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Effects of Birth Control Policies on Women’s Age at First Birth in China

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Abstract
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Keywords
Age at first birth, China, Birth control policies, Educational expansion

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Effects of Birth Control Policies on Women’s Age at First Birth in China

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Abstract The end of the “one-child” policy in China has brought the discussion of how much birth control policies have actually affected women’s childbearing behavior back into the spotlight. Some people suggest that birth control policies explain most of the fertility decline in China, but others believe that socioeconomic development has also played a decisive role. To shed light on these questions, instead of analyzing the impacts of policies on the overall level of fertility directly, we explore the effects of different local birth control policies on another aspect of childbearing behavior, timing of first birth. This study yields two significant findings. First, women who followed less strict birth control policies tended to have their first birth earlier than those who followed the strictest one-child policy. Second, concurrent with educational expansion, there was more heterogeneity in fertility intentions and variation in birth control policies among younger, higher-educated cohorts than their older, less-educated counterparts. Together, these imply that the effect of birth control policies was still strong, even for more educated young women. The Chinese fertility rate might see a temporal rise under the newly loosened birth control policy while the trend to low fertility will continue in the medium to long term.

Keywords Age at first birth; China; Birth control policies; Educational expansion;

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The fertility transition and fertility level in China have received considerable attention due to both the strict birth control policies and the country’s sheer population size. The intention of limiting population growth in China started around 1953, when the population was 581 million. In 1962, the total population increased dramatically to 700 million, which pushed the government to advocate later marriage and promote a few urban educational programs directed towards maternal and child health. National population policies and population programs started in the early 1970s, when the total fertility rate (TFR) was above 5 and the population was 850 million. At this point, China accounted for more than one fourth of the world population, but only 7 percent of the world’s arable farmland. The “later, longer and fewer (wan-xi-shao)” campaign, which started in 1973, was the first influential national policy. It stressed later marriage (wan), longer intervals between births (xi), and fewer children (shao). The more widely known one-child policy was launched in 1980. At this point, the population of China was almost 1 billion people, the majority of whom were to be in childbearing ages, with half under 21 years old and two-thirds under 30 years old. However, great resistance to this strict policy resulted in a more flexible policy known as “kai xiaokou, du dakou" in 1984, which allowed more couples to have a second child, and limited births of parity three and higher as well as unauthorized second births. On Oct 29th, 2015, the largest change in China’s birth control policies since the 1990s was announced – a second child is now generally allowed.

The decline of fertility in China has been remarkable, dropping from a TFR higher than 5 in the early 1970s to replacement level (TFR around 2.1) in the early 1990s (UNPD 2015). It continued dropping until 2000 and has stabilized around 1.60 since then. The rapid decline of TFR has ushered in a new era with its own set of challenges, namely population aging. The proportion of the population older than 60 years old is now more than 15% (NBS 2015), and the baby boomers (born between 1962 and 1970) will start to enter this group in the next couple decades. This challenge combined with current low fertility levels has pushed the government to relieve the birth control policy.

Popular media and policy discussions have hence focused on one critical question since the announcement of the policy reversal in 2015: How much influence will the 2015 loosened policy have on Chinese childbearing behavior? While there seems to be some consensus that the potential effect is likely to be small (The Economist 2015; Buckley 2015), evidence for this conclusion is not always convincing. Specifically, we argue in this paper that to answer this question, we need to examine how past birth control policies have affected Chinese women’s childbearing behavior and how much fertility has been constrained by the birth control policies before 2015, particularly among young cohorts. If the previous birth control policies had limited impacts on women’s childbearing behavior, we might see trivial effects and the fertility trend will not be affected by the 2015 policy change. Thus more loosened policies or even polices encouraging childbearing should be implemented in the near future to counteract the forthcoming aging challenge. If women’s childbearing behavior was still constrained by the previous policies, the fertility level will recover under the loosened birth control policy.

Though some studies on policy effects claimed that around 300 to 400 million births were averted before the 21th century in China due to the policy influence (W. Chen and Zhuang 2004; Wang 2006; Mosher 2011), the effects of the policies on women’s childbearing behavior have been debated. Some studies revealed that more than half of the drop in Chinese fertility from pre-transitional levels before 1970 to near replacement level in 1990 were due to government influence (Feeney and Feng 1993). A simulation of the fertility rate (based on the experience of other
countries) sought to examine what the fertility rate in China would have been in the absence of birth control policies, and this study put Chinese TFR at 2.5 in 2008 (Tao and Yang 2011), in contrast to the actual TFR of around 1.6. However, rapid socioeconomic development and globalization in recent decades have brought about an ideational shift from resisting to embracing the “small family” ideal in Chinese families (Merli and Smith 2002; H. Zhang 2007). Some evidence suggests that China’s current low fertility is not simply a prescribed result of the one-child policy, as socioeconomic development has played a decisive role (J. Chen et al. 2009; Zheng et al. 2009; Cai 2010). One meta-analysis reported that the ideal number of children has stabilized between 1.6 and 1.8 since 2000 (Hou 2015).

These controversies come from the difficulty in disentangling the impacts of birth control policies from the influence of rapid socioeconomic development in China. Though the mechanism of how economic growth affects fertility level is not straightforward, educational expansion, which is one of the main aspects of socioeconomic development, can affect women’s childbearing behavior directly. There is ample evidence that more educated women have fewer children. First, women with higher education have higher labor force participation rates and face higher opportunity costs of raising a child, resulting in fewer children (Becker 1991). Moreover, more education not only spreads values about gender equity, but also increases the real power of gender autonomy (McDonald 2000), which has empowered women in their decision-making in relation to both household labor and fertility. Besides, educational expansion is supposed to postpone women’s childbearing: the longer the time spent in school, the lower the risk of being exposed to pregnancy because of the reduced time available to engage in sexual activity early in the life course (Grant 2015). This is particularly true in China where, before 2005, students enrolled in college or universities were not allowed to get married by law. Also, the longer a young woman remains in school, the longer exposure she has to alternative values for postponing childbearing behavior (Bavel 2010). These, taken together, suggest that higher education will delay childbearing, shorten the duration of women at childbearing years, and result in fewer children that a woman will bear during her lifespan.

