \in [\frac{n_2^u - n_2^l}{n_1^u - n^p}, 1)$. *A birth-control policy restricts the fertility level of a proportion* $\lambda \in (0,1)$ *of generation-1 mothers to* $n_{r,1} = n^p$, *which is lower than the lower bound of generation 2,* $n^p < n_2^l$. *The remaining* $1 - \lambda$ *proportion of unrestricted generation-1 mothers attain* $n_{ur,1} = n_1^u$. *The strength of* $\lambda$ *pins down equilibrium fertility for generation 2.*

*If* $\lambda \in (0, 1 - \frac{\alpha(n_2^l - n^p)}{(1-\alpha)(n_2^u - n_2^l)})$, *then*

$$\begin{cases} n_{r,2}^* & = N_{r,2} = \alpha n^p + (1-\alpha)\frac{\alpha\lambda n^p + (1-\lambda) n_2^u}{1 - \lambda + \alpha\lambda}, \\ n_{ur,2}^* & = n_2^u, \\ \bar{n}_2 & = \frac{\alpha\lambda n^p + (1-\lambda) n_2^u}{1 - \lambda + \alpha\lambda}. \end{cases}$$

*If* $\lambda \in [1 - \frac{\alpha(n_2^l - n^p)}{(1-\alpha)(n_2^u - n_2^l)}, \frac{\alpha(n_1^u - n_2^u)}{(1-\alpha)(n_2^u - n_2^l)}]$, *then*

$$\begin{cases} n_{r,2}^* & = n_2^l, \\ n_{ur,2}^* & = n_2^u, \\ \bar{n}_2 & = \lambda n_2^l + (1-\lambda) n_2^u. \end{cases}$$

*If* $\lambda \in (\frac{\alpha(n_1^u - n_2^u)}{(1-\alpha)(n_2^u - n_2^l)}, 1)$, *then*

$$\begin{cases} n_{r,2}^* & = n_2^l, \\ n_{ur,2}^* & = N_{ur,2} = \alpha n_1^u + (1-\alpha)\frac{\lambda n_2^l + (1-\lambda)\alpha n_1^u}{\lambda + \alpha - \lambda\alpha}, \\ \bar{n}_2 & = \frac{\lambda n_2^l + (1-\lambda)\alpha n_1^u}{\lambda + \alpha - \lambda\alpha}. \end{cases}$$

Proofs of Lemmas 2 and 3 are relegated to Appendix Section A.6.

Lemmas 1–3 immediately predict that when $\alpha \in (0, 1]$ and $\lambda \in (0, 1]$, the one-shot birth-control policy in generation 1 reduces the fertility of generation 2. When there is no birth-control policy, by Lemma 1, the fertility of generation 2 stays at the upper bound. The one-shot birth-control policy in generation 1 reduces the average fertility of generation 2 to $\bar{n}_2$, which is, by Lemmas 2 and 3, strictly lower than the upper bound $n_2^u$.

**Changing Policy Coverage ($\lambda$)**

Fig. 2a and Fig. 2b illustrate how equilibrium fertility changes with $\lambda$ when $\alpha \in (0, \frac{n_2^u - n_2^l}{n_1^u - n^p})$ and $\alpha \in [\frac{n_2^u - n_2^l}{n_1^u - n^p}, 1)$, respectively. Solid red lines represent equilibrium fertility for individuals with restricted mothers ($n_{r,2}^*$), and dashed blue lines represent equilibrium fertility for those with unrestricted mothers ($n_{ur,2}^*$). In both figures, when $\lambda$ increases from zero, $n_{r,2}^*$ immediately declines until it reaches the lower bound $n_2^l$; $n_{ur,2}^*$ initially sticks to the upper bound $n_2^u$, but eventually starts to decline when $\lambda$ passes a threshold value. Based on Lemmas 2 and 3, we derive Lemmas 4–7 to depict the evolution of $n_{r,2}^*$, $n_{ur,2}^*$, and $\bar{n}_2$ in response to changes in $\lambda$.

**Lemma 4** *When $\lambda$ increases from zero to $\underline{\lambda}$, $n_{r,2}^*$ strictly decreases to the lower bound $n_2^l$. Further increases in $\lambda$ have no effect on $n_{r,2}^*$.*

1. *If* $\alpha \in (0, \frac{n_2^u - n_2^l}{n_1^u - n^p})$, $\underline{\lambda} = 1 - \frac{n_2^l - n^p}{(1-\alpha)(n_1^u - n^p)}$.
2. *If* $\alpha \in [\frac{n_2^u - n_2^l}{n_1^u - n^p}, 1)$, $\underline{\lambda} = 1 - \frac{\alpha(n_2^l - n^p)}{(1-\alpha)(n_2^u - n_2^l)}$.

*In both cases, $\underline{\lambda}$ strictly increases as $\alpha$ decreases or as $n^p$ increases.*

**Lemma 5** *When $\lambda$ increases from 0 to $\bar{\lambda}$, $n_{ur,2}^*$ remains at the upper bound $n_2^u$. When $\lambda$ passes the threshold $\bar{\lambda}$, $n_{ur,2}^*$ strictly decreases with $\lambda$.*

1. *If* $\alpha \in (0, \frac{n_2^u - n_2^l}{n_1^u - n^p})$, $\bar{\lambda} = \frac{n_1^u - n_2^u}{(1-\alpha)(n_1^u - n^p)}$.

2. *If* $\alpha \in [\frac{n_2^u - n_2^l}{n_1^u - n^p}, 1)$, $\bar{\lambda} = \frac{\alpha(n_1^u - n_2^u)}{(1-\alpha)(n_2^u - n_2^l)}$.

*In both cases,* $\bar{\lambda}$ *strictly increases as* $\alpha$ *increases or as the gap between the upper bounds of period 1 and period 2* $(n_1^u - n_2^u)$ *increases.*

**Lemma 6** *When* $\lambda$ *increases from zero to one, the average fertility of generation 2 decreases:* $\frac{\partial \bar{n}_2}{\partial \lambda} < 0$.

Proofs of Lemmas 4–6 are relegated to Appendix Section A.7.

**Changing Strength of Maternal versus Peer Effects ($\alpha$)**

A comparison of Fig. 3a and Fig. 3b suggests that the relative strength of maternal versus peer effects ($\alpha$) affects the convergence of fertility between generation-2 individuals with restricted and unrestricted mothers. When the peer effect becomes more prominent (smaller $\alpha$), the gap in equilibrium fertility between the two groups, $n_{ur,2}^* - n_{r,2}^*$, becomes smaller. We can prove Lemma 7:

**Lemma 7** *When the peer effect is more prominent (smaller* $\alpha$*), the gap in equilibrium fertility between generation-2 individuals with restricted mothers and unrestricted mothers becomes smaller:* $\frac{\partial(n_{ur,2}^* - n_{r,2}^*)}{\partial \alpha} \geq 0$.

*Proof.* See Appendix Section A.7.

We next explore scenarios in which $\alpha$ takes on extreme values of zero or one. When $\alpha = 1$, P2 collapses to P1, in which the peer effect is absent and mother's fertility exclusively shapes the fertility norm. As shown in Fig. 3c, the equilibrium fertility of individuals with restricted parents remains at the lower bound; for those with unrestricted parents, equilibrium fertility remains at the upper bound.

When $\alpha = 0$, the fertility norm is determined solely by the average fertility of peers. Consequently, past birth-control policies find no way to affect the fertility of the current generation. Akerlof (1997) has shown that the peer effect alone would result in multiple equilibria. As shown in Fig. 3d, when $\alpha = 0$, equilibrium fertility can take any value between $n_2^u$ and $n_2^l$. Interestingly, if we introduce a minimal degree of maternal effect by assigning $\alpha$ a value slightly larger than zero, multiple equilibria collapse into a unique equilibrium. The maternal effect turns out to provide an anchoring point for the multiple equilibria that arise from the peer effect alone.

**Lasting Effects under the Peer Effect**

The lasting fertility-reduction effect of the one-shot birth-control policy extends beyond generation 2. To illustrate, we again suppose that the economy consists of four generations: 0, 1, 2, and 3. The fertility of generation 0 begins at a relatively high level $n^*_{i,0} = \tilde{n}_0 \in [n^l_0, n^u_0]$. Child price rises or child preference diminishes in generation 1 and remains stable thereafter, and these variations are strong enough to reduce fertility in generation 1: $n^*_{i,0} > n^u_1 = n^u_2 = n^u_3$. In the absence of birth-control policies, by Lemma 1 equilibrium fertility from generations 0 to 3 follows path OABC in Fig. A1.

Paths OA'B'C' and OA"B"C" in Fig. A1 trace equilibrium fertility for restricted and unrestricted lineages ($n^*_{r,t}$ and $n^*_{ur,t}$), respectively. The one-shot birth-control policy in generation 1 lowers the average fertility for generations 2 and 3. Under the peer effect, equilibrium fertility tends to converge over generations between restricted and unrestricted lineages. The speed of convergence is higher when the peer effect is more pronounced. The average fertility of generation $t$ decreases as the policy coverage expands, i.e., $\frac{\partial \bar{n}_t}{\partial \lambda} < 0, \forall t \geq 1$.

Our model prediction for the fertility-reduction effect of birth-control policies is consistent with that of De Silva and Tenreyro (2020), who suggest that birth-control policies alter family-size norms and significantly accelerate the decline in fertility toward replacement level. Despite the acceleration effect, birth-control policies do not affect the ultimate fertility level.[44] Different from De Silva and Tenreyro (2020), we predict a lasting effect of birth-control policies on reducing the fertility level. While De Silva and Tenreyro (2020) focus on episodes of fertility transition toward replacement-level fertility, our model is better suited to the recent experience of upper-middle income countries, as shown in Fig. 1c.

## A.5 Proof of Lemma A.1

We expand our model to include the peer effect by integrating the expected fertility of peers into the fertility norm. The utility maximization problem of individual $i$ in generation $t$ is

$$\begin{aligned} \max_{c_{i,t}, n_{i,t}} U_{i,t} = \; & \ln(c_{i,t}) + \gamma \ln(n_{i,t}) - \sigma |\ln(n_{i,t}) - \ln(N_{i,t})|, \\ \text{s.t.} \quad & \alpha n_{i,t-1} + (1-\alpha)\bar{n}_t = N_{i,t}, \\ & c_{i,t} + p_t n_{i,t} = y_t, \end{aligned} \tag{P2}$$

[44] De Silva and Tenreyro (2020) define fertility norms as a weighted average between the fertility of the previous generation and long-term replacement-level fertility. Birth-control policies increase the weight attributed to replacement-level fertility, and thereby lower the fertility norm.

where $N_{i,t}$ denotes the fertility norm, which is a weighted average of mother's fertility ($n_{i,t-1}$) and the expected fertility of peers ($\bar{n}_t$). The weight $\alpha \in [0,1]$ represents the relative strength of maternal versus peer effects. The utility function is a piecewise function:

$$U_{i,t} = \begin{cases} \ln(y_t - p_t n_{i,t}) + \gamma \ln(n_{i,t}) - \sigma(\ln(N_{i,t}) - \ln(n_{i,t})), & \text{if } N_{i,t} > n_{i,t} \\ \ln(y_t - p_t n_{i,t}) + \gamma \ln(n_{i,t}) - \sigma(\ln(n_{i,t}) - \ln(N_{i,t})), & \text{if } N_{i,t} \leq n_{i,t} \end{cases}$$

We will arrive at the optimal solution via a case-by-case discussion. For simplicity, suppose $n_{i,t-1} = n_{t-1}$ is the same for each individual $i$.

**Case 1.** Suppose that fertility norm $N_{i,t}$ is higher than the individual's optimal fertility ($N_{i,t} > n^*_{i,t}$). Then the individual's utility function takes the form $\ln(c_{i,t}) + (\gamma + \sigma)\ln(n_{i,t}) - \sigma \ln(N_{i,t})$. When $N_{i,t} > n^*_{i,t}$, the utility function is continuously differentiable at $n^*_{i,t}$. The FOCs determine optimal fertility:

$$n^*_{i,t} = \frac{\gamma + \sigma}{1 + \gamma + \sigma} \frac{y_t}{p_t} \equiv n^u_t.$$

The condition $N_{i,t} > n^*_{i,t}$ would be satisfied if and only if $n_{t-1} > n^u_t$.

**Case 2.** Symmetrically, when the fertility norm $N_{i,t}$ is sufficiently low ($N_{i,t} < n^*_{i,t}$), the individual's utility function becomes $\ln(c_{i,t}) + (\gamma - \sigma)\ln(n_{i,t}) + \sigma \ln(N_{i,t})$. The FOCs give optimal fertility

$$n^*_{i,t} = \frac{\gamma - \sigma}{1 + \gamma - \sigma} \frac{y_t}{p_t} \equiv n^l_t.$$

The condition $N_{i,t} < n^*_{i,t}$ would be satisfied if and only if $n_{t-1} < n^l_t$.

**Case 3.** When the fertility norm lies between the lower and upper bounds ($n^l_t \leq N_{i,t} \leq n^u_t$), we will prove $n^*_{i,t} = N_{i,t}$ using contradiction. Suppose $n^*_{i,t} < N_{i,t}$. By the reasoning in case 1, we have $n^*_{i,t} = n^u_t$. So $n^u_t < N_{i,t}$, contradiction. Suppose $n^*_{i,t} > N_{i,t}$. By the reasoning in case 2, we have $n^*_{i,t} = n^l_t$. So $n^l_t > N_{i,t}$, contradiction. Thus we must have $n^*_{i,t} = N_{i,t}$. In equilibrium, since every lineage has the same $n_{i,t-1} = n_{t-1}$, we must have $N_{i,t} = n_{t-1}$ for each $i$.

To sum up, the above case-by-case discussion gives

$$n_{i,t}^{*}=\begin{cases} n_t^u & \text{if} \quad n_{t-1}>n_t^u, \\ n_{t-1} & \text{if} \quad n_t^l \leq n_{t-1} \leq n_t^u, \\ n_t^l & \text{if} \quad n_{t-1}<n_t^l, \end{cases}$$

where $[n_t^l, n_t^u] = [\frac{\gamma-\sigma}{1+\gamma-\sigma}\frac{y_t}{p_t}, \frac{\gamma+\sigma}{1+\gamma+\sigma}\frac{y_t}{p_t}]$, and $n_{i,t-1} = n_{t-1}$ is the same for each $i$. We have finished the proof of Lemma 1.

