Why has the birth rate relatively increased in China's wealthy cities?

Chen, Nana and Xu, Hangtian

Hunan University

1 February 2021

Why has the birth rate relatively increased in China's wealthy cities?♣

Nana Chen and Hangtian Xu[*]

February 2021

Abstract: China's wealthy cities tended to have low birth rates in past decades, but this relationship has disappeared in conjunction with the substantial relaxation of the one-child policy after 2011. This study develops a conceptual framework for the relationship between average household wealth and compliance with the one-child policy across cities and concludes that the compliance rate was greater in wealthier cities when above-quota births were fined according to household wealth and with limited liability. The relaxation of this policy has eliminated this inequality, leading to an increase in wealthy cities' birth rates relative to those of other cities. A causal analysis exploiting variations in city-level birth rates and fertility policy compliance rates from 2008 to 2019 supports our hypotheses. Moreover, our results suggest that the fertility relaxation has resulted in a greater proportion of newborns in wealthy cities, which is expected to increase the next generation's human capital.

Keywords: one-child policy, two-child policy, birth rate, household income, China

JEL codes: J13, J18, R10

♣ We acknowledge the financial support from the National Natural Science Foundation of China under project 71703034. Declarations of interest: none. Please address all correspondence to Hangtian Xu.

[*] Chen: School of Economics and Trade, Hunan University, Changsha, P. R. China (email: chennana@hnu.edu.cn); Xu: School of Economics and Trade, Hunan University, Changsha, P. R. China (email: hangtianxu@gmail.com; website: https://hangtianxu.weebly.com/).

1. Introduction

In general, countries' total fertility rates (TFRs) and income levels are inversely correlated.[1] For example, according to World Bank data, the TFR of OECD countries has lagged the replacement fertility rate (i.e., roughly 2.1) since 1980, whereas the average TFR of the world's least developed countries has stabilized above 4.0. Potential mechanisms driving this contradictory wealth-fertility pattern include the opportunity costs of childbearing and investments in the quality rather than the quantity of children (e.g., Becker, 1960; Weller, 1977; Kirk, 1996; Galor and Weil, 2000; Iyigun, 2000; Blackburn and Cipriani 2002; Fernihough, 2017).

Recently, however, the TFR has widely rebounded in OECD countries. Researchers have documented that the negative relationship between fertility and economic development has weakened after 2000, and a positive relationship has emerged in some countries (Myrskylä et al., 2009; Bongaarts and Sobotka, 2012; Luci-Greulich and Thévenon, 2014; Fox et al., 2019). Some point to gender equality improvements as the potential driver of rising fertility levels in advanced economies. As a country transitions from a regime dominated by the traditional male breadwinner-female housewife arrangement to a regime in which gender equality holds dominant normative status, the TFR first declines and then rises, and its dynamics follow a U-shaped curve (Esping-Andersen and Billari 2015; Goldscheider et al. 2015).

Others argue that the process of economic growth generates enough resources that households can rear more children while still investing the desirable amount in each child's education (Luci-Greulich and Thévenon, 2014; Ohinata and Varvarigos, 2020). Moreover, fertility rebounds are more likely to emerge in economies with both high income levels and substantial public assistance to working parents with young children, including generous parental leave schemes, area-wide childcare services, and reasonable costs of marketizing (i.e., outsourcing) the parental time burden (Luci-Greulich and Thévenon, 2014; Bar et al., 2018).

Until now, fertility rebounds have not been systematically detected in developing economies. By exploiting changes in city-level birth rates in China, however, we find the first evidence of a fertility rebound in a large developing country. The negative correlation between income levels and birth rates among Chinese cities, which was previously evident, has gradually weakened and became positive after 2011. However, the above-mentioned mechanisms, which are posited to describe advanced economies, are unlikely to operate in China. First, the average GDP per capita of China's wealthiest cities (top 25%) was 85,000 yuan (approximately US$13,000) in 2015, which is only one-third of that of OECD countries (i.e., close to the average level of OECD countries in the late 1960s at constant prices).[2] The standard of living in China's wealthy cities is clearly far below the level of economic abundance necessary to overlook the trade-off between quality and quantity in childbearing.[3] Second, gender equality advancements, which can be approximated by gender wage differences, have not made substantial progress in China in recent years. Iwasaki and Ma (2020) conducted a meta-analysis of more than 1,000 estimates from previous studies to investigate China's gender wage gap. Their results show that the gender wage gap has increased rather than decreased from the 2000s to the 2010s. This result is closely related to the rapid development of the

---

[1] TFR is defined as the number of children that would be born to a woman if she were to live to the end of her childbearing age and bear children based on the current age-specific fertility rates.

[2] Data sources: World Bank Databank and the Statistics Bureaus of provincial governments.

[3] On the contrary, relative to the wage premiums in China's wealthy cities, the high cost of living is considered more dominant.

private sector, as wage discrimination against women is greater in the private sector than in the public sector.[4] Thus, the differences in the changes in birth rates across Chinese cities are caused by other factors that remain uninvestigated in the literature.[5]

This study attempts to understand the drivers of relatively increasing birth rates in China's wealthy cities by considering the role of the recently introduced fertility relaxation policy. For nearly 40 years, China implemented the one-child policy (OCP), which strictly controlled the number of newborns such that couples in most urban areas could only have one in-quota child. This policy was gradually liberalized from 2011 to 2015 such that all couples could have two in-quota children. This liberalized policy is called the two-child policy (TCP).

Although this fertility relaxation policy was implemented homogeneously across cities with different income levels, we explore the relation between city-level birth rates and the evolving fertility policy and the influence of a city's wealth level on this relation. We first introduce a conceptional model describing fertility choice under heterogeneous compliance with the family planning policy. We assume that under the OCP, an above-quota birth is subject to a mandatory fine that is proportional to local households' average wealth levels. When the fine exceeds the total value of a family's cash and goods, the excess is not levied. Thus, only families whose total wealth exceeds the fine can pay the fine in full (i.e., the financial penalty is limited liability). In addition, the net value of an above-quota child to a couple is increasing and concave in the couple's total wealth. Couples can therefore maximize their utility by having an above-quota child and paying the fine if the net value of the child is greater than the fine levied. Otherwise, a couple's optimal strategy is to abide by the OCP.