Our findings are based on a nationally-representative micro-level data, and examine the timing of giving birth rather than fertility level to affirm the effect of birth control policies in shaping Chinese women’s childbearing behavior, even for young cohorts during a period of rapid socioeconomic development in China in the late 1990s and early 2000s. After controlling for various variables measuring socioeconomic status and development levels, women who followed less strict policies tended to have first births earlier than those who followed the strictest one-child policy. We also find a U-shaped effect of policy among young cohorts: the less strict policies tended to have the strongest effects on timing of childbearing among the least educated and most educated groups. Based on these results, we expect that the fertility rate might rise in the short term. To infer the effect of policies on fertility, we code the exact birth control policy for each woman and use extended Cox model for analysis on age at first birth. To capture the socioeconomic change across cohorts, we conduct statistical models separately for successive birth cohorts. These cohort-specific analyses also show that the relationship between educational level and women’s birth control policies is different across cohorts along with the educational expansion. There was more heterogeneity among younger, more educated cohorts. That is, they had more variation in both birth control policies and fertility intentions than older cohorts. This increasing heterogeneity in the more educated group helps us to identify how the policies shaped women’s childbearing behavior.
Analyzing effects of birth control policies

The task of assessing the impacts of birth control policies on women’s childbearing behavior is complicated by the fact that, since 1984, local governments have started to make their own birth control policies. At least 20 minor exceptions have been made for a second child (Gu et al. 2007) and the localized policies can be grouped into four categories: 1) One-child policy: each couple is expected to have only one child. 2) One-and-a-half-child policy: couples are allowed to have a second child after a specified birth interval if the first birth is a girl. 3) Two-child policy: couples are allowed to have two children. 4) Three-or-more-child policy: couples from minority groups or couples who meet several criteria can have more than two children [Figure 1]. Even in the same province, different women will follow different policies. Gu et al. (2007) computed the average provincial and national policy fertility levels (zhengce shengyulu)² based on different birth policies of 420 prefecture-level units³ in China. It turns out that during late 1990s, about 35.4 percent of Chinese people followed the one-child policy and the majority of Chinese lived in areas with a policy fertility level at 1.3 to 2.0 children per couple. However, most of the current research has estimated the policy effects based on the change of aggregate fertility rate at either the regional or national level, which estimates the fertility level of a group of women who actually followed different policies. Given the large variation of birth control polices even within the same region, we cannot learn their impacts on individual’s childbearing behavior and how people will react to the 2015 policy change from these studies. Others have concentrated their studies on subgroups with less policy variation and indicated that socioeconomic development was the most important factor of the transition to below-replacement fertility in China (Zheng et al. 2009; Cai 2010). However, the conclusions from these studies are only for highly-selected subgroups (less than 10% of Chinese population) and not for the general population. The two provinces (Zhejiang and Jiangsu) they studied are the most developed provinces with the highest GDP per capita since the early 1990s. Zhejiang province was one of the only two provinces (another is Xinjiang with much less strict birth control because of a high proportion of minority groups) that actually accomplished the goal of birth control policies in 1989 (Peng 2015). Jiangsu province is one of the two provinces (another is Sichuan province) with the strict one-child policy since 1980 without more loosened local polices. In all, these studies on Chinese fertility level did not show clearly how the previous birth control policies shaped women’s childbearing behavior at the individual level, and thus provided limited information about how individuals’ childbearing behavior will react to the 2015 loosened policy.

A further complication is that the impact of birth control policies on childbearing behaviors is intertwined with the influence of educational expansion. According to the sixth census conducted in 2010, only around 20% of the women in 1970 birth cohort received at least high school education, while it rose to about 38% for women born in 1983 and further increased to around 50% for women in 1989 birth cohort [Figure 2]. Rapid educational expansion and socioeconomic development in China have changed people’s fertility intentions, which mitigate the policy constraints for young cohorts. More importantly, in China, the educational expansion helped spread the knowledge of reproductive health and reasons for implementing birth control. This also partly

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² Fertility levels that would be obtained locally if all married couples had births at the levels permitted by local policy
³ Prefecture-level units are directly under the jurisdiction of the province
explained why, at the start of the birth control policies, more educated people showed higher acceptance (Merli and Smith 2002). Most people started to learn the same language (Mandarin) for communication after going to school, as the Chinese language consists of hundreds of local language varieties, many of which are not mutually intelligible. According to diffusion theory (Bongaarts and Watkins 1996; McNicoll 2011) for contemporary fertility transitions observed in other countries, fertility decline is not simply an adjustment to changing socioeconomic circumstances. Social interaction, which is largely based on sharing the same language intelligible to one another, acts as a channel for fertility change. More rapid fertility decline occurs in countries where a multiplicity of channels connects communities, and slower fertility decline happens where such channels are sparse. Thus, accompanied with educational expansion, the effects of birth control policies on childbearing behavior become unclear. On the one hand, education and urbanization were producing conditions for an incipient transition and the fertility decline was underway in some subgroups even before direct birth control policies were implemented (Lavely and Freedman 1990). The high acceptance of policy-sanctioned family size occurred in the most urban and industrialized counties and in the counties with the most rigid family planning policy (Merli and Smith 2002). On the other hand, we can never assign education as the “cause” of the substantial drop of fertility level in China, because women’s education levels are also a proxy for other community-level factors, such as more developed cities with better health services and stricter birth planning programs. Previous studies proved that the strong relationship between education and fertility weakened in China after the onset of government-sponsored fertility control programs, undermined by policy goals and bureaucratic regulations tailored to specific urban levels (Lavely and Freedman 1990). The acceptance of policy-sanctioned family size also followed a clear development gradient (Merli and Smith 2002).

As will be explained in the following data and method sections, we solve the first problem by coding the exact birth control policy that a woman should follow and examining the timing of giving first birth rather than fertility level directly. The second problem is solved by conducting statistical models for successive cohorts to capture the undergoing educational expansion and its impacts on women’s childbearing behavior.

Data and variables

Data

The data used for this study are 20 percent random cases drawn from China’s 2005 1% Population Inter-census Survey (mini-census). It was conducted by the National Statistics Bureau who collected information on 1% Chinese population in 2005. This nationally-representative survey covers demographic information of all household members, living conditions, and the number of children that a woman has ever born. Based on this micro-level information, the specific birth control policy that a woman follows can be coded according to the personal characteristics reported in the survey. It solves the problem imbedded in the previous literature that the exact birth control policy cannot

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4 These varieties can be classified into seven to ten groups, the largest being Mandarin (e.g. Beijing dialect), Wu (e.g. Shanghainese), Min (e.g. Taiwanese Hokkien), and Yue (e.g. Cantonese). The differences are similar to those within the Romance languages, with variation particularly strong in the more rugged southeast, described as “different accents for every 5 kilometers (shili butong yin)” in Chinese.
be coded from aggregate data. Also, as this survey covers samples from all provinces in mainland China, individuals are clustered in the provincial level, which allows us to control for the different socioeconomic and development speed among provinces in our statistical models.

**Dependent variable: Age at first birth**

In this paper, instead of assessing the fertility level directly, we look at the impact of different birth control policies on another important indicator of childbearing behavior, age at first birth (AFB). As we explain below, studying AFB is a desirable approach. AFB is a good indicator of the number of children that a couple tends to have, for the association between early childbearing and higher completed fertility has long been widely observed (Bumpass, Rindfuss, and James 1978; Trussell and Menken 1978; Morgan and Rindfuss 1999). Studies also prove the connections between age at first attempt to become pregnant and the number of children or the propensity to have any children (after eliminating possible genetic influences) (Kohler, Rodgers, and Christensen 1999). A recent study based on longitudinal data also underscored the importance of combining timing and number outcomes, which might fruitfully be employed together in demographic modeling (Miller, Rodgers, and Pasta 2010). All these studies suggest that the more children a couple wants to have, the sooner they want to start having them.

