One-Child Policy, Marriage Distortion, and Welfare Loss

Wei Huang and Yi Zhou

Abstract

Using plausibly exogenous variations in the ethnicity-specific assigned birth quotas and different fertility penalties across provinces over time, we provide new evidence for the transferable utility model by showing China’s One-Child Policy induced a significantly higher unmarried rate among the population and more interethnic marriages. Using sufficient statistic approach, we further find that the welfare loss caused by the fertility policy, in terms of reduced fertility and marriage distortion, is around 4.9 percent of annual household income, with marriage distortion contributing 17 percent of this. These findings highlight the unintended behavioral responses to public policies and corresponding social consequences. (JEL codes: H20, I31, J12, J13, J18)

Keywords: One-Child Policy, Marriage Distortion, Welfare Loss
“No union is more profound than marriage, for it embodies the highest ideals of love, fidelity, devotion, sacrifice, and family. In forming a marital union, two people become something greater than once they were.”

——Justice Anthony Kennedy

I. Introduction

Marriage is an important source of happiness and plays an important role in generating and redistributing welfare among individuals (e.g., Stutzer and Frey, 2006; Zimmermann and Easterlin, 2006; Dupuy and Galichon, 2014). Since Becker (1973, 1974) built up the original transferable utility model for the marriage market over 40 years ago, an established strand of literature has used and applied this model and its wide-ranging implications (Rao, 1993; Edlund, 2000; Angrist, 2002; Chiappori et al., 2002; Botticini and Siow, 2003). Choo and Siow (2006) further developed the model to derive a reduced-form testable formula explicitly linking unobserved marriage gains to the observed marriage outcomes. Then they used this formula to estimate the loss of marriage gains due to the national legalization of abortion in the United States in 1973.

However, there is little empirical evidence for the cornerstone of the transferable utility model, i.e., that individual marriage behavior and market equilibrium are shaped by potential marriage gains. The major difficulty is the rareness of exogenous variation in marriage gains since there is almost no such event or policy that assigns different gains to various types of marriages.

This paper first sheds some light on this by estimating the effects of the One-Child Policy (OCP) on marriage equilibrium outcomes. Since children are important fruits of marriages and can be sources of joy or future supporters, compulsory fertility restrictions would reduce potential marriage gains, distort individual incentives in the marriage market, and thus alter the marriage equilibrium outcomes.1 Some unique features of the OCP implementation make it a natural setting

---

1China has the largest marriage market in the world because of its huge population. The OCP was initiated in the late 1970s and has restricted the fertility of hundreds of millions of couples for about 35 years. On Oct 29th 2015, China’s government announced it would abandon the one-child policy and all couples would be allowed to have two children.
in which to investigate questions about the possible effects of distortions caused by the disincentives to have children on marriage. Unlike birth control policies in other nations, the OCP directly and compulsorily assigned limited birth quotas to couples. These quotas were strictly implemented by the Population and Family Planning Commissions (PFPC) at every level of government. In addition, the OCP had large ethnic, spatial, and temporal variations in implementation. First, different birth quotas were assigned to both-Han (H-H), both-minority (M-M) and Han-minority (H-M) couples, according to local policies. In almost all provinces, H-H couples are strictly constrained to only one (or conditionally two) births, while M-M couples were legally permitted to have more births or were not even subject to the OCP (Baochang et al., 2007; Li et al., 2011; Huang et al., Forthcoming). About half of the provinces extended the coverage of this exemption to H-M couples (referred to as preferential-policy regions, hereafter), but the others did not (non-preferential-policy regions). Second, different levels of financial penalties were imposed for an illegal birth across provinces and across years. These OCP penalties ranged from one to five times a local household’s yearly income, and were applied to any illegal birth above the quota in the corresponding province.\(^2\)

To investigate how expected marriage gains affected marriage outcomes, we derive three intuitive and testable hypotheses after incorporating the OCP in the model of Choo and Siow (2006). The first hypothesis is that the OCP would increase the unmarried rate due to lower expected gains from marriage, especially for Han people;\(^3\) second, the OCP would increase the H-M marriage rate, particularly in the preferential-policy regions; and third, in the preferential-policy regions, the OCP would increase the utility transfer from a Han spouse to his (or her) minority spouse within H-M couples.

Our empirical results provide sound evidence for the hypotheses above. Using the regional and temporal variations in the fertility penalty combined with census data in China, we find that an

\(^2\)Local governments are responsible for collecting the financial penalties, and a number of administrative penalties such as confiscation of property and excluding children born outside from the hukou system are employed to assist the OCP penalty collection.

\(^3\)Note that being unmarried does not mean staying single forever here. Many merely delayed marriages. Hence, increased unmarried rate can be also understood as not married in early ages.
increase in the fertility penalty at age 18-25 by one yearly local household income increases the unmarried rate by 1.7 percentage points (39 percent of the mean) among Han people. Moreover, in the preferential-policy regions, the same increase in fertility penalty also increases H-M marriage rate by 0.6 percentage points (20 percent of the mean) for Han people and 2.1 (15 percent of the mean) percentage points for minorities, respectively. Finally, among H-M couples in the preferential-policy regions, higher fertility penalty is associated with higher education of spouses for the minorities but not for the Han people.

Investigation using several control groups provides further evidence for the hypotheses and the exogeneity of the variations that we employ. In contrast to the above significant impacts, fertility penalty has imposed a much smaller and insignificant effect on the unmarried rate of the minorities, as well as on the H-M marriages in the non-preferential-policy regions. Also, among the H-M couples in non-preferential-policy regions, the fertility penalty is not correlated with the education of spouse for either Han people or for minorities.

As the model suggests, the OCP affects marriage outcomes through changing the expectations in the number of births. Although the expectations cannot be observed, we still provide some evidence by showing that the policy-induced H-M marriages tend to result in more births ex post. More specifically, we show that, in the presence of the preferential policy, the regions with larger positive effects of the OCP on the H-M marriage rate tend to have weaker negative effects of the OCP on fertility; however, the correlation is much weaker in the non-preferential-policy regions. These findings consistently suggest that some H-M marriages were motivated by the reduction in marriage gains due to the OCP in terms of the restriction on the number of permitted children.

The OCP-induced marriage behaviors are fairly consistent with the predictions originating from the transferable utility model of Choo and Siow (2006) and we conclude that the OCP has caused

---

4There are 4.4 percent of Han people in the sample having a status as single.
5The H-M marriage rates are 3.0 percent for Han and 14 percent for minorities in the preferential-policy regions. In the econometric framework, besides the local minority proportion and sex ratios in the birth cohort of local province, we also controlled for the fixed effects for the ethnicities, type of hukou, provinces, cohorts, and calendar years, and the province-specific linear trends in birth cohorts throughout the whole analysis.
6Previous literature used education as a pre-marital investment (Chiappori et al., 2009; Lafortune, 2013). We follow this literature here and assume that higher education indicates more transfers to spouse in marriages.
a significant distortion in marriage market because of the policy-induced expectation in number of children to give birth. Therefore, it is natural to ask how much social welfare loss is caused by the distortion since policy-induced behavior distortion is generally associated with a social welfare loss (Chetty, 2008, 2009a,b; Hendren, 2013). Following the methodology in Chetty (2009b), we derive a formula for the social welfare loss caused by the OCP in fertility and marriage market as a whole. This formula only depends on the estimated reduced-form elasticities. More specifically, the welfare deadweight loss (DWL) is composed of two parts: the first originates from policy-induced declined fertility (“mechanical” effects); while the second part pertains to the marriage distortion analyzed above (“distortion” effects). The approach to welfare analysis in this paper is different from the traditional approach which structurally estimates a model’s primitives and then numerically simulates the effects of a policy. Compared to the traditional approach, our approach is less model-dependent and more empirically credible (Chetty, 2008, 2009b). To the best of our knowledge, this is the first study to estimate the welfare loss caused by the OCP and also the first endeavor to apply the sufficient statistics approach to the marriage market.

By applying the reduced-form estimates to the model, we show that the total social welfare loss is about 4.9 percent of total yearly household income, of which 0.85 percent originates from the marriage distortion. Therefore, these estimates suggest that, not accounting for the “distortion” effect would substantially underestimate the total social welfare loss by 17 percent. As marriages are almost prerequisites for children in China, marriage choices are distorted by fertility policies and thus a welfare loss based only on the fertility reduction of married couples is not the whole story. These results highlight that the unintended behavioral responses following from the OCP in terms of marriage distortion is a significant component of the welfare loss. These findings also provide some new insights into public economics, namely that the relationship between commodities need to be considered when estimating the welfare loss of taxation.7

This paper is organized as follows: section II introduces the context of this study, especially the

7In this study, children are considered to be downstream “goods” of marriages. Taxing children (OCP) has brought significant distortions in marriage behaviors because the expected potential marriages would be eroded for most people. Our results are similar to the findings in Busse et al. (2013) who found that gasoline prices have significant impacts on the prices and quantities of sales in the new and used car markets.
background of the OCP. Section III develops a theoretical framework for the empirical predictions and the welfare implications. Section IV presents the empirical strategy and the marriage distortion caused by the OCP. Section V calculates the welfare loss caused by the OCP based on the estimates in the previous sections, and section VI concludes.

II. Context: China’s One-Child Policy

China’s OCP was first announced in 1978, and it appeared in the amended Constitution in 1982. Legal measures such as monetary penalties and subsidies were employed for the effective enforcement of OCP since 1979 (Banister, 1991). In early 1984, the Communist Party Central Committee issued Central Document 7 as a guideline for local implementation of fertility policies (Greenhalgh, 1986). Because of the “practical difficulties” experienced in earlier years, one important feature of Document 7 was greater flexibility in local practices. As a slogan at that time said, “Open a small hole to close up a big one.” The central government believed that some small compromises would make the whole policy more acceptable.

The central government authorized provincial governments to design specific regulations according to their local conditions. Indeed, both the effectiveness of the implementation of the OCP and inter-ethnic harmony were on the list of evaluation criteria for local officials. Appendix A provides more details about China’s ethnic minorities. Therefore, preferential terms were exclusively granted to M-M or H-M couples (Baochang et al., 2007). Han residents living in urban areas were mostly allowed to have only one child, but those living in rural areas could have one or two. M-M couples were legally permitted to have more births or even were not subject to the OCP. About half of the provincial governments extended the coverage of this exemption to H-M couples but the others did not. For example, the Population and Family Planning Statute of Qinghai states, “Families can have one more births, if one or both sides of the couple are from minority groups.” We collected data regarding the exemption terms for H-M couples in every province from the website of the National Health and Family Planning Commission of China. According to the historical policies that that we can find, there was no temporal variation in the existence of pref-
erential terms for H-M couples in various provinces.\(^8\) We plotted the provinces with exemption terms geographically in Figure 1a.

[Figures 1a and 1b about here]

We additionally use the average fertility financial penalty for one unauthorized birth on the province-year panel from 1979 to 2000. The data is from Ebenstein (2010). The OCP penalties or fertility fines, also known as “social maintenance fees” in China, were formulated in multiples of yearly household income, which is consistent with its wide use in previous literature (Ebenstein, 2010; Wei and Zhang, 2011; Huang et al., Forthcoming). Figure 1b plots the pattern of fertility penalty from 1980 to 2000 in each province. The penalties in different provinces generally follow different patterns, both in timing and in magnitude. For example, Liaoning provinces raised the penalty from one year’s income to five in 1992, while Guizhou raised the penalty from two to five years income in 1998. The average level of the penalty was higher in the 1990s than in the 1980s, which is consistent with stricter policy enforcement in the 1990s. We use this to identify the impact of the OCP on marriage outcomes in following empirical analyses.