## A.6 Proofs of Lemmas A.2–A.3

To uncover the implications of the peer effect, we introduce heterogeneity to $n_{i,t-1}$ by assuming that a proportion $\lambda \in (0,1)$ of generation-1 women are restricted by the one-shot birth-control policy to give birth to only $n^p$ children, while the remaining $1-\lambda$ of generation-1 women are unrestricted and give birth to $n_1^u$ children. The birth-control policy is binding: $n^p < n_1^u$. In generation 2, two sets of fertility norms emerge: Daughters with restricted mothers are exposed to a fertility norm

$$N_{r,2} = \alpha n^p + (1-\alpha)\bar{n}_2,$$

while daughters with unrestricted mothers are exposed to a fertility norm

$$N_{ur,2} = \alpha n_1^u + (1-\alpha)\bar{n}_2.$$

Because $n^p < n_1^u$, we must have $N_{r,2} < N_{ur,2}$. In the face of distinct fertility norms, individuals in generation 2 may opt for different levels of optimal fertility.

We denote the equilibrium fertility of generation-$t$ individuals in the restricted lineage as $n_{r,t}^*$, and those in the unrestricted lineage as $n_{ur,t}^*$. A Nash equilibrium is sustained by a condition of rational expectation:

$$\bar{n}_t = \lambda n_{r,t}^* + (1-\lambda) n_{ur,t}^*.$$

That is to say, individuals optimize by solving for P2 in expectation of the optimal fertility choices of others. In the Nash equilibrium, no individual has an incentive to deviate given

the optimal fertility of others.

We obtain the model solution $(n^*_{r,2}, n^*_{ur,2})$ by solving for P2 of both restricted and unrestricted lineages under the condition of rational expectation. As in previous derivations, we define $n^l_t = \frac{\gamma-\sigma}{1+\gamma-\sigma}\frac{y_t}{p_t}$ and $n^u_t = \frac{\gamma+\sigma}{1+\gamma+\sigma}\frac{y_t}{p_t}$. Because $N_{r,2} < N_{ur,2}$, we discuss four cases, as follows.

**Case 1.** Suppose that the fertility norm of individuals with a restricted mother, $N_{r,2}$, lies between the lower and upper bounds ($n^l_2 \leq N_{r,2} \leq n^u_2$), while the fertility norm of individuals with an unrestricted mother, $N_{ur,2}$, lies above the upper bound ($N_{ur,2} > n^u_2$). By a reasoning similar to Proposition 1, individual optimization gives

$$n^*_{r,2} = N_{r,2},$$
$$n^*_{ur,2} = n^u_2.$$

The rational expectation condition further requires

$$\begin{aligned} \bar{n}_2 &= \lambda N_{r,2} + (1-\lambda)n^u_2 \\ &= \lambda(\alpha n^p + (1-\alpha)\bar{n}_2) + (1-\lambda)n^u_2 \\ \Rightarrow \bar{n}_2 &= \frac{\alpha\lambda_2 n^p + (1-\lambda)n^u_2}{1-\lambda+\alpha\lambda}. \end{aligned}$$

Substituting the above expression of $\bar{n}_2$ into $N_{r,2}$ and $N_{ur,2}$ in the inequalities $n^l_2 \leq N_{r,2} < n^u_2$ and $N_{ur,2} > n^u_2$, we obtain a parameter restriction

$$\lambda < \min\{\frac{n^u_1 - n^u_2}{(1-\alpha)(n^u_1 - n^p)}, 1 - \frac{\alpha(n^l_2 - n^p)}{(1-\alpha)(n^u_2 - n^l_2)}\}.$$

**Case 2.** Suppose that the fertility norm of individuals with a restricted mother, $N_{r,2}$, lies between the lower and upper bounds ($n^l_2 \leq N_{r,2} \leq n^u_2$), while the fertility norm of individuals with an unrestricted mother, $N_{ur,2}$, also lies between the lower and upper bounds ($n^l_2 < N_{ur,2} < n^u_2$). Using a logic similar to that in Proposition 1, individual optimization gives

$$n^*_{r,2} = N_{r,2},$$
$$n^*_{ur,2} = N_{ur,2}.$$

The rational expectation condition requires

$$\begin{aligned}\bar{n}_2 &= \lambda N_{r,2} + (1-\lambda) N_{ur,2} \\ &= \lambda(\alpha n^p + (1-\alpha)\bar{n}_2) + (1-\lambda)(\alpha n_{ur,1} + (1-\alpha)\bar{n}_2) \\ \Rightarrow \bar{n}_2 &= \lambda n^p + (1-\lambda) n_{ur,1}.\end{aligned}$$

Substituting the above expression of $\bar{n}_2$ into $N_{r,2}$ and $N_{ur,2}$ in the inequalities $n_2^l \leq N_{r,2} < n_2^u$ and $n_2^l \leq N_{ur,2} < n_2^u$, we obtain parameter restrictions

$$\begin{aligned}&\alpha \in (0, \frac{n_2^u - n_2^l}{n_1^u - n^p}), \\ &\lambda \in (\frac{n_1^u - n_2^u}{(1-\alpha)(n_1^u - n^p)}, 1 - \frac{n_2^l - n^p}{(1-\alpha)(n_1^u - n^p)}).\end{aligned}$$

**Case 3.** Suppose that the fertility norm of individuals with a restricted mother, $N_{r,2}$, lies below the lower ($N_{r,2} \leq n_2^l$), while the fertility norm of individuals with an unrestricted mother, $N_{ur,2}$, lies above the upper bounds ($N_{ur,2} > n_2^u$). Individual optimization gives

$$\begin{aligned}n_{r,2}^* &= n_2^l, \\ n_{ur,2}^* &= n_2^u.\end{aligned}$$

The rational expectation condition requires

$$\bar{n}_2 = \lambda n_2^l + (1-\lambda) n_2^u$$

Substituting the above expression of $\bar{n}_2$ into $N_{r,2}$ and $N_{ur,2}$ in the inequalities $N_{r,2} \leq n_2^l$ and $N_{ur,2} \geq n_2^u$, we obtain a parameter restriction

$$\begin{aligned}&\alpha \in [\frac{n_2^u - n_2^l}{n_1^u - n^p}, 1) \\ &\lambda \in [1 - \frac{\alpha(n_2^l - n^p)}{(1-\alpha)(n_2^u - n_2^l)}, \frac{\alpha(n_1^u - n_2^u)}{(1-\alpha)(n_2^u - n_2^l)}].\end{aligned}$$

**Case 4.** Suppose that the fertility norm of individuals with a restricted mother, $N_{r,2}$, lies below the lower ($N_{r,2} \leq n_2^l$), while the fertility norm of individuals with an unrestricted mother, $N_{ur,2}$, lies between the lower and upper bounds ($n_2^l < N_{ur,2} < n_2^u$). Individual

optimization gives

$$n^*_{r,2} = n^l_2,$$
$$n^*_{ur,2} = N_{ur,2}.$$

The rational expectation condition requires

$$\begin{aligned} \bar{n}_2 &= \lambda n^l_2 + (1-\lambda)N_{ur,2} \\ &= \lambda n^l_2 + (1-\lambda)(\lambda n_{ur,1} + (1-\lambda)\bar{n}_2) \\ \Rightarrow \bar{n}_2 &= \frac{\lambda n^l_2 + (1-\lambda)\alpha n^u_1}{\lambda + \alpha - \lambda\alpha}. \end{aligned}$$

Substituting the above expression of $\bar{n}_2$ into $N_{r,2}$ and $N_{ur,2}$ in the inequalities $N_{r,2} \leq n^l_2$ and $n^l_2 \leq N_{ur,2} \leq n^u_2$, we obtain parameter restrictions

$$\lambda > \max\{1 - \frac{n^l_2 - n^p}{(1-\alpha)(n^u_1 - n^p)}, \frac{\alpha(n^u_1 - n^u_2)}{(1-\alpha)(n^u_2 - n^l_2)}\}.$$

**Case 5.** Suppose that the fertility norm of individuals with both restricted and unrestricted mothers lies above the upper bound ($N_{ur,2} > N_{r,2} > n^u_2$). Individual optimization gives

$$n^*_{r,2} = n^u_2,$$
$$n^*_{ur,2} = n^u_2.$$

The rational expectation condition requires

$$\bar{n}_2 = \lambda n^u_2 + (1-\lambda)n^u_2 = n^u_2.$$

Substituting the above expression of $\bar{n}_2$ into $N_{r,2}$ and $N_{ur,2}$ in the inequalities $N_{ur,2} > N_{r,2} > n^u_2$, we have

$$N_{r,2} = \alpha n^p + (1-\alpha)n^u_2 > n^u_2,$$

which contradicts that $n^p < n^u_2$. Hence, this case cannot establish a fertility equilibrium.

**Case 6.** Suppose that the fertility norm of individuals with both restricted and unrestricted mothers lies below the lower bound ($n^l_2 > N_{ur,2} > N_{r,2}$). Individual optimization

gives

$$n^*_{r,2} = n^l_2,$$
$$n^*_{ur,2} = n^l_2.$$

The rational expectation condition requires

$$\bar{n}_2 = \lambda n^l_2 + (1-\lambda) n^l_2 = n^l_2.$$

Substituting the above expression of $\bar{n}_2$ into $N_{r,2}$ and $N_{ur,2}$ in the inequalities $n^l_2 > N_{ur,2} > N_{r,2}$, we have

$$N_{ur,2} = \alpha n^u_1 + (1-\alpha) n^l_2 < n^l_2,$$

which contradicts that $n^u_1 > n^l_2$. Hence, this case cannot establish a fertility equilibrium.

Summing up the above case-by-case discussions, we reach Lemmas 2 and 6 in Appendix Section A.4.

## A.7 Proofs of Lemmas A.4–A.7

We further conduct comparative analyses of the equilibrium fertility.

First, we discuss the impacts of $\lambda$ on the average fertility in generation 2. The equilibrium fertility when $\alpha \in (0, \frac{n^u_2 - n^l_2}{n^u_1 - n^p})$ is summarized in Lemma 2. Within each of the three $\lambda$ ranges, the average fertility strictly decreases as $\lambda$ increases. Furthermore, when comparing the three ranges of $\lambda$, the smaller ranges consistently yield strictly higher average fertility values. Therefore, the average fertility in generation 2 strictly decreases as $\lambda$ increases within $(0, 1)$. The equilibrium fertility when $\alpha \in [\frac{n^u_2 - n^l_2}{n^u_1 - n^p}, 1)$ is summarized in Lemma 3. Similarly, we can again obtain that the average fertility in generation 2 strictly decreases as $\lambda$ increases within $(0, 1)$. In summary, we have $\frac{\partial \bar{n}_2}{\partial \lambda} < 0$. Furthermore, as the average fertility strictly decreases with increasing $\lambda$, this implies that the fertility norms of individuals both with and without restricted mothers also strictly decrease as $\lambda$ rises.

We further discuss how the equilibrium fertility of individuals with and without restricted mothers changes as $\lambda$ increases. First, the equilibrium fertility of individuals with restricted mothers strictly decreases with increasing $\lambda$ until it reaches the cutoff value $\underline{\lambda}$, at which point $n^*_{r,2}$ hits the lower bound $n^l_2$. Further increases in $\lambda$ have no impact on $n^*_{r,2}$. Specifically, as shown in Lemma 2, when $\alpha \in (0, \frac{n^u_2 - n^l_2}{n^u_1 - n^p})$, $\underline{\lambda} = 1 - \frac{n^l_2 - n^p}{(1-\alpha)(n^u_1 - n^p)}$. As shown in

Lemma 3, when $\alpha \in [\frac{n_2^u - n_2^l}{n_1^u - n^p}, 1)$, $\underline{\lambda} = 1 - \frac{\alpha(n_2^l - n^p)}{(1-\alpha)(n_2^u - n_2^l)}$. In summary, $\underline{\lambda}$ increases as $\alpha$ decreases or as $n^p$ increases. Second, the equilibrium fertility of individuals with unrestricted mothers initially remains at the upper bound $n_2^u$ as $\lambda$ increases from 0. When $\lambda$ reaches the cutoff value $\bar{\lambda}$, then $n_{ur,2}^*$ begins to strictly decrease as $\lambda$ further increases. When $\alpha \in (0, \frac{n_2^u - n_2^l}{n_1^u - n^p})$, $\bar{\lambda} = \frac{n_1^u - n_2^u}{(1-\alpha)(n_1^u - n^p)}$. When $\alpha \in [\frac{n_2^u - n_2^l}{n_1^u - n^p}, 1)$, $\bar{\lambda} = \frac{\alpha(n_1^u - n_2^u)}{(1-\alpha)(n_2^u - n_2^l)}$. In summary, $\bar{\lambda}$ increases as $\alpha$ increases or as the gap between the upper bounds in period 1 and period 2 widens.

Second, we analyze the impact of $\alpha$ on the gap between the equilibrium fertility. As $\alpha$ increases, which indicates a greater influence of parental fertility on fertility norms, $N_{r,2}$ decreases while $N_{ur,2}$ increases. This results in a larger gap in the equilibrium fertility between individuals with restricted mothers and unrestricted mothers, i.e., $\frac{\partial(n_{ur,2}^* - n_{r,2}^*)}{\partial \alpha} \geq 0$.

In subsequent generations, the optimal fertility levels of all individuals, whether they have restricted ancestors or not, tend to converge due to the peer effect. Therefore, we have $\bar{n}_t < n_t^u$, which suggests that even though only a $\lambda$ ($\lambda \in (0, 1)$) proportion of women were subject to a one-shot birth-control policy in generation 1, the equilibrium fertility for all subsequent generations decreases. Moreover, as $\bar{n}_t = \lambda_t N_{r,t} + (1 - \lambda_t) N_{ur,t}$, $\frac{\partial \lambda_t}{\partial \lambda} > 0$, $\frac{\partial N_{r,t}}{\partial \lambda} < 0$, and $\frac{\partial N_{ur,t}}{\partial \lambda} < 0$; therefore, we have $\frac{\partial \bar{n}_t}{\partial \lambda} < 0$, which verifies that the equilibrium fertility of subsequent generations decreases as $\lambda$ increases.