In Chinese contexts, it would make sense for women who followed less strict policies to have more children during their lifespan than women who followed the one-child policy. If the previous birth control policies constrained women’s complete fertility rate, we would observe that women who followed less strict policies gave birth earlier than women who followed the one-child policy. In this sense, examining the timing of giving birth also answers the question of whether the birth control policies still affect women’s childbearing behavior after decades of fast socioeconomic development. If so, we can expect that, after the elimination of the one-child policy, women would have more children during their lifespan and have a higher completed fertility rate. Further, by learning how much the timing of childbearing has been affected by these policies, we also warrant further research estimating how much the TFR change can be attributed to the changing timing of giving birth and how much to the quantum fertility level. Scholars have long highlighted that the conventional estimate of observed period TFR is biased if the timing of childbearing is changing (Ryder 1956; Ryder 1980; Bongaarts and Feeney 1998), known as the tempo effect or tempo distortion. Both the quantum and tempo changes, confounded with period and cohort changes, give rise to the observed year-by-year changes in fertility rate (Bongaarts and Sobotka 2012). The tempo-affected TFR might introduce both some misinterpretation of fertility level trends and exaggeration of the gap between intended and achieved family size. If the loosened policy will affect women’s AFB, further research about the impacts of the 2015 loosened policy should take the tempo distortion into account when studying the fluctuation of the period TFR that will be observed in the near future.

The data provide the birth year of women and her children, so we can compute the AFB for women from different birth cohorts. Because different birth control policies were implemented in 1984, we only focus on women born between 1970 and 1983 (22 to 35 years old in 2005). When the policies were localized, the 1970 cohort was 14 years old, one year younger than the conventional used youngest age (15 years old) of childbearing age for women. Those born in 1983 were 22 years old in 2005. The AFB is not explicitly incorporated in the mini-census questionnaire, so we

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5 In China, a student who progressed through school on time and without interruptions would be expected to finish middle school by
estimate AFB by subtracting the birth year of the household head or the wife of the household head from her first child’s birth year (see detailed description of the estimation procedure in Appendix). For any study concerning the timing of life-course events, observed cases are censored in cross-sectional data. Women who had not had their first birth before 2005 are censored and are also included in our data.

Specifically, we also consider the potential selection issue resulting from getting information from the women who are the household head or the wife of the household head. Single or childless women are less likely to be a household head or a wife of a household head, especially women in young cohorts who are likely to receive more education and postpone getting married. To eliminate this selection issue, we also draw childless women who were coded as “daughters” in the household, into our database. Thus our analysis will not be biased when comparing the timing of giving first birth among successive cohort groups.

**Independent variable: Birth control policies**

The coding of birth control policy for each woman is based on the criteria of different local policies in 1984. We code the exact policy according to the major policy settings [Figure 1]\(^6\), because other exceptions for a second child or child at higher order only cover a trivial proportion (Gu et al. 2007, 20). Two categories of birth control policies are specified in this analysis: the strictest one-child policy and the less strict policies, including the one-and-a-half-child policy, two-child policy and the three-or-more-child policy.

The criteria for different birth control policies mainly consist of three components: hukou status\(^7\), minority or not, and provinces where the hukou is registered for both the women and her husband. For married women with matched husband’s information or women with nonagricultural hukou, the birth control policy can be easily coded. However, the policy cannot be directly coded for women who are married but missing husbands’ information or single with agricultural hukou, because the information on the husband is needed to meet the criteria for less strict birth control policies. We solve this problem in two steps. First, we assume that those who were not migrants in 2005 were likely to be married to males with the same hukou and follow less strict policies. This assumption is legitimate because our sample only consists of those older than 22 and most of them should have finished their education. It is unlikely for them to change hukou status, because the transition of hukou status is most likely to happen when people graduate from universities or colleges. Also, even if single women with agricultural hukou moved to urban areas after 2005, they were unlikely to marry a man with nonagricultural hukou, who was considered more advantageous, because of the traditional hypergamy in China (Mu and Xie 2014; Yu and Xie 2015). Second, single female migrants with agricultural hukou are also coded to follow the less strict policies and contribute person years to this category to provide a relatively conservative estimate. That is, we code the policies only based on the eligibility of female. Less than 1.8% of the cases cannot be coded for this main independent variable in our study. Our final dataset has 139,919 cases.

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\(^6\) For those who can follow less strict policies, information of both couple is needed, thus there is a potential selection in that who can follow less strict policies are selected with higher risk of giving birth by being married. We also run robust test (Appendix Table B and C) after adopting a different strategy of coding, in which the exact birth control policy that a woman has to follow only depends on her own characteristics. Because only the information of female is needed by this strategy, all the 142,462 cases are utilized in the robust tests. The results of these robust tests also support our argument.

\(^7\) hukou status is the status of each person registered in the Household Registration System in Mainland China. It mainly has two statuses: non agriculture and agriculture.
Statistical methods and model specification

We use the extended Cox regression to model the effects of different birth control policies on the hazard rate of entry into parenthood. Compared with parametric models of event history analysis, the Cox model uses partial likelihood estimation (semi-parametric model), which works reasonably well with a wide range of baseline hazard functions when the shape of the hazard function is not *a priori* known. Compared with the most widely used Cox model, the extended Cox regression permits us to allow for non-proportionality (interaction with time). The Efron method is used for better approximation when we conduct Cox regression for discrete-time data (Allison 2014). For this analysis, the risk of giving birth is assumed to begin at age 15. Though the legal age of marriage in China is 22 for males and 20 for females since 1981, some people still take the wedding date as the start of marriage (instead of registered marriage), which is accepted by friends and relatives. Births given after this culturally accepted marriage are rarely considered as births out of wedlock. Many Chinese studies have proved it true even for recent cohorts (Yu and Xie 2015).

As has been explained, the educational expansion can change people’s fertility intentions and mitigate the constraints imposed by the birth control policies. However, concurrent with the rapid educational expansion, the composition of women, in terms of different policies, shifts across cohorts, and affects our study on the timing of giving first birth. A previous study has indicated that there is a lower selectivity over time for young women who achieve higher levels of grade attainment (Berelson 1974), especially under the rapid educational expansion. In this study, we term “selectivity” as women who are the most educated and tend to be those who have to follow the strictest one-child policy. This selectivity is high before 1990, because women who had more access to education were living in urban areas and also had to follow the strictest one-child policy. With rapid educational expansion, the population composition of underlying factors affecting childbearing behaviors also shifted, as large numbers of students who would have had limited exposure to schooling could now have more access to educational resources (Grant 2015). In this sense, educational expansion has led to more heterogeneity in young cohorts. That is, the highly educated women in older cohorts were of high selectivity, but the young cohorts with higher proportion of better educated people were of lower selectivity compared with their older counterparts. So, women in young cohorts within high educational level tended to show more variation of birth control policies, and revealed stronger policy effects than women from older cohorts because of more heterogeneity within them.