Our model predicts that, under the OCP, wealthier cities tend to have relatively lower birth rates because higher income couples are more likely to comply with the policy. In other words, the rate of compliance with the fertility policy (RCFP), or the proportion of in-quota newborns to total newborns, is greater in wealthier cities. We then test three hypotheses to determine which wealth-related urban characteristics underlie the wealth–birth rate relationship. After the implementation of the TCP, we expect that fertility suppression in wealthier cities has fallen and that birth rates have grown relatively more in these cities; birth rates in other cities have increased relatively less because the implementation of the previous OCP was less effective (**Hypothesis I**). At the same time, we expect that the RCFP of low-income cities has increased more than that of wealthy cities because more newborns who previously counted as over-quota births under the OCP are now recognized as in-quota births (**Hypothesis II**). The correlation between the amount of OCP-related fine payments and a city's wealth level is uncertain because wealthier cities levied higher average fines for above-quota children under the OCP, but fewer couples chose to go against the OCP in these cities (**Hypothesis III**). Note that the terms "wealthy city" and "high-income city" are interchangeable in this study. Although the collection standard for OCP-related penalties is related to average household wealth rather than annualized household income, we use a city's GDP per capita and disposable income per capita as proxies for its wealth level because wealth data are not available.

---

[4] Moreover, Agarwal et al. (2020) find that, after the fertility policy relaxation in China, the salary of female new hires was reduced in 2012-2014 relative to the salary of male new hires, and employers hired fewer female employees. This policy change signaled employers about an anticipated increase in the childbearing burdens of females, and influenced labor market outcomes for females.

[5] In addition, Goldstein et al. (2009) and Bongaarts and Sobotka (2012) suggest that the upturns in the period TFR in Europe of 1998–2008 can be simply explained by a decline in the pace of fertility postponement (or the tempo distortion of period fertility). We will show in Footnote 11 and Figure 2 that this is not the reason for the fertility rebound in Chinese cities.

Our empirical results using sub-national data on GDP per capita, disposable income per capita, birth rates, the RCFP, and OCP-related fine payments support the above three hypotheses. With the partial relaxation of the fertility policy from 2012 to 2015 and its full relaxation since 2016, birth rates in China's wealthy cities have exhibited stepwise increases relative to those of other cities. At the same time, the RCFP has relatively increased in low-income cities. This pattern still holds if we control for latent confounding factors that are heterogeneous across cities, including the number of in-quota children per family (NIQCPF) allowed by the OCP before the policy was relaxed, the proportion of the floating population and minorities, the proportion of the population of childbearing age, the supply of health and educational facilities, and the local minimum wage standard. We also control for the growth in the de jure population, GDP per capita, and house prices in previous years, all of which are potentially associated with local birth rates, as discussed in the literature. We find that under the OCP, the amount of OCP-related fine payments per capita was lower in wealthier regions despite their higher fine collection standards because fewer couples violated the OCP and had above-quota children.

Our results imply that China's previous family planning program may have led to inequality in childbearing across couples (or cities) with different wealth levels and that the abolition of the OCP has largely eliminated this inequality. After the introduction of the TCP, the proportion of newborns in wealthy cities increased. As a result, the next generation's average human capital will be greater than that of previous generations because wealthy families tend to provide their children with better education and living conditions, which are beneficial for long-term human capital accumulation (Bar et al., 2018).

This study contributes to the literature in three respects. First, we identify an unintended consequence of China's relaxation of its fertility policy, that is, the recently observed fertility rebound. This result contributes to the existing theories focusing on the quality-quantity trade-off, the opportunity costs of childbearing, and gender equality (Myrskylä et al., 2009; Bongaarts and Sobotka, 2012; Luci-Greulich and Thévenon, 2014; Bar et al., 2018). Second, we provide a careful micro-level analysis of the short-term effects of China's TCP. Such analyses are still scarce. Our study differs from existing research, which mainly focuses on the TCP's aggregate effects on the TFR, sex selection, abortions of unapproved pregnancies, maternal health outcomes, the gender employment gap, and so on (e.g., Attané, 2016; Zeng and Hesketh, 2016; Liang et al., 2018; Li et al., 2019; Agarwal et al., 2020). We examine the different effects of the TCP on different income groups and validate that ignoring this dimension biases evaluations of policy outcomes. Third, we provide causal evidence on the compositional effects of China's family planning policy. This evidence offers insights on long-term human capital accumulation in China. In this regard, Wang and Zhang's (2018) analysis is highly relevant to this study. They found that China's OCP reduced the next generation's average human capital level because it was significantly more strictly implemented in urban areas than in rural areas (i.e., it increased China's rural–urban fertility ratio), whereas human capital investments in children are significantly lower in rural areas. Our study suggests that the recent TCP has alleviated this fertility distortion by encouraging wealthier families to bear children.

The remainder of this paper is organized as follows. Section 2 introduces background information on China's fertility policy relaxation. Section 3 describes the conceptional framework and hypotheses for our study. Section 4 details the empirical strategy and results. Section 5 concludes and provides a discussion.

2. Family Planning Policies in China

The OCP was formally introduced in China in the 1970s to control China's rapid population growth. Couples were required to apply for a birth permit before having a child. In most cases, an urban couple was only allowed to have one child under this policy. However, because of the labor needs of farming households and the difficulty of controlling their birth behavior, families in some rural areas were allowed to have two children (see Appendix C for a detailed discussion of the city-specific implementation of the OCP). Over the subsequent decades, China has come under fire regarding this family planning policy and its methods of enforcement.

Families who did not comply with the OCP were subject to penalties, including fines (also known as *Social Maintenance Fees*, which ranged from one-half of the local average annual household income to eight or more times that level), the confiscation of belongings, and administrative sanctions for government employees. The specific collection standard for above-quota birth fines was proportional to the level of local economic development and accounted for the specific family's income level and the order of the above-quota birth.[6]

[Figure 1 about here]

This policy intervention is one of the key reasons that China's TFR continued to fall in recent decades, although some of the fertility decline may be attributed to economic development. As Figure 1 shows, China's TFR has been consistently below the world average since 1985. From a cross-country perspective, China's TFR is not only far below the expected level based on its standard of living as an upper-middle-income country but is also lower than that of OECD member countries. The crude birth rate (hereafter, the birth rate), that is, the ratio of new births to the de jure population, also exhibits a prominent downward trend (Figure 1).

