THE UNIVERSITY OF CHICAGO

Fertility Preferences and Fertility Outcomes in China: A Two-way Causal Analysis

By

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Abstract

This study explores the bidirectional causality between fertility preferences and outcomes in China, using the latest two waves of the Chinese General Social Survey (CGSS 2018 and 2021). The findings highlight significant implications for two contrasting phenomena observed in the data: 1) A progressive shift from son preference to daughter preference overall across cohorts; 2) A persistent gender discrepancy between fertility outcomes and preferences - actual fertility outcomes are *more* skewed towards boys than ideal fertility preferences suggest. The shift towards the daughter preference can be attributed to the "girl-updating" mechanism: having girls on average reduces the gender gap in preferences by approximately 0.5 children, while the effects of having boys are less consistent. On the other hand, the gender discrepancy between fertility outcomes and preferences can be explained by two behavioral patterns: 18% of the discrepancy comes from people with a son preference taking more aggressive measures to ensure male offsprings, whereas 82% is attributed to the "*implicit son preference*" among people with a balance preference, who opt for a boy when limited to only one child. Moreover, a dynamic Difference-in-Difference study suggests that during the early stage of birth control policies, *urban* residents with a balance preference suffer from increasingly stricter constraints of having only one child than their rural counterparts, exacerbating the skewed sex ratio.

Keywords: Fertility; Son preference; Sex Ratio; Gender Inequality; One-child Policy

1 Background and Motivation

The Son preference has deep historical roots in Chinese culture, manifesting in a highly biased sex ratio favoring boys, for which China is widely known. However, recent trends suggest a reversal in this pattern. Based on my analysis of the latest two waves of the Chinese General Social Survey (CGSS 2018 and 2021), there appears to be a shift in fertility preferences among Chinese people toward favoring girls, beginning with the 1970s cohorts. This raises an intriguing research question: What are the driving forces behind this shift, and how does the mechanism of preference transition operate?

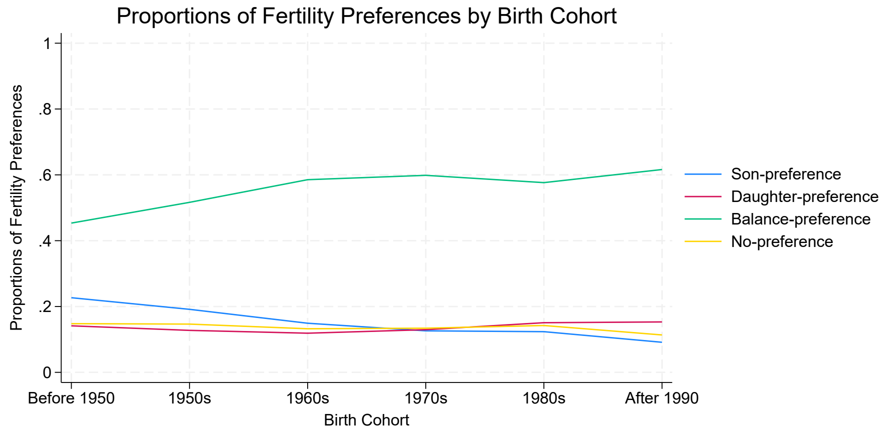
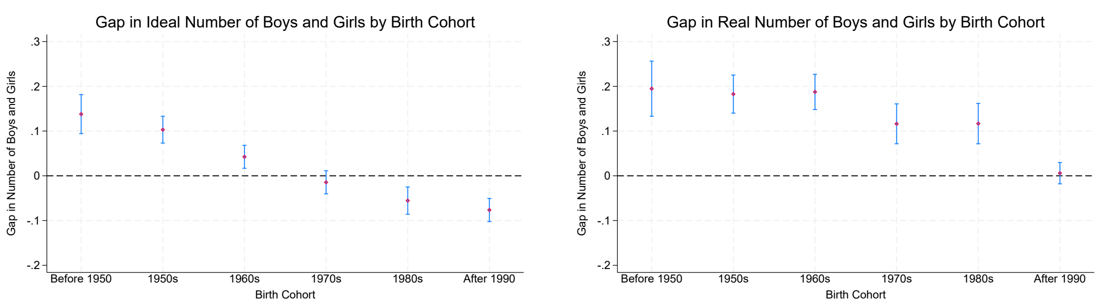


Figure 1: Proportions of Fertility Preferences by Birth Cohort

It is also insightful to compare ideal fertility preferences with actual fertility outcomes. I calculate the gender gap in the fertility outcomes and and the gender gap in ideal fertility preferences separately. The findings reveal a persistent discrepancy: actual outcomes are more biased towards boys than the ideal preferences suggest. Notably, for the 1970s cohort, even when ideal preferences indicate no gender difference, their actual fertility outcomes still favor boys. It might be suspected that respondents are reluctant to disclose their true preferences due to policy concerns. However, this concern is largely mitigated by the survey instructions, which asked respondents to report their preferences "without the influence of any policy." Exploring the reasons behind this persistent discrepancy between fertility outcomes and preferences is another key focus of my research.



(a) The Gap in **Ideal** Numbers

(b) The Gap in **Real** Numbers

Figure 2: A Persistent Discrepancy Between the Real and Ideal Gaps

In my current study, I am dedicated to exploring the causal interactions between fertility preferences and outcomes, addressing the two key questions aforementioned. Naturally, fertility preferences can shape outcomes through the parental choice of abortion. Analyzing the heterogeneous effects across different preferences could help explain the gender discrepancy between outcomes and preferences. Conversely, fertility outcomes and experiences can reshape these initial preferences. The causal effects derived from fertility outcomes may illuminate the increasing preference for girls.

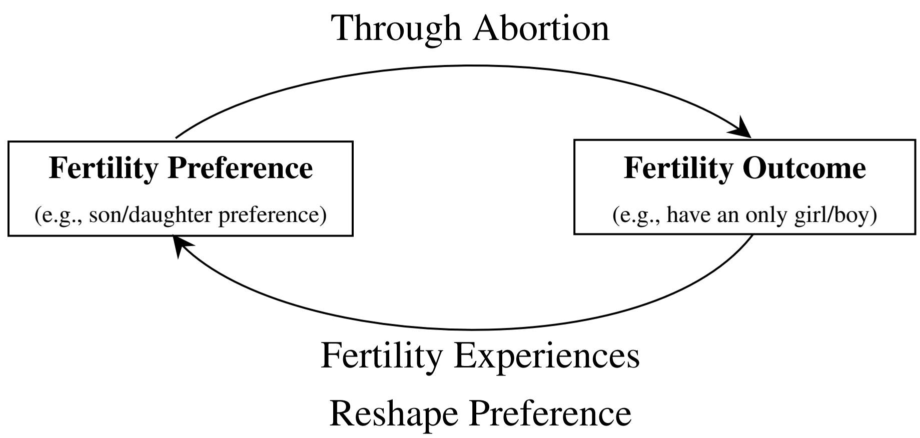


Figure 3: Two-way Causal Interactions

2 Literature and Contributions

There is rich literature about the fertility preferences, realized reproductive outcomes, and the relationship between them. First, scholars have found that features of fertility preferences, such as *family size* and *timing*, are unstable and malleable. Yeatman et al. (2013)[14] found that the family size preferences respond to interpersonal relationships and reproductive circumstances among Malawian women. Another study on the same population from Sennott and Yeatman (2012)[11] tracked the fertility preferences of young Malawian women every four month and found timing preference of fertility was unstable over time. Interestingly, people might have a misperception of these fertility preferences being stable, as found in the study from Muller et al. (2022)[8] among Kenyan women. By contrast, the *gender-based* fertility preferences exhibit higher stability for decades, for example, persistent son preferencea exist in East and South Asia, which is tied to the fundamental social views of gender and cannot be easily changed [1]. Secondly, the actual fertility outcomes are commonly investigated regarding the fertility rate and sex ratio at birth. Famous findings include a notable decrease in the fertility rate as female education increases [7] and a commonly skewed sex ratio towards boys in developing economies [2]. Thirdly, the fertility preferences and outcomes are closely interrelated. Bhrolcháin et al. (2015)[10] argued that the fertility behavior is essentially determined by rational fertility choice and the preferred family size is a discovery that has a dynamic development process involving various factors.