## A.8 Model Extension: Quadratic Utility Function

Our theoretical conclusions do not rely on the choice of functional form of the utility function. Our theoretical conclusions are based on the general solution form rather than the specific expressions of upper and lower bounds. Thus, changing the utility function without altering the specific expressions of the upper and lower bounds will not affect the deduction of our conclusions.

For example, our conclusion is also robust to this quadratic utility functional form following Akerlof (1997) and Spolaore and Wacziarg (2022). At time $t$, generation $t$ is in adulthood, when a woman consumes $c_t$ and rears $n_t$ children. The utility maximization problem of generation $t$ can be simplified to

$$U_t = -an_t^2 + bn_t + c - \sigma|n_t - n_{t-1}|, \tag{P1'}$$

where $a$ represents the intrinsic cost of childbearing and $b$ represents the intrinsic benefits of childbearing. Generation $t$ would lose $\sigma$ in utility if her fertility $n_t$ deviates from her mother's fertility $n_{t-1}$ by one point.

When $\sigma \geq 0$ and conditional on $n_{t-1}$, the optimal fertility of generation $t$ is

$$n_t^* = \begin{cases} n_t^u, & \text{if} \quad n_{t-1} > n_t^u, \\ n_{t-1}, & \text{if} \quad n_t^l \leq n_{t-1} \leq n_t^u, \\ n_t^l, & \text{if} \quad n_{t-1} < n_t^l, \end{cases}$$

where $[n_t^l, n_t^u] = [\frac{b-d}{2\sigma}, \frac{b+d}{2\sigma}]$.

The only difference between this solution and Proposition 1 is the specific expression of the upper bound $n_t^u$ and the lower bound $n_t^l$. The general form of the optimal fertility for generation $t$ is consistent with Proposition 1.

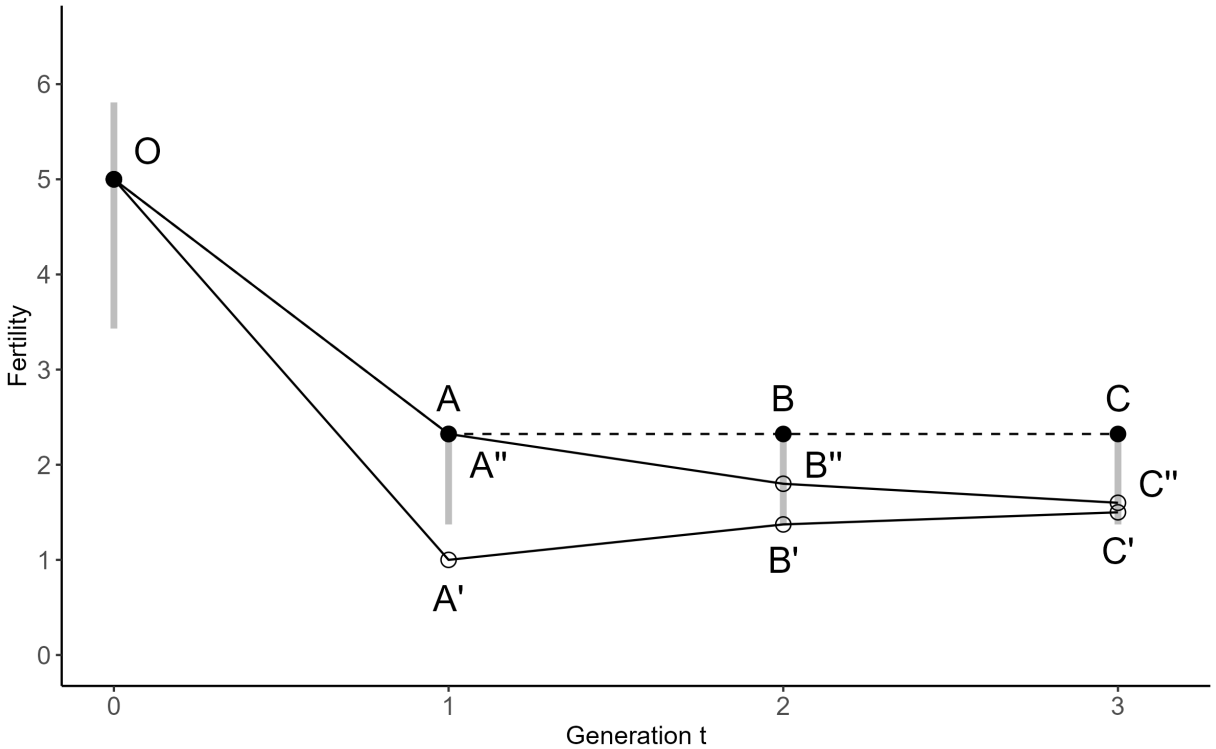



Figure A1: Theoretical Predictions for the Intergenerational Effects of One-Shot Birth-control Policies for Generation 1, under the Peer Effect. The $x$-axis denotes generations, the $y$-axis shows fertility levels, and vertical gray lines represent the fertility interval $[n_t^l, n_t^u]$ for each generation $t$. The dashed line denotes a path of fertility transition when the birth-control policy never comes into existence. Solid lines depict the fertility transition paths for two lineages when a one-shot birth-control policy restricts fertility for specific lineages in generation 1. The solid line depicts the fertility transition paths when a compulsory birth-control policy restricts fertility for a segment of generation 1, but not for other generations. The solid lines trace fertility trends for women with first-generation ancestors treated (OA'B'C') and untreated (OA"B"C").

# B Further Details on the Institutional Background

## B.1 Before Implementation of the Compulsory OCP: "Award One, Punish Three"

Before implementation of the compulsory OCP—China's national One-Child system, commonly known as "Award One, Punish Three"—bore similarities to policies in Singapore and certain other countries. In October 1978, the central government articulated the principle that "one child is optimal for a family, two children are sufficient, and three children are prohibited," as documented in the "Report on the First Meeting of the State Council Leading Group on Family Planning." Essentially, couples who comitted to cease childbearing after one child received a set of rewards as their child grew up. Economic penalties were imposed only on couples with more than three children.

The Award One, Punish Three policy proved ineffective during 1979-1982. For instance, in 1981, 30.9% of mothers aged between 20 and 45 with one child in Guangdong, where only the Award One, Punish Three policy rather than the compulsory OCP was implemented, successfully had another baby during 1979-1982. In contrast, only 9.1% of mothers with one child in Liaoning, where the compulsory One-Child Policy was enforced, managed to give birth to a second child during the same period.[45] Numerous couples signed the pledge in advance to receive the reward but then broke the contract to have a second child. Banister (1984) cited a 1981 scholarly report from Wuhan assessing the national situation: A considerable number of those who received the certificate and the award put it aside for safekeeping. They did not dare spend it, because they planned to return it when they had a second child.[46]

There are at least two reasons for the failure of Award One, Punish Three. On the one hand, there were no severe penalties for families who broke the contract and had a second child. On the other hand, couples were eager to have more children as a means of investing in future support when they would be older, since the social pension system had not yet

[45] While provincial governments had the authority to formulate regulations based on local social, economic, political, and cultural conditions, a small proportion of provinces, including Liaoning, opted to impose severe penalties on unauthorized second-order births instead of adhering solely to the Award One, Punish Three principle. Data are calculated using the 1982 Census.

[46] Cheng Du. "China's population, some problems and their solutions." Wuhan daxuexuebao, shehui kexue ban (Wuhan University Journal, Social Sciences Edition), No. 3 (1981), p. 8.

been developed.[47]

## B.2 The Immediate Effect of the OCP Rollout

We use total fertility rates in each Chinese province before 1982, as computed by Coale and Chen (1987), to investigate the immediate impact of the OCP rollout.[48] We further drop the period before 1972 to avoid the impact of the Later, Longer, and Fewer Campaign. We employ the following standard specification to conduct the event study:

$$Y_{p,t} = \sum_{l \neq -1, l \geq -3} \beta_l \mathbb{I}\{t - T_p = l\} + \theta_t + \alpha_p + \epsilon_{p,t}, \tag{B1}$$

where $Y_{p,t}$ is the variable that indicates the total fertility rate in province $p$ during year $t$, and $T_p$ denotes the year province $p$ implemented the OCP. We include year fixed effects ($\theta_t$) and province fixed effects ($\alpha_p$). We also control for predetermined economic and demographic conditions, and allow for nonparametric trends for provinces with different conditions.

Fig. C1 demonstrates the impact of the OCP on period fertility rate. The insignificant coefficients for $\beta_l < 0$ demonstrate that the fertility rate is consistent across provinces before the rollout of the OCP, conditional on the covariates. The significantly negative coefficients for $\beta_l \geq 0$ show that the total fertility rate undergoes a sharp decline 1 year after implementation of the OCP. Notably, the policy effect is subject to a 1-year delay, owing to the mandatory 9-month gestation period for pregnancies. Mothers who were already pregnant in the year of policy implementation are less likely to be affected and can proceed with their planned childbirth. Moreover, the treatment effect remains consistent for both relative year 1 and relative year 2, which indicates the stability of policy intensity during that period.

## B.3 Determinants of OCP Rollout

We examine the potential correlation between the year of OCP rollout and predetermined demographic, economic, and political factors. We collect data on potential correlated factors in each province and investigate their correlation with the time of OCP implemen-

[47] Our model partially accounts for this pattern, since the intrinsic benefits and costs of childbearing for first-generation women remain unchanged, which renders it challenging to alter the fertility level.

[48] Coale and Chen (1987) only calculated the total fertility rates of each province before 1982.

tation.

First, the demographic status in one province may be correlated with OCP implementation time. For example, a rising birth rate may increase pressure on these provincial governments to implement the reform. Conversely, provinces with a larger population and shared culture may resist implementing the OCP and thus implement later. Therefore, we include total population, urban and rural population, and birth and death rates from the previous year as independent variables separately.

Second, provinces with more aggressive implementation of the OCP may have also actively promoted economic development. Therefore, we use the GDP growth rate of each province to proxy for economic development and the share of primary and secondary industry in GDP to proxy for the local economic structure. Also, we use the share of fiscal expenditure in GDP to proxy for the behavior of local provincial governments.

Third, provinces with closer political ties to the central government may implement the OCP earlier. We use the distance to Beijing to proxy for this factor.

In all, we regress the dummy variable that indicates *whether the province implemented mandatory OCP in a particular year* on lagged macro economic indices. We also control for the fixed effects for year and province with province-specific linear trends. We restricted macro-level data from 1971 to 1990 to fully capture potential correlations. Appendix C Table C2 shows the estimated results for these regressions.

# C Supplementary Figures and Tables

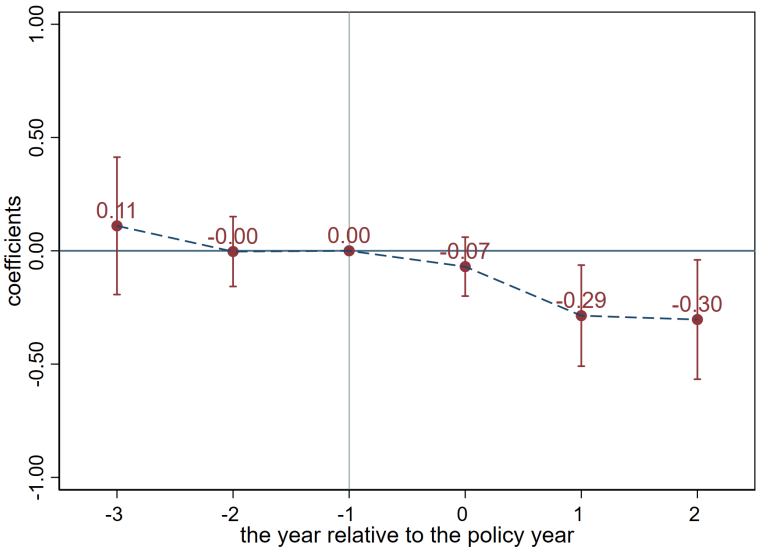



Figure C1: Immediate Impact of the OCP Rollout on TFR during 1973-1982. This figure plots the coefficients estimated using Eq. B1. The dependent variable is TFR. Data on TFR prior to 1982 are sourced from Coale and Chen (1987). The analytical period includes the years 1973 to 1982. Control variables include province fixed effects, year fixed effects, and province-specific linear trends. Robust standard errors are clustered at province level. Vertical bars represent confidence intervals at the 90% level.

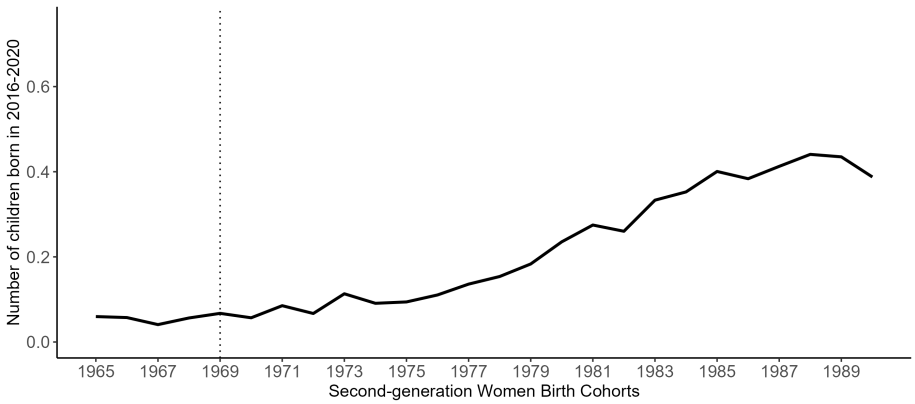



Figure C2: Change in Second-generation Fertility by Cohort between 2015 and 2020. The $x$-axis represents the birth cohorts of second-generation women, while the $y$-axis indicates the change in average fertility levels for each cohort between 2015 and 2020. The analysis is based on data from the 2020 census and 2015 mini-census. We calculated the average number of children per birth cohort for each survey year and then computed the differences in fertility across these cohorts.