To capture the changing relationship between policies and education over time, we compare childbearing behavior for successive birth cohorts. Due to fast socioeconomic change, especially educational expansion, we divide all the birth cohorts (born between 1970 and 1983) into three groups: Cohort I (born between 1970 and 1974), Cohort II (born between 1975 and 1979), and Cohort III (born between 1980 and 1983). For control variables, because the *hukou* status is the main criterion of birth control policy and the variable used for policy coding of single women, it is not included in the model to avoid multicollinearity. Instead, we use living conditions, including access to tap water, flushing toilets and welfare, to control for individuals’ socioeconomic status. These variables might perform better than the *hukou* status in terms of controlling for other potential factors related to AFB, because they measure the living conditions and access to public goods of individuals directly. A dummy variable indicating whether a woman belongs to a minority group is also included in our models. Since all the cases in our data are clustered at the provincial
level, we conduct Cox models with stratification by 31 provinces in our analysis, with the assumption that the baseline rate of each province is different, and allow for the interaction between province and time. So the regional differences and impact of varying speeds of socioeconomic development can be controlled for in our analysis.

**Results**

**Patterns of timing at first birth**

We describe how patterns of timing at first age changed over different policies and educational levels for different cohorts, respectively. We present the first quartile (25%), median (50%) and third quartile (75%) of the age at first birth by cohorts and policies [Table 1], and also by cohorts and educational levels [Table 2]. For example, in Table 1, for women from Cohort II following the one-child policy, 25% gave birth before age 23 and half of them gave birth before age 27. Because the sample is censored at age 22-25 for Cohort III, some information is missing. For the women in the youngest cohort group following the one-child policy, less than 25% gave birth when they took the 2005 mini census.

Comparing the timing of giving first birth, young cohorts postponed their childbearing behavior substantially. 25% of women from Cohort I and Cohort II gave birth to their first child at age 21 and 22, respectively. But for Cohort III, one-quarter of them gave birth before 24 years old. We also find a general pattern of earlier childbearing across women who followed less strict birth control policies within each cohort group. For example, in Cohort I, 25% of women following the one-child policy had their first birth before age 22, but for those following less strict policies, it was age 21. In Cohort II, half of the women who followed the one-child policy gave birth before age 27, but for women who followed less strict policies, half of them gave birth before age 23. Less than one quarter of the women who followed the one-child policy in Cohort III gave birth before 2005, but of those who followed less strict policies, 25% gave birth before 23 years old. Additionally, within each cohort group, women with higher educational levels tended to give birth later. This corresponds to the findings in other research about the timing of first birth and education.

In sum, the postponement of childbearing behavior is clear across cohorts. Within each cohort group, both the birth control policies and educational attainment affected the timing of first birth.

**Impacts of birth control policies and educational expansion**

Table 3 presents coefficients from the Cox models by different cohort groups. Negative coefficients indicate lower risks of entry into parenthood, namely older age at first birth and/or higher chance of childlessness. The first columns for each cohort group are the baseline models with our main independent variables and control variables. The results in the second columns are non-proportional models after specifying the stratification by provinces (i.e. adding the interaction terms between provinces and time to the baseline models), which allows for different functions of time for each province without making any parametric assumption (Allison 2014). Thus these models not only account for the significant regional differences within China, but also take the impact of varying development speeds or trajectories of different provinces into account. The decline of widely-used measures for comparing maximum likelihood models (AIC and BIC) suggests that the inclusion of
these interactions improve our estimates substantially. By comparing the coefficients of policies between models with and without the interaction terms within each cohort group, we can see that the effective sizes of policies are bigger in models with interaction terms. For the youngest cohort group, the policy effect becomes statistically significant. That is, after controlling for the confounding influence of development as a period impact, the policy effects tended to be stronger.

Because the models in the second columns fit the data much better, our analyses are mainly based on results of these models. The models for all three cohorts show that the pure effects of less strict birth control policies increased the odds of giving first birth for all cohorts. For Cohort I, compared with women following one-child policy, women who were eligible for less strict policies have 29.30% \( (e^{0.257} - 1) \) higher odds of parenthood. For Cohort II and Cohort III, the odds is 19.01% and 9.75% higher for women following less strict policies than those who followed one-child policy. These persistent policy effects suggest that women who were eligible for less strict policies tended to give birth earlier than those who followed the one-child policy for all the cohorts. However, the coefficient of polices is getting smaller, which indicates that the ideational change towards smaller family size made the birth control policies less effective across cohorts. That is, for young cohorts with lower fertility intentions, the constraints imposed by the policies weakened. Besides, the effect sizes of educational levels are bigger in young cohorts, which also suggests that socioeconomic development has gradually changed people’s fertility intentions independently of policies. As development first affected the most educated people and then followed the education gradient, the differences among people with different educational levels are bigger and the coefficients of education become larger, concurrent with the rapid socioeconomic development in China. Compared with the effect size of less strict birth control, the impact of receiving more education is much bigger. Thus, we can expect that, in the long term, the fertility rate will not rise remarkably even without the strict birth control policy.

The results in Table 4 present the coefficients of policies, education, and their interaction terms. For Cohort I, none of the coefficients of the interaction terms is statistically significant, which indicates the same policy effects for all the educational levels. For Cohort II, one interaction term shows significant different risks of giving birth. For women who were illiterate or finished primary school, those who followed less strict policies have 30.21% higher odds of giving first birth than those who followed the one-child policy. Moreover, for Cohort III, all of the interaction terms become statistically significant and positive, which indicates that after the educational expansion, there was more heterogeneity within each educational level. Specifically, for the highly educated group, the increasing proportion of women who were eligible for the less strict policies but might have not finished high school without educational expansion contributed to the strong interactive effects. The AIC and BIC also indicate that the inclusion of the interaction terms improve the models for the young cohorts but not the older cohorts. Both of the measures show that for the Cohort I, the model without the interaction terms is better than that with the interaction terms. However, for Cohort III, the model with the interaction terms have smaller AIC and BIC than the model without the interaction term. Though the pure policy effect for our reference group (women with only middle school education) is not positively significant for Cohort III, our estimates for policy effects are conservative, as explained in the Data and Variable section. Thus, we expect a U-shaped influence of policy among people with different educational levels.