III. The Model and Implications

3.1 Marriage Distortion under the One-child Policy

We follow the framework of Choo and Siow (2006) to analyze the impact of the OCP on marriage outcomes. People are divided into two types: Han (\(H\)) or minority (\(M\)). Under the circumstance of the OCP, we suppose there are two periods: in the first period, people decide whether to marry and to whom they marry; in the second period, married people decide how many children to have. However, people are able to anticipate the number of children to have according to the potential

\(^8\)The data source is the website of the National Health and Family Planning Commission: http://www.nhfpc.gov.cn/zhuzhan/dftl/lists.shtml. However, the exemption terms may have some variations within provinces in rural/urban regions and in different ethnicities. For example, Zhuang ethnicity may not have a preferential policy in certain regions, and some provinces also specify that the preferential policy may only apply for rural areas but not for urban areas. Our analysis also accounts for this variation.
types of marriages and local fertility policies, and thus behave correspondingly in the marriage market.

**Fertility choice under the OCP** We solve the problem backward. A certain couple \((i, j)\) choose the number of children to give birth to, \(n_{ij}\), in order to maximize the household utility under the fertility policy depicted by \((\overline{n}_{ij}, f)\), where \(\overline{n}_{ij}\) is the birth quota assigned to the couple \((i, j)\), and \(f\) is the fertility penalty for an additional illegal birth. For simplicity, the households solve the problem as follow:

\[
\max_{n_{ij}} u(n_{ij}) + y_{ij} - n_{ij}C - \delta_{n_{ij} \geq \overline{n}_{ij}} (n_{ij} - \overline{n}_{ij})f
\]

where \(u(\cdot)\) is the utility from the number of children given birth to and is uniformly applied to all couples, with \(u' > 0\) and \(u'' < 0\); \(y_{ij}\) is the exogenously given household income and \(C\) is the fixed cost of raising a child. \(\delta_{n_{ij} \geq \overline{n}_{ij}}\) is an indicator function which equals to 1 if \(n_{ij} \geq \overline{n}_{ij}\), and 0 otherwise. We assume that utility function is quasi-linear such that the utility can be interpreted in monetary units directly.\(^9\) For simplicity, we also assume the couple can choose any positive number of children \(n_{ij} \in \mathbb{R}^+\), and define \(u_{ij}\) as the maximized household utility for couple \((i, j)\). Then we have \(\frac{\partial u_{ij}}{\partial f} = -\delta_{n_{ij} \geq \overline{n}_{ij}} (n_{ij}^* - \overline{n}_{ij}) \leq 0\), implying that fertility penalties would reduce the utility when the birth quota is binding (i.e., \(n_{ij}^* - \overline{n}_{ij} \geq 0\)). Therefore, the fertility penalty would have larger negative effects on the household utility gained from the number of children when the birth quotas are fewer. According to the OCP implementation, the negative marginal effects of fertility penalty on the household utility would be larger for H-M couples in non-preferential-policies regions and for all H-H couples, and smaller or even equal to zero for H-M couples in preferential-policy regions and for all M-M couples.

**Marriage market distortion** Following the setting in Choo and Siow (2006), for a type \(i\) man to marry a type \(j\) woman, he must transfer an amount of income \(\tau_{ij}\) to her. The marriage market clears

---

\(^{9}\)The quasi-linear utility function simplifies the welfare implication in previous literature. See Chetty (2009b) for examples.
when, given equilibrium transfers $\tau_{ij}$, the demand by type $i$ men for type $j$ spouses is equal to the supply of type $j$ women for type $i$ men for all $i, j$. We assume the numbers of men and women of Han people are both $\bar{H}$ and those of minority people are $\bar{M}$, with $\bar{H} > \bar{M}$. Every individual considers matching with a member of the opposite gender or staying single. Let the utility of a type $i$ man $g$ who marries a type $j$ woman be

$$V_{ijg} = \tilde{\alpha}_{ij} - \tau_{ij} + \epsilon_{ijg}$$

where $\tilde{\alpha}_{ij}$ denotes the gross marriage gains to the man $i$ in potential marriage $(i,j)$. For simplicity, suppose the above utility gained from the number of children is divided between men and women equally. Therefore, $\tilde{\alpha}_{ij} = \frac{1}{2}u_{ij} + \tilde{a}_{ij}$, where $\frac{1}{2}u_{ij}$ denotes the utility that a type $i$ man expects to gain from the quantity of children if he marries a type $j$ woman. $\tilde{a}_{ij}$ represents the systematic gross return to a type $i$ man married to a type $j$ woman other than that from the quantity of children. The payoff to a type $i$ man $g$ from remaining unmarried is denoted by $V_{i0g} = \tilde{\alpha}_{i0} + \epsilon_{i0g} = \tilde{a}_{i0} + \epsilon_{i0g}$.

The women’s problem is symmetric, thus we let the utility of a type $j$ woman $k$ who marries a type $i$ man be

$$W_{ijk} = \tilde{\gamma}_{ij} + \tau_{ij} + \epsilon_{ijk}$$

in which $\tilde{\gamma}_{ij} = \frac{1}{2}u_{ij} + \tilde{b}_{ij}$, where $\frac{1}{2}u_{ij}$ denotes the utility gained from the expected number of children to women $j$, and $\tilde{b}_{ij}$ represents the systematic gross return to a type $j$ woman married to a type $i$ man other than that from the quantity of children. The payoff of remaining unmarried is given by $W_{0jk} = \tilde{\gamma}_{0j} + \epsilon_{0jk}$.

Following the assumption in Choo and Siow (2006), we also assume that $\epsilon_{ijg}$, $\epsilon_{i0g}$, $\epsilon_{ijk}$, and $\epsilon_{0jk}$ are independently and identically distributed random variables with a type I extreme-value distribution. A man $g$ of type $i$ will choose according to $V_{ig} = max_{j} \{ V_{i0g}, V_{iHg}, V_{iMg} \}$. A women $k$ of type $j$ will choose according to $W_{jk} = max_{i} \{ W_{0jk}, W_{Hjk}, W_{Mjk} \}$. Defining $\alpha_{ij} = \tilde{\alpha}_{ij} - \tilde{\alpha}_{i0}$, $\gamma_{ij} = \tilde{\gamma}_{ij} - \tilde{\gamma}_{i0}$, and $\mu_{ij}$ as the number of $(i,j)$ marriages, we consider the following symmetric equilibrium for men and women (i.e., $\mu_{ij} = \mu_{ji}$): for $i,j \in \{ H, M \}$,
\[
\tau_{ij} = \frac{\ln \mu_{i0} - \ln \mu_{0j} + \alpha_{ij} - \gamma_{ij}}{2};
\]
\[
\ln \mu_{ij} = \frac{\ln \mu_{i0} + \ln \mu_{0j}}{2} + \frac{\alpha_{ij} + \gamma_{ij}}{2},
\]
with \( \mu_{H0} + \mu_{HH} + \mu_{HM} = H \), \( \mu_{M0} + \mu_{MH} + \mu_{MM} = M \).

For type \( i \) individuals (\( i \in \{H, M\} \)), we denote the married rate as \( r^{i}_{m} \), and the H-M marriage rate (conditional on married) as \( r^{i}_{HM} \). Assuming that the fertility penalty does not affect the utility of being single or the systematic gross return other than that from the number of children, we have the following empirically examinable implications (See Appendix B for detailed mathematic proof).

- **The fertility penalties increase the unmarried rate of Han people, especially in non-preferential-policy regions** (i.e., \( \frac{\partial r^{H}_{m}}{\partial f} < 0 \) and \( \frac{\partial r^{H}_{m}}{\partial f}_{|\text{no-pre}} < \frac{\partial r^{H}_{m}}{\partial f}_{|\text{pre}} < 0 \));

Because birth-quota restrictions and fertility penalties have reduced the potential gains from marriage, more Han people would choose to delay their marriages or stay single. In this analysis, we do not differentiate these two, and only investigate whether the respondent was married or not at the time of the survey. In addition, because minority people are generally not subject to the restrictions, we expect that such effects would be significant only for Han people. Since the Han people in preferential-policy regions may have incentives to marry minorities to escape from the fertility restrictions, the effects should be weaker in these regions.

- **The fertility penalties increase the H-M marriage rate for both Han and minorities only in preferential-policy regions** (i.e., \( \frac{\partial r^{H}_{HM}}{\partial f}_{|\text{pre}} > 0 \) and \( \frac{\partial r^{M}_{HM}}{\partial f}_{|\text{pre}} > 0 \));

In the presence of preferential policies, because H-M marriage is a way to bypass the fertility restrictions legally for Han people, a higher level of penalty would induce greater incentives for Hans to marry minorities. In contrast, people would not have policy-induced incentives to participate in such marriages when the preferential policy is absent because there is no additional birth quota for the H-M couples.\(^{10}\)

\(^{10}\)We investigate interethnic marriage not only because interethnic marriage is an important marriage outcome impacted by the OCP but also because interethnic marriage has been widely used as an indicator of social boundaries between two ethnic groups in sociological and economic studies (Kalmijn, 1991; Qian and Lichter, 2007; Fryer, 2007).
• The fertility penalties increase the marriage transfer from Han to minorities only in preferential-policy regions (i.e., \( \partial r_{HM} / \partial f \big|_{pre} > 0 \)).