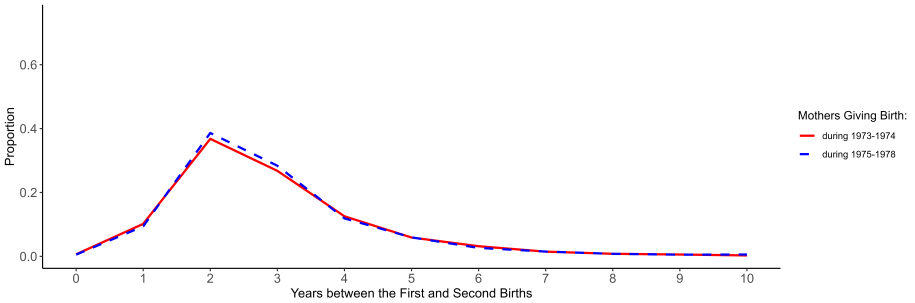
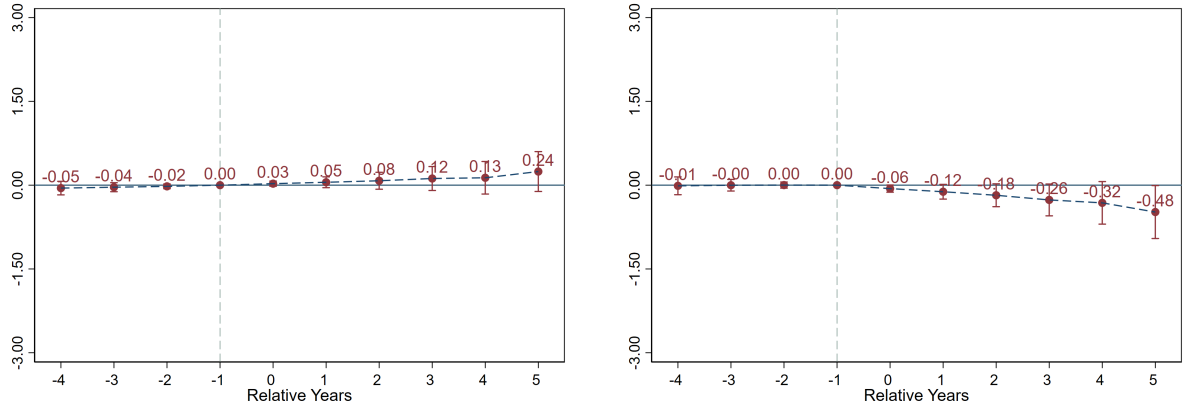



Figure C3: Distribution of Birth Spacing between First and Second Birth before the OCP Rollout. This figure shows the distribution of birth spacing between first- and second-birth in provinces that implemented the OCP post-1981. The solid red line represents the birth spacing distribution for urban Han women with births in 1973-1974, and the dashed blue line for those with births in 1975-1978. The analysis is based on data from the 1990 census and is restricted to provinces in which the OCP was implemented after 1981. We identified the birth sequence of each mother using information on household relations.




(a) Second-generation OCP Exposure in Ages 6–20 (b) Second-generation OCP Exposure in Ages 20–45

Figure C4: Correlation Between OCP Rollout and Second-generation OCP Exposure. Figures (a) and (b) show the coefficients estimated using Eq. 2, with second-generation women's OCP exposure as the dependent variable. Figures (a) and (b) use different measures as the dependent variables: Figure (a) uses the mean fine rate for ages 6 to 20 in birth province $p$ for cohort $c$, while Figure (b) uses the same measure for ages 20 to 45. Fine rate data prior to 2000 were gathered by Ebenstein (2010), while post-2000 fine rate data were compiled manually from provincial regulations. These analyses are confined to samples that represent exposure to women born between 1969 and 1980. Control variables of both figures include province fixed effects, cohort fixed effects, and province-specific cohort linear trends. Robust standard errors in both figures are clustered at province level. Vertical bars represent confidence intervals at the 90% level.

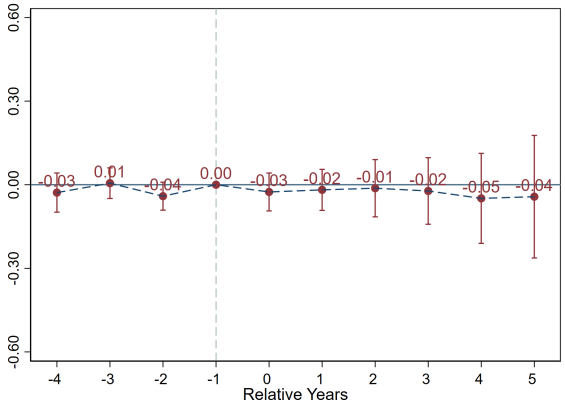
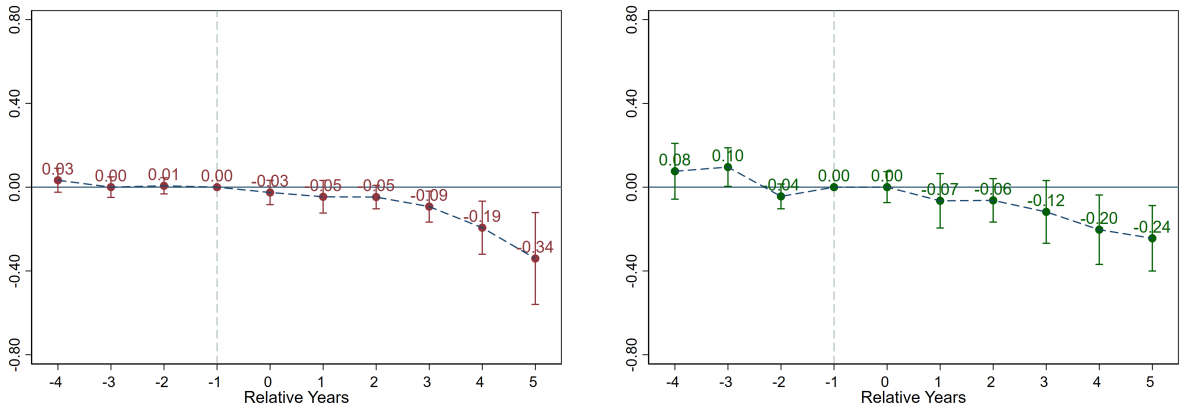
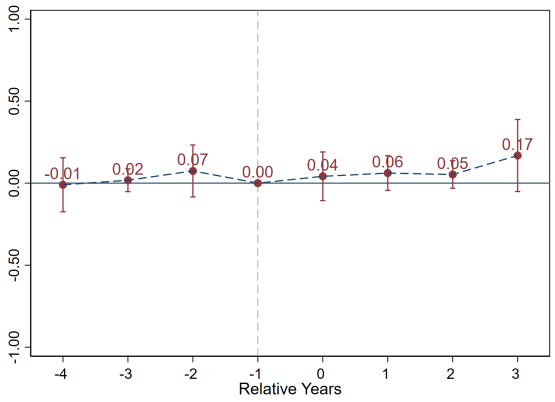



Figure C5: Impact of the OCP Rollout on Second-generation Fertility before OCP Relaxation. This figure shows the coefficients estimated using Eq. 2. The dependent variable is the number of children ever born by 2013. Data are from the 2015 mini-census and samples are restricted to urban Han women born during 1969-1980. Control variables include province fixed effects, cohort fixed effects, and province-specific cohort linear trends. Robust standard errors are clustered at province level. Vertical bars represent confidence intervals at the 90% level.

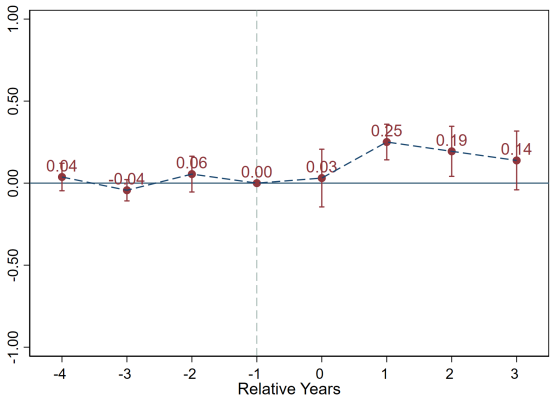



(a) Estimated Using Sun and Abraham (2021) (b) Estimated Using Callaway and Sant'Anna (2021)

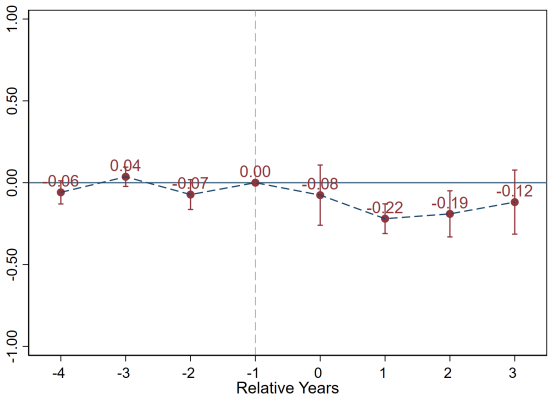
Figure C6: Impact of the OCP Rollout on Second-generation Fertility after OCP Relaxation: Robustness to Heterogeneous Treatment Effects. Figures (a) and (b) show coefficients estimated using the estimators proposed by Sun and Abraham (2021) and Callaway and Sant'Anna (2021), respectively. The dependent variable in both figures is the number of children ever born by 2020. Data in both figures are from the 2020 census and samples are restricted to urban Han women born during 1969-1980. Control variables in Figure (a) include province fixed effects, cohort fixed effects, and province-specific cohort linear trends. Robust standard errors in both figures are clustered at province level. Vertical bars represent confidence intervals at the 90% level.




(a) Number of Desired Children in 1987

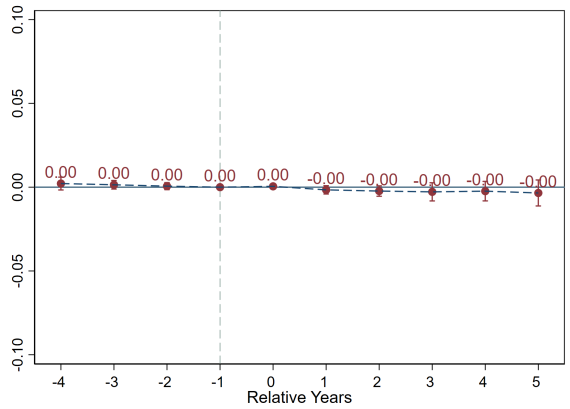



(b) Owning a One-child Certificate before 1987

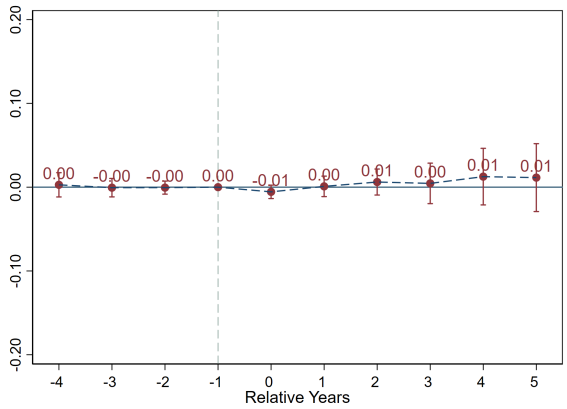



(c) Having another Child before 1987

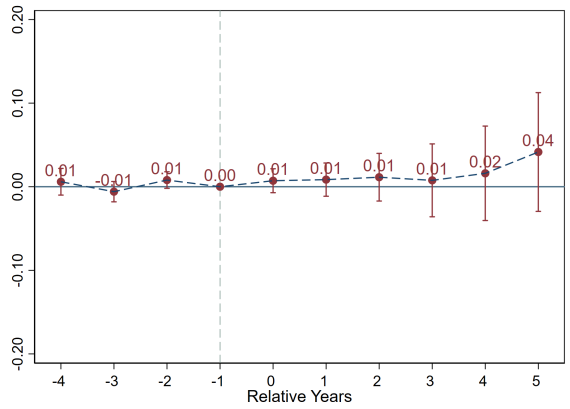
Figure C7: Impact of the OCP Rollout on First-generation Fertility Outcomes in FIDS. Figures (a), (b), and (c) plot the coefficients estimated using Eq. 2. Figures (a), (b), and (c) use different measures as the dependent variables: Figure (a) uses the desired fertility, Figure (b) uses whether the mother owns a one-child certificate, and Figure (c) uses whether second-generation women had another sibling. Data in all figures are from the 1987 FIDS and samples are restricted to urban Han mothers of women born during 1969-1980. Control variables in all figures include province fixed effects, cohort fixed effects, and province-specific cohort linear trends. Robust standard errors in all figures are clustered at province level. Vertical bars represent confidence intervals at the 90% level.