The comparisons among cohorts show that, for young cohorts, the interaction between policies and educational levels got stronger in affecting the age at first birth. These differences of
interaction terms among different cohorts result from the small overlap between strictest one-child policy and high educational level in young cohorts, as has been discussed in previous parts. Older cohorts who were more educated were highly selected. With the rapid educational expansion in China, young cohorts with more variation in family background, which determined the exact birth control policy for a woman to follow, were receiving more education compared with older cohorts. We see this variation by comparing composition of women following different birth control policies among those who graduated from high school or above across cohorts [Table 5]. In Cohort I, only 9.98% of women who had finished at least high school were eligible for less strict policies, but this proportion increased to 15.39% in Cohort II and further grew to 22.42% in Cohort III. We can also find some proof by comparing the educational composition within woman who followed the same policy across cohorts [Table 6]. Overall, educational improvement was fast across cohorts. The biggest absolute increase of the proportion of women graduated from high school or above happened to women who followed the one-child policy. However, the proportion of those graduating from high school or above tripled from about 4% in Cohort I to more than 14% in Cohort III for those who were eligible for less strict policies. Thus, for women who followed less strict policies, the educational expansion was more efficient than those who followed one-child policy. With the educational expansion, women who followed less strict policies from Cohort III were more likely to achieve higher educational level than previous cohorts. Also, for those who were highly educated, the variation of birth control policies was bigger in Cohort III than in Cohort I and II.

In summary, our analyses of policies and comparisons between cohorts suggest that Chinese women’s childbearing behavior was postponed considerably under the rapid socioeconomic development, and that the constraints imposed by the policies weakened over time. However, even for young cohorts, the birth control polices still affected women’s childbearing behavior significantly. Along with educational expansion, the underlying shifting composition in more educated women across cohorts promised greater heterogeneity of fertility intentions and larger variation of birth control policies in younger and more educated cohorts. The results also showed that even for the more educated population, women who were eligible for less strict policies tended to give birth earlier and might have had more children than their counterparts. Thus for young cohorts, the policies presented a U-shaped impact, implying that the least educated and the most educated groups were likely to be most affected by a less restrictive birth-control policy.

Discussion and Conclusion

Previous studies on the impact of China’s birth control policies on fertility change provided a mixed picture. The controversies over policy effects rise from the difficulty in disentangling the influences of socioeconomic development on changing people’s childbearing behavior. Also, the complicated birth control polices prevented these studies from revealing the policy effects on individual’s childbearing behavior by only examining the aggregate fertility level. Capitalizing on micro-level data with individual-level policy identification, we try to solve these two problems by 1) coding the exact policy that a woman has to follow, 2) comparing the results among successive cohorts to control for cohort effects, and 3) adopting stratification methods in the Cox model to allow interaction between province and time to minimize the period effects. We also contribute to the studies on Chinese women’s childbearing behavior by examining the timing of giving first birth rather than fertility level directly. Our descriptive results suggest that the postponement of childbearing
behavior was remarkable across cohorts and women. Within each cohort group, women with higher educational level tended to have their first births later, which is consistent with other studies. Besides, women who were eligible for less strict policies also had their first birth earlier than those who had to follow the strictest one-child policy, suggesting strong effects of the policy women’s childbearing behavior even among young women in recent cohorts.

Through the comparisons of multivariate analyses among cohorts, we find that both birth control policies and education were important factors shaping young Chinese women’s childbearing behavior. More importantly, we find that for women in young cohorts, the interactions between policies and education were significant. These strong interactive effects did not appear in older cohorts because of the high selectivity: women who were highly educated were also those who had to follow the strictest one-child policy. However, for the young cohorts, there was more heterogeneity of fertility intentions and more variation of birth control polices among women with high educational levels because of rapid educational expansion. As a result, there is a U-shaped effect of policy: being subject to a more relaxed policy regime had the strongest accelerating effect on childbearing among the least educated (a group diminishing in size) and among the most educated (a group that is rapidly expanding).

Some studies indicate that socioeconomic development is the reason for the drop of fertility level in China. However, our results suggest that we cannot come to this conclusion for sure, because birth control policies are still imposed in China and counterfactual facts can hardly be built. Highly educated people showed higher acceptance of birth control policies (Merli and Smith 2002) partly because they were more likely to have lower fertility intentions. But these highly educated people were also who were most likely to understand the rationale of implementing birth control policies in China. Now after decades of rapid educational expansion, the highly educated groups had more heterogeneity and more variation of birth control policies, so the strong policy effects started to show for these highly educated people. As an old Chinese proverb goes, “It takes ten years to grow trees but a hundred years to rear people.” Even though fast urbanization, educational expansion, and low fertility intentions produced the conditions for low fertility level in China, some Chinese still constrain their childbearing behavior to keep the low birth rate.

Our analysis also implies that the fertility rate will rise under the 2015 loosened policy in the near future. Because the 2015 policy generally allows for a second child and some women have been following the two-child policy since 1984, we have an idea as to how women who followed the strict one-child policy will behave under the 2015 universal two-child policy. As we have suggested, the timing of giving first birth is a good indicator of complete fertility rate. Because women who followed less strict birth control policies tended to have their first births earlier, after controlling for other variables, we would expect that, under the 2015 universal two-child policy, women will give birth earlier and expect to have more children during their lifespan. This will push up the quantum level of period fertility rate. Also, the changing timing of giving birth will bring tempo distortion to the fertility measure. The slowdown of the postponement of childbearing behavior, which might be brought by the policy change, will also induce the recovery of the period fertility rate. However, the rise of the fertility rate might be temporary, as the results also show that the effective size of policies is declining with the impact of education growing across cohorts. The results also show that the influence of education remains bigger than the policy effects, which indicates that the trend of low fertility rate is irreversible. Besides, as some studies have revealed, any serious change in China’s birth control policies is likely to derive from initiatives at the local level (Merli, Qian, and
Smith 2004). The policy change was made only after the government believed there will be an appropriate reaction, which is neither a remarkable rise nor no effects at all. The elimination of the strict one-child policy, in our opinion, is therefore likely to lead to a rise of fertility rate in the short term, while overall, fertility will remain at a fairly low level in the long run.

In November 2013, a minor change in China’s birth control policies allowed couples to have a second child if one of the couple comes from a one-child family. Early statistics indicated that only about 10% of the couples eligible for a second child applied in 2014, and some scholars claimed that China is in the “low fertility trap” (Ma and Gu 2015). However, others believe it is still too early to tell if the previous policy change made any difference (Liu and Wang 2015). First of all, though the policy was announced in November 2013, implementation of the new policy lagged locally. For example, Beijing started the loosened policy in February 2014. Second, 2015 is the “Goat Year”, which is traditionally considered as an unlucky birth year for girls. Because most of the eligible couples for the 2013 loosened policy were from older cohorts, some of them might still take it into account when they decide the timing of giving birth. Data also showed that more than 50,000 applications for a second child were made in Beijing between January 2015 and August 2015, compared with only 30,000 made in 2014. This increase partly reflected the lagged reaction to the policy change and the impact of the “Goat Year”. Further, a recent study also indicated that though the fertility rate of first births is decreasing in recent years because of the postponement of childbearing, the fertility rate of second child has been stable and seen a bit increase since 2000 (Zhao 2016). Besides, the reaction to the loosened birth control policy in 2013 should not be a reference for the newly released one in 2015 because of different groups of people who are eligible. The eligible couples for the 2013 loosened policy were those from which either of the couple came from a one-child family. The one-child families were highly selected, as we have mentioned, in terms of nonagricultural hukou, living in more developed areas and highly educated. Because of the traditional hypergamy in China (Mu and Xie 2014; Yu and Xie 2015), children from one-child families were less likely to be married with people not from one-child families, most of whom were from less developed areas. If there were, the couples eligible for the 2013 loosened policy tended to have lower fertility intentions than the couples eligible for the 2015 loosened policy.