This demographic decline has resulted in a growing aging issue. To alleviate this problem, China recently began to formally phase out the OCP. It was first replaced with a partial two-child policy (PTCP) in November 2011; this policy permitted couples to have two children if both members of the couple were only children.[7] This policy was then relaxed in December 2013 to allow couples to have two children if one member of the couple was an only child. However, based on China's demographic structure in 2010, the proportion of married women aged 20–34 who met this criterion was only 21.3%.[8] The law was therefore changed again in October 2015 to the universal two-child policy (UTCP), which extended the right to have two children to all couples.

The overall effect of fertility policy relaxation is considered inadequate. Although China's birth rate increased slightly in 2016 and 2017, this encouraging trend did not last long, as the birth rate hit record

---

[6] Short and Zhai (1998), Li and Zhang (2003), Ebenstein (2010), and Goodkind (2017) summarized some survey-based collection standards of above-quota birth fines. The most well-known case of penalization is against film director Yimou Zhang, who was fined 7.5 million yuan ($1.2 million) in 2013 for having two above-quota children (Reuters, 2014); the fine amount was 400 times the disposable income per capita in China that year.

[7] This policy was implemented nationwide in 2011, but some provincial administrations have already implemented it before then.

[8] This proportion is calculated based on the data from the China Family Panel Studies (a nationally representative, annual longitudinal survey of Chinese families and individuals by Peking University).

lows in 2018 and 2019 (Figure 1). People thus believe that the TCP, which increased the birth quota, cannot solve the demographic problem, which stems from insufficient fertility demand. In fact, the main reasons for China's low birth rate are argued to be unequal access to public resources across the registered (*Huji Renkou*) and floating populations and the increasing cost of living in large cities.[9] In response to these demand-side problems, incentives for couples to have two children have been piloted in localities with low birth rates.[10]

[Figure 2 about here]

However, the stylized facts shown in Figure 2, which decomposes the fertility patterns of Chinese women from 2009 to 2018 according to their reproductive ages and child order structures, provide an opposing perspective. The upper panel shows that the first-child fertility pattern has shifted downwards, that is, the first-child birth rate has declined over time. Moreover, the age group with the highest first-child birth rate has shifted from 20–24 to 25–29 years old.[11] Importantly, first births were not affected by the fertility policy relaxation. The middle panel shows the pattern for second births in the same period. Compared with 2009–2011 (before the fertility policy was relaxed), the curve of second births shifts upward after the policy is relaxed, implying that the second-child fertility rate increased significantly after the TCP's implementation. The case of third births (the bottom panel) is similar. Although more recent data on these indicators have not been released, we expect that this trend has continued. In 2019, 59.5% of all newborns in China were second children or higher, a significant increase from 51.2% in 2017 and 50.0% in 2018 (National Health Commission of the People's Republic of China, 2020).

Thus, the national decline in the newborn population in 2018 and 2019, shown in Figure 1, was mainly due to the continuous decline in the first-child birth rate, which dominated the TCP's positive effects. In other words, the birth rate would likely have fallen more drastically after 2017 if the TCP had not been implemented.[12]

[Figure 3 about here]

Figure 3–a shows the city-level relationship between per capita GDP and birth rates from 2008 to 2019. From 2008 to 2011, they are significant negatively correlated, whereas from 2012 to 2015, when the

---

[9] China's low birth rate, especially in its large cities, has received widespread attention. Some studies conclude that this is because large cities have a large number of floating population, and their birth rates are significantly lower, because they are discriminated in the access of education and medical resources (Chen and Wu, 2006; Guo, 2010; Li and Guo, 2014; Zhou, 2015). Others believe that the high cost of housing matters, because favorable living conditions encourage childbirth (Kulu and Vikat, 2007). Although the wealth effect brought about by the increase in housing prices will encourage fertility, for those who do not have a house, high housing costs will inhibit fertility (Yi and Zhang, 2010; Öst, 2012; Dettling and Kearney, 2014). The latter has been shown to outperform the former in China (Ge and Zhang, 2019; Clark et al., 2020; Liu et al., 2020). Note that these studies on China's housing market and fertility decision analyzed data before the abolition of the OCP and paid more attention to cross-sectional differences. In other words, they did not consider the adjustment of the fertility decision caused by the fertility policy relaxation.

[10] For example, these couples will be entitled to income tax reduction and support for payment of tuition fees for their children, and be assisted when they return to work after maternity leave. In addition, local administrations pay special attention to the building of nursery facilities and kindergartens, especially in densely-populated urban areas.

[11] Figure 2 can also negate the explanation of the tempo effect of China's birth rate changes after the implementation of the TCP, as mentioned in Footnote 5. Regarding the pattern of the first childbirth, the birth rate of the 20–24 and 25–29 age groups consistently decreased during 2009–2018. Although the birth rate of women over 35 years old had a slight increase, it has no way to essentially affect the overall birth rate, nor can they validate the tempo effect.

[12] Shi et al. (2018) and Liu and Chen (2019) present similar opinions regarding the effects of the TCP on birth rate in China.

fertility policy was partially loosened, this relationship weakens. With the complete abolition of the OCP after 2015, the negative correlation disappears, implying that birth rates in wealthy cities have increased relative to those in other cities. In Figures 3–b and 3–c, we use disposable income per capita and average house prices, respectively, instead of GDP per capita to measure the relationship between wealth levels and birth rates. The results are similar with these proxies for wealth, indicating that residents of wealthier cities became relatively more willing to bear children after the fertility policy was relaxed.

3. A Simple Model of Fertility Choice under the OCP

To support our discussion of the heterogeneous impacts of relaxing the fertility policy on city-level birth rates, we introduce a simple conceptual framework. This framework extends Li and Zhang's (2003) benchmark model and exploits the limited liability feature of the penalty system for above-quota births.