In particular, within the context of China, gender-based fertility preferences, abortion, and fertility policies have been extensively researched. Jiang et al. (2015) [5] identified a "son-stopping" mechanism in Shaanxi Province, where women with a son preference are less likely to have a second child. This is largely because they engage in sex-selective abortions to ensure their firstborn is a boy. Policy-wise, Li et al. (2011) [6] applied a Difference-in-Difference design to census data, showing that the One-child policy greatly led to a biased sex ratio towards more boys. However, there is growing evidence showing the son preference is declining. Zhou et al. (2012) conducted in-depth interviews with 212 individuals who exhibited considerably weakened the son preference, though still existing. Wei and Zhang (2023)[12] find parents invest in girls more in terms of after-school education from the China Education Panel Survey (2013-2014), indicating a daughter preference.

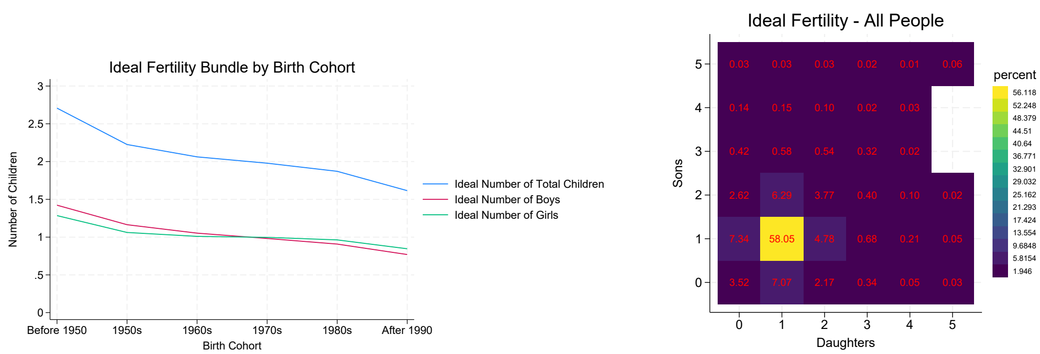
Although numerous studies have examined the causes and impacts of the son preference in China, few have explored why the fertility outcomes are even more skewed towards boys than the ideal fertility preferences indicate. Additionally, the literature seldom considers the two-way causality between fertility preferences and outcomes, particularly in the *reverse* direction. Moreover, no existing studies have investigated the potentially unique behavioral patterns among individuals with a balance preference for sons and daughters. My research aims to fill these gaps in the literature, enhancing our understanding of the interactions between fertility preferences and outcomes. This work could also illuminate the *mechanism* by which the One-child policy may have intensified the biased sex ratio.

3 Data

The primary data source for my research is the latest two waves of the Chinese General Social Survey (CGSS 2018 and 2021), which I have combined into a pooled cross-sectional dataset comprising 20,937 records. These surveys provide essential information about the respondents, including aspects related to fertility, education, income, gender, marital status, and more. To ensure robustness, I have also incorporated regional variables at the provincial level as controls. These include sex ratio, average years of education, dependency ratio, GDP per capita, and other relevant metrics.

3.1 Ideal Fertility Bundle (IFB)

In the questionnare, each individual i was asked about their ideal fertility choice unaffected by any policy. Presumably, this reveals the unique fertility bundle that generates the highest utility for i, denoted by (s_i^*, d_i^*). s_i^* is the ideal number of boys and d_i^* is the ideal number of girls. For people who reported $s_i^* > d_i^*$, they are identified as individuals with a son preference. Similarly, people with a daughter preference are identified by $s_i^* < d_i^*$. For people with a balance preference, they have an ideal fertility bundle satisfying $s_i^* = d_i^*$. Note that there is an essential distinction between people with a balance preference and with no preference. The former group reports specific (s_i^*, d_i^*) while the latter group reports no s_i^*, d_i^* (i.e., (s_i^*, d_i^*) is undefined) and serves as the control group in my study. The accompanying graphs illustrate the average ideal fertility bundle by birth cohort and the distribution of each specific ideal bundle. We observe a decline in the ideal number of children alongside a shift towards favoring more girls. Meanwhile, nearly 60% of respondents prefer a balanced composition of one boy and one girl. The behavior of this group could be pivotal in influencing the observed gender gap.



(a) The Average IFB

(b) The Distribution of IFB

Figure 4: A Overview of Ideal Fertility Bundle (IFB)

4 Model and Empirical Strategies

4.1 A Fertility Model with Relatively Consistent Preferences

Conducting an observational study presents challenges in examining causal effects due to selection bias. The bidirectional causality between fertility preferences and outcomes further complicates this issue. To facilitate our understanding of the causal interactions among these variables, I develop a simple fertility model accompanied by specific assumptions to guide the analysis. This model posits that an individual, i, with a defined ideal fertility bundle, experiences three distinct life stages:

1. **Pre-fertility Period**
   - Individual i starts with $(s_i^*, d_i^*, S_i = 0, D_i = 0)$.
   - (s_i^*, d_i^*) is the initial ideal fertility bundle.

- $(S_i = 0, D_i = 0)$ is the initial fertility outcome (naturally 0).

2. **Fertility Period**
   - The individual makes fertility decision based on (s_i^*, d_i^*).
   - The fertility outcome now becomes (S_i', D_i').
   - It follows a process characterized by $\Pr((S_i', D_i')|(s_i^*, d_i^*))$.

3. **Post-fertility Period**
   - The individual reflects on their fertility outcomes and experiences, and updates their ideal fertility preference to $(s_i^{*\prime}, d_i^{*\prime})$.
   - Note that since it is post-fertility, so the updated $(s_i^{*\prime}, d_i^{*\prime})$ will not further affect the fertility outcome.
   - The process is characterized by $\Pr((s_i^{*\prime}, d_i^{*\prime})|(s_i^*, d_i^*, S_i', D_i'))$.

In this model, transitions in ideal fertility bundles are constrained among specific preferences. A person with initial bundle (s_i^*, d_i^*) cannot transit to a state of no preference post-fertility, where the post-fertility ideal bundle $(s_i^{*\prime}, d_i^{*\prime})$ is undefined. Similarly, the model excludes the possibility that a person of initially no preference developing a specific preference $(s_i^{*\prime}, d_i^{*\prime})$ after fertility. This underscores a feature of consistent preferences within the model. Furthermore, I extend the assumption of relatively consistent preferences to individuals with other preferences, stipulating that the order relation between s_i^* and d_i^* is almost perfectly maintained post-fertility. Mathematically, this implies:

$$
\begin{aligned}
\Pr(s_i^{*\prime} > d_i^{*\prime}|s_i^* > d_i^*, S_i', D_i') &\approx 1 \\
\Pr(s_i^{*\prime} = d_i^{*\prime}|s_i^* = d_i^*, S_i', D_i') &\approx 1 \\
\Pr(s_i^{*\prime} < d_i^{*\prime}|s_i^* < d_i^*, S_i', D_i') &\approx 1
\end{aligned} \tag{1}
$$

In other words, the *qualitative feature* of fertility preference is preserved after fertility, although the intensity of the preference may vary. For instance, a person with a son preference before experiencing fertility will continue to prefer sons afterwards, but the degree of this preference can change. This assumption is supported by findings suggesting that fertility preferences are largely shaped by fundamental life views, education level, and economic status.[9] The preferences may be influenced by fertility outcomes and experiences, yet such changes are unlikely to be drastic.