However, the great shift of Chinese ideational change toward small family makes the strict birth control unnecessary. Though the birth rate might see a bump in recent years, because some older cohorts still want to have a second child under the loosened policy, the change to a general two-child policy might not receive impressive reaction from the young cohorts. The long-term low fertility intentions guarantee that the fertility rate will not rise substantially under the loosened policy. Also, the increasing cost of raising a child has become a main concern of young cohorts about giving birth. Besides, research has suggested that women’s position in the labor market has deteriorated in urban China (S. Li and Ma 2007; C. Li and Li 2008), after the government stopped guaranteeing jobs to graduates after 1996. Specifically, the worsening trend is concentrated among mothers (Y. Zhang and Hannum 2015). The increasing wage gap between mothers and childless women in urban China was partly due to the economic transition that shifted part of the cost of childbearing from the state and employers back to women (Jia and Dong 2012). The growing gender inequality might lead to lower fertility of women.

This increasing gender inequality might be a resistance to the decreasing trend of son preference. Many studies revealed that the son preference affects the fertility level positively and

the actual fertility level is higher than the desired fertility level due to son preference (Song and Tao 2012). Empirical analysis on fertility intentions of migrants (Yang 2015) indicates that people may internalize the norms of having fewer children, but having a son remains a must. This will lead to the uncertainty of Chinese fertility level, and it may maintain higher fertility in China than that in South Korea or Japan. So other related policies should be accompanied with the loosening of the birth control, either for embracing the challenge or for people’s wellbeing.
<table>
<thead>
<tr>
<th>Year</th>
<th>Policy Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>‘Later, longer and fewer’ policy</td>
</tr>
<tr>
<td>1980</td>
<td>One-child policy (with about 20 exceptions)</td>
</tr>
<tr>
<td>1984</td>
<td>Either of the couple has non-agricultural <em>hukou</em> Chongqing (had been a part of Sichuan province till 1997)</td>
</tr>
<tr>
<td>2005</td>
<td>Two-child policy</td>
</tr>
<tr>
<td></td>
<td>The couple are both the single child in their own family (gradually implemented in provinces)</td>
</tr>
<tr>
<td></td>
<td>The couple have agricultural <em>hukou</em> in Ningxia, Yunnan, Qinghai, Guangdong, Hainan</td>
</tr>
<tr>
<td></td>
<td>The couple are both from minority groups (14 provinces)</td>
</tr>
<tr>
<td></td>
<td>The couple are both from minority groups and at least one is agricultural <em>hukou</em>, or both agricultural <em>hukou</em> and at least one is from minority group (Liaoning and Hunan)</td>
</tr>
<tr>
<td></td>
<td>The couple are both from agricultural <em>hukou</em> and at least one is from minority group (Guizhou)</td>
</tr>
<tr>
<td></td>
<td>The couple are both from minority groups and agricultural <em>hukou</em> (Henan and Gansu)</td>
</tr>
<tr>
<td></td>
<td>Non-agricultural <em>hukou</em> in Tibet</td>
</tr>
<tr>
<td></td>
<td>Three-or-more-child policy</td>
</tr>
<tr>
<td></td>
<td>The couple are both from minority groups whose population is smaller than 100 thousand</td>
</tr>
<tr>
<td></td>
<td>At least one of the couple is from 4 minority groups (Heilongjiang)</td>
</tr>
<tr>
<td></td>
<td>Agricultural <em>hukou</em> in Tibet</td>
</tr>
</tbody>
</table>

Note: Only major birth control policies are listed

*Figure 1 Variation in birth control policies in China between 1973 and 2005*
Figure 2 Percent of graduating from high school or above for women across cohorts

Table 1 Descriptive statistics for timing at first birth for women follow different policies across three cohort groups

<table>
<thead>
<tr>
<th>Age at First Birth</th>
<th>25%</th>
<th>50%</th>
<th>75%</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cohort I (born in 1970-1974)</td>
<td>21</td>
<td>23</td>
<td>26</td>
<td>61,083</td>
</tr>
<tr>
<td>One-child policy</td>
<td>22</td>
<td>25</td>
<td>27</td>
<td>26,268</td>
</tr>
<tr>
<td>Less strict policies</td>
<td>21</td>
<td>23</td>
<td>25</td>
<td>34,815</td>
</tr>
<tr>
<td>Cohort II (born in 1975-1979)</td>
<td>22</td>
<td>25</td>
<td>30</td>
<td>42,805</td>
</tr>
<tr>
<td>One-child policy</td>
<td>23</td>
<td>27</td>
<td>.</td>
<td>19,483</td>
</tr>
<tr>
<td>Less strict policies</td>
<td>21</td>
<td>23</td>
<td>27</td>
<td>23,322</td>
</tr>
<tr>
<td>Cohort III (born in 1980-1983)</td>
<td>24</td>
<td>.</td>
<td>.</td>
<td>36,031</td>
</tr>
<tr>
<td>One-child policy</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>14,877</td>
</tr>
<tr>
<td>Less strict policies</td>
<td>23</td>
<td>.</td>
<td>.</td>
<td>21,154</td>
</tr>
</tbody>
</table>

Sources: 2010 Census in China
### Table 2 Descriptive statistics for timing at first birth for women with different educational levels across three cohort groups

<table>
<thead>
<tr>
<th></th>
<th>Age at First Birth</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25%</td>
<td>50%</td>
<td>75%</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Cohort I (born in 1970-1974)</td>
<td>21</td>
<td>23</td>
<td>26</td>
<td>61,083</td>
<td></td>
</tr>
<tr>
<td>Illiteracy or Primary School</td>
<td>20</td>
<td>22</td>
<td>24</td>
<td>19,416</td>
<td></td>
</tr>
<tr>
<td>Middle School</td>
<td>21</td>
<td>23</td>
<td>25</td>
<td>27,434</td>
<td></td>
</tr>
<tr>
<td>High School or above</td>
<td>24</td>
<td>26</td>
<td>29</td>
<td>14,233</td>
<td></td>
</tr>
<tr>
<td>Cohort II (born in 1975-1979)</td>
<td>22</td>
<td>25</td>
<td>30</td>
<td>42,805</td>
<td></td>
</tr>
<tr>
<td>Illiteracy or Primary School</td>
<td>20</td>
<td>22</td>
<td>25</td>
<td>9,876</td>
<td></td>
</tr>
<tr>
<td>Middle School</td>
<td>22</td>
<td>24</td>
<td>27</td>
<td>18,333</td>
<td></td>
</tr>
<tr>
<td>High School or above</td>
<td>25</td>
<td>29</td>
<td></td>
<td>14,596</td>
<td></td>
</tr>
<tr>
<td>Cohort III (born in 1980-1983)</td>
<td>24</td>
<td></td>
<td></td>
<td>36,031</td>
<td></td>
</tr>
<tr>
<td>Illiteracy or Primary School</td>
<td>21</td>
<td>24</td>
<td></td>
<td>5,545</td>
<td></td>
</tr>
<tr>
<td>Middle School</td>
<td>23</td>
<td></td>
<td></td>
<td>17,106</td>
<td></td>
</tr>
<tr>
<td>High School or above</td>
<td></td>
<td></td>
<td></td>
<td>13,380</td>
<td></td>
</tr>
</tbody>
</table>