Under the OCP, we assume that the net value a household receives from having an above-quota child is $U(W)$, which is determined by the household's wealth (W). Every couple has the same value function, which satisfies $U(W)>0$, $U'(W)>0$, and $U''(W)<0$. In other words, the net value of an above-quota child is positive, and it is increasing and concave in W.[13] This assumption implies that all couples will have an above-quota child if there is no penalty. $U(W)$ crosses the 45-degree line at W_o, the point at which the net value of the above-quota child equals total wealth. To the left of this point, the net value of an above-quota child is greater than household wealth, whereas household wealth is dominant to the right (Figure 4).

[Figure 4 about here]

We define a as the number of households in a city and assume that wealth is evenly distributed across households, with an average wealth of W^m. In other words, the poorest and richest households have wealth levels of W^m-$a/2$ and $W^m+a/2$, respectively. The local administration sets up a penalty system to control above-quota childbearing. Because it is difficult to precisely identify each household's wealth level and willingness to pay for an above-quota child, the fine is set equal to the average household wealth (i.e., W^m).[14] However, fine payments are limited liability, meaning that if a couple's total wealth is less than W_m, the couple may have an above-quota child by paying a fine that is equal to all of their wealth.

Based on these settings, we can make three deterministic claims that will guide our empirical analysis. We list the claims below and provide the relevant proofs in Appendix A.

Claim 1: Every couple in a city with $W^m<W_o$ will have an above-quota child by paying the fine (i.e., *Full policy failure*). In such a city, the fines collected by the local government will increase with W^m.

Claim 2: Every couple in a city with $W^m>Max(W^{mk}, W_o+a/2)$, where W^{mk} is the wealth level that satisfies $U(W^{mk}+a/2)=W^{mk}$, will not have an above-quota child (i.e., *Full policy compliance*). The local administration collects no fines.

Claim 3: For couples in a city with $W_o \leq W^m \leq Max(W^{mk}, W_o+a/2)$, the OCP is partially effective (i.e., *Partial policy effectiveness*), and the share of couples that comply with the OCP is an increasing function of W^m. The relationship between the city's wealth level and the amount of fines collected is uncertain. On the one hand, wealthier cities set higher average collection standards, increasing the fines imposed, but on the

[13] To simplify our analysis, we do not consider the situation where the utility gain from having a child is negative.

[14] We can also set it to be a multiple of W^m, which will not affect our main predictions.

other hand, fewer families in wealthier cities choose to violate the OCP by paying fines.

Summarizing these three claims, we expect to find a positive (negative) correlation between a city's wealth level and its RCFP (birth rate).[15] This prediction is logically consistent with the evidence shown by previous studies (Li and Zhang, 2003; Chen and Jin, 2014). Using data on births in China during the OCP period, both studies found that when other conditions were similar, the proportion of high-income families who violated the policy was significantly lower than that of low-income families. Li and Zhang's (2003) interpretation of this result precisely coheres with our theory, whereas Chen and Jin (2014) suggest that for low-income families, the cost of childbearing is more likely to be lower than the related long-term benefits of an additional child associated with family labor supply and care for the elderly. This explanation is essentially compatible with our model.

Thus, we expect that after the TCP's implementation, the fertility demand of wealthier cities will increase to a greater extent, leading to relatively more significant fertility growth [**Hypothesis I**]. At the same time, the RCFP in low-income cities will increase relative to that in wealthier cities because a higher proportion of childbearing in low-income cities was previously above-quota. With the relaxation of the fertility policy, these births become in-quota births [**Hypothesis II**]. We predict that the relationship between the total fines collected by the local administrations and cities' average household wealth is uncertain [**Hypothesis III**]. We can empirically test all of these hypotheses by exploiting city-level changes in fertility behavior before and after the TCP was introduced.

4. Empirical Analysis

4.1 Data

Our key independent variable is a city's wealth level, which we primarily proxy with a city's GDP per capita. Our sample covers 261 cities at the prefecture level or above from 2008 to 2019, covering 94.5% of national GDP and 83.7% of the total population as of 2008; the average city-level de jure population is 4.3 million.[16] The sample size is slightly reduced in some years based on data availability. We use disposable income per capita as an alternative proxy for a city's wealth level. Because this statistic is generally reported separately for urban and rural areas, we calculate a weighted value of city-level disposable income per capita based on the ratio of the urban to the rural population; due to data availability restrictions, the data for this variable cover only 156 cities from 2009 to 2019.

The main outcome variables of interest include the birth rate (i.e., the number of births per 1,000 people, measured as the de jure population) and the RCFP. We use the birth rate rather than the TFR as the primary measure of fertility changes because data for the latter are not reported to the public at the city level in China.[17] Most provincial governments do not report data on the RCFP, with the exception of

---

[15] There is another reason why the RCFP in wealthier cities is higher. A couple in wealthier cities has a higher probability to have a decent job. Violation of the OCP will put the couple at risk of being dismissed. Therefore, this high opportunity cost strengthens the abiding by the OCP of families in wealthy cities. This kind of penalty is, however, likely to be negligible for low-income families. This mechanism is essentially consistent with our model, that is, the wealthier the city, the higher the average cost of an above-quota child relative to the net value.

[16] To be specific, our sample covers 242 prefecture-level cities (or autonomous prefectures), 15 sub-provincial cities, and four provincial cities. The city we define includes both its urban (*Shixiaqu*) and rural areas (*Xian* and *Xianjishi*).

[17] TFR is generally considered a better fertility indicator because it is less likely to be affected by the age distribution of the population like the birth rate. Note that the national birth (or death) rate calculated based on the aggregation of total number reported at the sub-national level is

Zhejiang and Hunan Provinces and four provincial cities (i.e., Beijing, Chongqing, Shanghai, and Tianjin). To remedy this lack of data, we use county (i.e., the administrative unit below prefecture-level cities) data for Hunan Province. To the best of our knowledge, Hunan is the only province that discloses county-level RCFP data. Data on OCP-related fine payments are only available at the provincial level for 2012.[18] The data sources and summary statistics are described in Appendix B.