4.2 Empirical Strategies

With the assumption of relatively consistent preference embedded in our fertility model, we are now positioned to define corresponding econometric models that bypass the issue of bidirectional causality. First, I define all relevant variables for the analysis. An individual i, based on their initial ideal fertility bundle before experiencing fertility (s_i^*, d_i^*), can be classified into one of four categories, with each represented by a dummy variable: SP_i for Son Preference, DP_i for Daughter Preference, BP_i for Balance Preference, and NP_i for No Preference.

$$\begin{cases} SP_i = 1, & \text{if } s_i^* > d_i^* \\ DP_i = 1, & \text{if } s_i^* < d_i^* \\ BP_i = 1, & \text{if } s_i^* = d_i^* \\ NP_i = 1, & \text{if } s_i^*, d_i^* \text{ not defined} \end{cases} \tag{2}$$

Similarly, I use $SP_i', DP_i', BP_i', NP_i'$ to denote the preferences if they are post-fertility, based on the updated ideal fertility bundle $(s_i^{*\prime}, d_i^{*\prime})$. On the other hand, an individual i is also classified into 4 groups based on their fertility outcomes, OB_i for Only Boys, OG_i for Only Girls, M_i for Mixture of Boys and Girls, NC_i for No child,

$$\begin{cases} OB_i = 1, & \text{if } S_i' > 0, D_i' = 0 \\ OG_i = 1, & \text{if } S_i' = 0, D_i' > 0 \\ M_i = 1, & \text{if } S_i' > 0, D_i' > 0 \\ NC_i = 1, & \text{if } S_i' = 0, D_i' = 0 \end{cases} \tag{3}$$

where (S_i', D_i') is i's fertility outcome at the end of fertility period. Note that in the data, the majority of the respondents had passed the mean childbearing age (25-30). Only 12% who were born after 1990 are during the pre-fertility or fertility period at the time of survey. Thus, $(s_i^{*\prime}, d_i^{*\prime})$ and (S_i', D_i') are observed for most respondents.

After identifying the fertility categories as treatment variables, it is crucial to specify the variables of interest. First, to evaluate the treatment effects from preferences $P_i \in \{SP_i, DP_i, BP_i\}$, I focus on the gender gap in real fertility outcomes, denoted as $RGAP_i = S_i' - D_i'$. Individuals with no preference serve as the control group, thus defining the study group as $\{i : P_i = 1 \vee NP_i = 1\}$, where $P_i \in \{SP_i, DP_i, BP_i\}$. The econometric model is structured as follows:

$$RGAP_i = \alpha + \tau^P P_i + \beta_1 \mathbf{X}_i + \beta_2 \lambda_j + \epsilon_i \tag{4}$$

where $\mathbf{X}_i$ is the individual controls, λ_j is the provincial controls, and τ^P captures the treatment effect of the preference P_i. The reverse causality problem is gone since the fertility outcome $RGAP_i$ cannot affect the initial fertility preference P_i by design. Note that the pre-fertility dummies P_i are largely unobserved in the data, and we only know the post-fertility dummies P'_i. Fortunately, the assumption of relatively consistent preferences allows P'_i to serve as a reliable proxy for P_i. This is based on the premise that fertility outcomes do not fundamentally alter the qualitative characteristics of fertility preferences.

In response to the observed phenomenon where fertility outcomes exhibit a stronger bias towards boys than indicated by ideal fertility preferences, I formulate the following two hypotheses. First, there could be heterogeneity in the fertility manipulation between people with a son and daughter preference.

Hypothesis 1 (H1) *People with a son preference manipualte fertility towards boys to a significantly greater extent than people with a daughter preference (towards girls). Mathematically,*

$$|\tau^{SP}| > |\tau^{DP}|, \tau^{SP} > 0, \tau^{DP} < 0 \tag{5}$$

Note that the strengths of observed son and daughter preferences are almost equivalent in magnitude, as indicated by the post-fertility gender gap in ideal preferences (with average values of 1.30 for son preference and −1.30 for daughter preference). This equivalence in magnitude is a fundamental prerequisite for Hypothesis 1 to explain the discrepancy between outcomes and preferences.

Another potential source of discrepancy may arise from the majority of survey respondents, who exhibit an ideal balance preference. When faced with limitations, their preferences may display different characteristics:

Hypothesis 2 (H2) *People with a balance preference have an implicit son preference when they can only have one child, and they will take action to manipulate fertility towards a boy in this case. Mathematically,*

$$(\tau^{BP}|One\ child) > \tau^{BP} > 0 \tag{6}$$

In the reverse direction, to investigate the treatment effect of outcomes $O_i \in \{OB_i, OG_i\}$, I focus on the gender gap in post-fertility preferences, denoted by $IGAP'_i = s_i^{*\prime} - d_i^{*\prime}$. Individuals with no children serve as the control group, thereby defining the study group as $\{i : O_i = 1 \vee NC_i = 1\}$, where $O_i \in \{OB_i, OG_i\}$. The econometric model is:

$$IGAP'_i = \alpha + \tau^O O_i + \beta_1 \mathbf{X}_i + \beta_2 \lambda_j + \epsilon_i \tag{7}$$

where $\mathbf{X}_i$ is the individual controls, λ_j is the provincial controls, and τ^O captures the treatment effect of fertility outcomes O_i. There is also no reverse causality, as the post-fertility preference, denoted as $IGAP'_i$, cannot influence O_i since the fertility period has concluded. Instead, O_i can only be affected by the pre-fertility preference $IGAP_i$, which remains largely unobserved.

The updating mechanism from outcomes might provide insights into the observed shift from son preference to daughter preference across successive cohorts. A plausible hypothesis is:

Hypothesis 3 (H3) *The experience of bearing and raising girls can more significantly update fertility preferences towards favoring girls than the counter-force from having boys. Mathematically,*

$$|\tau^{OG}| > |\tau^{OB}|, \tau^{OB} \geq 0, \tau^{OG} < 0 \tag{8}$$

By categorizing preferences into pre- and post-fertility periods, we effectively separate and model the two-way causality in two distinct stages as discussed above. The primary challenge that remains for causal analysis is selection bias and omitted variable bias, which I plan to address using two methodologies: Propensity Score Matching (PSM) and Instrumental Variable (IV).