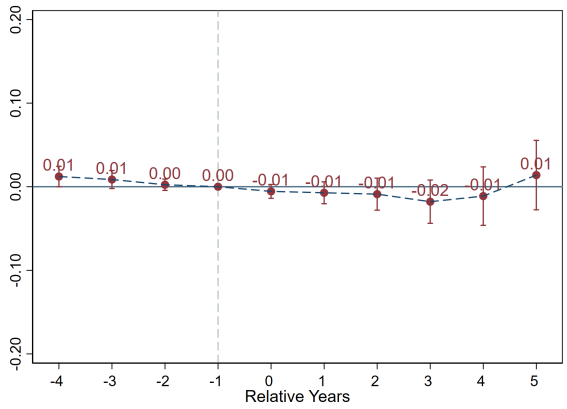

(a) Primary School Completion (Yes = 1)




(b) Junior High School Completion (Yes = 1)

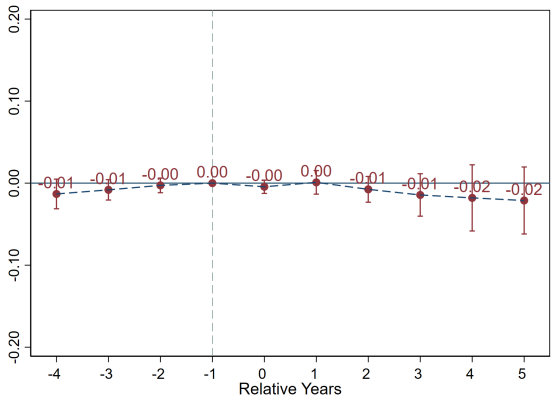



(c) Senior High School Completion (Yes = 1)

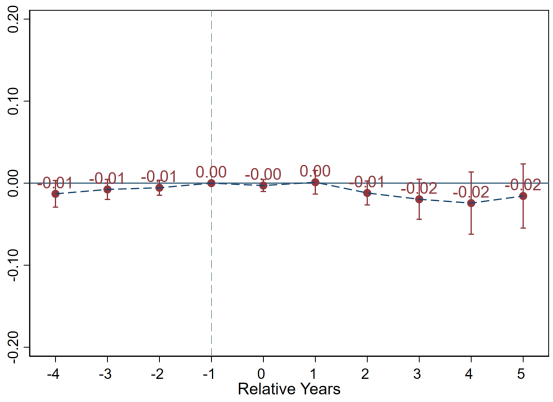



(d) College Completion (Yes = 1)

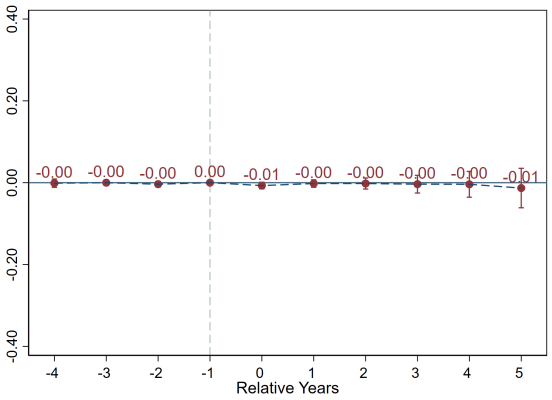
Figure C8: Impact of the OCP Rollout on Second-generation Women's Human Capital Accumulation before OCP Relaxation. Figures (a)-(d) show coefficients estimated using Eq. 2, with second-generation women's educational attainment as the dependent variable. Figures (a) to (d) use different measures of educational attainment as dependent variables: Figure (a) for primary school completion, Figure (b) for junior high school completion, Figure (c) for senior high school completion, and Figure (d) for college completion. Data in all figures are from the 2010 census and samples are restricted to urban Han women born during 1969-1980. Control variables in all figures include province fixed effects, cohort fixed effects, and province-specific cohort linear trends. Robust standard errors in all figures are clustered at province level. Vertical bars represent confidence intervals at the 90% level.




(a) Participating in the Labor Market (Yes = 1)

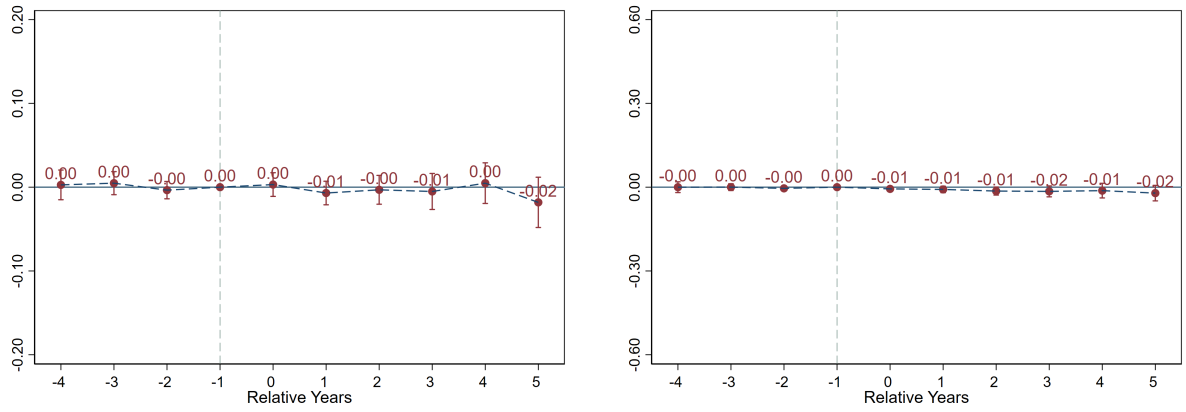



(b) Working in the Past Week (Yes = 1)




(c) Ln(Total Working Hours in the Past Week + 1)

Figure C9: Impact of the OCP Rollout on Second-generation Women's Labor Market Outcomes before OCP Relaxation. Figures (a) to (c) plot the coefficients estimated using Eq. 2, with second-generation women's labor market outcome as the dependent variable. Figures (a) to (c) use different measures of labor market outcomes: participation (Figure a), working status (Figure b), and log working hours in past week (Figure c). Data are from the 2010 census and samples are restricted to urban Han women born between 1969 and 1980. Control variables in all figures include province fixed effects, cohort fixed effects, and province-specific cohort linear trends. Robust standard errors in all figures are clustered at province level. Vertical bars represent confidence intervals at the 90% level.




(a) Coresiding with Parents or Parents-in-law (Yes = 1)

(b) Coresiding with People Older than 60

Figure C10: Impact of the OCP Rollout on Second-generation Women's Living Arrangement before OCP Relaxation. These figures plot the coefficients estimated using Eq. 2, with second-generation women's living arrangement as the dependent variable. Dependent variables include binary indicators for women's living arrangement: coresidence with parents or parents-in-law (Figure a) and coresiding with people older than 60 (Figure b). Data are from the 2010 census and samples are restricted to urban Han women born between 1969 and 1980. Control variables in both figures include province fixed effects, cohort fixed effects, and province-specific cohort linear trends. Robust standard errors in both figures are clustered at province level. Vertical bars represent confidence intervals at the 90% level.

Table C1: OCP Document

| Provinces | Date | Document | Details |
|---|---|---|---|
| Beijing | 11/01/1979 | Interim Provisions of Beijing on Population and Family Planning | Encourage a couple (including one or both remarried couples) to have only one child, and give praise and reward to couples who have only one child in their lifetime. For couples who have three or more children, social support fees are levied on children who have exceeded their family planning. |
| | **11/28/1980** | **On the Revision of Interim Provisions of Beijing on Population and Family Planning on Certain Issues** | Systematically control the birth of a second child, and specify that only those who meet one of several conditions can apply for the birth of a second child: ... |
| Tianjin | 01/27/1979 | Document 6 (1979) | Encourage couples to have only one child, ... |
| | 10/- -/1979 | Document 85 (1979) | Encourage a couple (including one or both remarried couples) to have only one child, and give praise and reward to couples who have only one child in their lifetime. For couples who have three or more children, social support fees are levied on children who have exceeded their family planning. |
| | **04/17/1981** | **Decision on Encouraging Late Childbearing and Controlling the Second Birth** | Systematically control the birth of a second child, and specify that only those who meet one of several conditions can apply for the birth of a second child: ... |
| Hebei | 07/- -/1979 | Document 122 (1979) | Generally encourage a couple to have only one child during their lifetime... |
| | **04/13/1981** | **Supplementary Provisions on Certain Issues of Family Planning** | Generally mandate having fewer and better children: A couple is mandated to have only one child. Only those with several of six special circumstances can have a second child... |
| | 05/01/1982 | Interim Provisions of Hebei on Family Planning | Expand the special circumstances to have a second child from six articles to twelve articles... |
| Shanxi | 10/01/1979 | Interim Provisions of Shanxi on Family Planning | Generally encourage a couple to have only one child during their lifetime... |
| | **04/05/1981** | **Report on Family Planning in the Province in 1980 and Opinions for the Next Two Years** | All government officials and employees of state-owned enterprises are restricted to having only one child... |
| | 12/01/1982 | Provisions of Shanxi on Family Planning | Expand the control over the birth of a second child and specify that only those who meet one of several conditions can apply for the birth of a second child: ... |

| Provinces | Date | Document | Details |
|---|---|---|---|
| Inner Mongolia | **06/15/1982** | **Document 143 (1982)** | All state cadres and workers and urban residents are mandated to have only one child per couple. |
| Liaoning | 06/16/1979 | Document 131 (1979) | Generally encourage a couple to have only one child during their lifetime... Couples who have the ability to bear children and voluntarily have only one child will be praised and rewarded. |
| | **04/03/1980** | **Supplementary Provisions on Issues of Family Planning** | A couple is mandated to have only one child, and those who are allowed to have two children under special circumstances must be spaced at least several years apart. |
| | 06/24/1982 | Supplementary Provisions on Issues of Family Planning | Expand the special circumstances that allow having a second child... |
| Jilin | **09/26/1979** | **Document 299 (1979)** | A couple is mandated to have only one child, and those who are allowed to have two children under special circumstances must be spaced at least several years apart. The parents of all babies born outside the local government's birth plan each year will be penalized. |
| | 03/22/1980 | Approval of the Relaxation of the Korean Ethnicity Family Planning in Yanbian Korean Autonomous Prefecture | The number of children born to Korean families can be relaxed to two children per family. |
| | 08/18/1984 | Document 111 (1984) | Expand the special circumstances that allow having a second child... |
| Heilongjiang | **09/- -/1979** | **Document 263 (1979)** | Generally mandate a couple to have one child for a lifetime. In principle, the birth of a second child is no longer allowed except for some special cases ... |
| | - -/- -/1981 | Notice on Accelerating Economic and Cultural Construction in Minority Areas | The number of children born to ethnic minorities can be relaxed to two children per family. |
| | - -/- -/1983 | Document 10 (1983) | Expand the range of people who can have a second child, such as a rural family with one child ... |
| Shanghai | 09/01/1979 | Provisions on Family Planning | Provide incentives for parents who promised to bear one child for their lifetime ... |
| | **08/−/1981** | **Provisions of Shanghai on the Implementation of Family Planning** | Generally mandate a couple to have one child for their lifetime. In principle, the birth of a second child is no longer allowed except for some special cases ... |

| Provinces | Date | Document | Details |
|---|---|---|---|
| Jiangsu | 07/31/1979 | Document 106 (1979) | Reward couples with one child for their lifetime ... |
| | 10/–/1979 | Jiangsu Birth Planning Office Issued Document 36 (1979) | Further clarify the range of authorized births ... |
| | **06/–/1982** | **Document 86 (1982)** | Generally mandate a couple to have one child for their lifetime. In principle, the birth of a second child is no longer allowed except for some special cases ... Couples violating family planning policies by having a second child will result in wage deductions. |
| Zhejiang | - -/- -/1979 | Document 108 (1979) | Encourage a couple (including one or both remarried couples) to have only one child, and give praise and reward to couples who have only one child in their lifetime. For couples who have three or more children, social support fees are levied on children who have exceeded their family planning. |
| | **03/04/1982** | **Interim Regulations of Zhejiang on Population and Family Planning** | Systematically control the birth of a second child, and specify that only those who meet one of several conditions can apply for the birth of a second child: ... |
| Anhui | 04/09/1979 | Document 38 (1979) | Encourage a couple (including one or both remarried couples) to have only one child, and give praise and reward to couples who have only one child in their lifetime. For couples who have three or more children, social support fees are levied on children who have exceeded their family planning. |
| | **05/09/1981** | **Interim Provisions of Anhui on Implementing Family Planning** | Systematically control the birth of a second child, and specify that only those who meet one of several conditions can apply for the birth of a second child: ... |
| Fujian | 06/01/1979 | Document 32 (1979) | Encourage a couple (including one or both remarried couples) to have only one child, and give praise and reward to couples who have only one child in their lifetime. For couples who have three or more children, social support fees are levied on children who have exceeded their family planning. |
| | –/–/1981 | Opinions on A Number of Issues in Family Planning | "Rewarding one, restricting the interval, and not allowing three" |
| | **03/08/1982** | **Notice on Family Planning** | Systematically control the birth of a second child, and specify that only those who meet one of several conditions can apply for the birth of a second child: ... |
| | **05/–/1982** | **Provisions on Several Policies on Family Planning** | Further clarify the range of authorized second births for several special cases for rural and urban residents separately ... |
| Jiangxi | **04/24/1981** | **Several Provisions of Jiangxi on Family Planning (trial)** | Systematically control the birth of a second child, and specify that only those who meet one of several conditions can apply for the birth of a second child: ... |
| | 01/18/1983 | Interim Provisions of Jiangxi on Problems of Family Planning | Expand the range of people who can have a second child ... |

| Provinces | Date | Document | Details |
|---|---|---|---|
| Shandong | **03/31/1980** | **Interim Provisions of Shandong on Family Planning** | Systematically control the birth of a second child, and specify that only those who meet one of several conditions can apply for the birth of a second child: ... |
| | 07/–/1982 | Notice on the Issue of Controlling the Second Birth | Expand the range of people who can have a second child ... |
| Henan | **07/- -/1981** | **Interim Provisions of Henan on Family Planning** | Systematically control the birth of a second child, and specify that only those who meet one of several conditions can apply for the birth of a second child: ... |
| | 06/–/1982 | Opinions On the implementation of the Central Committee of the Communist Party of China and the State Council <Directive on Further Improvement of Family Planning> | Expand the range of people who can have a second child ... |
| Hubei | 09/- -/1979 | Document 140 (1979) | Encourage a couple (including one or both remarried couples) to have only one child, and give praise and reward to couples who have only one child in their lifetime. For couples who have three or more children, social support fees are levied on children who have exceeded their family planning. |
| | **06/13/1981** | **Document 82 (1981)** | Systematically control the birth of a second child, and specify that only those who meet one of several conditions can apply for the birth of a second child: ... |
| Hunan | 05/26/1979 | Document 58 (1979) | Encourage a couple (including one or both remarried couples) to have only one child, and give praise and reward to couples who have only one child in their lifetime. For couples who have three or more children, social support fees are levied on children who have exceeded their family planning. |
| | **05/10/1982** | **Provisions of Hunan on Family Planning** | Systematically control the birth of a second child, and specify that only those who meet one of several conditions can apply for the birth of a second child: ... |
| Guangdong | 02/02/1980 | Regulations of Guangdong on Population and Family Planning | Encourage a couple (including one or both remarried couples) to have only one child, and give praise and reward to couples who have only one child in their lifetime. For couples who have three or more children, social support fees are levied on children who have exceeded their family planning. |
| | **06/01/1986** | **Regulations of Guangdong on Population and Family Planning (revision)** | Systematically control the birth of a second child, and specify that only those who meet one of several conditions can apply for the birth of a second child: ... |