4.2 Econometric specification

Our first regression model separately estimates the impacts of the PTCP and the UTCP on birth rates in wealthy cities:

$$\text{Birthrate}_{it} = \alpha_0 + \alpha_1 \text{Partial}_t \cdot \ln(\text{GDPpc}_i) + \alpha_2 \text{Universal}_t \cdot \ln(\text{GDPpc}_i) + \rho_i \text{City}_i \cdot t + \mu_i + \delta_t + \varepsilon_{it}. \quad (1)$$

The outcome of interest is the birth rate in city i at time t. On the right-hand side of the model, Partial_t and Universal_t are dummy variables that equal one if year t is in the implementation period of the PTCP (2012–2015) or the UTCP (2016–2019), respectively. $\ln(\text{GDPpc}_i)$ is the logarithm of the GDP per capita of city i in 2008. City and year fixed effects are represented by μ_i and δ_t. These variables control for all time-invariant differences between cities and time-varying changes that affect all sample cities, respectively. We also include city-specific linear time trends ($\text{City}_i \cdot t$) to consider the potential that differences across cities may widen during the long time frame of our analysis. The interaction between $\text{Partial}_t/\text{Universal}_t$ and $\ln(\text{GDPpc}_i)$ is the core of our identification strategy. α_1 and α_2 capture the differential effects of the PTCP and the UTCP, respectively, on the birth rates of wealthy cities relative to those of other cities. These effects are expected to be positive if births tend to increase more significantly in wealthier cities after the fertility policy is relaxed (**Hypothesis I**). We expect α_2 to be greater than α_1 because the UTCP has a more universal impact on reproductive behavior.

In our second specification, we replace $\ln(\text{GDPpc}_i)$ with three dummies (G_J) indicating the quartile of city i's GDP per capita in 2008 (i.e., 25th–50th%, 50th–75th%, and highest 25% of GDP per capita, with the lowest 25% used as the benchmark):

$$\text{Birthrate}_{it} = \alpha_0 + \textstyle\sum_{J=1}^{3} \beta_J \text{Partial}_t \cdot G_J + \sum_{J=1}^{3} \gamma_J \text{Universal}_t \cdot G_J + \rho_i \text{City}_i \cdot t + \mu_i + \delta_t + \varepsilon_{it}. \quad (2)$$

This specification allows us to distinguish heterogeneous effects of the fertility policy relaxation in specific city groups. According to **Hypothesis I**, we expect the coefficients of the interactions between the quartile dummy variables representing wealthier cities and the policy-treatment time dummy to be positive and greater than the coefficients of the other interactions. Before proceeding to formally estimating the regressions, we examine Figure 5, which shows the changes in the birth rates from 2008 to 2019 for the four GDP per capita quartiles. We find that the gap in the birth rates of the higher and lower GDP per capita quartiles has gradually narrowed, especially after the implementation of the UTCP in 2015, although birth rates dropped in 2018 and 2019 for all quartiles. Note that the jump in the second quartile's birth rate

---

generally 0.5–1.1 points lower than the official national birth (or death) rate disclosed by the National Bureau of Statistics, because the latter will consider the missing report, which is however omitted by the sub-national reporting of these indicators. We suppose that the rate of missing report, which is stable at the national level during our study period, is heterogeneous across cities but constant over the study period, or changes similarly across cities. Therefore, this flaw in data will essentially not affect our empirical results, because we will control city and year fixed effects in all our regression exercises.

[18] Data on OCP-related fine payments are generally not public. In July 2013, a lawyer named Youshui Wu from Zhejiang Province sent a public letter to all provincial governments in mainland China requesting disclosure of the OCP-related fine payments; 24 out of 31 provincial governments responded to him and disclosed relevant data of 2012.

in 2010 is partially caused by missing values, as the sample size in this year is only 183.

[Figure 5 about here]

We also consider a vector of time-invariant city-level characteristics ($\mathbf{X}_i$) in our augmented model, as shown in Equation (3):

$$\text{Birthrate}_{it} = \alpha_0 + \alpha_1 \ln(\text{GDPpc}_i)\cdot\text{Partial}_t + \alpha_2 \ln(\text{GDPpc}_i)\cdot\text{Universal}_t + \mathbf{X}_i'\mathbf{Partial}_t\mathbf{\Phi}_1 + \mathbf{X}_i'\mathbf{Universal}_t\mathbf{\Phi}_2 + \rho_i\text{City}_i\cdot t + \mu_i + \delta_t + \varepsilon_{it}. \quad (3)$$

These variables are expected to influence the TCP's effects through other mechanisms and are therefore potential confounding factors in our estimates. Their influence is captured by the interactions between $\mathbf{X}_i$ and $\mathbf{Partial}_t$/$\mathbf{Universal}_t$.

We examine **Hypothesis II** by replacing the dependent variables in Equations (1)–(3) with the RCFP and estimating the equations using county-level data. In these specifications, we expect α_1 and α_2 to be negative, as the RCFP tends to increase more significantly in lower-income cities after the fertility policy relaxation. Because city-level fine payments data are unavailable, we test **Hypothesis III** using provincial cross-sectional data.

4.3 Wealthier cities have higher growth in birth rates

Baseline results. Columns 1 and 2 of Table 1 report the results of estimating Equation (1). City-specific linear time trends are not included in the results in column 1 (subsequent results are presented similarly). Both columns show that after the fertility policy relaxation, birth rates increase more significantly for cities with higher GDPs per capita. The average GDP per capita of cities in the wealthiest 25% of cities in 2008 was 50,007 yuan, which is five times the average GDP per capita of cities in the first wealth quartile (i.e., 9,789 yuan). The coefficients in column 1 indicate that, relative to the base period (i.e., 2008–2011), the birth rate in the richest quartile of cities increased by 0.76 (1.56) points relative to the lowest-income group in 2012–2015 (2016–2019), equivalent to 6.8% (14.1%) of the sample mean of 11.1.[19]

[Table 1 about here]

The results of estimating Equation (2) are presented in columns 3 and 4 of Table 1. We find that the estimates of the relative birth rate changes in the top and bottom wealth quartiles are highly consistent with those in columns 1 and 2. The birth rates of cities in the second and third quartiles did not change significantly relative to the benchmark city group after the fertility policy relaxation. Although the relevant estimated coefficients are all positive, their values are less than the estimated coefficients for the top wealth quartile, which is consistent with our expectation.