4.2.1 Propensity Score Matching (PSM)

Propensity Score Matching is a widely used technique in the observational studies where treatments are not randomized. It relies on the assumption of conditional independence,

$$Y_{i0}, Y_{i1} \perp\!\!\!\perp D_i | X_i \tag{9}$$

where $Y \in \{RGAP, IGAP'\}$, $D \in \{P, O\}$, and X is the observables which could be individual or regional covariates. The first step is to calculate the propensity scores typically by estimating a Probit regression model,

$$\Pr(D_i = 1 | X_i) = \Phi(\alpha + \beta X_i) \tag{10}$$

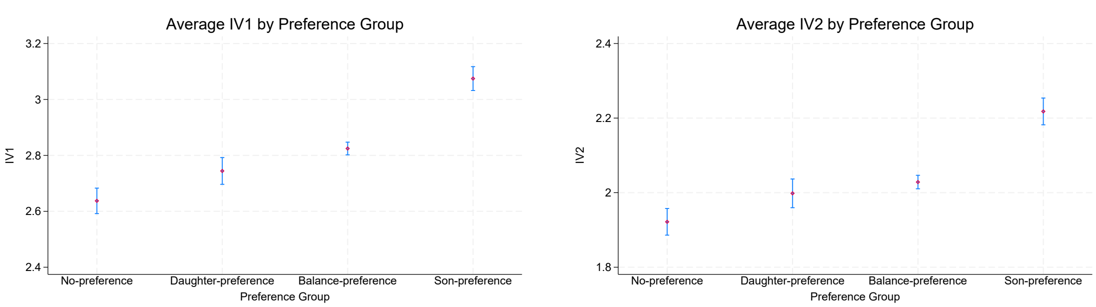
After calculating the propensity scores for each record, the next step involves matching each record to the most similar records in the comparison group based on these scores. The default matching method employed in this analysis is single nearest neighbor. Following matching, balance tests are typically conducted to ensure that the treatment effect mimics random assignment. It is important to note that the Propensity Score Matching (PSM) approach generally estimates the Average Treatment Effect on the Treated (ATT) rather than the Average Treatment Effect (ATE).

4.2.2 Instrumental Variables (IV)

In addition to PSM, I also explore the use of instrumental variables (IVs) that exert exogenous shocks to influence treatment dummies. Finding perfect IVs in an observational survey that satisfy both relevance and exogeneity conditions is empirically challenging. However, examining the results with appropriate caution is still valuable. For assessing the treatment effects associated with fertility preferences, I utilize opinion-based instruments related to gender inequality and life attitudes. These IVs are assumed to be conditionally independent of the potential outcomes, given the observable variables, thus serving as random shocks. For the dummies SP_i and BP_i, I consider two variables related to specific aspects of gender inequality. Respondents provided ratings on a scale from 1 (strongly disagree) to 5 (strongly agree) on their agreement with two statements:

1. Males are born to have better abilities than females. ($IV1_i$)
2. When in recession, females should be fired first. ($IV2_i$)

The relevance plots indicate a strong correlation between the instrumental variables $IV1_i$ and $IV2_i$, and the treatment groups SP_i and BP_i. Individuals with a son preference or balance preference consistently show higher group averages than those with no preference. Intuitively, if someone believes that males surpass females in abilities or economic status, they are more likely to prefer sons, who are perceived to be more capable of thriving in society. However, it is less obvious why those who favor a balanced gender ratio also tend to agree that males are superior. One hypothesis is that these individuals exhibit an implicit son preference, i.e., Hypothesis 3. While this group ideally desires an equal number of sons and daughters, they might lean towards having son(s) if restricted to an odd number of children or just one child. The forthcoming empirical results from the IV estimations will either confirm or refute this Hypothesis 3 of the implicit son preference.



(a) IV1 (b) IV2

Figure 5: Relevance Plots for IV1 and IV2

For the instrument of DP_i, using $IV1_i$ and $IV2_i$ proves problematic due to an irrational correlation: people with a daughter preference unexpectedly show higher agreement that males are superior compared to the no-preference group, which is counterintuitive. Instead, I consider $IV3_i$, which focuses on life attitudes. Respondents were asked to rate the extent to which they agree with the following statement:

1. I prefer a life with challenges and risks rather than a peaceful life.

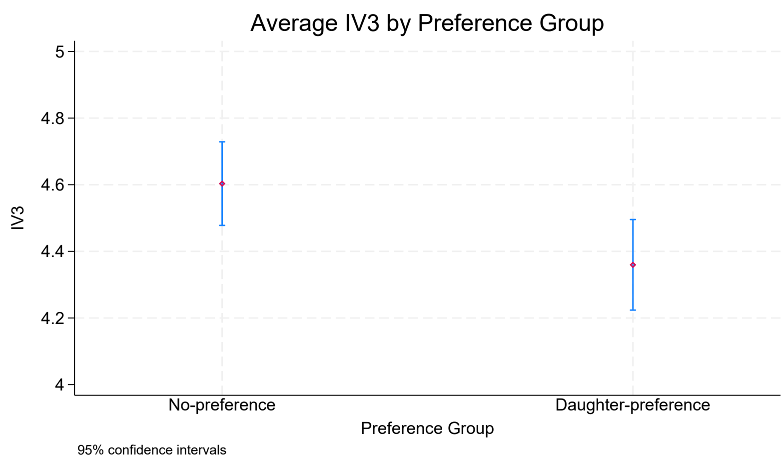


Figure 6: Relevance Plot for IV3

As predicted, people with a daughter preference tend to like a more peaceful and less aggressive life relative to the no-preference group.[3] After detailing the IV choices, I use 2SLS to estimate the treatment effect,
First-stage regression:

$$P_i = \delta + \gamma_1 IV_i + \gamma_2 \mathbf{X}_i + \gamma_3 \lambda_j + v_i \tag{11}$$

Second-stage regression:

$$RGAP_i = \alpha + \tau^P \hat{P}_i + \beta_1 \mathbf{X}_i + \beta_2 \lambda_j + \epsilon_i \tag{12}$$

In the reverse direction, I use the variable $Married_i$ to serve as an instrumental variable denoting marriage experiences. It is intuitive that having been married could lead an individual from having no children to having children, reflecting a natural progression in life stages. The relevance plot confirms this strong correlation. Still, we have the exogeneity assumption that whether having marriage experiences is as if randomly assigned conditional on a comprehensive set of observables. The corresponding 2SLS regression models are structured as follows:

First-stage regression:

$$O_i = \delta + \gamma_1 Married_i + \gamma_2 \mathbf{X}_i + \gamma_3 \lambda_j + v_i \quad (13)$$

Second-stage regression:

$$IGAP_i' = \alpha + \tau^O \hat{O}_i + \beta_1 \mathbf{X}_i + \beta_2 \lambda_j + \epsilon_i \quad (14)$$

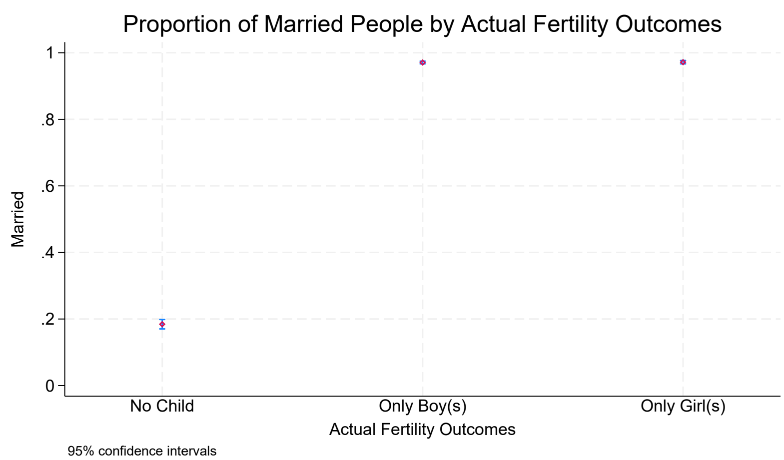


Figure 7: Relevance Plot for $Married_i$

5 Results

5.1 Son Preference and Daughter Preference in Action

First, to determine whether the intensity of fertility manipulation varies between people with a son preference and daughter preference, results from both PSM and IV methods are analyzed. Due to data limitations and the strength of IV relevance, the IV results may exhibit high variance and lack precision in magnitude. Consequently, I use the PSM results for *quantitative* inference and employ the IV results as a *qualitative* robustness check. Additionally, I report two estimates for PSM: one set of estimates is based on matching individual characteristics, and another set includes both individual and regional characteristics.