### Table 3 Coefficients of selected variables in models of transition into parenthood

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Less strict policies</td>
<td>Model A1 0.128*** (0.011)</td>
<td>Model A2 0.257*** (0.013)</td>
<td>Model B1 0.093*** (0.015)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Model B2 0.174*** (0.017)</td>
<td>Model C2 0.031 (0.030)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Model C2 0.093** (0.035)</td>
<td></td>
</tr>
<tr>
<td>Educational Level (Ref: Middle school)</td>
<td>Model A1 0.190*** (0.010)</td>
<td>Model B1 0.334*** (0.014)</td>
<td>Model C2 0.622*** (0.027)</td>
</tr>
<tr>
<td>Illiteracy or primary school</td>
<td>Model A2 0.170*** (0.010)</td>
<td>Model B2 0.292*** (0.015)</td>
<td>Model C2 0.527*** (0.027)</td>
</tr>
<tr>
<td>High school or above</td>
<td>Model B1 0.734*** (0.018)</td>
<td>Model B2 0.742*** (0.019)</td>
<td>Model C2 -1.101*** (0.038)</td>
</tr>
<tr>
<td>High school or above</td>
<td>Model B2 -0.443*** (0.014)</td>
<td>Model C2 -1.170*** (0.039)</td>
<td></td>
</tr>
<tr>
<td>Other Variables Controlled</td>
<td>Model A1 Yes</td>
<td>Model A2 Yes</td>
<td>Model B1 Yes</td>
</tr>
<tr>
<td>Interaction between 31 Provinces and Time</td>
<td>Model B2 No</td>
<td>Model C2 Yes</td>
<td></td>
</tr>
<tr>
<td>No. of subjects</td>
<td>61,083</td>
<td>61,083</td>
<td>42,805</td>
</tr>
<tr>
<td>AIC</td>
<td>1,148,851</td>
<td>780,277</td>
<td>583,128</td>
</tr>
<tr>
<td>BIC</td>
<td>1,148,914</td>
<td>780,340</td>
<td>583,189</td>
</tr>
</tbody>
</table>

Note: Standard errors in parentheses, * p < 0.05, ** p < 0.01, *** p < 0.001

Other Controlled Variables: access to tap water (Ref: no tap water), access to flushing toilet (Ref: no flushing toilet), access to welfare (Ref: no welfare), whether belonging to minority groups.
Table 4 Coefficients of Models with interactions term between policies and educations

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Birth Control Policies (Ref: One-child policy)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less strict policies</td>
<td>0.247*** (0.015)</td>
<td>0.166*** (0.021)</td>
<td>-0.053 (0.040)</td>
</tr>
<tr>
<td><strong>Educational Level (Ref: Middle school)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiteracy or primary school</td>
<td>0.154*** (0.022)</td>
<td>0.209*** (0.036)</td>
<td>0.240** (0.077)</td>
</tr>
<tr>
<td>High school or above</td>
<td>-0.452*** (0.015)</td>
<td>-0.739*** (0.022)</td>
<td>-1.377*** (0.049)</td>
</tr>
<tr>
<td>Interaction between Education and Policy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiteracy or primary school * Less strict policies</td>
<td>0.022 (0.025)</td>
<td>0.098* (0.039)</td>
<td>0.343*** (0.081)</td>
</tr>
<tr>
<td>High school or above* Less strict policies</td>
<td>0.037 (0.033)</td>
<td>-0.032 (0.038)</td>
<td>0.491*** (0.075)</td>
</tr>
<tr>
<td><strong>Other Variables Controlled</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interaction between 31 Provinces and Time</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

No. of subjects: 61,083, 42,805, 36,031
AIC: 780,280, 390,852, 107,089
BIC: 780,361, 390,930, 107,165

Note: Standard errors in parentheses, * p < 0.05, ** p < 0.01, *** p < 0.001
Other Controlled Variables: access to tap water (Ref: no tap water), access to flushing toilet (Ref: no flushing toilet), access to welfare (Ref: no welfare), whether belonging to minority groups.

Table 5 Proportion of Following Different Policies for Women Graduated from High School or above

<table>
<thead>
<tr>
<th></th>
<th>Proportion of Following Different Policies (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>One-Child policy</td>
</tr>
<tr>
<td></td>
<td>Less strict policies</td>
</tr>
<tr>
<td>Cohort I (born in 1970-1974)</td>
<td>90.02</td>
</tr>
<tr>
<td>Cohort II (born in 1975-1979)</td>
<td>84.61</td>
</tr>
<tr>
<td>Cohort III (born in 1980-1983)</td>
<td>77.58</td>
</tr>
</tbody>
</table>

Table 6 Proportion of Graduating from High School or above for Women Followed Different Policies

<table>
<thead>
<tr>
<th></th>
<th>Proportion of Women Graduated from High School or above (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>One-Child Policy</td>
</tr>
<tr>
<td></td>
<td>Less strict policies</td>
</tr>
<tr>
<td>Cohort I (born in 1970-1974)</td>
<td>48.78</td>
</tr>
<tr>
<td>Cohort II (born in 1975-1979)</td>
<td>63.39</td>
</tr>
<tr>
<td>Cohort III (born in 1980-1983)</td>
<td>69.77</td>
</tr>
<tr>
<td></td>
<td>4.08</td>
</tr>
<tr>
<td></td>
<td>9.63</td>
</tr>
<tr>
<td></td>
<td>14.18</td>
</tr>
</tbody>
</table>
To estimate AFB for each woman, we need to know the birth date of her first child. However, the birth date of the first child is not explicitly incorporated in the mini-census questionnaire. Instead, it only includes a question on the number of children ever born (CEB). Therefore, the women’s AFB is established using the following procedure, which is an innovation, as previous studies in this line of research have not tried to calculate AFB in this way.