We do have some concerns about measurement issues. The relative wealth level of a city may change over our sample period, which may lead to measurement bias if we approximate wealth levels with the initial city-level GDP per capita. Thus, we use the mean GDP per capita of a city during 2008–2019 to reflect its wealth level, and the estimation results are shown in columns 5 and 6 of Table 1. In columns 7 and 8, we

[19] The calculation is as follows: ln(50007/9789) × 0.467 = 0.76; ln(50007/9789) × 0.955 = 1.56.

use disposable income per capita as an alternative proxy for a city's wealth level. The results of these estimations are robust both in terms of statistical significance and the values of the coefficients.

The two rightmost columns of Table 1 show the results when we examine the common trend assumption by including interactions between $\ln(GDPpc_i)$ and dummies for the years 2009, 2010, and 2011. The coefficients of these interactions are all insignificant, indicating no evidence of significant deviations from the trends before the fertility policy relaxation.

The impacts of the NIQCPF. We consider potential confounding factors and mechanisms in turn by adding relevant control variables ($\mathbf{X}_i$). First, we consider the NIQCPF allowed by the OCP before the fertility policy was relaxed. Different family planning policies were implemented across provinces prior to the TCP's introduction. Some provinces implemented a strict OCP, whereas others only applied this policy to urban residents and some of their rural residents. Moreover, birth policies for ethnic minorities were generally more relaxed. Thus, the TCP may have had differential effects on fertility behavior even though it was homogeneously implemented across cities. If a higher proportion of a city's population complied with looser birth policies prior to the TCP's implementation, the impact of the TCP on that city's birth rate will be lower. This channel conflicts with the wealth effect on which we focus, and, thus, we need to control for the NIQCPF in our augmented model. We calculate the city-level NIQCPF based on a city's urban–rural population ratio, ethnic composition, sex ratio of newborn, and local fertility policies; Appendix C provides more details.

Figure 6 plots city-level GDP per capita in 2008 against the NIQCPF under the OCP. We find that the two variables are negatively correlated (slope = -0.09 (0.02); R-square = 0.082), implying that wealthier cities generally have a lower NIQCPF. If these cities' birth rates increase after the implementation of the TCP only because their birth quotas were previously lower rather than because their compliance rates were higher under the OCP, then we expect our key coefficients of interest (α_1 and α_2) to no longer be significant after we control for the interaction terms between the NIQCPF and the policy-treatment time dummy.

[Figure 6 and Table 2 about here]

We first replace $\ln(GDPpc_i)$ with $NIQCPF_i$ in Equation (1) and estimate this adjusted model to check whether the NIQCPF's effect on wealthy cities' birth rates is similar to the effect of GDP per capita. The results, shown in columns 1 and 2 of Table 2, suggest that cities with lower NIQCPFs tend to exhibit higher growth in birth rates after the TCP is implemented. However, the relationship almost disappears when we consider both $NIQCPF_i$ and $\ln(GDPpc_i)$, as in Equation (3). The results in columns 3 and 4 of Table 2 validate that our baseline results are robust to controlling for the NIQCPF. The coefficients of the interactions between the time dummies and $\ln(GDPpc_i)$ are almost the same as those in columns 1 and 2 of Table 1, whereas the coefficients reflecting the impact of the NIQCPF are mostly insignificant, with much smaller (or even differently signed) values. Moreover, we estimate Equation (1) using a subsample with NIQCPFs between 1.33 and 1.46; in other words, we exclude cities with NIQCPFs in the top and bottom quartiles. We find that even for this subsample, in which the NIQCPF is almost homogeneous, our main results are still robust (columns 5 and 6 of Table 2).

Other confounding factors. We next examine the influences of other confounding factors on our baseline results in turn. These factors are: ***a***) the proportion of the ethnic minority population; ***b***) the proportion of the population of childbearing age, measured by the share of the population aged 15–29; ***c***) the gender balance, which is calculated as the absolute value of (female population/total population - 0.5); ***d***) population growth during 2008–2011 and 2011–2015; ***e***) the logarithm of the de jure population per square kilometer; ***f***) the logarithm of the number of full-time primary school teachers per 1,000 people, defined as the de jure population; ***g***) the logarithm of the number of hospital and health center beds per 1,000 people, defined as the de jure population; ***h***) a city's de jure population relative to its registered population; ***i***) the growth in GDP per capita during 2008–2011 and 2011–2015; ***j***) the logarithm of the minimum wage standard per month (yuan); and ***k***) the growth in house prices during 2008–2011 and 2011–2015. To ensure reasonable data quality, we obtain ***a*** and ***b*** from 2010 Census data, ***c*** and ***e***-***h*** from 2009 data, and ***j*** from 2015 data; see Table A1 for more details on data sources and summary statistics.

[Table 3 about here]

The share of the minority population (***a***) affects not only the pre-relaxation tightness of the fertility policy, as mentioned previously, but also household preferences for childbearing.[20] The results when this indicator is included in $\mathbf{X}_i$ are shown in column 1 of Table 3. The results in Panel A include only two-way fixed effects, and those in Panel B further include city-specific linear time trends.

We consider factors ***b***, ***c***, and ***d*** to control for the demographic structure. For instance, according to Figure 2, women aged 20–34 have the highest propensity to bear children. Cities with a higher proportion of the population aged 15–29 in 2010 are more likely to have a higher proportion of the population aged 20–34 in 2015 and, thus, are more likely to experience higher fertility growth after the fertility policy relaxation. Moreover, a balanced gender ratio and strong population growth are expected to be conducive to a fertility increase. Factor ***e*** controls for the relative scarcity of land in a city; factors ***f*** and ***g*** reflect the tightness of access to education and medical resources, respectively; and factor ***h*** captures the proportion of the population with restricted access to local public resources (a high de jure population relative to the city's registered population indicates a high floating population ratio). These factors affect local residents' willingness to bear children. We also consider the potential impact on the subsequent birth rate of short-term city-level economic shocks, which we reflect by lagged growth in GDP per capita (***i***). As Bar et al. (2018) suggest, we also consider local minimum wage standards (***j***), which are likely to influence the cost of parental care marketization, which, in turn, affects the reproductive choices of high-income families. The last variable that we add to the vector $\mathbf{X}_i$ is lagged house price growth (***k***); prior studies find that the net impact of local housing prices on birth rates is ambiguous (see Footnote 9).