There is compelling evidence that individuals with a preference for sons or daughters actively manipulate fertility outcomes to favor their preferred gender. However, as hypothesized, the intensity of this manipulation - most likely through abortion - varies between the two preferences. For those with a son preference, the estimated treatment effects, denoted as $\hat{\tau}^{SP}$, are 0.8402 and 0.9013. By contrast, for those with a daughter preference, the estimates $\hat{\tau}^{DP}$ are -0.7010 and -0.7123. This indicates that, on average, individuals with a son preference take more significant actions to widen the gender gap in fertility outcomes. They do so by approximately 0.15 to 0.20 more than their counterparts with a daughter preference, who aim to narrow the gap. The findings are consistent and robust across subgroups of individuals with one or two children.

Table 1: PSM on Individual Covariates: Son Preference

	All People	**With Child(ren)**	**One Child**	**Two Children**
ATT	.8402	.9427	.7109	1.0433
SE	.0491	.0532	.0510	.1034
Treated	2973	2742	1100	738
Untreated	2634	2263	1194	683
Total	5607	5005	2294	1421
T-stats	17.098	17.7186	13.9357	10.0892
95% CI	(.7439, .9365)	(.8384, 1.0470)	(.6109, .8108)	(.8406, 1.2460)
Individual Covariates	Yes	Yes	Yes	Yes
Regional Covariates	No	No	No	No

Table 2: PSM on Individual Covariates: Daughter Preference

	All People	**With Child(ren)**	**One Child**	**Two Children**
ATT	-.7010	-.7946	-.5177	-.7728
SE	.0466	.0544	.0575	.1117
Treated	2626	2264	1016	559
Untreated	2634	2263	1194	683
Total	5260	4527	2210	1242
T-stats	-15.0438	-14.6023	-9.0025	-6.9144
95% CI	(-.7924,-.6097)	(-.9012,-.6879)	(-.6304, -.4050)	(-.9918, -.5537)
Individual Covariates	Yes	Yes	Yes	Yes
Regional Covariates	No	No	No	No

Table 3: PSM on Individual and Regional Covariates: Son Preference

	All People	**With Child(ren)**	**One Child**	**Two Children**
ATT	.9013	.9215	.7981	1.0274
SE	.0504	.0558	.0524	.1093
Treated	2931	2714	1085	728
Untreated	2599	2236	1179	674
Total	5530	4950	2264	1402
T-stats	17.8639	16.5040	15.2264	9.3918
95% CI	(.8024,1.0002)	(.8120,1.0309)	(.6954, .9008)	(.8130, 1.2418)
Individual Covariates	Yes	Yes	Yes	Yes
Regional Covariates	Yes	Yes	Yes	Yes

Table 4: PSM on Individual and Regional Covariates: Daughter Preference

	All People	**With Child(ren)**	**One Child**	**Two Children**
ATT	-.7123	-.8057	-.5637	-.9110
SE	.0461	.0554	.0592	.1136
Treated	2590	2234	1004	551
Untreated	2599	2236	1179	674
Total	5189	4470	2183	1225
T-stats	-15.4383	-14.5428	-9.5211	-8.0144
95% CI	(-.8027,-.6219)	(-.9143,-.6971)	(-.6797, -.4476)	(-1.1338, -.6882)
Individual Covariates	Yes	Yes	Yes	Yes
Regional Covariates	Yes	Yes	Yes	Yes

On the other hand, the IV results corroborate the qualitative conclusion that individuals with either a son or daughter preference actively manipulate fertility outcomes towards their preferred gender. The IV estimates for $\hat{\tau}^{DP}$ appear larger in magnitude compared to $\hat{\tau}^{SP}$. However, as discussed earlier, given the limited strength of IV relevance and data constraints (only the wave of the CGSS 2018 includes the instrument $IV3_i$), the IV results are subject to inaccuracy and substantial variance.

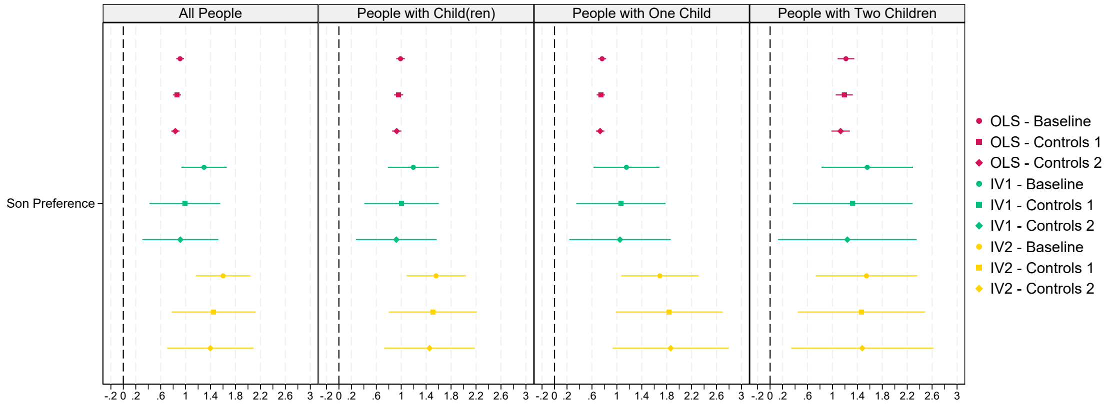


Figure 8: Treatment Effects of SP_i

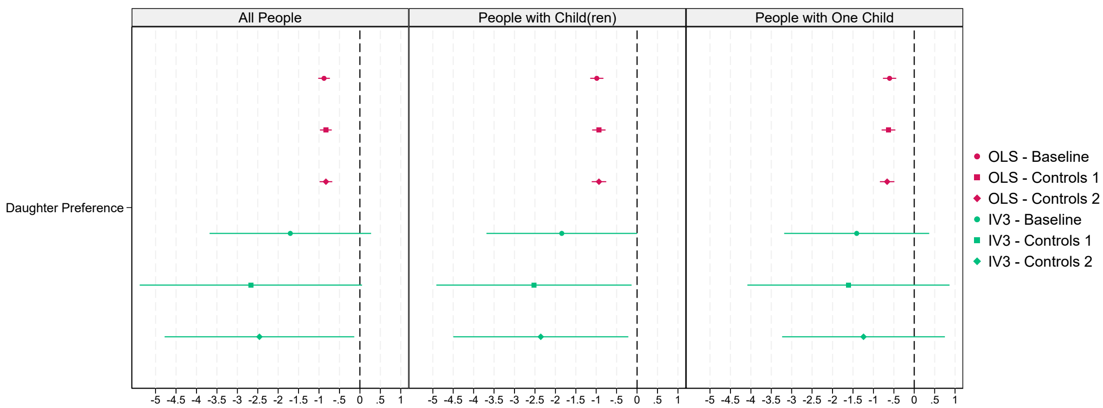


Figure 9: Treatment Effects of DP_i

5.2 Revealed Implicit Son Preference

An intriguing scenario of fertility manipulation might be observed among individuals with a balance preference. I test the Hypothesis 3 of implicit son preference, which means that people with an ideal balance preference may favor having a boy if they can only have one child. The overall PSM results indicate a positive treatment effect $\hat{\tau}^{BP} = 0.1580, 0.1427$, supporting the implicit son preference hypothesis. For a more detailed analysis, I consider the estimates conditional on family size: having one child versus two children. The estimate $(\hat{\tau}^{BP}|\text{One Child}) = 0.2220, 0.1545$ is higher than the unconditional estimate, confirming the presence of implicit son preference again. Conversely, the estimate $(\hat{\tau}^{BP}|\text{Two Children}) = 0.1598, 0.1254$ is also positive but barely reaches significance at the 5% level and does not hold when matching includes both individual and regional covariates. This aligns with the prediction from a balance preference under no obvious constraint.