1. For each woman selected, we have information on the children that live in her household. The original data was organized as one observation per individual, instead of one observation per household. So we matched all the individuals in one household and transformed the data frame to be one observation per household (i.e. from long form to wide form) [Appendix Figure]. As a result, we get 112,995 matched households out of 128,133 households (for women born between 1970 and 1983) from the original data, based on the assumption that whether being matched or not is unrelated to woman’s AFB.

<table>
<thead>
<tr>
<th>Household Id</th>
<th>Individual Id</th>
<th>Variable 1</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>A</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>B</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>B</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>B</td>
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<tr>
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<tr>
<td>50</td>
<td>1</td>
<td>A</td>
</tr>
<tr>
<td>50</td>
<td>2</td>
<td>C</td>
</tr>
</tbody>
</table>

APPENDIX Figure Data Transformation from Long Form to Wide Form

<table>
<thead>
<tr>
<th>Household Id</th>
<th>Variable 1 for 1st Individual</th>
<th>Variable 1 for 2nd Individual</th>
<th>Variable 1 for 3rd Individual</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>2</td>
<td>B</td>
<td>A</td>
<td>.</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>50</td>
<td>A</td>
<td>C</td>
<td>...</td>
</tr>
</tbody>
</table>

2. After matching the number of CEB reported by the women and the number of children living together, the first child can be identified by children’s years of birth. Because the mini census reports the year and month of births of all household members, woman’s AFB can be estimated as the difference between the birth year of the woman and her first child identified. All the women were between 22 and 35 years old in our sample and under-five mortality in China is low (< 40 per 1,000 in 2000 and <23 per 1,000 in 2005 (WHO 2015)), so it is reasonable to assume that children are living together with their mother.
### APPENDIX TABLE A Descriptive Statistics of Main Variables

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Birth Policy (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One-child policy</td>
<td>43.00</td>
<td>45.52</td>
<td>41.29</td>
</tr>
<tr>
<td>Less strict policies</td>
<td>57.00</td>
<td>54.48</td>
<td>58.71</td>
</tr>
<tr>
<td><strong>Education (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiteracy or primary school</td>
<td>31.79</td>
<td>23.07</td>
<td>15.39</td>
</tr>
<tr>
<td>Middle school</td>
<td>44.91</td>
<td>42.83</td>
<td>47.48</td>
</tr>
<tr>
<td>High school or above</td>
<td>23.30</td>
<td>34.10</td>
<td>37.13</td>
</tr>
<tr>
<td>Tap water (%)</td>
<td>57.93</td>
<td>63.29</td>
<td>63.40</td>
</tr>
<tr>
<td>Flush toilet (%)</td>
<td>31.52</td>
<td>37.47</td>
<td>34.84</td>
</tr>
<tr>
<td>Enrolled in any welfare (%)</td>
<td>35.89</td>
<td>36.46</td>
<td>32.32</td>
</tr>
<tr>
<td>Minority Groups (%)</td>
<td>9.66</td>
<td>11.69</td>
<td>11.69</td>
</tr>
<tr>
<td><strong>Numbers of Observations</strong></td>
<td>61,083</td>
<td>42,805</td>
<td>36,031</td>
</tr>
<tr>
<td><strong>Numbers of Having given birth</strong></td>
<td>56,589</td>
<td>29,187</td>
<td>8,121</td>
</tr>
</tbody>
</table>

### APPENDIX TABLE B Robust Tests for Models in Table 3

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Birth Control Policies (Ref: One-child policy)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less strict policies</td>
<td>0.096***</td>
<td>0.239***</td>
<td>0.092***</td>
</tr>
<tr>
<td></td>
<td>(0.011)</td>
<td>(0.013)</td>
<td>(0.016)</td>
</tr>
<tr>
<td><strong>Educational Level (Ref: Middle school)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiteracy or primary school</td>
<td>0.190***</td>
<td>0.170***</td>
<td>0.335***</td>
</tr>
<tr>
<td></td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.014)</td>
</tr>
<tr>
<td>High school or above</td>
<td>-0.458***</td>
<td>-0.440***</td>
<td>-0.718***</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.014)</td>
<td>(0.018)</td>
</tr>
<tr>
<td><strong>Other Variables Controlled</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interaction between 31 Provinces and Time</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>No. of subjects</strong></td>
<td>61,991</td>
<td>61,991</td>
<td>43,780</td>
</tr>
<tr>
<td><strong>AIC</strong></td>
<td>1,167,461</td>
<td>793,491</td>
<td>598,557</td>
</tr>
<tr>
<td><strong>BIC</strong></td>
<td>1,167,525</td>
<td>793,555</td>
<td>598,618</td>
</tr>
</tbody>
</table>

Note: *Standard errors in parentheses, *p < 0.05, **p < 0.01, ***p < 0.001

Other Controlled Variables: access to tap water (Ref: no tap water), access to flushing toilet (Ref: no flushing toilet), access to welfare (Ref: no welfare), whether belonging to minority groups.
### APPENDIX TABLE C Robust Tests for Models in Table 4

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Birth Control Policies (Ref: One-child policy)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less strict policies</td>
<td>0.231*** (0.015)</td>
<td>0.200*** (0.021)</td>
<td>0.144*** (0.042)</td>
</tr>
<tr>
<td><strong>Educational Level (Ref: Middle school)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiteracy or primary school</td>
<td>0.164*** (0.023)</td>
<td>0.228*** (0.038)</td>
<td>0.274*** (0.080)</td>
</tr>
<tr>
<td>High school or above</td>
<td>-0.450*** (0.016)</td>
<td>-0.728*** (0.023)</td>
<td>-1.261*** (0.050)</td>
</tr>
<tr>
<td><strong>Interaction between Education and Policy</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiteracy or primary</td>
<td>0.009 (0.025)</td>
<td>0.074 (0.041)</td>
<td>0.285*** (0.084)</td>
</tr>
<tr>
<td>school * Less strict policies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school or above*</td>
<td>0.046 (0.032)</td>
<td>0.059 (0.039)</td>
<td>0.338*** (0.075)</td>
</tr>
<tr>
<td>Less strict policies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Variables Controlled</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Interaction between 31 Provinces and Time</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>No. of subjects</strong></td>
<td>61,991</td>
<td>43,780</td>
<td>36,691</td>
</tr>
<tr>
<td><strong>AIC</strong></td>
<td>793,493</td>
<td>401,593</td>
<td>111,120</td>
</tr>
<tr>
<td><strong>BIC</strong></td>
<td>793,575</td>
<td>401,671</td>
<td>111,197</td>
</tr>
</tbody>
</table>

Note: Standard errors in parentheses, * p < 0.05, ** p < 0.01, *** p < 0.001

Other Controlled Variables: access to tap water (Ref: no tap water), access to flushing toilet (Ref: no flushing toilet), access to welfare (Ref: no welfare), whether belonging to minority groups.
References


Hesketh, Therese, and Zhu Wei Xing. 2006. “Abnormal Sex Ratios in Human Populations: Causes and


http://www.who.int/gho/countries/chn/country_profiles/en/.