The regression results including these confounding variables are shown in columns 2–6 of Table 3, and the results of all specifications are all compatible with the baseline results. In all of the estimates, the UTCP has a more substantial stimulating effect on fertility in wealthier cities. The results for the PTCP are less significant, but the coefficients are still positive.

[Table 4 about here]

[20] Ethnic minorities have a stronger preference for childbearing than the Han-nationality even before the implementation of the OCP (Zhang, 2006).

Finally, we consider the motives for imposing above-quota birth fines. Local governments may not set the heaviest possible fine policy for full compliance with the OCP because they care about their total revenue from fines. Revenue-constrained local governments may choose fine levels that enable some rich households to bear children so that they can collect more revenue (Greenhalgh et al., 1994; Li and Zhang, 2003). This decision will cause OCP implementation to be endogenous to the local fiscal balance, which is highly correlated with the local wealth level. To address this concern, we estimate Equation (1) using a subsample of cities in provincial administrations where OCP-related fine payments accounted for less than 1% of total fiscal revenue. As column 1 of Table 4 shows, the results for this subsample are robust. We find similar results when we further narrow the sample to cities in provincial administrations where this ratio is less than 0.5%, as column 2 shows.

4.4 Lower-income cities have higher RCFP growth

We next examine **Hypothesis II**. Figure 7–a plots the RCFP in 2010 against GDP per capita in the same year at the city level (data are only available for 29 cities, as mentioned in Section 4.1). The pattern is consistent with our hypothesis, that is, the RCFP increases with GDP per capita. Even within a province with largely homogeneous fertility policies, we observe significantly fewer above-quota births in wealthier cities.[21]

[Figure 7 about here]

We classify these cities into wealth groups, as defined in Equation (2), and we find that cities in the top quartile have always had higher RCFPs, whereas cities in the other three quartiles had relatively lower RCFPs before 2015 (Figure 7–c). After the UTCP's implementation, the RCFP has risen rapidly in low-income cities, and the gap between the top and bottom quartiles has narrowed. Note that in 2013–2015, this gap grew despite the PTCP's introduction. A possible reason is that the PTCP, which was announced in 2011, is a directional family planning adjustment from "*control*" to "*release*" even though it only applied to a small number of couples. Local family planning departments significantly relaxed their regulatory efforts, and some households that preferred to have a second child seized the opportunity (Qiao, 2015). This relaxation may have led to a decrease in the RCFP during 2013–2015.

To address the issue of the insufficient sample size at the city level, we next examine the effects of the TCP on the RCFP using county-level data for Hunan Province. Using data from county-level administrative units, including *Shixiaqu*, *Xian*, and *Xianjishi*, within this province has some merit. These units have similar fertility policies and preferences for childbearing prior to the fertility policy relaxation, rendering the identification of the TCP's effects partly immune to omitted variable issues. Our birth rate data cover 124 counties from 2012–2019, with our RCFP data spanning 2012–2018 (earlier data are not available). Thus, we can compare changes in fertility behavior between the period when the PTCP was implemented and the period when the TCP began to apply to all couples.

We divide the full sample of counties into four subsamples according to their GDP per capita levels in 2012,

[21] Figure 7–b also plots the RCFP in 2010 against the NIQCPF. There is a negative correlation between the two, which means that cities with tight birth quotas did not produce more above-quota children. Conversely, these cities have higher OCP compliance rates because they are generally wealthier.

and we find that the birth rate was lowest in the wealthiest counties during 2012–2015. However, this pattern reversed after the UTCP's implementation (Figure 8–a). In 2019, the birth rate in the wealthiest counties was 1.2 points higher on average than that of the remaining three quartiles. Focusing on changes in the RCFP (Figure 8–b), the pattern is again consistent with our hypothesis; lower-income counties exhibit more significant RCFP growth.

[Figure 8 and Table 5 about here]

Table 5 shows the formal regression results for this analysis. Counties with lower wealth levels, measured by GDP per capita in 2012, have higher RCFP growth after the introduction of the UTCP (column 1). This result is robust to controlling for the NIQCPF and the minority population share (i.e., their interactions with the UTCP time dummy) (column 2), which are associated with the local tightness of the birth quota and childbearing preferences, respectively, and to using disposable income per capita as an alternative measure of a county's wealth level (column 3). The fourth column shows the results of estimating Equation (2). We find that the RCFP of the counties in the lowest-income quartile increased by 5.1 percentage points after 2015 relative to the counties in the highest-income quartile (i.e., the benchmark group). As a robustness check, we replace the dependent variable with the birth rate; columns 5-8 report the corresponding results, which are highly consistent with our city-level baseline estimations (Table 1).

4.5 Wealthier cities collected fewer OCP-related fines

Finally, we test **Hypothesis III** by regressing fine payments per capita on GDP per capita using provincial cross-sectional data for 2012. As in previous estimations, we include the NIQCPF and the minority population share as control variables. Note that the PTCP was officially approved in November 2011, and, thus, 2012 is the first year with partial fertility relaxation. Because the PTCP only relaxed the birth restrictions for a very small number of families, most families were still subject to the OCP in 2012. In addition, the collection of OCP-related fines lagged the births of newborns, meaning that many of the fines imposed in 2012 were associated with above-quota births from when the OCP was still in effect. Thus, the fine payments in 2012 may reflect the degree of compliance with the OCP.

[Table 6 about here]

The first column of Table 6 reports the related estimation results. Provinces with higher GDPs per capita have significantly lower OCP-related fine payments. This result implies that relatively fewer OCP violations occurred in wealthier provinces, reducing the fines levied; this mechanism overwhelmed the effects of higher average standards for fines for above-quota births in these provinces. Column 2 reports the results when we replace the outcome of interest with birth rates; again, these results are consistent with our previous results that birth rates tended to be lower in wealthier regions under the OCP.