In the preferential-policy regions, the price of a minority spouse in the marriage market would increase when the fertility penalty becomes heavier, because a minority spouse is associated with additional birth quotas in these regions for Han people. Therefore, the transfers from the Han spouse to the spouse in a H-M marriage would increase when fertility penalty increase. However, since the transfers cannot be directly observed in the data, this paper investigates the association of the minority ethnicity with the education level of the spouse in H-M couples to test this hypothesis.\(^{11}\)

3.2 Welfare Implications

The model above yields the probability that a utility-maximizing man of type \( i \) marries a woman of type \( j \) is \( P_{ij} = \frac{e^{\tilde{\alpha}_{ij}}}{\sum_j e^{\tilde{\alpha}_{ij}}} \) and the expected utility of a man of type \( i \) is \( S_i(\tau) = \ln(\sum_j e^{\tilde{\alpha}_{ij}}) \). Since the utility is in monetary units under the quasi-linear utility setting, social surplus is the summation of the expected utilities of men and women, and the fertility penalties collected by the government:

\[
\Pi = \sum_i \overline{m}_i \ln(\sum_j e^{\tilde{\alpha}_{ij}}) + \sum_j \overline{n}_j \ln(\sum_i e^{\tilde{\gamma}_{ij}}) + \sum_{i,j \neq 0} \mu_{ij} c_{ij} f
\]

where \( \overline{m}_i \) and \( \overline{n}_j \) denote the number of men of type \( i \) and that of women of type \( j \), respectively. We denote \( c_{ij} = \delta_{n_{ij} \geq \overline{n}_j} (n_{ij} - \overline{n}_{ij}) \) as the number of illegally-born children for couple the \( (i, j) \), divide the above equation by the total population of men (or women) (i.e., \( \overline{H} + \overline{M} \), the number of the households), and then take the derivatives with respect to the penalty fine rate (See Appendix

\(^{11}\)There is also a strand of economic literature studying marriage transfers in terms of dowries (Botticini and Siow, 2003; Anderson and Bidner, 2015), bride exchange(Jacoby and Mansuri, 2010).
Cf o rm a t h e m a tic p r o o f s). T h e n , w e h a v e
\[ \frac{d\pi}{df} = \sum_{i \in \{H,M\}} P_i \left( \sum_{j \in \{H,M\}} r^i_m r^i_{ij} c_{ij} (e^i_m + e^i_{ij} + e^c_{ij}) \right) \] (*)

where \( \pi \) is the surplus per household, \( P_i \) is the proportion of type \( i \) people in the population, \( r^i_m \) is the married rate for type \( i \) people, and \( r^i_{ij} \) is the proportion of married type \( i \) people involved in type \( i - j \) marriages with \( i, j \in \{H,M\} \). And \( e^i_m, e^i_{ij} \) and \( e^c_{ij} \) are the elasticities of \( r^i_m, r^i_{ij} \) and \( c_{ij} \) with respect to the penalties \( f \), respectively. The equation (*) indicates that the welfare loss depends only on the basic statistics and behavior responses to the penalties, suggesting that the corresponding elasticities (i.e., \( e^i_m, e^i_{ij} \) and \( e^c_{ij} \)) are sufficient statistics to estimate the social welfare loss (Chetty, 2008, 2009a,b; Hendren, 2013). More importantly, these behavioral responses can be derived directly from OLS estimations.

In the equation (*), the welfare loss for the ethnicity \( i \) is \( \sum_{j \in \{H,M\}} r^i_m r^i_{ij} c_{ij} (e^i_m + e^i_{ij} + e^c_{ij}) \), and the social welfare loss is the population weighted mean of it. Within the parentheses, the first term captures the part whether individuals choose to marry or not: it is expected to be negative due to the lower expected gains from marriage. The second term captures potential welfare gain or loss from the policy-induced changes in marriage matching for different types of people: it may be positive or negative depending on the assignment of expected marriage gains. Therefore, the first two terms capture the welfare loss caused by the distortion in the marriage market and we term it “distortion” effects.

The final term originates from the fertility restrictions by the penalties and we name it “mechanical” effect. It is expected to be negative. Had we followed the traditional way to consider the tax incidence on the “taxed goods”, the estimated total welfare loss of the OCP would only account for the part caused by the reduction in fertility, which is captured by this final term. However, the “distortion” effects in the marriage market would be ignored, and it is thus an empirical question as to how much the welfare loss caused by marriage distortion contributes to the total.

It should be noted that the model only looks into the effects of OCP on marriage market and
fertility in a partial equilibrium framework. It does not take into account the potential externalities of number of children or other dimensions, including the impacts of the fertility policies on the status of women and the quality of children, though some of these factors are investigated in previous literature (Miller, 2010; Rosenzweig and Zhang, 2009). The next few sections provides empirical evidence of the effects of OCP, and estimate the social welfare loss as well as the proportion caused by the distortion effects.

**IV. Data**

The main data used in this study are the 2000 Population Census and the 2005 One Percent Population Survey (referred as Census 2000 and 2005, thereafter). Both of the data sets contain gender, education level, year and month of birth, region of residence, type of hukou (urban/rural), hukou province, ethnicity, marital status, and number of children. For each household, the relationship of each member with the household head is also available, which may include spouse, offspring, siblings, parents, etc. We use this information to identify couples in the households. Sampling weights are applied throughout the whole analysis.

We restrict our sample to those aged between 25 and 55. We keep those aged 25 or above because the outcomes in marriage market would be close to equilibrium and the late marriage age in China usually refers to age 25. We also drop those aged 55 or above because seniors may suffer from mortality selection and then be widowed after this age. The cohorts in the sample are those born during 1945-1980. Since the OCP started in 1979, almost all people in the sample were born before the OCP, and there are about two thirds of the cohorts with marriage market affected by the OCP, if we suppose the first affected cohort is that aged 22 (i.e., the age most people choose to marry) when the OCP started. Our results are robust with different sample restrictions in age.

In the questionnaire, marital status is categorized into five groups: 1 for unmarried, 2 for those in a first marriage, 3 for remarried, 4 for divorced, and 5 for widowed. Every married couple was asked about the year and month of their first marriage. For accuracy and simplicity, we only keep the sample who were single or in their first marriages (96 percent of the original sample). Based
on the answers to the marital status and the ethnicity of spouse, we examine two outcomes in the marriage market: unmarried status and H-M marriage. Because we analyze the sample by Hans and minorities, these two outcomes fully capture whether the respondents were married and to whom they were married. To make the empirical results easier to interpret and to derive the needed parameters in equation (*) for estimating the welfare loss, we use different samples for these two outcomes. First, we use the full sample derived above to study the impact of the OCP on whether the person is married or not. Then, we keep the married ones with information on spouse (88 percent of the sample) to study the impact of the OCP on whether people married others of their own ethnicity (Han/minorities), or of different ethnicities. When information on the spouses is missing, it is mainly because the spouses were not currently living in the household or they refused to answer.

Table 1 shows the mean values and standard deviations for the main variables used in this study, by Hans and minorities. The first three columns are for the full sample, and the next three are for married people. Panel A presents the results for marriage outcomes. According to the results, 4.6 percent of people (i.e., 4.4 percent of Han and 6.6 percent of minorities) were unmarried at the time of the survey. Among married people, 2.9 percent were involved in H-M marriages. Because the number of Han people and the number of minority people involved in H-M marriages are the same but the population size of the minorities is much smaller (8.4 percent of the population), the H-M marriage rate is 1.6 percent for Hans and 17.4 percent for minorities. Given that the H-M marriage rate would be 6.5 percent if Han and minorities had married randomly, H-M marriages are still relatively rare compared with homogamy. The reasons could be 1) that people prefer homogamy partially because of the shared culture and language, and lower communication costs; and 2) that the interaction across different ethnicities is relatively less than that within the same ethnic group.

12Note that being unmarried does not mean staying single forever here. Unmarried rate can be also understood as being not married at certain ages.
13The use of all the married couples also gives consistent results. In doing so, we first assume that all the married ones with missing information of spouse are homogamy because most of the marriages are within ethnicity. Then, instead of assuming they are homogamy, we assume they are in another group, namely “missing” group, and repeat our analysis. Both of the two yield consistent results.
14This phenomenon is also found in the U.S. (Fryer, 2007) and is similar to homophily in the coauthorship of scientific papers (Freeman and Huang, 2015).
ethnicity because the minorities tend to inhabit certain geographical regions.

Panel B presents descriptive statistics of the demographic and socioeconomic status variables. On average, minorities are of lower socio-economic status than Han people. The proportion of Hans living in urban regions (43 percent) is much higher than that of minorities (26 percent). The average educational attainment of minorities is also substantially lower, with 16 percent being illiterate. Gender composition is almost balanced and the average age is about 39 across all samples.

V. Empirical Results

5.1 Marriage outcomes responding to the OCP fine rate change

We start the analysis by applying an “event study” to investigate how marriage outcomes respond to the variations in the fertility fines. For each group based on the type of hukou (urban/rural), ethnicity (Han/minorities), and survey year (2000/2005), we first calculate the changes in the fertility penalties at ages 18-25 and the changes in marriage outcomes (i.e., unmarried rate and H-M marriage rate) in two consecutive birth cohorts, within the same hukou province. We use the fertility penalties at age 18 to 25 because this is when most individuals prepare for marriage and seek spouses.¹⁵

We then plot the changes in the marriage outcomes against those in the fertility penalties, weighted by the corresponding population size. Figures 2a and 2b show the results. For the outcome of unmarried status, we divide the sample into Hans and minorities because the OCP mainly restricted the fertility of Han people rather than minorities. For the outcome of H-M marriage, we divide the sample into preferential-policy regions and non-preferential-policy regions because the positive correlation is supposed to exist only in preferential-policy regions. The change in the

¹⁵Figure A2 plots the distribution of marriage age, and shows that most marriages are formed during this age period (about 80 percent). We also tried the penalties at other age periods and the results are consistent. We also trim the sample for this event study to those born later than 1950, because those born earlier would not have been subject to variations in the fine rate when they were 18-25.
penalty rate is divided into five categories. A higher value means a stricter policy at age 18-25 compared to the prior birth cohort. The positive slopes for the thick blue lines in both figures indicate that stricter fertility policy increases the unmarried rate as well as the H-M marriage rate in corresponding treated groups. In contrast, the increase in the penalty rate appears to be uncorrelated with unmarried rate for the minorities, and H-M marriage rate for the non-preferential-policy regions. Table A1 also provides consistent evidence by conducting OLS estimation.16

[Figures 2a and 2b about here]

5.2 Econometric framework

To estimate the impact of the OCP on the marriage outcomes, we conduct the following regressions:

\[ Y_{ijbt} = \beta_0 + \beta_1 \text{Fine}_{jb}^{18-25} + X_{ijbt} + D_{ijbt} + \gamma_{j} Prov_j \times YoB_b + \epsilon_i \] (1)

where the dependent variable, \( Y_{ijbt} \), is the marriage outcome variable of an individual \( i \) of birth cohort \( b \) in hukou province \( j \) and year \( t \). \( \text{Fine}_{jb}^{18-25} \) denotes the mean value of the fertility penalties in province \( j \) for birth cohort \( b \) when aged 18-25. The coefficient, \( \beta_1(s) \), is of central interest because it captures the effects of the OCP penalties on marriage outcomes. We match the penalty rate according to the individual’s hukou province rather than their current living province, because most inter-province migrants in China cannot change their hukou place. By doing so, we actually assume that the marriage market is independent within each province, and that individuals seek for potential spouses in the same hukou province. Therefore, it may be a potential concern if many people once changed their hukou provinces or met their spouses in other provinces. We argue this may not be a first-order issue. First, the cohorts we choose in this analysis are born before 1980

\[ \text{Table A1 provides OLS consistent estimates for these by additionally controlling for ethnicities, type of residence, year of birth, calendar year, and interactions of the last two. The results show that, if the OCP penalty rate increases by one year of local household income, then the unmarried rate will increase by 1.1 percentage points and the H-M marriage rate for Han people in the preferential-policy regions will increase by 0.6 percentage point, respectively. The marriage outcomes of the control groups are not significantly influenced by the changes in penalty rate, and both the coefficients are much smaller and insignificant. Ideally, the total number of observations should be 6448. However, the number usually is smaller due to some missing values. All the standard errors are clustered at the province level.} \]
and most of the people did not change their hukou province.\textsuperscript{17} Second, the individual activities over the life cycle, such as migration and other social activities, are mostly conducted within the same province.\textsuperscript{18} These findings provide validity for matching the fertility penalties according to the hukou province. But it is noteworthy that our results are consistent if we use the birth province in census 2005 or current living province to match the information.