| Provinces | Date | Document | Details |
|---|---|---|---|
| Guangxi | 11/06/1979 | Provisions of Guangxi on Problems of Family Planning Work | Encourage a couple (including one or both remarried couples) to have only one child, and give praise and reward to couples who have only one child in their lifetime. For couples who have three or more children, social support fees are levied on children who have exceeded their family planning. |
| | **11/25/1982** | **Interim Provisions of Guangxi on Family Planning** | Systematically control the birth of a second child, and specify that only those who meet one of several conditions can apply for the birth of a second child: ... |
| Hainan | | Implementing the Provisions of Guangdong | |
| Chongqing | | Implementing the Provisions of Sichuan | |
| Sichuan | **08/04/1980** | **Document 177 (1980)** | Mandate couples who are non-agricultural employees, including national cadres, to have only one child ... |
| | 07/–/1981 | Document | Mandate all couples to have only one child... |
| Guizhou | 06/16/1979 | Interim Provisions of Guizhou on Family Planning | Encourage a couple (including one or both remarried couples) to have only one child, and give praise and reward to couples who have only one child in their lifetime. For couples who have three or more children, social support fees are levied on children who have exceeded their family planning. |
| | **03/15/1982** | **Interim Provisions of Guizhou on Family Planning (Revision)** | Systematically control the birth of second child, and specify that only those who meet one of several conditions can apply for the birth of a second child: ... |
| Yunnan | 07/09/1979 | Document 157 (1979) | Encourage a couple (including one or both remarried couples) to have only one child, and give praise and reward to couples who have only one child in their lifetime. For couples who have three or more children, social support fees are levied on children who have exceeded their family planning. |
| | 04/17/1982 | Resolution on Further Improving Family Planning | Impose fines on an unauthorized third birth... |
| | **08/26/1984** | **Party Committee of the Provincial Family Planning Commission's Opinions on Implementing Central Government's No.7 Document (1984)** | Systematically control the birth of a second child, and specify that only those who meet one of several conditions can apply for the birth of a second child: ... |

| Provinces | Date | Document | Details |
|---|---|---|---|
| Tibet | 05/08/1992 | Interim Provisions of Tibet on Family Planning | Systematically control the birth of a second child, and specify that only those who meet one of several conditions can apply for the birth of a second child: ... |
| Shaanxi | 07/01/1979 | Document 101 (1979) | Encourage a couple (including one or both remarried couples) to have only one child, and give praise and reward to couples who have only one child in their lifetime. For couples who have three or more children, social support fees are levied on children who have exceeded their family planning. |
| | **05/01/1981** | **Interim Provisions of Shaanxi on Family Planning** | Systematically control the birth of a second child, and specify that only those who meet one of several conditions can apply for the birth of a second child: ... |
| | 10/31/1981 | Supplementary Provisions of Shaanxi on Family Planning | Expand the special circumstances to have a second child ... |
| Gansu | 07/14/1979 | Document 152 (1979) | Encourage one child per family in urban areas ... |
| | **03/16/1982** | **Document 105 (1982)** | Systematically control the birth of a second child, and specify that only those who meet one of several conditions can apply for the birth of a second child: ... |
| Qinghai | 09/–/1979 | Notice of Certain Provisions on Population Planning and Family Planning in the Province (Trial Run) | Encourage one child per family in urban areas ... |
| | **05/31/1982** | **Interim Provisions of Qinghai on Family Planning** | Systematically control the birth of a second child, and specify that only those who meet one of several conditions can apply for the birth of a second child: ... |
| Ningxia | 06/–/1980 | Trial Provisions of Certain Issues of Family Planning | Encourage one child per family in urban areas ... |
| | **08/18/1982** | **Interim Regulations of Ningxia on Family Planning** | Systematically control the birth of a second child, and specify that only those who meet one of several conditions can apply for the birth of a second child: ... |
| Xinjiang | 07/01/1988 | Interim Provisions of Xinjiang on Minority Family Planning | Encourage one child per family in urban areas ... |
| | **07/01/1992** | **Regulations of Xinjiang on Population and Family Planning** | Systematically control the birth of a second child, and specify that only those who meet one of several conditions can apply for the birth of a second child: ... |

Table C2: Correlations of OCP Implementation Year with Macro Indices

| *Dependent Variables* | (1) *Whether the OCP was Implemented in Year T* | (2) *Implemented Year* |
|---|---|---|
| *Panel A: Demographic factors* | | |
| Population | 0.006 | |
| | (0.697) | |
| Urban Population | 0.044 | |
| | (0.580) | |
| Rural Population | 0.033 | |
| | (0.680) | |
| Birth Rate | 0.003 | |
| | (0.532) | |
| Death Rate | 0.001 | |
| | (0.967) | |
| *Panel B: Socioeconomic factors* | | |
| GDP Growth Rate | 0.005 | |
| | (0.867) | |
| Share of Primary Industry in GDP | -0.004 | |
| | (0.649) | |
| Share of Secondary Industry in GDP | 0.003 | |
| | (0.631) | |
| Share of Fiscal Expenditure in GDP | 0.002 | |
| | (0.752) | |
| *Panel C: Political ties* | | |
| Geographic Distance to Beijing | | 0.003*** |
| | | (0.001) |

*Note*: Panels A and B present the correlation between time-specific and province-specific demographic and socioeconomic factors with the indicators of OCP implementation across provinces and years. Panel C examines the correlation between province-specific political ties and the OCP implementation times. In Panels A and B, the dependent variables are an indicator of whether the OCP was implemented in year $T$ and independent variables include the demographic and socioeconomic factors that vary across provinces and years. The regression sample is limited to the years 1971 to 1990. All independent variables represent one-year leads. Data on independent variables are from *A compilation of statistical information on the six decades of the new China* that authors compiled manually. Control variables include province fixed effects, year fixed effects, and province-specific year linear trends. Robust standard errors clustered at province level are in parentheses. In Panel C, the dependent variable is the OCP implementation year in each province, and the key independent variable is the geographic distance to Beijing, with additional controls for demographic and socioeconomic factors in the regression. Robust standard errors are in parentheses.*** $p<0.01$, **$p<0.05$, *$p<0.1$.

Table C3: Impact of the OCP Rollout on Human Capital Accumulation, Labor Market Outcomes, and Living Arrangements

| | *Human capital accumulation* | | | | *Labor market outcomes* | | | *Living arrangements* |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Dependent Variables | Primary school (Yes = 1) | Junior high school (Yes = 1) | Senior high school (Yes = 1) | College or above (Yes = 1) | Working status (Yes = 1) | Labor participation (Yes = 1) | Logarithm of working hours | Coresiding with parents or parents-in-law (Yes = 1) |
| Relative Year -4 | 0.002 | 0.003 | 0.006 | 0.012 | -0.013 | -0.001 | -0.013 | 0.003 |
| | (0.002) | (0.009) | (0.010) | (0.007) | (0.010) | (0.006) | (0.011) | (0.011) |
| Relative Year -3 | 0.001 | -0.001 | -0.006 | 0.009 | -0.008 | -0.000 | -0.008 | 0.005 |
| | (0.002) | (0.007) | (0.007) | (0.007) | (0.007) | (0.004) | (0.008) | (0.008) |
| Relative Year -2 | 0.001 | -0.001 | 0.008 | 0.002 | -0.006 | -0.004 | -0.003 | -0.004 |
| | (0.001) | (0.005) | (0.006) | (0.004) | (0.006) | (0.004) | (0.005) | (0.006) |
| Relative Year -1 | - | - | - | - | - | - | - | - |
| | - | - | - | - | - | - | - | - |
| Relative Year 0 | 0.000 | -0.006 | 0.007 | -0.006 | -0.003 | -0.007 | -0.004 | 0.003 |
| | (0.001) | (0.005) | (0.009) | (0.005) | (0.004) | (0.005) | (0.005) | (0.009) |
| Relative Year 1 | -0.002 | 0.001 | 0.008 | -0.007 | 0.001 | -0.002 | 0.001 | -0.007 |
| | (0.002) | (0.007) | (0.012) | (0.008) | (0.009) | (0.006) | (0.009) | (0.009) |
| Relative Year 2 | -0.002 | 0.006 | 0.011 | -0.009 | -0.012 | -0.002 | -0.008 | -0.003 |
| | (0.002) | (0.009) | (0.017) | (0.012) | (0.009) | (0.008) | (0.010) | (0.010) |
| Relative Year 3 | -0.003 | 0.005 | 0.008 | -0.018 | -0.020 | -0.004 | -0.014 | -0.005 |
| | (0.003) | (0.015) | (0.027) | (0.016) | (0.015) | (0.013) | (0.016) | (0.013) |
| Relative Year 4 | -0.002 | 0.013 | 0.016 | -0.011 | -0.024 | -0.004 | -0.018 | 0.005 |
| | (0.004) | (0.021) | (0.034) | (0.021) | (0.023) | (0.019) | (0.025) | (0.015) |
| Relative Year 5 | -0.003 | 0.011 | 0.042 | 0.014 | -0.016 | -0.013 | -0.021 | -0.018 |
| | (0.005) | (0.025) | (0.043) | (0.025) | (0.024) | (0.029) | (0.025) | (0.018) |
| Observations | 198,203 | 198,203 | 198,203 | 198,203 | 198,203 | 189,414 | 198,203 | 189,431 |
| Mean of dep. var. | 0.994 | 0.876 | 0.389 | 0.0768 | 0.758 | 36.35 | 0.810 | 0.164 |

*Note*: This table shows estimated results of the impact of OCP rollout on various outcomes of second-generation women. Data are from the census 2010, and samples are all restricted to urban Han women born during 1969-1980. The table shows the estimates estimated using Eq. 2, and each column shows results estimated using different variables as dependent variables. Control variables in all columns include province fixed effects, cohort fixed effects, and province-specific cohort linear trends. Robust standard errors clustered at province level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table C4: Estimates using Ethnic Minorities

| *Sample* | *Census 2020* |
|---|---|
| *Dependent Variable* | *Number of Children ever Born by 2020* |
| Relative Year -4 | 0.008 |
| | (0.028) |
| Relative Year -3 | 0.000 |
| | (0.028) |
| Relative Year -2 | -0.001 |
| | (0.032) |
| Relative Year -1 | - |
| | - |
| Relative Year 0 | -0.020 |
| | (0.034) |
| Relative Year 1 | -0.033 |
| | (0.033) |
| Relative Year 2 | -0.034 |
| | (0.029) |
| Relative Year 3 | -0.053 |
| | (0.036) |
| Observations | 3,288 |
| Mean of dep. var. | 1.477 |

*Note*: This table shows the estimates of Eq. 2. Data are from the census 2020 and samples are further restricted to urban woman of ethnic minorities who are culturally more similar to Han women and were born during 1965-1980. The dependent variable is the number of children ever born by 2020. Control variables include prefecture fixed effects and cohort fixed effects. Robust standard errors clustered at province and ethnicity level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

# D Further Details on the CFPS and FIDS

## D.1 Details on the CFPS Sample

We first pool six waves of the CFPS and restrict the data to urban Han women born during 1969-1980 to construct the second-generation samples. We then further construct the third-generation samples using information on the parent-child relationship provided by the CFPS.[49] Table D1 Panel A reports that the desired number of children for the second generation is 1.735, while the desired fertility level for the third generation has declined to 1.532. This indicates a continuing decline in the intention to have children over time in China.

## D.2 Details on the FIDS Sample

We use data from the Fertility In-Depth Survey (FIDS) conducted in 1987, which contains information on the fertility intention of first-generation women. This study is part of a program that administered in-depth surveys on the population's fertility and related factors in various provinces and municipalities of China. The 1987 survey was conducted across six provinces: Liaoning, Beijing, Guangdong, Guizhou, Gansu, and Shandong, and represent an average across these regions.

We designate women with urban Han daughters born between 1969 and 1980 as our first-generation samples. As shown in Table D1 Panel B, the number of desired births of second-generation women is 2.024, which is higher than the number of desired births of second- and third-generation women calculated using the CFPS. We also generate a variable to indicate whether second-generation women had a sibling by 1987. We find that 62.1% of second-generation women in these six provinces had a sibling by 1987.

[49] We use the accurate household structure provided by the CFPS to identify children of the second generation (i.e, third-generation individuals). In all, mothers born between 1969 and 1980 are referred to as second-generation mothers, and children whose mothers were born between 1969 and 1980 as the third generation.

Table D1: Summary Statistics of FIDS and CFPS Samples

| *Variables* | (1) *Mean* | (2) *Std.Dev.* | (3) *N* |
|---|---|---|---|
| *Panel A: CFPS 2012, 2014, and 2018* | | | |
| Desired number of children of second-generation women | 1.735 | 0.542 | 1,591 |
| Desired number of children of third generation | 1.532 | 0.643 | 1,498 |
| *Panel B: FIDS 1987* | | | |
| Whether second-generation women had a sibling by 1987 (Yes = 1) | 0.621 | 0.485 | 2,669 |
| Whether first-generation women had a one-child certificate (Yes = 1) | 0.385 | 0.487 | 2,669 |
| Desired number of children in 1987 | 2.024 | 0.654 | 2,669 |

*Notes*: Data for Panel A are from the China Family Panel Study (CFPS) 2012, 2014, and 2018. Samples in Panel A are restricted to urban Han women born during 1969-1980, along with their children. For Panel B, data are from the 1987 FIDS, and samples are restricted to the mothers of urban Han women born during 1969-1980.

# E Further Details on the Empirical Analysis of Fertility Norm Evolution

## E.1 Robustness: Birth Spacing $s = 4$

As shown in Section 5, the primary question of our specification is to identify the second-generation women's birth cohort for which the policy had a discernible impact, based on the birth interval length experienced by their mothers.