Table 5: PSM on Individual Covariates: Balance Preference

	All People	**One Child**	**Two Children**
ATT	.1580	.2220	.1598
SE	.0421	.0460	.0774
Treated	9321	3432	3992
Untreated	2345	1150	663
Total	11666	4582	4655
T-stats	3.7512	4.8215	2.0628
95% CI	(.0754,.2406)	(.1317, .3122)	(.0079, .3116)
Individual Covariates	Yes	Yes	Yes
Regional Covariates	No	No	No

Table 6: PSM on Individual and Regional Covariates: Balance Preference

	All People	**One Child**	**Two Children**
ATT	.1427	.1545	.1254
SE	.0432	.0496	.0831
Treated	9144	3378	3922
Untreated	2317	1135	655
Total	11461	4513	4577
T-stats	3.2976	3.1150	1.5091
95% CI	(.0578,.2275)	(.0572,.2517)	(-.0374,.2883)
Individual Covariates	Yes	Yes	Yes
Regional Covariates	Yes	Yes	Yes

The IV results further affirm the implicit son preference hypothesis. The coefficient plots indicate a generally positive treatment effect from BP_i. This effect is particularly significant for subgroups with one child and an odd number of child(ren). By contrast, the estimates for subgroups with two children and an even number of children do not reach significance at the 5% level in all specifications.

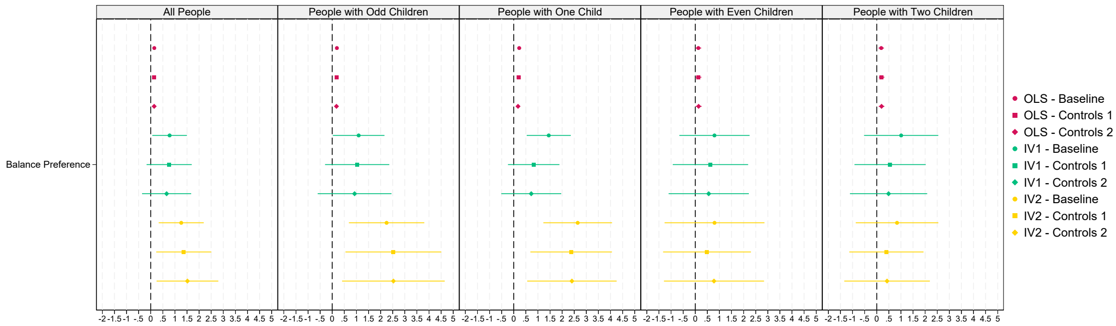


Figure 10: Treatment Effects of BP_i

5.3 A "Girl-updating" Mechanism

To explore the effects in the reverse direction, the impact of having boys versus girls on ideal fertility preferences is assessed. To ensure robustness, scenarios with only one child, either a boy or a girl, are also considered to control for the total number of children. According to the PSM results, both having boys ($\hat{\tau}^{OB} = 0.2161, 0.3211$) and having girls ($\hat{\tau}^{OG} = -0.5244, -0.4939$) update the ideal fertility preferences towards the gender of the children. However, the effect of having girls is more pronounced, with substantially larger t-statistics and magnitude. Furthermore, in scenarios with only one boy or girl, $\hat{\tau}^{OB}$ shows no significant effect, whereas $\hat{\tau}^{OG}$ continues to indicate a strong effect of shrinking the ideal gender gap.

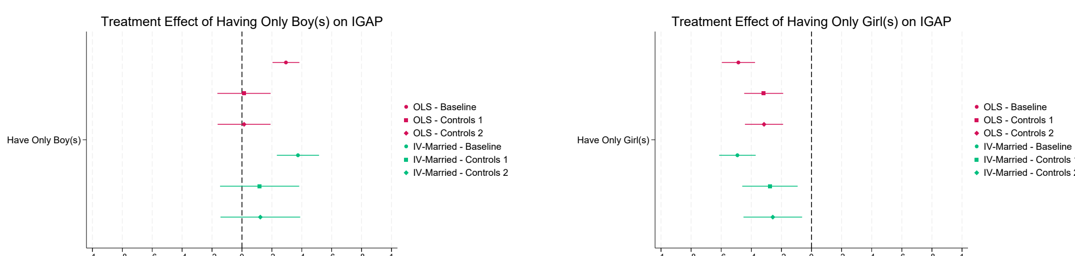
Table 7: PSM on Individual Covariates

	Only Boys	**Only Girls**	**An Only Boy**	**An Only Girl**
ATT	.2161	-.5244	.1128	-.2790
SE	.0745	.0847	.0793	.0757
Treated	5380	3047	3756	2114
Untreated	2325	2325	2325	2325
Total	7705	5372	6081	4439
T-stats	2.8989	-6.1908	1.4225	-3.6851
95% CI	(.0700, .3623)	(-.6904, -.3584)	(-.0426, .2684)	(-.4275, -.1306)
Individual Covariates	Yes	Yes	Yes	Yes
Regional Covariates	No	No	No	No

Table 8: PSM on Individual and Regional Covariates

	Only Boys	**Only Girls**	**An Only Boy**	**An Only Girl**
ATT	.3211	-.4939	.0987	-.3716
SE	.0817	.0872	.0821	.0843
Treated	5293	2990	3687	2072
Untreated	2252	2252	2252	2252
Total	7545	5242	5939	4324
T-stats	3.9287	-5.6605	1.2017	-4.4045
95% CI	(.1609, .4814)	(-.6650, -.3229)	(-.06229, .2597)	(-.5369, -.2062)
Individual Covariates	Yes	Yes	Yes	Yes
Regional Covariates	Yes	Yes	Yes	Yes

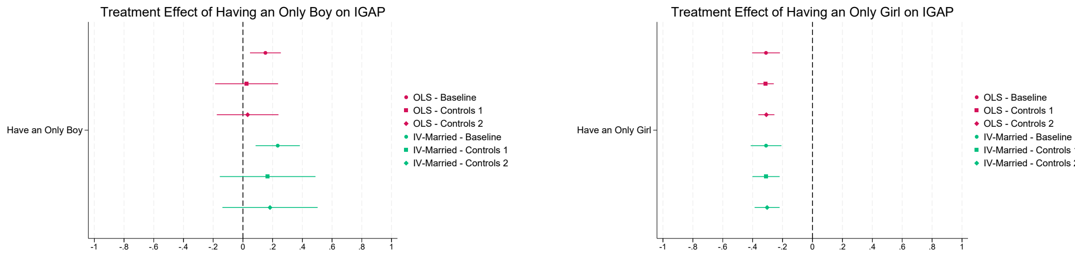
The IV method reveals a more remarkable distinction between the effects of having boys and having girls. After incorporating control variables, the impact of having boys is no longer significant at the 5% level in all models, whereas the effect of having girls remains consistently negative on the ideal gender gap. This pattern holds true in the cases of single-child families as well.