The term, $X_{ijbt}$, includes continuous variables such as the male and female proportions of minorities, and the Han and minority proportions of men, in the local province $j$ of birth cohort $b$, which are used to control the relative size of Han and minorities as well as the gender composition in the local marriage market. The other term, $D_{ijbt}$, includes a series of other covariates: dummies for ethnicities to capture the time-invariant differences among the different ethnicities, such as time-invariant cultures or attitudes toward interethnic marriages; dummies for gender, age, and the interaction of the two, to allow for the time-invariant and age profile differences between men and women; dummies for province, type of hukou and their interaction, to control for the geographical fixed effects; and dummies for the year and their interaction with birth cohort dummies, to allow for the changes of the age profile over time. Finally, we also control for the provincial specific linear trends in the birth cohort, $\text{Prov}_j \times YoB_b$, to capture the potential changes in local subjective attitudes towards staying single or being in an interethnic marriage. This framework is the main identification strategy throughout our analysis, and the standard errors are clustered at the province level to allow autocorrelation within the same province over time.

Considering the differences in marriage markets and marital norms between Hans and minorities, we allow for this heterogeneity by dividing the sample by Hans and minorities to conduct regressions for the two groups separately. There are some other good reasons for doing so. First, the OCP aims to restrict the population of Han people rather than minorities, and thus we expect differential effects of fertility penalty on unmarried status for the two groups. Second, since the

\textsuperscript{17}Although the census data do not provide information about previous hukou, we calculate this using other micro-level data sets and find the proportion with changed hukou provinces is smaller than 5 percent in the same cohorts.

\textsuperscript{18}Migration in China is mostly intra-province rather than inter-province; the proportion of people whose current living province is the same as their hukou province is over 93 percent in our sample. In addition, 97 percent of individuals have the same hukou province and birth province, and over 90 percent of people have the same current-living and birth provinces, according to birth province information in the 2005 census.
numbers of Han and minority people involved in H-M marriages are the same but the H-M marriage proportion in each group are significantly different because of different population sizes, it may be more straightforward to interpret the estimates if we conduct regressions separately for the two groups. Finally, the coefficients $\beta_1$ could be interpreted at the individual level rather than at the couple level for different ethnic groups, and then it would be easier to estimate the corresponding elasticities in equation (*) directly to calculate the potential welfare loss.

5.3 The OCP increased the proportion with an unmarried status

Table 2 reports the OLS estimates for the impacts of the OCP on unmarried status. The first three columns are the results for Han people and the rest are for minorities. The estimates suggest that an increase in OCP penalties by one year of local household income predicts an increase of 1.7 percentage points in the unmarried rate for Hans, while the estimate is insignificant and much smaller (0.46 percentage point) for minorities. Since the mean value of the unmarried rate is 4.4 percent for Han people and 6.6 percent for the minorities, the effects on unmarried status for Han are larger than those for minorities on both absolute and relative scales.

By dividing the Han sample into preferential-policy regions and non-preferential-policy regions, we find the effects of the OCP on unmarried status are greater and more significant in non-preferential-policy regions. An increase in OCP penalties by one year of local household income leads to an significant increase of 1.97 percentage points in the unmarried rate for Hans in non-preferential regions but only 0.93 percentage point for Hans in preferential-policy regions. Since there is no significant difference between the mean unmarried rates for the two different types of regions, the gap in effects is larger on both absolute and relative scales. In contrast, for the minorities, the effects of the fertility penalties are insignificant, much smaller, and even opposite in the preferential-policy regions. One possible explanation is that minority people would become relatively more valuable in the marriage market if the penalty has increased, because they have additional birth quotas. These results for minorities also provide some supportive evidence to the exogeneity of the fertility-penalty rate. That is, we should also find some effects of the OCP for
minorities if the effects were driven by some omitted variables correlated with both penalty rates and the unmarried rates, such as economic development or changes of attitudes towards marriage.

Figures 3a and 3b show the gender-specific point estimates for $\beta_1(s)$, as well as the corresponding 90-percent confidence intervals. Figure 3a presents the results for the Han people. An increase of one year of local household income in the penalty rate causes an increase of 2 to 3 percentage points in unmarried rates among Han people. Also, the magnitudes of the coefficients are larger for men than for women. For example, in non-preferential-policy regions, the coefficient for men is 2.5 times larger than that for women. But this may not mean that the effects for men are larger. Because the mean values of the unmarried rates for men is also much higher than that for women, the effects of the OCP on unmarried status are similar for men and women on a relative scale.\footnote{In the sample, 7.2 percent of Han men and 1.6 percent of Han women are unmarried, and 10.3 and 2.6 percent of minority men and women, respectively, are unmarried.} In contrast, Figure 3b shows that the impact of the OCP on the unmarried rate is consistently much smaller and more insignificant for the minorities in all the subsamples.

5.4 The OCP increased H-M marriages

We investigate the effects of the OCP on H-M marriages in this section. As mentioned above, some regions consistently allowed H-M couples to have more children, while others did not. The non-preferential-policy regions are used as the control group in this section. Before the regression analysis, we plot the H-M marriage rate of all couples over the birth cohorts in Figure 4, based on whether the local region had the preferential policy.

Figure 4 shows fairly parallel trends in the H-M marriage rate across the two types of regions before the early 1950s cohorts. The preferential-policy regions saw an increase from 3.5 to 7
percent and the non-preferential-policy regions saw an increase from 1.5 to 2.3 percent. However, the two lines start to diverge after the 1955 birth cohorts, who were aged 25 at the start of the OCP. The preferential-policy regions increased by 2.8 percentage points from 4.1 to 6.9 percent while those without the preferential policy only increased by 0.3 percentage points from 1.9 to 2.2 percent. However, the birth cohort trends for the average fine rates at age 18-25 for both types of regions, as presented by the two dashed lines, are very similar. This implies that the strictness of the OCP itself may not have created significant differences. Thus, the divergence of the H-M marriage rate of the two types of regions should be mainly caused by the preferential policy for H-M couples.

Since the increase in the H-M marriage rate in the preferential-policy regions, as shown in Figure 5, may merely be caused by a higher minority proportion in the local population, we conduct the regression analysis, and report the results in Table 3. The estimates in columns 1 and 4 of Table 3 show positive impacts of the OCP on the H-M marriages for both Han and for minorities. And the rest of the columns show that the effects are larger and more significant for the preferential-policy regions for both Hans and minorities, suggesting that the local minority proportion may not be the first-order factor that leads to the pattern in Figure 4. Specifically, an increase in the penalty rate by one year of local household income is associated with an increase of 0.6 percentage points in the H-M marriage rate for Han people and with an increase of 2.1 percentage points for the minorities. But the effects are much smaller and insignificant for the Han people in the non-preferential-policy regions. We also find that, in the non-preferential-policy regions, the minorities became less likely to marry Han people because doing so would “waste” the birth quota which is valid only if they were to marry other minorities.

[Table 3 about here]

Figures 5a and 5b show consistent results with the gender-specific subsamples. Also note that the impact of the OCP is quite similar between men and women; we do not find a significant gender difference in the marriage-behavior response to the OCP, either in absolute or relative scales.
As mentioned earlier, we use the married-couple sample where information is complete for both spouses, so the effects estimated here must be interpreted as those effects that are conditional on being married. The first concern is that marriage ages are different across groups: if H-M marriages systematically have a higher or lower marriage age and this difference is correlated with the fertility-penalty rate, then the estimates of the impacts of the OCP on H-M marriages could be biased. However, we argue that this may not be a serious issue. First, the difference in the age of first marriage between H-M marriages and other types of marriages is small, and we find no evidence that those involved in H-M marriages tend to marry later because of the OCP. Also, if we trim the sample to those aged over 30, we still find consistent effects. Note that over 95 percent of all marriages are formed before age 30, for any ethnicity and for any type of marriages.

Another concern is that the OCP induced delayed marriages and thus people would get to meet more people before marriage and thus the marriage outcomes tend to be more diversified, especially for the preferential-policy regions because of the higher minority rate. To rule out this possibility, we conduct a similar analysis of interethnic marriages among minorities and report the results in Table A3. If the above hypothesis is true, we could expect that higher fertility penalties would also lead to more interethnic marriages among the minorities. The results suggest that the OCP did not motivate minorities to marry other minorities, and indicate that the above concern may not be an important issue.

5.5 Children: incentives for H-M marriage

We argue above that a primary motivation for the H-M marriages in the preferential-policy regions is to have more children legally. This section provides evidence to support this argument. The main difficulty in performing such a test is that the expectation about the number of children is unobservable. Based on the ex post data, we examine this by checking whether the regions with

\[\text{For men, the average age of H-M marriages is 23.8 and that of the other marriages is 24.2; for women, the ages are 22.0 and 22.2, respectively.}\]

\[\text{The results are available upon request.}\]
a more positive impact on H-M marriages are also the regions with less negative impacts on the number of children of H-M couples. The rationale is straightforward: if policy-induced H-M couples are formed to seek additional childbirth quotas, they would be more likely to have more births ex post, and thus the negative effect of the penalties on the number of children should be smaller.22

The presence of non-preferential-policy regions provides a natural control group. In these regions, we expect that the impact on H-M marriages should not be correlated with the impact on the number of children because individuals have no policy-induced incentives to form H-M couples. Specifically, we divide Han people into 62 subsamples by the hukou province and by the type of hukou (urban/rural). Then for each subsample, we conduct the following regressions:

\[ HM_{ibt} = \theta_1 Fine_{18-25}^{b} + X_{ibt} + D_{ibt} + \epsilon_{i1} \tag{2-1} \]

where the dependent variable, \( HM_{ibt} \), denotes whether an individual \( i \) is involved in a H-M marriage; \( Fine_{18-25}^{b} \) denotes the average penalty rate at age 18-25 for the birth cohort \( b \) in the local province \( j \); \( X_{ibt} \) denotes the minority proportion for both males and females in the birth cohort \( b \) of the local province; and \( D_{ibt} \) denotes a set of control variables, including indicators for education levels, gender, calendar year, and groups of birth cohorts (i.e., for every 10 years).23

Then we keep the Han people involved in H-M marriages and conduct the following regressions on each subsample:

\[ Children_{ibt} = \theta_2 Fine_{18-25}^{b} + X_{ibt} + D_{ibt} + \epsilon_{i2} \tag{2-2} \]

Here we keep all the other control variables the same and only switch the dependent variable to the number of children ever born to the mother in the household. For each subsample \((s)\), we can get a \( \theta_1^s \) and \( \theta_2^s \). We plot \( \theta_2^s \) against \( \theta_1^s \) and investigate how they are correlated, weighted by the population size in each cell. Figure 6a shows the pattern in non-preferential-policy regions

---

22 We thank Professor Lawrence Katz for providing kind suggestions for this methodology. Any errors are ours.

23 We cannot control for the specific year of birth dummies here because the \( Fine_b \) is in the level of the year of birth. The results are robust to the different years of birth categories.
and Figure 6b shows the pattern in the presence of preferential policies\(^\text{24}\). We find a very weak correlation between the impact on fertility and the impact on H-M marriages in Figure 6a, but a significantly positive correlation in Figure 6b, which implies that the effect of the OCP on fertility would be partially offset by the policy-induced H-M marriages. Therefore, Figures 6a and 6b provide some evidence that the expected number of children is an important factor that individuals consider in their marriage decision.