First, we provide support for identification of the unaffected birth interval using descriptive evidence from the mini-census 2005. Fig. E1 plots the average proportion of second-generation women who are only children (only-child rate hereafter) over their birth year relative to the OCP rollout. The only-child rate was relatively low and stable for women who were born 5 years before the OCP rollout. This indicates that the majority of second-generation women born during that time were able to have another sibling, as their parents originally intended. However, for women who were born within 4 years before the OCP, the only-child rate experienced a significant increase. This increase can be attributed to their inability to have a second sibling due to the OCP rollout and primarily signifies the existence of the 4-year natural birth interval.

Second, we provide empirical evidence by examining the distribution of birth spacing prior to the OCP rollout. We focus on mothers in provinces that implemented the OCP after 1981 and calculate the intervals between first and second births using data from the 1990 census. The solid blue line of Fig. C3 represents the distribution of birth spacing for mothers who gave birth before 1974 and were not affected by implementation of the OCP. The graph reveals that over 90% of these families were able to have another child within a 4-year interval following the birth of their first child. In contrast, the dashed red line represents the distribution of birth spacing for mothers who gave birth between 1975 and 1978, within 4 years prior to OCP implementation. The distribution indicates that no adjustments were made by these families in their fertility plans in anticipation of future fertility restrictions imposed by the OCP.

Our analyses suggest a natural birth spacing of up to 4 years between the first and second births. Mothers in provinces treated later may shorten their birth interval in anticipation of impending birth restrictions. In sensitivity analyses, we adjust the birth interval

to 3 years in provinces that adopted the OCP later. Estimated results, presented in Fig. E2a, remain robust after this adjustment.

## E.2 Robustness: "Last-treated Group"

In Section 5, we use the last-treated provinces as the control group following Lafortune et al. (2018); Bailey et al. (2021); and Goodman-Bacon (2021) by interacting the indicator of relative year with the dummy $Early_P$. We further provide the rationale behind this specification and robustness analysis.

Since OCP implementation time ranges from 1979 to 1992 over different provinces, a traditional event study fundamentally requires a timing-based data structure. However, the traditional event study is likely to suffer from the problem of multicollinearity by saturating the unit and time fixed effects (Miller, 2023; Borusyak et al., 2021). Thus, the specification may be less efficient for our estimation. Following Lafortune et al. (2018); Bailey et al. (2021); Goodman-Bacon (2021); and Sun and Abraham (2021), we transmit the last-treated provinces to the never-treated provinces by restricting our samples to a relatively small time horizon. Our data structure combines variation in event dates and includes both treated and untreated units, which provides us with two sources of identification: the comparison of treated and control units and the timing of the policy.

We offer robustness analysis for the choice of last-treated groups. We use a traditional timing-based event study design to re-estimate Eq. 2. As Fig. E2b shows, we find coefficients similar to our baseline estimates, while the estimates are less efficient.

## E.3 Robustness: Quadratic Trends

The range of birth cohorts for individuals in this study is intentionally kept relatively short, since we aim to minimize the impact of fecundity rate bias. We extend our samples to include 1965–1980 women's birth cohorts and include provincial quadratic trends in women's birth cohorts. As shown in Fig. E3c, estimates are also similar in magnitude to our baseline estimates.

## E.4 Sample Construction: Pinning Down Fertile Cohorts

As illustrated in Section 5, we adopt a data-driven approach to inform the choice of birth cohorts following Bailey et al. (2021). The idea is to use the outcome variable to find the

location of the kink that maximizes the within $R^2$. We use the 2020 census and restrict the samples to urban Han women born between 1965 and 1975, which is a period expected to manifest the kink in fertility patterns. Specifically, we define different birth years as the kink $k$ and estimate the following equation:

$$Y_{pc} = \theta_p + D'_{pc}\rho_1 + aD'_{pc}\rho_2 + \epsilon_{pc}, \tag{E1}$$

where $D'_{pc}$ is a vector of dummy variables, $I(1965 \leq c < k)$, $I(k \leq c < 1975)$, and $k$'s are different kinks as previously defined. $Y_{pc}$ is the variable that indicates the number of children ever born in 2020 and $\theta_p$ is province fixed effects.

In keeping with the results of this data-driven procedure, we find the kink is at the 1969 cohort and use this sample for our main analysis.

We also conduct sensitivity analyses of different birth cohorts. First, we expand our sample to include women born during 1970–1981. Also, we introduce a dummy variable that indicates whether the relative year equals 5 to enhance estimation efficiency. Second, we narrow our sample to women born during 1971–1980. Consistent estimates across samples of various birth cohorts, as illustrated in Fig. E3a and Fig. E3b, demonstrate the robustness of our specifications.

## E.5 Robustness: Additional Controls

As discussed at the end of Section 5.4, we will introduce additional controls that affect intrinsic benefits and costs in childbearing in detail in this section.

First, we control for four socioeconomic and policy shocks in our regression: the Great Famine (1959–1961), the Cultural Revolution (1966–1976), the Later, Longer, and Fewer (LLF) Campaign during the 1970s, and the Compulsory Education Law (CEL) (around 1986). These events may affect the intrinsic benefits of childbearing. The first event is the Great Famine, which significantly reduced people's mental health (St Clair et al., 2005). Following the literature on the great famine, we use the historical provincial mortality rate in 1960 reported by the NBS to proxy for famine severity. The second event is the Cultural Revolution, which decreased people's trust. We follow Walder (2014) and construct a measure of exposure to the Cultural Revolution by province. We add interaction terms between birth cohort dummies and proxies to Eq. 2. The third event is the LLF Campaign, which significantly restricted women's completed births during 1969 and may correlate

with OCP implementation time. We generate a dummy variable $Longer_i$ on whether second-generation individuals are affected by the LLF Campaign. The fourth event is implementation of the CEL around 1986, which improved women's education levels and thus may decrease fertility (Cygan-Rehm and Maeder, 2013). We use information on CEL implementation in each province. We use the data and generate a dummy variable $CEL_i$ for whether second-generation individuals are affected by the law.

Second, we control for interactions between birth cohort dummies and predetermined variables. As for potential confounding of the socioeconomic conditions, we include interactions between birth cohort dummies and provincial economic/population growth rates prior to the policy during 1969-1979. Data for economic/population growth rates during 1969-1979 are collected from the *Compilation of statistical data of the 60 years of the People's Republic of China*. We also consider cultural confounding factors. With respect to cultural factors, Zhang (2019) argues that raising children for old-age support is a long-lasting cultural tradition in China, rooted in the values of filial piety and kinship-based clan culture. As such, clan culture may be highly correlated with completed births within a given family and can be transmitted over generations. If clan culture is correlated with OCP implementation time in each province, we may overestimate the intergenerational effects of first-generation fertility restrictions. Following Zhang (2019), we construct a proxy variable for clan culture using genealogy books compiled during the Ming and Qing dynasties. We group the original data into different provinces and then rescale the data using the population in each province in 1920. We take the logarithm of the variable and add interactions of the logarithm and birth year into our analysis, as shown in Eq. 2. For the political factors, we use the distance to Beijing to proxy for political ties across different provinces.

The results presented in Figs E4-E5 show estimated results of including various control variables in our analysis. We find that our results remain robust after including these additional covariates. Data for control variables are collected from the *Compilation of statistical data of the 60 years of the People's Republic of China*.

## E.6 Correlation Between OCP Exposure of Mothers and Early-

## life OCP Exposure of Daughters

Early-life exposure of the second-generation women is likely to start from the beginning of the 1990s, since the oldest cohort incorporated in our baseline analysis was born in 1969. The most significant policy change they experienced was legalization of the OCP in the 2000s and its gradual relaxation during the 2010s. These changes have relatively minor variations in policy changes in different provinces, since they are largely nationwide in scope. Thus, changes in early-life exposure of second-generation women across different cohorts are similar for different provinces, conditional on linear trends.

Other than early-life exposure during ages 20-45, some scholars also argue that the exposure of second-generation women during ages 6-20 also matters in determining their fertility. We thus test whether the exposure for second-generation women during ages 6-20 is correlated with the initial OCP rollout using the same method. Fig. C4a shows estimated results. Again, OCP exposure does not appear to correlate over generations.

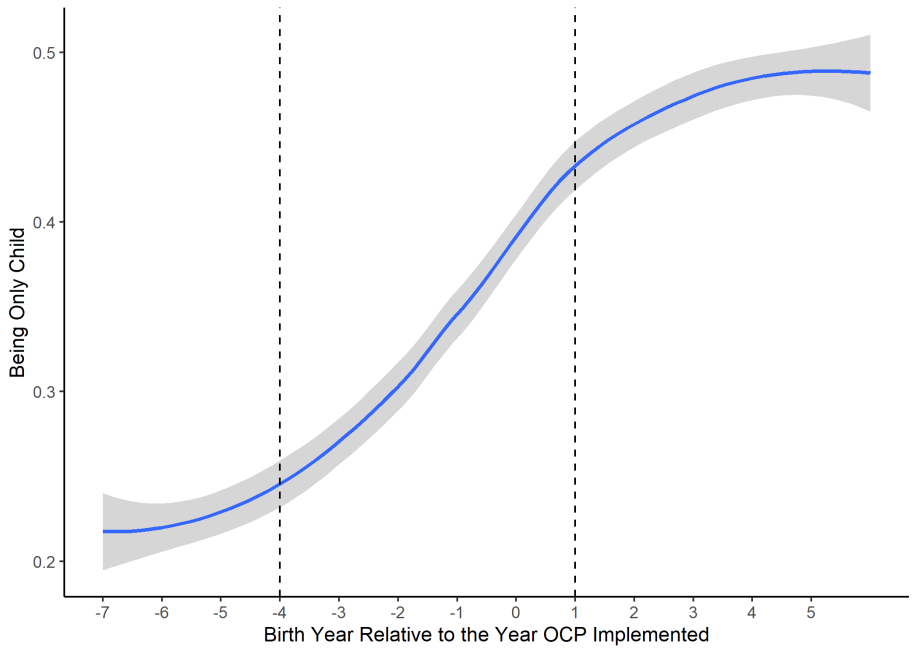
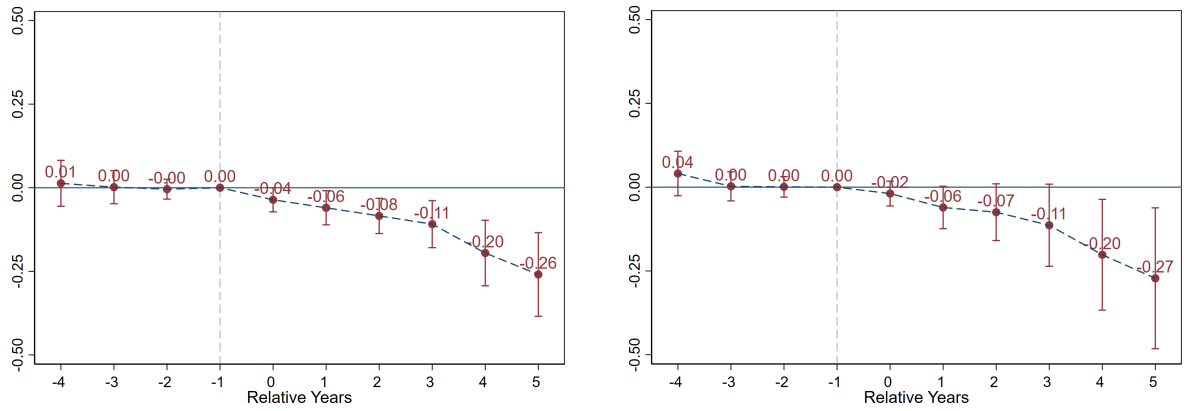


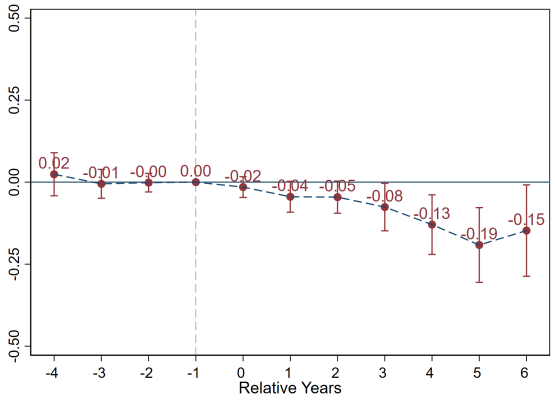

Figure E1: Only-child Rate of Second-generation Women over Years. This figure shows the trend in the probability of second-generation women being an only child over relative years, where "relative year" is defined as the birth year offset from the year of OCP implementation. Data are from the mini-census 2005 and samples are restricted to urban Han women born between 1975 and 1980. The blue line is fitted using the method of *LOESS* and the gray area represents the 95% confidence interval for the estimated smooth line.



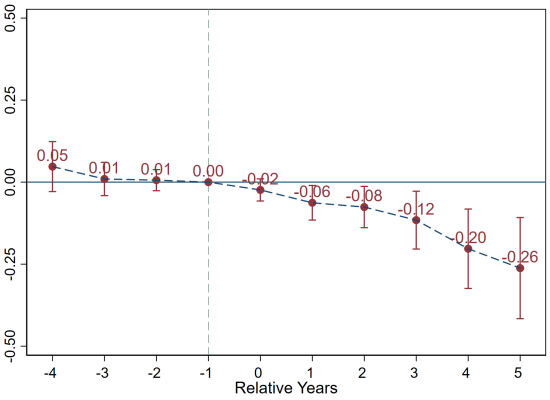

(a) Adjusting Unaffected Birth Spacing $s$ for Provinces that Implemented OCP Later

(b) Without "$Early_p$"

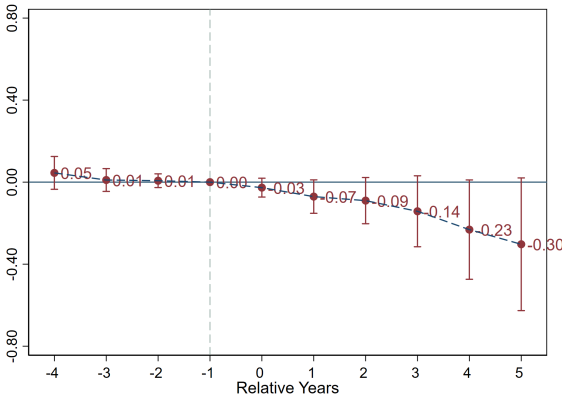
Figure E2: Impact of the OCP Rollout on Second-generation Women's Fertility in the 2020 Census: Alternative Empirical Specifications. Figure (a) plots coefficients estimated using Eq. 2. We adjust the baseline definition of the unaffected birth spacing, $s$, as specified in Eq. 3, by adjusting the spacing from 4 to 3 years for those provinces that implemented the OCP at a later time. Figure (b) plots coefficients estimated using $Y_{icp} = \alpha_p + \theta_c + \delta_p \cdot c + \sum_{l \neq -1} \beta_l \cdot D^l_{cp} + \epsilon_{icp}$, where the notations are the same as Eq. 2. In Figures (a) and (b), the dependent variable is the number of children ever born by 2020. Data in both figures are from the 2020 census, and samples are further restricted to urban women born during 1969-1980. Control variables in both figures include province fixed effects, cohort fixed effects, and province-specific cohort linear trends. Robust standard errors in both figures are clustered at province level. Vertical bars represent confidence intervals at the 90% level.