(a) Having Only Boys

(b) Having Only Girls

Figure 11: Treatment Effects of Having Only Boys or Girls



(a) Having an Only Boy

(b) Having an Only Girl

Figure 12: Treatment Effects of Having an Only Boy or Girl

6 Discussion

The comprehensive empirical evidence presented in the Results section allows us to formally address the two research questions. First, the transition from son preference to daughter preference can be attributed to an updating mechanism influenced by fertility outcomes. Specifically, having girls appears to reduce the gender gap in ideal preferences by approximately 0.5 children, whereas the effects of having boys do not have consistent evidence as support. The underlying reasons for this “girl-updating” mechanism are intriguing to explore, as they likely encompass a broad array of socioeconomic factors. Nowadays, raising boys in China carries more costs and responsibility compared with raising girls, for example, preparing the wedding house. [13] Thus, raising girls may impose a less financial burben on the family, which makes people favor more girls after the fertility experiences. At the same time, the results also support my assumption of “relatively consistent preference”. The magnitude of treatment effects from having girls is only $0.5 < 1.0$, which could not fundamentally change the qualitative feature of fertility preferences on average.

Secondly, the gender discrepancy between fertility outcomes and ideal fertility preferences could be explained by both Hypothesis 1 and Hypothesis 2, as confirmed by the data. But which preference group is the main driving force remains dicussing. In the data, 15.52% of the respondents prefer boys and 13.49% prefer girls. Recall that the corresponding gender gaps in the ideal fertility bundle for SP_i and DP_i are almost the same in magnitude, i.e., 1.30 for SP_i and -1.30 for DP_i. With the PSM estimates of $\hat{\tau}^{SP} = 0.9013$ and $\hat{\tau}^{DP} = -0.7123$, we can approximately calculate the discrepancy contributed by intensity difference between SP_i and DP_i as:

$$-15.52\% \cdot (1.30 - 0.9013) + 13.49\% \cdot (1.30 - 0.7123) = 0.0174 \tag{15}$$

On the other hand, recall the estimate of $\hat{\tau}^{BP} = 0.1427$ and 55.55% of respondents have a balance preference, so the discrepancy contributed by BP_i is,

$$55.55\% \cdot 0.1427 = 0.0793 \tag{16}$$

The total discrepancy from both sources is,

$$0.0174 + 0.0793 = 0.0967 \tag{17}$$

The total average discrepancy in the data is 0.0974, which could be almost perfectly explained by the heterogeneity among different preference groups. Specifically, 18% is explained by intensity heterogeneity between τ^{SP} and τ^{DP}, and 82% is explained by the implicit son preference shown in τ^{BP}. Note that the ideal fertility bundle is recorded post-fertility in the data. Therefore, the observed $IGAP_i'$ already incorporates the reverse causal effects from fertility outcomes. Strictly speaking, the pre-fertility gap $IGAP_i$ should be estimated first and used for the most accurate comparison and calculation. Due to the complexity and time constraint, current analysis does not implement this procedure. Below is a plot that visualize the discrepancy by birth cohort that have ups and downs with an average of 0.0974. Note that the hike in the discrepancy happened for Cohort 1960s, 1970s and 1980s.

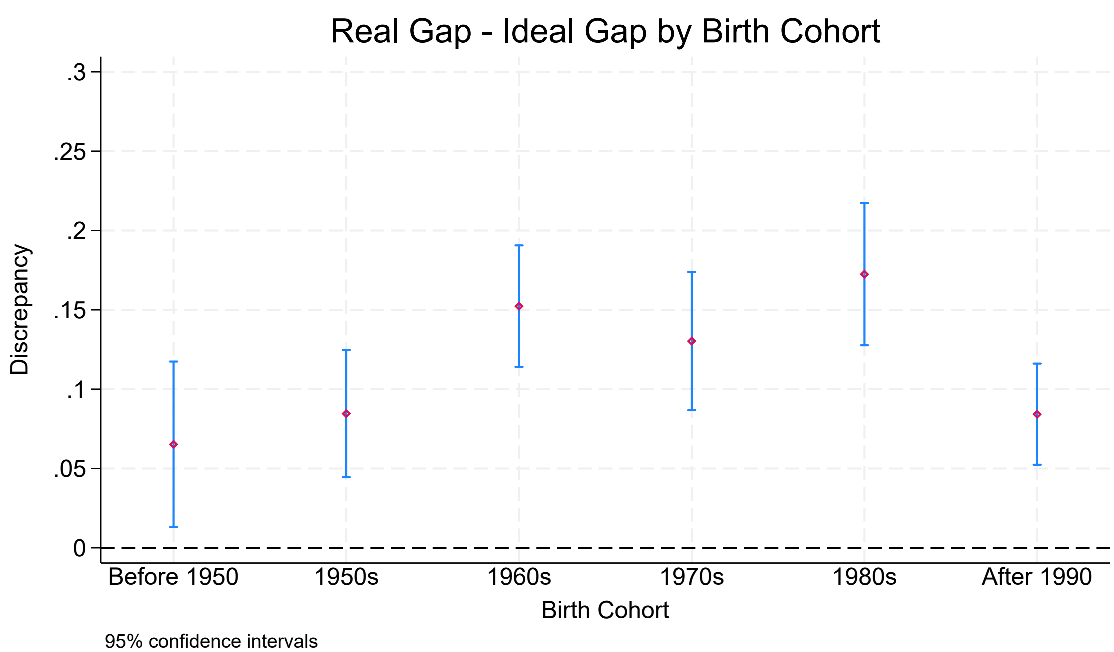
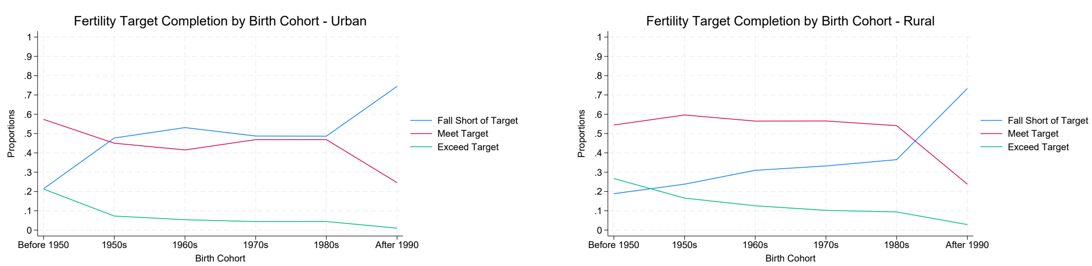


Figure 13: Discrepancy in Real and Ideal Gender Gaps by Cohort

6.1 Linking to One-child Policy

The discrepancy between the real and ideal gender gaps has shown a sharp increase starting from the 1960s cohort, which may relate to China's birth control policies, notably the One-child policy (1979-2015). How the policy potentially widened the discrepancy is thus worth exploration. A challenge in this analysis is the nationwide implementation of the One-child Policy, which leaves no clear control group. However, the intensity of the policy enforcement varied significantly between urban and rural residents. Data shows that a much higher proportion of urban residents did not meet their fertility targets compared to their rural counterparts. To explore this, I perform a dynamic Difference-in-Difference (DID) study between urban and rural residents to examine the evolution of this urban-rural gap over time. Although this approach does not allow for a rigorous causality statement, it can still yield valuable insights into the impact of birth control policies.