5.6 Associations of the OCP with education of spouse among H-M marriages

The third hypothesis of the model states that more “transfers” from Han spouses to minority spouses in H-M couples will happen if the implementation of the OCP becomes tougher and a preferential policy is in place. This is because the value of a minority partner as reflected by the additional birth quotas can be brought into marriage. However, the “utility transfers” cannot be directly observable. Thus we examine, in the preferential-policy regions, whether the minorities in H-M marriages marry more highly educated people in presence of higher fertility penalties.\(^\text{25}\) We expect that, in preferential-policy regions, the educational attainments of the spouses of minorities should be higher in H-M couples since the minorities are more “valuable” in the marriage market as the penalty rates increase. In contrast, this should not hold true for either the spouses of the Han people in the same regions, or for the minorities in the non-preferential policy regions. Therefore, we trim the sample to those H-M couples, and divide the sample into regions with preferential policies and those without, and then conduct the following regression separately by Hans and minorities:

\[
Education_{ijbt}^{spouse} = \alpha_0 + \alpha_1 F in e_{ijb}^{18-25} + X_{ijbt} + D_{ijbt} + \gamma_j P ro v_j \times Y o B_b + \epsilon_i \tag{3}
\]

\(^{24}\)Consistent with the finding that the policy-induced H-M marriages mostly happened in the preferential-policy regions, the weighted mean value of the impacts on H-M marriage is 0.1 in Figure 6a but 0.3 in Figure 6b.

\(^{25}\)In previous literature (Chiappori et al., 2009; Lafortune, 2013), education is viewed as pre-marital investment and predicts higher household income, and we consider the education of spouse as received utility transfer in marriages.
where the dependent variable is education level of the spouse, on a scale of 1 to 5 – the larger the value, the higher the education level. All the other variables are kept the same as those in equation (1). Panel A and Panel B of Table 4 report the ordered logit estimates for Hans and for minorities, respectively. Consistent with our expectation, the estimates show that higher penalty is significantly associated with a higher education level of the spouses of the minorities in H-M couples, but this positive association only exists for the minorities in the preferential-policy regions. The coefficient is as high as 0.96. By comparison, the coefficient for the Hans in the same regions is 0.019, and that for minorities in non-preferential-policy regions is 0.03. Both of the latter two are insignificant.

[Table 4 about here]

**VI. Welfare Analysis**

Recalling that reduced-form elasticities are sufficient statistics for the deadweight loss of social welfare, this section applies the individual behavioral response to the OCP penalties to the Equation (\(^*\)) to calculate the welfare loss caused by the distortion. The most important parts of Equation (\(^*\)) are the three terms in parentheses. The first two terms reflect the distortion in the marriage market and the third term captures the reduction in fertility.

Based on the data of the number of children observed in the each household, we can directly calculate the number of illegal birth children \(c_{ij}\). Then we use the same identification strategy above to estimate the effects of penalties for different types of marriages to make the whole analysis consistent. Table 5 reports the results. Consistent with our expectations, the effects are mainly from H-H couples. The insignificant but sizable coefficient for Han-Han couples reflects a large heterogeneity within the population and are consistent with the ongoing debate about the magnitude of the policy-induced fertility decline (Schultz and Zeng, 1995; McElroy and Yang, 2000). Columns 3 and 4 shows that the effects of illegal birth are one scale smaller for H-M couples, and around zero for M-M couples.
In Table 2, 3, and 5, we have estimated the needed marriage and fertility responses to the OCP penalties to calculate the welfare loss. Table 6 reports the results. We calculate the loss by Han and minorities, respectively. Panel A reports the basic statistics in equation (\textsuperscript{*}) (i.e., \(P_i^r, r^i_m, r^i_{ij}\) and \(c_{ij}\)). Panel B reports the elasticities of unmarried, intra- or inter-ethnicity marriage, and number of illegal children born with respect to the fertility penalties, by the ethnicity combinations of \(i\) and \(j\). Panel C reports the welfare gain/loss induced by one unit increase in the penalty (the unit is yearly local household income) for each ethnicity \(i\). Along with the notation in the equation (\textsuperscript{*}), we specifically calculate the marriage distortion and the fertility reduction in the parentheses for each ethnicity combination, and report them in the first two rows of Panel C. The unit for welfare loss is the percentage of yearly household income. So for the Han ethnicity, the welfare loss originates from both fertility reduction (-3.32) and marriage market distortion (-0.71), indicating that the distortion of the marriage market actually captures 18 percent of the total welfare loss for the Han people. For the minorities, some of them actually were better off from the OCP in the marriage market and the welfare loss in the fertility reduction is also smaller in magnitude than that for Han people. The final column reports the social welfare loss by calculating the mean values weighted by the population proportion \(P_i\). These estimates suggest that the one unit increase in penalty will induce a welfare loss, which is 3.75 percent of local yearly household income. Because the average penalty at age 18-25 is 1.3 (times of household income) for those birth cohorts born later than 1955, by assuming that the elasticities are constant across the birth cohorts afterwards, we conclude that the total welfare loss caused by the OCP is 4.9 percent of yearly household income, to which marriage distortion contributes 0.85 percent of yearly household income. It indicates that the traditional way to calculate the policy-induced welfare loss, which does not consider the distortion in marriage market (i.e., the distortion effects), would significantly underestimate the total welfare loss.
Therefore, these findings highlight the importance of considering the “distortion effects” when calculating relevant welfare loss. This raises the question as to under what circumstances do we need to consider the “distortion effects” and why most of the previous studies did not take them into account in their welfare analyses. Children (“the taxed good”) are different from most normal goods in the market, because most children are born in wedlock and thus children are the natural fruits of marriages. A higher tax will prevent more people from marrying because their expected marriage gains become lower than the “married or not” threshold. The “mechanical effects” only consider the welfare loss among those who are married, and cannot take into account those whose expected marriage gains would fall below the threshold of “married or not” because they are censored when conducting the traditional analysis.\textsuperscript{26}

\section*{VII. Conclusions and Discussion}

This study provides new evidence on the implications and extensions of the transferable utility model by exploiting the plausibly exogenous deductions in marriage gains that are caused by the large, strict, and long-lasting fertility policies in China, and, for the first time, estimates the welfare loss caused by the OCP in both fertility and marriage.

Using the temporal and regional variations in the penalty rate for an additional illegal birth, as well as regional variations in the implementation of certain preferential fertility policies for H-M couples, we find evidence for the model by showing that 1) The higher the OCP penalty at age 18-25 is, the higher the unmarried rate is, especially for the Han ethnicity; 2) an increase in the penalty rate induces more H-M marriages, but only in the preferential-policy regions; and 3) the minorities in interethnic marriages are more likely to marry highly-educated Han spouses when the penalty rate is higher in the presence of preferential policies.

Based on the theoretical framework, we further estimate the welfare loss induced by the OCP.\textsuperscript{26}

\textsuperscript{26}However, this study is not the first one to reveal the relationship between different “goods” and its consequences. For example, Busse et al. (2013) found that gasoline prices have significant impacts on prices and quantities of sales in the new and used car market.
The welfare loss is composed of two parts: one is the reduction in individual fertility (the “mechanical” effect), and the other is the distortion in the marriage market (“distortion” effects). More importantly, the welfare loss depends only on the fertility and marriage outcome elasticities, with respect to the penalty rate. The elasticities provide sufficient statistics to calculate the corresponding social-welfare deadweight loss. Applying the estimated reduced-form elasticities to the model shows that the distortion of the marriage market actually brings about a welfare loss approximately equal to 0.85 percent of the yearly household income, which captures about 17 percent of the total loss caused by the OCP. The estimates suggest that the OCP has led to a large distortion in marriage equilibrium outcomes. The large impact on H-M marriage outcomes implies that the unintended but rational behavioral responses to the policy potentially create large and persistent impacts on the culture, development, and societies of minorities. This calls for future studies on the behavioral and social impacts of other similar ethnic-specific policies.

Our findings also suggest a significant welfare loss caused by the OCP in both fertility and marriage. This paper enhances the current literature by studying the largest fertility policy in the world and by extending the sufficient statistic approach to the marriage market. The estimates suggest that the relationship between different goods needs to be considered when studying the potential consequences of policies or taxations. Children (the “goods” that are taxed by the OCP) are different from other normal goods because they are the natural fruits of marriage. Our findings suggest the heavy tax on children has distorted the marriage market, which has contributed a significant proportion of welfare loss.

This study also suffers from some limitations. First, the most important measure for the OCP is the financial penalty for an additional illegal birth. However, the government implemented other strict regulations at the same time. For example, workers in the public sector risked losing their jobs if they did not comply with the OCP, and this is not covered by the monetary penalty we consider here. We need to bear in mind when interpreting the estimates that they only reflect the impacts of the monetary penalty rather than the overall effects of the OCP. In addition, some social conflicts have happened in the process of collecting the OCP penalties, especially in remote and
poor regions. There are also some illegally born children who were not registered and were not eligible to receive formal education. These facts suggest that the deadweight loss induced by the OCP may be beyond the numbers in our study. Finally, our model and empirical analysis look into the effects on marriage and fertility only, but do not take into account other dimensions, including the impacts of the fertility policies on the status of women and the quality of children, as well as some possible spillover effects on human capital and social burden, though some of these factors are investigated in previous literature. We are looking forward to future studies, which may shed light on these questions.

References


Banister, Judith, China’s changing population, Stanford University Press, 1991.