(a) Using Samples of 1969 - 1981 Birth Cohorts

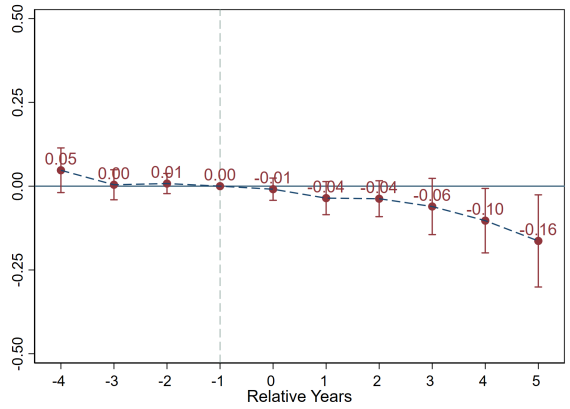



(b) Using Samples of 1971 - 1980 Birth Cohorts

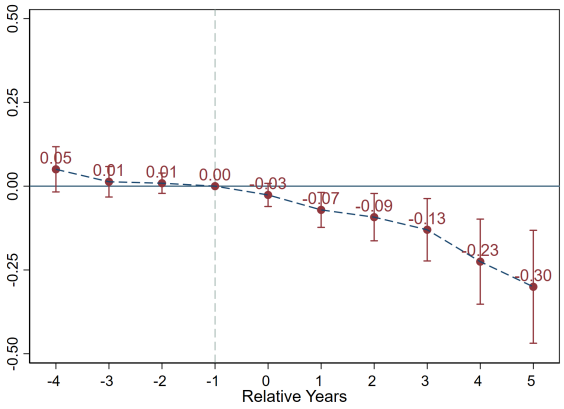



(c) Using Samples of 1965- 1980 Birth Cohorts and Controlling for Quadratic Province-specific Cohort Trends

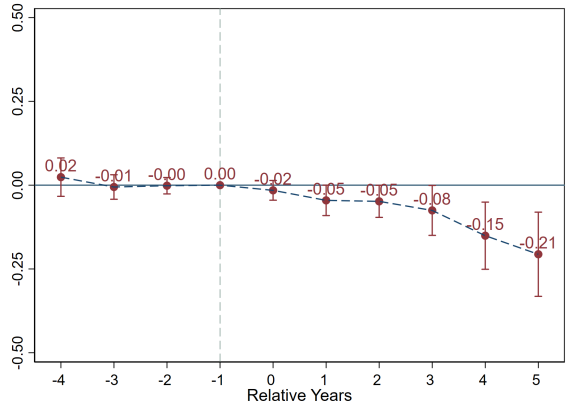
Figure E3: Impact of the OCP Rollout on Second-generation Fertility in the 2020 Census: Alternative Cohort Intervals. These figures all plot coefficients estimated using Eq. 2. The dependent variable is the number of children ever born by 2020. Figures (a)-(c) show the coefficients estimated using samples restricted to alternative cohort intervals. Data are from the 2020 census. Samples are restricted to urban Han women, with each figure representing different birth cohorts: those born between 1969 and 1981 in Figure (a), between 1971 and 1980 in Figure (b), and between 1965 and 1980 in Figure (c). Control variables in all figures include province fixed effects, cohort fixed effects, and province-specific cohort linear trends. Specifically, in Figure (c) we further control for province-specific cohort quadratic trends. Robust standard errors in Figures (a) and (b) are clustered at province level, while in Figure (c) standard errors are computed using the wild bootstrap method with 10,000 repetitions and also clustered at province level.



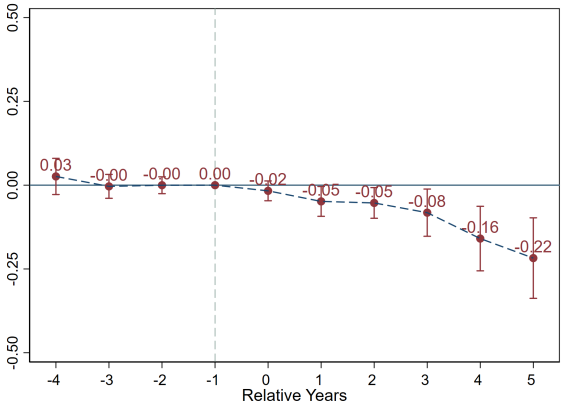

(a) Controlling for Great Famine Proxies




(b) Controlling for Cultural Revolution Proxies

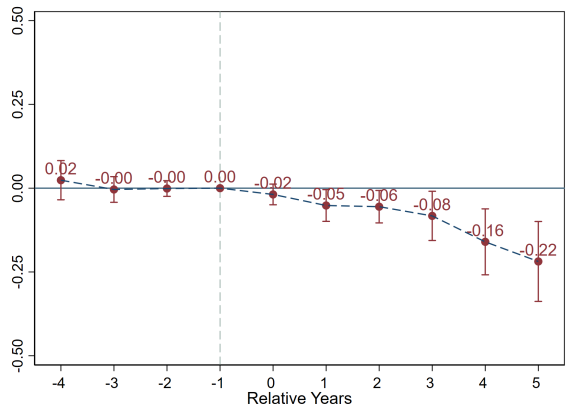



(c) Controlling for Later, Longer, Fewer Proxies

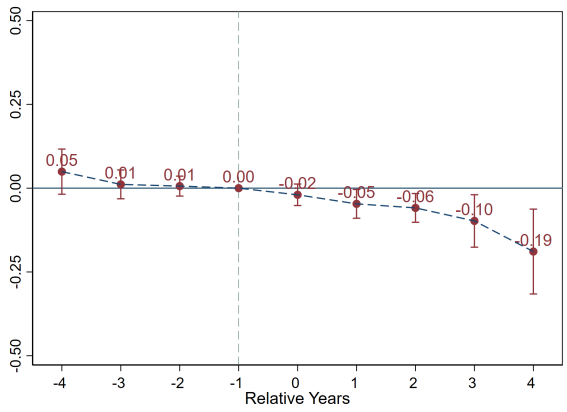



(d) Controlling for Compulsory Education Law Proxies

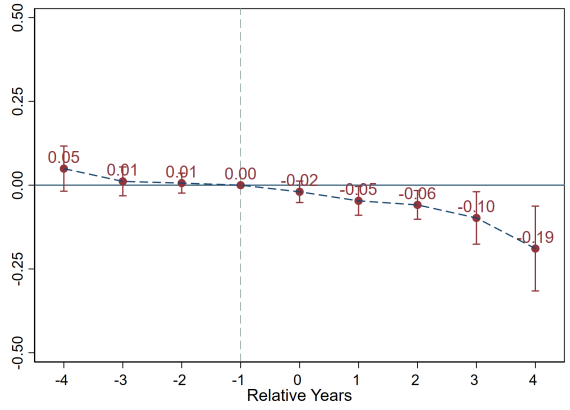
Figure E4: Impact of the OCP Rollout on Second-generation Fertility in the 2020 Census: Controlling for Policy Shocks. Figures (a)-(d) plot coefficients that are estimated using Eq. 2, controlling for different policy shocks by adding proxies that correspond to the birth cohorts from various provinces: Figure (a) controls for the Great Famine (1959-1961), Figure (b) for the Cultural Revolution (1966-1976), Figure (c) for the Later, Longer, Fewer Campaign during the 1970s, and Figure (d) for the Compulsory Education Law (around 1986). The dependent variable in all figures is the number of children ever born by 2020. Data are from the 2020 census, and samples are further restricted to urban women born during 1969-1980. Control variables in all figures include province fixed effects, cohort fixed effects, and province-specific cohort linear trends. Robust standard errors in all figures are clustered at province level. Vertical bars represent confidence intervals at the 90% level.



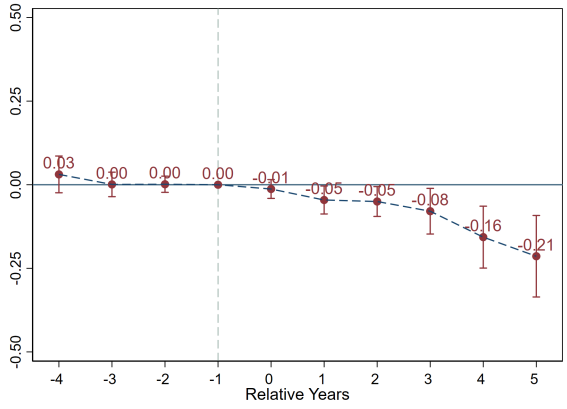

(a) Controlling for Economic Development Proxies




(b) Controlling for Clan Culture Proxies




(c) Controlling for Distance to Beijing




(d) Controlling for Socioeconomic Indicators that Vary across Provinces and Cohorts

Figure E5: Impact of the OCP Rollout on Second-generation Fertility in the 2020 Census: Controlling for Pre-OCP Conditions. Figures (a)-(d) plot coefficients that are estimated using Eq. 2, controlling for interactions between the cohort dummies and a series of variables that measure different pre-OCP conditions: Figure (a) controlling for socioeconomic factors, Figure (b) cultural factors, Figure (c) political factors, and Figure (d) socio-economic indicators varying across provinces and cohorts. The dependent variable in all figures is the number of children ever born by 2020. Data are from the 2020 census, and samples are restricted to urban women born during 1969-1980. Control variables in all figures include province fixed effects, cohort fixed effects, and province-specific cohort linear trends. Robust standard errors in all figures are clustered at province level. Vertical bars represent confidence intervals at the 90% level.

# F Further Details on the Empirical Analysis of the Ethnic Minority Sample

## F.1 Estimation Strategy

The sample mainly consists of urban ethnic minority women with two minor changes. First, we extend our sample to women born during 1965-1980, which ensures a sufficient sample size. Second, we exclude ethnic minorities whose fertility patterns significantly differ from those of Han women in the same region, given that we use the minority sample as a proxy for Han Chinese mothers unaffected by the OCP. This exclusion filters out ethnic minorities less culturally aligned with the Han Chinese population.

We re-estimate Eq. 2 using the sample of ethnic minorities with five changes. First, we omit province-specific cohort trends, given that ethnic minorities are exempt from stringent one-child restrictions. This renders the use of province-specific cohort trends unnecessary for accommodating the life-cycle fecundity pattern. Second, we introduce controls for the share of Han Chinese individuals within the residential region and its quadratic form in the regression. The optimal fertility for ethnic minorities (those whose mothers are untreated) decreases with the policy only when the share of women whose mothers are treated is sufficiently large. The treatment effect in the untreated group is nonlinearly determined by the proportion of women whose mothers were treated, which is proportional to the share of ethnic minorities. Third, we incorporate city fixed effects in the analysis to account for potential heterogeneity in residential habits and the proportion of ethnic minorities at city level. Fourth, we exclude relative years $l \geq 4$ from our analysis, since the samples from those relative years are insufficient for robust estimation. Fifth, we cluster standard errors at province and ethnicity level.

## F.2 Estimation of the weight $\alpha$

The analysis in the main text quantifies a lower bound on the contribution of the maternal effect in shaping fertility norms to the OCP effect on daughters' fertility. Interestingly, we are also able to establish a lower bound for a structural parameter: the strength of

maternal relative to peer effects, $\alpha$, in the woman's utility function (Eq. 1):

$$\begin{aligned}\alpha &= \frac{N_{ur,2} - N_{r,2}}{n_1^u - n^p} \\ &\geq \frac{n^*_{ur,2} - n^*_{r,2}}{n_1^u - n^p} \\ &= \frac{\lambda(n^*_{r,2} - n_2^u) + (1-\lambda)(n^*_{ur,2} - n_2^u) - (n^*_{ur,2} - n_2^u)}{n_1^u - (\lambda n^p + (1-\lambda)n_1^u)}.\end{aligned} \tag{F1}$$

The first equality is based on the fact that $N_{r,2} = \alpha n^p + (1-\alpha)\bar{n}_2$ and $N_{ur,2} = \alpha n_1^u + (1-\alpha)\bar{n}_2$, where $N_{r,2}$ ($N_{ur,2}$) is the fertility norm for those Han women whose mothers' fertility is (not) constrained by the OCP, as defined in Section 2.3. The second inequality is due to the fact that $N_{r,2} \leq n_2^{r*}$ and $N_{ur,2} \geq n_2^{ur*}$, as implied by Proposition 3. The third equality is straightforward.

We note that (1) our estimate of $\beta_l$ based on the main sample using women's fertility as the dependent variable (Fig. 6) is $\lambda(n^*_{r,2} - n_2^u) + (1-\lambda)(n^*_{ur,2} - n_2^u)$, as indicated by Eq. 4; (2) the same estimate based on the minority sample (Appendix C Table C4) is $n^*_{ur,2} - n_2^u$; and (3) the same estimate based on the main sample using women's sibling size (Fig. 5) as the dependent variable is $n_1^u - (\lambda n^p + (1-\lambda)n_1^u)$. Combining these three estimates, we are able to compute the lower bound of $\alpha$. Taking $l = 3$ as an example, we have $\alpha \geq 0.31 (= \frac{0.81-0.53}{0.91})$. Our result is in line with De Silva and Tenreyro (2020), who find that the average weight of the previous generation's fertility in forming the fertility norm for the current generation is around 0.4.