(a) Urban (b) Rural

Figure 14: Proportions of People by Fertility Target Completion

The parameter of interest I examine is $\tau = \Delta(\Pr[\text{Total Children} = 1|BP_i = 1, \text{Urban}] - \Pr[\text{Total Children} = 1|BP_i = 1, \text{Rural}])$, i.e., the difference in the urban-rural gap in the probability of having one child given balance preference. I define $D_i^{One} = \mathbb{1}[\text{Total Children} = 1], U_i = \mathbb{1}[\text{Identity} = \text{Urban}]$ and estimate the following specification among people with a balance preference,

$$D_i^{One} = \sum_b \tau_b U_i \times \mathbb{1}[\text{Birth Cohort} = b]_i + \alpha_j + \lambda_t + \beta \mathbf{X}_i + \epsilon_i \tag{18}$$

where τ_b is the difference in urban-rural gap for each birth cohort b, α_j is the regional fixed effects, λ_t is the cohort fixed effects, $\mathbf{X}_i$ is individual controls.

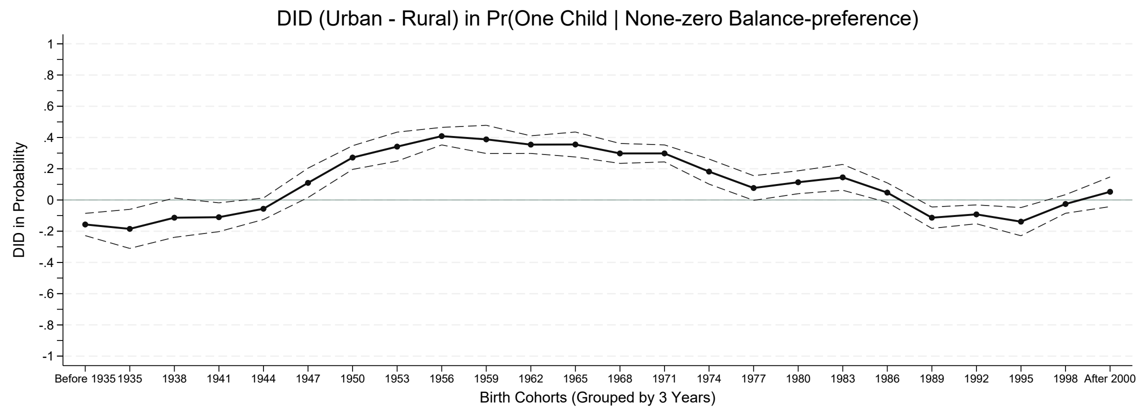


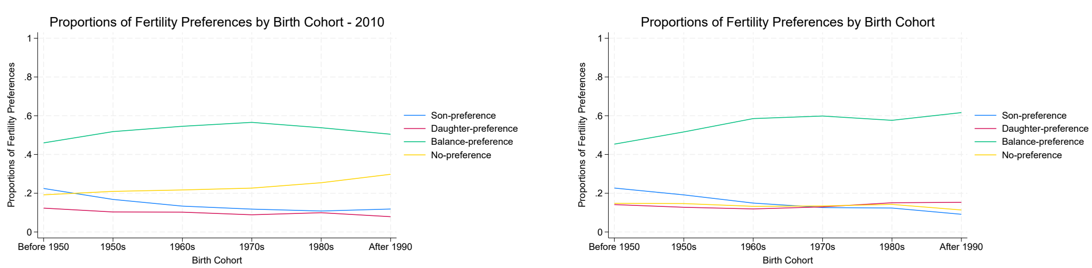
Figure 15: Discrepancy in Real and Ideal Gender Gap by Cohort

The results reveal a significant increase in τ_b, beginning with the 1950s cohort and reaching a peak increase of 40%. This suggests that the birth control policies, particularly in its early stages, likely had a more pronounced effect on urban residents with a balance preference by substantially raising the probability of having only one child. Furthermore, prior findings indicate that this group of urban residents will take action to ensure a boy when faced with the stringent constraint of one child. In this way, the One-child policy plausibly triggered the "implicit son preference" mechanism, leading to fertility outcomes that are more skewed towards boys than ideally anticipated.

7 Conclusion and Future Directions

Motivated by the two phenomena about fertility in the data, I comprehensively explore the dynamic interactions between fertility preferences and outcomes. The heterogeneous behavioral patterns among different preferences explain why fertility outcomes are more biased towards boys than the ideal fertility preferences show. One reason is people with a son preference are more likely to ensure boys through abortion compared with their counterparts with a daughter preference. A more important reason is that people with a balance preference reveal implicit son preference when limited to one child, whether due to personal circumstances or external influences. The One-child policy, a major external force, likely limited the number of children particularly among urban residents with a balance preference, thus amplifying the implicit son preference and resulting in a more skewed sex ratio towards boys in reality. The existence of implicit son preferences also teaches us lessons about the limitations of current surveys. As suggested by Hin et al. (2011)[4], reporting "second best ideals" could provide much more knowledge about the complicated fertility preferences besides "first best ideals". In this context, it could particularly help uncover the widespread implicit son preference hidden behind the balance preference, allowing for adjustments to fertility policies accordingly. In the reverse direction of causality, having girls shows a consistent effect on shrinking the gender gap in ideal fertility while having boys does not. This provides a perspective why a shift towards daughter preference is happening in China.

However, in conducting an observational study using pooled cross-sectional data, I rely on the strong assumption of "relatively consistent preferences" before and after fertility to logically structure the causal analysis. This assumption is bolstered by existing literature and findings from my research, which suggest that although having daughters can significantly shift preferences towards favoring girls, the average magnitude of the shift (0.5) is insufficient to alter the fundamental nature of preferences. Additionally, I compare the fertility preferences recorded in the CGSS 2010 with those from the latest surveys,



(a) CGSS 2010

(b) CGSS 2018/2021

Figure 16: A Comparison of Fertility Preferences in 2010 and 2018/2021

The trends in fertility preferences between the 2010 and 2018/2021 CGSS surveys are similar, particularly for son and daughter preferences. However, there is a noticeable shift in the proportions of those indicating a balance preference versus no preference. In 2010, a higher percentage of respondents reported having no preference, which decreased in the 2018/2021 surveys, probability shifting to a balance preference. This trend over time partially challenges the assumption of relatively consistent preferences. As a result, the causal statements need more careful investigation.

Although causal identification is challenging due to the nature of the data, this project presents other promising avenues for exploration. As outlined in the fertility model, the interactions between fertility preferences and outcomes can be described by the conditional probabilities $\Pr((S_i', D_i')|(s_i^*, d_i^*))$ and $\Pr((s_i^{*\prime}, d_i^{*\prime})|(s_i^*, d_i^*, S_i', D_i'))$. Estimating these distributions from the data could shed more light on the dynamics of fertility behavior. Additionally, the Age-Period-Cohort (APC) analysis, a method extensively utilized in public health to study diseases, can be adapted to study fertility. This approach allows for the isolation and examination of the effects attributable to age, time period, and birth cohort on fertility preferences and outcomes, enabling us to track changes over an individual's lifetime and across different cohorts.

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