### Table 1. Summary Statistics

<table>
<thead>
<tr>
<th>Sample</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Full</td>
<td>Han</td>
<td>Minority</td>
<td>Full</td>
<td>Han</td>
<td>Minority</td>
</tr>
<tr>
<td><strong>Panel A: Marriage outcomes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unmarried (%)</td>
<td>4.62</td>
<td>4.44</td>
<td>6.57</td>
<td>2.94</td>
<td>1.61</td>
<td>17.38</td>
</tr>
<tr>
<td></td>
<td>(21.00)</td>
<td>(20.59)</td>
<td>(24.78)</td>
<td>(16.88)</td>
<td>(12.58)</td>
<td>(37.89)</td>
</tr>
<tr>
<td>H-M marriage (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.94</td>
<td>1.61</td>
<td>17.38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(16.88)</td>
<td>(12.58)</td>
<td>(37.89)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H-H marriage (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>90.10</td>
<td>98.39</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(29.86)</td>
<td>(12.58)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M-M marriage (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.96</td>
<td>82.62</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(25.45)</td>
<td>(37.89)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Panel B: Demographics and Education levels</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minority (%)</td>
<td>8.64</td>
<td>8.42</td>
<td></td>
<td>8.64</td>
<td>8.42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(28.10)</td>
<td>(27.78)</td>
<td></td>
<td>(28.10)</td>
<td>(27.78)</td>
<td></td>
</tr>
<tr>
<td>Male (Yes = 1)</td>
<td>0.50</td>
<td>0.50</td>
<td>0.51</td>
<td>0.49</td>
<td>0.49</td>
<td>0.49</td>
</tr>
<tr>
<td></td>
<td>(0.50)</td>
<td>(0.50)</td>
<td>(0.50)</td>
<td>(0.50)</td>
<td>(0.50)</td>
<td>(0.50)</td>
</tr>
<tr>
<td>Urban (Yes = 1)</td>
<td>0.41</td>
<td>0.43</td>
<td>0.26</td>
<td>0.41</td>
<td>0.42</td>
<td>0.26</td>
</tr>
<tr>
<td></td>
<td>(0.49)</td>
<td>(0.49)</td>
<td>(0.44)</td>
<td>(0.49)</td>
<td>(0.49)</td>
<td>(0.44)</td>
</tr>
<tr>
<td>Age</td>
<td>39.40</td>
<td>39.49</td>
<td>38.42</td>
<td>39.82</td>
<td>39.91</td>
<td>38.89</td>
</tr>
<tr>
<td></td>
<td>(8.21)</td>
<td>(8.21)</td>
<td>(8.21)</td>
<td>(8.03)</td>
<td>(8.02)</td>
<td>(8.04)</td>
</tr>
<tr>
<td><strong>Education Levels</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiterate</td>
<td>0.06</td>
<td>0.05</td>
<td>0.16</td>
<td>0.06</td>
<td>0.05</td>
<td>0.16</td>
</tr>
<tr>
<td></td>
<td>(0.24)</td>
<td>(0.23)</td>
<td>(0.37)</td>
<td>(0.24)</td>
<td>(0.22)</td>
<td>(0.37)</td>
</tr>
<tr>
<td>Primary School</td>
<td>0.31</td>
<td>0.31</td>
<td>0.40</td>
<td>0.32</td>
<td>0.31</td>
<td>0.40</td>
</tr>
<tr>
<td></td>
<td>(0.46)</td>
<td>(0.46)</td>
<td>(0.49)</td>
<td>(0.47)</td>
<td>(0.46)</td>
<td>(0.49)</td>
</tr>
<tr>
<td>Junior High</td>
<td>0.43</td>
<td>0.44</td>
<td>0.30</td>
<td>0.43</td>
<td>0.44</td>
<td>0.30</td>
</tr>
<tr>
<td></td>
<td>(0.49)</td>
<td>(0.50)</td>
<td>(0.46)</td>
<td>(0.50)</td>
<td>(0.50)</td>
<td>(0.46)</td>
</tr>
<tr>
<td>Senior High</td>
<td>0.14</td>
<td>0.14</td>
<td>0.10</td>
<td>0.14</td>
<td>0.14</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
<td>(0.35)</td>
<td>(0.35)</td>
<td>(0.29)</td>
<td>(0.35)</td>
<td>(0.35)</td>
<td>(0.29)</td>
</tr>
<tr>
<td>College or above</td>
<td>0.06</td>
<td>0.06</td>
<td>0.05</td>
<td>0.05</td>
<td>0.06</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>(0.23)</td>
<td>(0.24)</td>
<td>(0.21)</td>
<td>(0.23)</td>
<td>(0.23)</td>
<td>(0.21)</td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td>5,677,311</td>
<td>5,223,157</td>
<td>454,154</td>
<td>4,692,977</td>
<td>4,330,059</td>
<td>362,918</td>
</tr>
</tbody>
</table>

Notes: Data source is Census 2000 and 2005. Sampling weights applied. Standard deviations are in parentheses.
Table 2. Impact of OCP on Marriage Outcomes: Unmarried Status

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample</td>
<td>Han sample</td>
<td>Minority sample</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean of Dep. Var.</td>
<td>4.44</td>
<td>4.95</td>
<td>4.21</td>
<td>6.57</td>
<td>6.61</td>
<td>6.49</td>
</tr>
<tr>
<td>Fertility fine rate at age 18-25</td>
<td>1.746*** (0.528)</td>
<td>0.934 (0.537)</td>
<td>1.971*** (0.611)</td>
<td>0.457 (0.619)</td>
<td>-0.204 (0.411)</td>
<td>0.439 (0.583)</td>
</tr>
<tr>
<td>Observations</td>
<td>5,223,157</td>
<td>1,622,652</td>
<td>3,600,505</td>
<td>454,154</td>
<td>289,864</td>
<td>164,290</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.102</td>
<td>0.104</td>
<td>0.102</td>
<td>0.125</td>
<td>0.119</td>
<td>0.145</td>
</tr>
</tbody>
</table>

Covariates Controlled for
- Local Minority Prop. Yes Yes Yes Yes Yes Yes
- Local Male Prop. Yes Yes Yes Yes Yes Yes
- Ethnicity FE Yes Yes Yes Yes Yes Yes
- Gender & Age FE Yes Yes Yes Yes Yes Yes
- Province & Hukou FE Yes Yes Yes Yes Yes Yes
- Age & Year FE Yes Yes Yes Yes Yes Yes
- Province-Yob Trends Yes Yes Yes Yes Yes Yes

Notes: Data source is Census 2000 and 2005. Dependent variable is multiplied by 100 so the coefficients can be interpreted in percent. The covariates include the local minority proportion in the birth cohort (Local Minority Prop.), local male proportion in the birth cohort (Local Male Prop.), dummies for ethnicities (Ethnicity FE), gender, age and their interaction (Gender & Age FE), hukou province, type of hukou and their interaction (Province & Hukou FE), survey year and its interaction with age (Age & Year FE). The province-specific year of birth linear trends (Province-Yob Trends) are also included to control the potential changes in local subjective attitudes towards marriage. Sampling weights are applied and robust standard errors in parentheses are clustered at province level.

*** p<0.01, ** p<0.05, * p<0.1
Table 3. Impact of OCP on Marriage Outcomes: Han-Minority Marriage

<table>
<thead>
<tr>
<th>Sample</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable</td>
<td>Han sample</td>
<td></td>
<td>Minority sample</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Han-Minorities Marriage (Yes = 100)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean of Dep. Var.</td>
<td>1.61</td>
<td>3.00</td>
<td>1.01</td>
<td>17.4</td>
<td>14.3</td>
<td>23.7</td>
</tr>
<tr>
<td>Fertility fine rate at age 18-25</td>
<td>0.227*</td>
<td>0.607***</td>
<td>0.116</td>
<td>0.863</td>
<td>2.063*</td>
<td>-0.666*</td>
</tr>
<tr>
<td></td>
<td>(0.122)</td>
<td>(0.269)</td>
<td>(0.074)</td>
<td>(0.773)</td>
<td>(1.139)</td>
<td>(0.359)</td>
</tr>
<tr>
<td>Observations</td>
<td>4,330,059</td>
<td>1,320,064</td>
<td>3,099,995</td>
<td>362,918</td>
<td>231,661</td>
<td>131,257</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.037</td>
<td>0.037</td>
<td>0.028</td>
<td>0.194</td>
<td>0.154</td>
<td>0.256</td>
</tr>
</tbody>
</table>

**Covariates controlled in both panels**

- Local Minority Prop.: Yes
- Local Male Prop.: Yes
- Ethnicity FE: Yes
- Gender & Age FE: Yes
- Province & Hukou FE: Yes
- Age & Year FE: Yes
- Province-Yob Trends: Yes

Notes: Data source is Census 2000 and 2005. The covariates are the same as those in Table 2. Sampling weights are applied and robust standard errors in parentheses are clustered at province level.

*** p<0.01, ** p<0.05, * p<0.1
Table 4. Ordered Logit Estimation: Impact of the OCP Penalties on Education of Spouse among H-M marriages

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent variable</strong></td>
<td>Education Level of Spouse (1-4, larger for higher education)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sample</strong></td>
<td>Full sample</td>
<td>Preferential-policy regions</td>
<td>No-Preferential policy regions</td>
</tr>
<tr>
<td><strong>Panel A: The sample is the Minorities in the H-M marriages thus the dependent variable is education level of Han people in these marriages</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fertility fine rate at age 18-25</td>
<td>0.0578**</td>
<td>0.0955*</td>
<td>0.0306</td>
</tr>
<tr>
<td></td>
<td>(0.0273)</td>
<td>(0.0507)</td>
<td>(0.0339)</td>
</tr>
<tr>
<td>Observations</td>
<td>63,005</td>
<td>34,566</td>
<td>28,439</td>
</tr>
<tr>
<td><strong>Panel B: The sample is the Han people in the H-M marriages thus the dependent variable is education level of Minorities in these marriages</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fertility fine rate at age 18-25</td>
<td>0.0380</td>
<td>0.0187</td>
<td>0.0579</td>
</tr>
<tr>
<td></td>
<td>(0.0259)</td>
<td>(0.0428)</td>
<td>(0.0450)</td>
</tr>
<tr>
<td>Observations</td>
<td>63,005</td>
<td>34,566</td>
<td>28,439</td>
</tr>
<tr>
<td><strong>Covariates controlled for in both panels</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local Minority Prop.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Local Male Prop.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Specific Ethnicity FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Gender &amp; Age FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Province &amp; Hukou FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Age &amp; Year FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Province-Yob Trends</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Notes: Data source is Census 2000 and 2005. Only H-M couples are included. The covariates are the same as those in Table 2. Ordered logit estimation is applied. Sampling weights are applied and robust standard errors in parentheses are clustered at province level. *** p<0.01, ** p<0.05, * p<0.1
<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample</td>
<td>All the couples</td>
<td>Han-Han Couples</td>
<td>Han-Minority Couples</td>
<td>Minority-Minority Couples</td>
</tr>
<tr>
<td>Fertility fine rate at age 18-25</td>
<td>-0.0191 (0.0285)</td>
<td>-0.0231 (0.0326)</td>
<td>-0.00620 (0.00928)</td>
<td>0.000130 (0.000142)</td>
</tr>
<tr>
<td>Observations</td>
<td>4,692,977</td>
<td>4,263,273</td>
<td>133,375</td>
<td>296,329</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.263</td>
<td>0.248</td>
<td>0.255</td>
<td>0.016</td>
</tr>
</tbody>
</table>

**Covariates controlled for**

- Local Minority Prop.  Yes  Yes  Yes  Yes
- Local Male Prop.  Yes  Yes  Yes  Yes
- Ethnicity FE  Yes  Yes  Yes  Yes
- Gender & Age FE  Yes  Yes  Yes  Yes
- Province & Hukou FE  Yes  Yes  Yes  Yes
- Age & Year FE  Yes  Yes  Yes  Yes
- Province-Yob Trends  Yes  Yes  Yes  Yes

Notes: Data source is Census 2000 and 2005. The covariates are the same as those in Table 2. Sampling weights are applied and robust standard errors in parentheses are clustered at province level.

*** p<0.01, ** p<0.05, * p<0.1
Table 6. Welfare loss caused by the OCP, by types of marriages

<table>
<thead>
<tr>
<th>Ethnicity $i$</th>
<th>Han</th>
<th>Minority</th>
<th>Han</th>
<th>Minority</th>
<th>Welfare gain/loss (Weighted by $P_i$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity $j$</td>
<td>Han</td>
<td>Minority</td>
<td>Han</td>
<td>Minority</td>
<td></td>
</tr>
<tr>
<td>(1) (2) (3) (4) (5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Panel A: Basic statistics in the data

- $(P_i)$ Prop. of $i$ 0.93 0.07 -
- $(r^i_m)$ Married rate of $i$ 0.96 0.96 0.94 0.94 -
- $(r^i_{ij})$ Prop. of $i$ married to $j$ 0.98 0.02 0.17 0.83 -
- $(e_{ij})$ Illegal births 0.25 0.10 0.10 0.00 -

Panel B: Estimated Elasticities with respect to penalties

- $(e^i_m)$ Married rate of $i$ -0.03 -0.03 -0.01 -0.01 -
- $(e^i_{ij})$ Marriage $i - j$ 0.00 0.22 0.08 -0.02 -
- $(e^i_{ij})$ Illegal births -0.14 -0.09 -0.09 0.00 -

Panel C: Welfare gain/loss of unit change in fine rate (% of yearly household income)

Marriage Distortion -0.71 0.11 -0.65
Fertility Reduction -3.32 -0.15 -3.10
Total -4.02 -0.04 -3.75

Notes: Data sources are Census 2000 and 2005. Statistics in Panel A are calculated from the corresponding samples. The estimates in Panel B are calculated from the results in Tables 2, 3 and 5. The estimates in Panel C are calculated from the results in Panel A and Panel B by plugging them into the equation (*). Welfare loss estimated in column 5 is the population weighted mean of those for the Han people and minorities.
Figure 1: Measures of the OCP: Preferential-Policy Regions and Fertility Penalties

(a) Preferential-Policy Regions v.s. Non-preferential-policy regions

(b) One-Child Policy Regulatory Fertility Penalties in 1980-2000, by Province

Notes: Data source for the preferential-policy regions in Figure 1a is from the website of National Health and Family Planning Commission of the people’s Republic of China. The website is http://www.nhfpc.gov.cn/zhuzhan/dftl/lists.shtml (Chinese Website accessed in November 2015). Data source for the fertility penalties in Figure 1b is Ebenstein (2010). The unit of penalties is times of local household annual income.
Figure 2: Marriage Outcomes Changed according to the Changes of the OCP Penalties at age 18-25

(a) Unmarried status, by Han and Minorities

(b) H-M marriage, by Preferential-Policy or No-Preferential Policy Regions

Notes: The data source is Census 2000 and 2005. X-axis is the categories of changes in the OCP penalties at age 18-25 in two consecutive birth cohorts and the Y-axis is the corresponding changes in unmarried rate (for Figure a) and H-M marriage rate (for Figure b) in each category. Standard errors are clustered at province level and 90% CIs are reported. The estimation is weighed by the population size of each birth cohort. The treated groups for unmarried rate and H-M marriage are Han ethnicity people and the people in preferential-policy regions, respectively.
Figure 3: Impact of the Fine Rate of the OCP at age 18-25 on Unmarried Status, by Gender, Region and Ethnicity

(a) Impact of the OCP on unmarried for Han ethnicity, by Gender and Region

(b) Impact of the OCP on unmarried for the Minorities, by Gender and Region

Notes: The data source is Census 2000 and 2005. We use equation (1) to estimate the effects of the OCP penalties on the unmarried rate. Figure a and figure b report the OLS coefficients on the fertility penalties at age 18-25 and the corresponding 90% confidential intervals for the Han people and minorities, respectively. Standard errors are clustered at province level and sampling weights are applied.
Figure 4: H-M Marriage rate and Fertility Fine at 18-25 over Year of Birth, by Preferential-Policy or No-Preferential Policy Regions

Notes: The data source is Census 2000 and 2005. The H-M marriage rates and penalties are plot against the birth cohorts, by whether the region has preferential policies or not. Sampling weights are applied.
Figure 5: Impact of the Fine Rate of the OCP at age 18-25 on H-M Marriages, by Gender, Region and Ethnicity

(a) Impact of the OCP on H-M Marriages for Han ethnicity, by Gender and Region

(b) Impact of the OCP on H-M Marriages for the Minorities, by Gender and Region

Notes: The data source is Census 2000 and 2005. We use equation (1) to estimate the effects of the OCP penalties on the H-M married rate. Figure a and figure b report the OLS coefficients on the fertility penalties at age 18-25 and the corresponding 90% confidential intervals for the Han people and minorities, respectively. Standard errors are clustered at province level.
Figure 6: Associations between Impacts of the OCP on H-M marriages and those on Fertility of these couples, by Preferential-Policy or No-Preferential Policy Regions

(a) Regions with no-preferential policy to Han-Minority couples

(b) Regions with preferential-policy to Han-Minority couples

Notes: The data source is Census 2000 and 2005. The full sample is divided by the province and for each subsample, equations (2-1) and (2-2) are estimated. The X-axis is the effects of the OCP penalties on H-M marriage rate and the Y-axis is the effects on number of children of those couples. Then we divide the sample by whether the region has the preferential policy or not, and report them in figure a and figure b, respectively. The size of the circle reflect the population size.
Appendix A: Ethnic Minorities in China

China is a populous country with controversial ethnic issues (Sautman, 1998; Kaup, 2000; Ma, 2007). Ma (2007) listed ten of China’s ethnic issues that are worthy of academic attention, and the first one among them is ethnic identification and nationalism. China officially has 56 ethnicities. Soon after the founding of the People’s Republic of China in 1949, the central government initiated a monumental project of ethnic identification. In the 1953 population census, more than 400 groups applied for national minority status (Fei, 1979). With guidance from a few Western-educated anthropologists, hundreds of research teams were sent to conduct fieldwork and collect information about the history, language and customs of each group. The main work of ethnic identification was finished in 1957, but follow-up revisions continued until the 1970s. The most recent revision was the recognition of the Jino people in 1979, right before the implementation of the OCP. Based on cultural characteristics and the will of the groups concerned, most of these self-nominated groups were recognized as minority people, and they were officially reclassified into 55 groups. Based on cultural characteristics and the will of the groups concerned, most of these self-nominated groups were recognized as minority people, and they were officially reclassified into 55 groups. According to Regulations on Household Registration of People’s Republic of China, every newborn’s ethnicity should be registered in the hukou system in the first month after birth. Ethnic identity is mainly determined by parents’ ethnicities. The children of intermarried families are permitted to follow either the father’s or mother’s ethnicity (Jia and Persson, 2015). Ethnic identity is strictly controlled, and thus it is difficult for individuals to make a fake claim.

According to the 2010 census, the Han ethnicity make up 91 percent of the population, while all of the other 55 ethnic groups account for the remainder. The largest minority group currently in China is Zhuang, with a population of 16.9 million in 2010. The smallest minority group, the Keba, has only 3682 members. Figure A1 shows the geographic distribution of all the 56 ethnic groups. As shown in the map, most ethnic minority groups live in regions on the western or northeastern
boarder. The current geographic pattern of ethnic distribution is mainly caused by the migration history of the Han Chinese (Poston Jr and Shu, 1987).

Appendix B: Marriage Market Distortion by the OCP

B.1 Solving the equilibrium

Based on the equilibrium conditions in Section 3.1, plug in the two ethnicities $H$ and $M$, and explicitly express the equations by ethnicities. We have the following set of equations:

$$\begin{align*}
\ln \mu_{HH} - \ln \mu_{H0} &= \frac{\alpha_{HH} + \gamma_{HH}}{2} \\
\ln \mu_{HM} - \ln \mu_{H0} - \ln \mu_{M0} &= \frac{\alpha_{HM} + \gamma_{HM}}{2} \\
\ln \mu_{MM} - \ln \mu_{M0} &= \frac{\alpha_{MM} + \gamma_{MM}}{2} \\
\mu_{H0} + \mu_{HH} + \mu_{MH} &= \bar{H} \\
\mu_{M0} + \mu_{MH} + \mu_{MM} &= \bar{M}
\end{align*}$$

For simplicity, we define $\theta_{HH} = \frac{\alpha_{HH} + \gamma_{HH}}{2}$, $\theta_{HM} = \frac{\alpha_{HM} + \gamma_{HM}}{2}$ and $\theta_{MM} = \frac{\alpha_{MM} + \gamma_{MM}}{2}$, which are the expected marriage gains for the H-H, H-M and M-M couples, respectively. Then we translate the equations above into proportions and rates:

$$\begin{align*}
\ln(h_m r_H^H) - \ln h_0 &= \theta_{HH} \\
\ln(h_m r_H^M) - \ln \bar{H} h_m r_H^M - \frac{1}{2}(\ln \bar{H} h_0 + \ln \bar{M} m_0) &= \theta_{HM} \\
\ln(m_m r_M^M) - \ln m_0 &= \theta_{MM} \\
\bar{H} h_m r_H^M &= \bar{M} m_m r_M^H \\
h_m + h_0 - m_m + m_0 &= r_H^H + r_M^H = r_M^M + r_H^M = 1
\end{align*}$$

where $h_m$, $h_0$ are the married and unmarried rates for Han ethnicity; and $m_m$, $m_0$ are married and unmarried rates for minorities. Similarly, $r_H^H$ and $r_H^M$ are the proportion of married Han people
marrying to Han and minorities, respectively; \( r_H^M \) and \( r_M^M \) are the proportion of married minority people marrying to Han and minorities, respectively. The first three equations are directly from the first three in (1). The fourth one means that the number of Han people involved in H-M marriages are the same with that of Minorities involved.

Then we take derivatives with \( f \) and note that \( \frac{\partial \theta_{HH}}{\partial f} = u_{HH}', \frac{\partial \theta_{HM}}{\partial f} = u_{HM}', \frac{\partial \theta_{MM}}{\partial f} = u_{MM}' \), and \( \frac{d r_M^M}{d f} = -\frac{d r_H^M}{d f}, \overline{H}h_m r_H^M = \overline{M}m_m r_M^M \), we have:

\[
\begin{cases}
  \left( \frac{1}{h_m} + \frac{1}{h_0} \right) e_h - \frac{1}{r_H^M} e_H = u_{HH}' \\
  -\frac{r_M^M}{h_m r_H^M} e_h - \frac{r_H^M}{r_H^M r_M^M} e_M + \left( \frac{1}{m_0} + \frac{1}{m_m} + \frac{r_H^M}{m_m r_M^M} \right) e_m = u_{MM}' \\
  \left( \frac{1}{h_m} + \frac{1}{2h_0} \right) e_h + \frac{1}{r_M^M} e_M + \frac{1}{2m_0} e_m = u_{HM}'
\end{cases}
\]

where \( e_h = \frac{d h_m}{d f}, e_m = \frac{d m_m}{d f}, \) and \( e_M^M = \frac{d r_M^M}{d f} \). The first two are the responses of married rates of Han and Minorities to one unit increase in the fertility fines; the last one represents the response of the H-M marriage rate among the Han ethnicity with respective to the fertility fines. We can solve these three equations above to derive the expressions in terms of \( u_{HH}', u_{HM}' \) and \( u_{MM}' \) for the three unknowns.

We first define \( \alpha_1 = \left( \frac{1}{h_m} + \frac{1}{h_0} \right), \alpha_2 = \frac{1}{r_H^M}, \alpha_3 = \frac{r_H^M}{h_m r_H^M}, \alpha_4 = \frac{r_H^M}{r_H^M r_M^M}, \alpha_5 = \left( \frac{1}{m_0} + \frac{1}{m_m} + \frac{r_H^M}{m_m r_M^M} \right), \alpha_6 = \left( \frac{1}{h_m} + \frac{1}{2h_0} \right), \alpha_7 = \frac{1}{r_M^M} \) and \( \alpha_8 = \frac{1}{2m_0} \). Obviously, \( \alpha_i > 0, \forall i \).

By solving the equations, we have:

\[
e_h = \frac{A u_{HH}' + \alpha_5 C}{\alpha_1 A + \alpha_2 B}
\]

\[
e_M^M = \frac{-B u_{HH}' + \alpha_4 C}{\alpha_1 A + \alpha_2 B}
\]

\[
e_m = \frac{u_{MM}' + \alpha_3 e_h + \alpha_4 e_M^M}{\alpha_5} (or = \frac{u_{MM}' + \alpha_5 e_h - \alpha_7 e_H'}{\alpha_8})
\]
where \( A = \alpha_5 \alpha_7 + \alpha_4 \alpha_8 \), \( B = \alpha_5 \alpha_6 + \alpha_3 \alpha_8 \), and \( C = \alpha_5 u'_{HM} - \alpha_8 u'_{MM} \).

Because \( \alpha_5 > \alpha_8 > 0 \) and \( u'_{HH} \leq u'_{HM} \leq u'_{MM} \leq 0 \), we have \( C \leq 0 \).

### B.2 Proof of Predictions

#### Proof of Predictions 1:

We have found that \( e_h = \frac{A u'_{HH} + \alpha_5 C}{\alpha_1 A + \alpha_2 B} \) and thus it’s easy to find that \( e_h < 0 \).

Without the loss of generality, we can reasonably assume that, in the preferential-policy regions, the One-Child policy has very little impact on the welfare of H-M marriage and M-M marriage. That is, \( u'_{HM} = u'_{MM} = 0 \). Thus, the absolute value of \( e_h \) will be lower in the preferential-policy regions because \( C = 0 \) when \( u'_{HM} = u'_{MM} = 0 \).

From (3), we have \( e_m = \frac{u'_{HM} - \alpha_6 e_h - \alpha_7 e_M}{\alpha_8} \). In the preferential-policy regions, the expression of \( e_m \) can be simplified as follow:

\[
e_m = \frac{(\alpha_7 B - \alpha_6 A) u'_{HH}}{\alpha_8 (\alpha_1 A + \alpha_2 B)} \tag{4}
\]

By substituting \( A = \alpha_5 \alpha_7 + \alpha_4 \alpha_8 \) and \( B = \alpha_5 \alpha_6 + \alpha_3 \alpha_8 \), we have \( \alpha_7 B - \alpha_6 A = (\alpha_3 \alpha_7 - \alpha_4 \alpha_6) \alpha_8 \).

Because \( \alpha_3 \alpha_7 - \alpha_4 \alpha_6 = -\frac{r_H}{2(h_0 r_M r_H^M)} < 0 \), \( e_m > 0 \) holds in the preferential-policy regions. That is, in these regions, the One-Child policy may have a positive effect on the marriage rate of minority people.

However, in the non-preferential-policy regions, whether \( e_m \) is positive or negative is inconclusive.

#### Proof of Prediction 2:

From \( \overline{r_H} m r_H^M = \overline{m} m r_M^H \), we have the expression of \( e_M^H \) as follow:

\[
e_M^H = r_M^H \left( \frac{1}{h_m} e_h + \frac{1}{m} e_M^M - \frac{1}{m} e_m \right) \tag{5}
\]

According to the formula (2), the sign of \( e_M^M \) is not generally determinate. The sign of \( e_M^H \) is indeterminate also because it’s linear combination of \( e_h, e_m \) and \( e_M^M \).

However, in the preferential-policy regions, we have \( e_M^M = \frac{-B u'_{HH}}{\alpha_1 A + \alpha_2 B} > 0 \) because \( C=0 \). That is,
in these regions, an increase of OCP penalty rate would increase the probability that a Han people choose to marry a minority people.

Moreover, in these regions, we can express \( e^H_M \) as follow by substituting formulas (1), (2) and (4):

\[
e^H_M = \frac{r^H_M (\frac{1}{h_m} A - \frac{1}{r^H_H} B - \frac{1}{m_m} D) u'_H}{\alpha_1 A + \alpha_2 B} \quad (6)
\]

where \( D = (\alpha_3 \alpha_7 - \alpha_4 \alpha_6) \). By substituting the values of \( a_i(s) \), we find that \( (\frac{1}{h_m} A - \frac{1}{r^H_H} B - \frac{1}{m_m} D) = -\frac{1}{h_0} (\frac{1}{h_m} + \frac{1}{m_0}) \frac{1}{r^H_H} < 0 \). Thus, \( e^H_M > 0 \) holds in the preferential-policy regions.

**Proof of Prediction 3:** By definition, \( \tau_{HM} = \frac{\ln \mu_{H0} - \ln \mu_{M0} + \alpha_{HM} - \gamma_{HM}}{2} \). We take derivatives and then have:

\[
\frac{d \tau_{HM}}{df} = -\frac{1}{h_0} e_h - \frac{1}{m_0} e_m \quad (7)
\]

Here, \( \frac{d \tau_{HM}}{df} \) is a linear combination of \( e_h \) and \( e_m \). In non-preferential-policy regions, it’s difficult to see the sign of \( \frac{d \tau_{HM}}{df} \). However, in preferential-policy regions, it’s obvious that the transfer from the Han spouse to the minority spouse is increasing in the fine rate because \( e_h < 0 \) and \( e_m > 0 \).

**Appendix C: Welfare Implications**

From the social welfare expressed as below,

\[
\Pi = \sum_i m_i \ln(\sum_j \exp(\tilde{\alpha}_{ij})) + \sum_j \tilde{m}_j \ln(\sum_i \exp(\tilde{\gamma}_{ij})) + \sum_{i,j \neq 0} \mu_{ij} c_{ij} f. \quad (8)
\]

We take derivatives with respective to the fertility penalty \( f \) to the equation above. Denote that \( P_{ij} = \frac{\exp(\tilde{\alpha}_{ij})}{\sum_k \exp(\tilde{\alpha}_{ik})} \) is the proportion of type \( i \) men married to type \( j \) women; correspondingly, \( Q_{ij} = \frac{\exp(\tilde{\gamma}_{ij})}{\sum_k \exp(\tilde{\gamma}_{kj})} \) the proportion of type \( j \) women married to type \( i \) men. Then we have:
\[
d\Pi = \sum_i \tilde{m}_i \sum_j P_{ij} \frac{d\bar{\alpha}_{ij}}{df} + \sum_j \tilde{m}_j \sum_i Q_{ij} \frac{d\bar{\gamma}_{ij}}{df} + \sum_{i,j \neq 0} \mu_{ij} c_{ij} + \sum_{i,j \neq 0} \left( \frac{d\mu_{ij}}{df} c_{ij} + \mu_{ij} \frac{dc_{ij}}{df} \right) f
\]  

(9)

Assuming the gains of being unmarried is not changed by the penalties, and considering that \( \bar{m}_i P_{ij} = \bar{m}_j Q_{ij} = \mu_{ij} \) for given \( i,j \), and \( \frac{d\bar{\alpha}_{ij}}{df} + \frac{d\bar{\gamma}_{ij}}{df} = \frac{du_{ij}}{df} = -c_{ij} \), we have

\[
\frac{d\Pi}{df} = -\sum_{i,j \neq 0} c_{ij} \mu_{ij} + \sum_{i,j \neq 0} \mu_{ij} c_{ij} + \sum_{i,j \neq 0} \left( \frac{d\mu_{ij}}{df} c_{ij} + \mu_{ij} \frac{dc_{ij}}{df} \right) f
\]

= \sum_{i,j \neq 0} \left( \frac{d\mu_{ij}}{df} c_{ij} + \mu_{ij} \frac{dc_{ij}}{df} \right) f

(10)

Divide the both sides by \( \bar{H} + \bar{M} \), we can have the equation (*) in the main text.
References


Table A1. Impact of Change in Fertility Fine Rate age 18-25 on Change in Marriage Outcomes

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>(1) Change in Unmarried Rate</th>
<th>(2) Change in Unmarried Rate</th>
<th>(3) Change in Unmarried Rate</th>
<th>(4) Change in H-M Marriage Rate</th>
<th>(5) Change in H-M Marriage Rate</th>
<th>(6) Change in H-M Marriage Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample</td>
<td>Full sample</td>
<td>Han</td>
<td>Minorities</td>
<td>Full sample</td>
<td>Preferential-Policy Regions</td>
<td>No-Preferential-Policy Regions</td>
</tr>
<tr>
<td>Change in Fertility Fine Rate at age 18-25</td>
<td>0.971** (0.375)</td>
<td>1.067** (0.395)</td>
<td>0.534 (0.583)</td>
<td>0.293* (0.164)</td>
<td>0.618** (0.333)</td>
<td>0.0756 (0.114)</td>
</tr>
<tr>
<td>Observations</td>
<td>6,136</td>
<td>3,106</td>
<td>3,030</td>
<td>6,268</td>
<td>2,463</td>
<td>3,805</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.462</td>
<td>0.610</td>
<td>0.138</td>
<td>0.003</td>
<td>0.013</td>
<td>0.004</td>
</tr>
</tbody>
</table>

*Covariates controlled for*

- Ethnicity (Han/minorities): Yes, Yes, Yes, Yes, Yes, Yes
- Hukou (Urban/Rural): Yes, Yes, Yes, Yes, Yes, Yes
- Year of Birth & Year FE: Yes, Yes, Yes, Yes, Yes, Yes

Notes: Data source is Census 2000 and 2005. The covariates include dummies for Han/Minorities, type of hukou, year of birth, survey year and interactions of the last two. Regressions are weighted by population in each birth cohort and robust standard errors in parentheses are clustered at province level.

*** p<0.01, ** p<0.05, * p<0.1
Table A2. Impact of OCP fine on Interethnic Marriages among Minorities

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable</td>
<td>Interethnic marriage among minorities (Yes = 100)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample</td>
<td></td>
<td>Preferential-Policy Regions</td>
<td>No-Preferential-Policy Regions</td>
</tr>
<tr>
<td>Mean of Dep. Var.</td>
<td>3.777</td>
<td>3.950</td>
<td>3.417</td>
</tr>
<tr>
<td>Fertility fine rate at age 18-25</td>
<td>0.245 (0.157)</td>
<td>0.0604 (0.150)</td>
<td>0.502 (0.343)</td>
</tr>
<tr>
<td>Observations</td>
<td>362,918</td>
<td>231,661</td>
<td>131,257</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.045</td>
<td>0.040</td>
<td>0.072</td>
</tr>
</tbody>
</table>

**Covariates controlled for**
- Local Minority Prop.     Yes    Yes    Yes
- Local Male Prop.     Yes    Yes    Yes
- Ethnicity FE     Yes    Yes    Yes
- Gender & Age FE     Yes    Yes    Yes
- Province & Hukou FE     Yes    Yes    Yes
- Age & Year FE     Yes    Yes    Yes
- Province-Yob Trends     Yes    Yes    Yes

Notes: Data source is Census 2000 and 2005. The covariates are the same as those in Table 2. Sampling weights are applied and robust standard errors in parentheses are clustered at province level.

*** p<0.01, ** p<0.05, * p<0.1
Figure A1. Geographic Ethnicity Distribution in China

Notes: This map is from the book “A Mosaic of Peoples: Life Among China’s Ethnic Minorities” (1992) by China Nationality Art Photograph Publishing House.
Figure A2. Distribution of Marriage Age

Notes: Data source is Census 2000 and 2005. Only married and the ones with valid marriage age are kept.