5. Concluding Remarks

Although China's nationwide birth rate has not continued to increase after China relaxed its fertility policy, our empirical analyses found that the TCP has effectively alleviated China's population problem by increasing the birth rate of second children. More encouragingly, the TCP has played an important role in improving the birth structure by increasing the number of newborns in wealthy cities and families. We expect that this outcome will improve the human capital accumulation of China's next generation.

Finally, we discuss some policy implications of these results. Proper anti-natalist policies may still be necessary in developing countries with extremely high fertility rates and, at the same time, effective policy responses to low fertility are needed in most advanced economies. However, designing better policies to minimize the cost of controlling (or increasing) fertility and, in particular, to avoid the additional costs of adverse selection is still a challenge facing governments. For example, although India did not have a national fertility policy as of 2020, many local laws apply penalties for having more than two children on a case-by-case basis, and others offer young couples limited financial rewards if they delay childbirth. Our results imply that such policies may lead to different outcomes, as the former may tend to affect wealthy families more, whereas the latter may be appreciated more by low-income families. These differences should be carefully considered in policymaking because they are associated with a country's long-term human capital accumulation.

Appendices

Appendix A: Proofs of Claims 1-3

Proof of Claim 1: Full policy failure (see Figure A1–a). In a city with $W^m<W_0$, it is easily seen that $W<Min(U(W), Fine)$ satisfies for the households whose total wealth is less than W^m. Although these households cannot pay the above-quota fine in full ($=W^m$), they will be happy to spend all their wealth to have an above-quota child. For households whose wealth is greater than W^m, we have: $Fine<Min(U(W), W)$, that is, these households are willing and able to pay the full fine to have an above-quota child. Thus, no family abides by the OCP in such a city.

The total fine payments collected by local governments can be divided into two parts: fines for which limited liability applies ($=a/2\times(W^m-a/4)$) and full fine payments ($=a/2\times W^m$). Both are increasing with W^m. Q.E.D.

[Figure A1 about here]

Proof of Claim 2: Full policy compliance (see Figure A1–b). We first define $G(W)=U(W+a/2)-W$. Then, it is straightforward to show that $G(W_0)=U(W_0+a/2)-W_0>0$, $G'(W)<0$, and $G''(W)<0$ for $W\in(W_0, +\infty)$. Thus, a unique W (i.e., W^{mk}, as noted in the main text) must exist such that $G(W^{mk})=0$, or $U(W^{mk}+a/2)=W^{mk}$. For a city whose average household wealth is greater than W^{mk} ($W^m>W^{mk}$), $G(W)<0$ holds for its wealthiest household. In other words, the full fine is greater than the net value of an above-quota child. Thus, the wealthiest household chooses not to have an above-quota child by paying the fine even if the fine is affordable (i.e., $W>Fine>U(W)$). Given that $U(W)$ is an increasing function, the fine is greater than the net value of an above-quota child for all households in this city.

We then consider the fertility decision of the poorest household in a city. $U(W^m-a/2)-(W^m-a/2)\geq 0$ is a precondition for the poorest household to have an above-quota birth. In other words, the net value of an above-quota child cannot be lower than total household wealth (limited liability applies to fine payments).

It is straightforward to show that this condition is only satisfied if $W^m \leq W_0 + a/2$. If a city's average household wealth is greater than $W_0+a/2$, the poorest household does not have an above-quota child at the expense of all of its wealth (i.e., $Fine > W > U(W)$).

Thus, all of the households in a city have $U(W) < Min(W, Fine)$ if $W^m > Max(W^{mk}, W_0+a/2)$. In other words, no households have an above-quota birth, and the OCP-related fine payments are zero. Q.E.D.

Proof of Claim 3: Partial policy effectiveness (see Figure A1–c). For cities where neither Claim 1 nor Claim 2 applies ($W_0 \leq W^m \leq Max(W^{mk}, W_0+a/2)$), we define the rate of OCP compliance as D, which is a function of W^m and can be decomposed into $D_1(W^m)$ and $D_2(W^m)$ ($D(W^m)=D_1(W^m)+D_2(W^m)$).

$D_1(W^m) \in [0, 1/2]$ refers to the share of households for which $Fine > W > U(W)$ applies. These households comply with the OCP because they are unable to pay the fine in full ($W < W^m$) and, moreover, are unlikely to have an above-quota child at the expense of all their wealth. It is straightforward to show that $D_1(W^m)=Min(a/2, W^m-W_0)/a$, which is an increasing function of W^m. $D_2(W^m)$, which is within the range [0, 1/2], refers to the share of households for which $W \geq Fine > U(W)$ applies. These households are able to pay the fine in full, but the fine is greater than their net value of an above-quota child. It is easily seen that $D_2(W^m)=Min(a/2, V(W^m)-W^m)/a$, where $V(W)$ is the inverse function of $U(W)$. Because $1 > U'(W) > 0$ when $W > W_0$, it follows that $V'(W)=1/U'(W)>1$, that is, $D_2(W^m)$ is an increasing function of W^m. To sum up, when $W_0 \leq W^m \leq Max(W^{mk}, W_0+a/2)$, $D(W^m)$ increases with W_m.[22] Q.E.D.

Appendix B: Summary statistics

[Table A1 about here]

Appendix C: Calculation of the NIQCPF

The 31 mainland Chinese provincial-level administrations can be grouped into four categories according to their provincial-level fertility policies:

1) Beijing, Chongqing, Jiangsu, Shanghai, Sichuan, and Tianjin: almost all couples can have only one child.
2) Hainan, Ningxia, Qinghai, Xinjiang, and Yunnan: a rural couple can have two children, whereas a urban couple can have only one child.
3) Tibet: the OCP only applies to Han-nationality residents; Tibetan urban residents and governmental officials can have two children, and there are no strict fertility controls for Tibetan rural residents, although all families are encouraged to have no more than three children (three-child policy).
4) The remaining 19 provinces: a 1.5-child policy is implemented in rural areas, that is, couples may have a second child after a specified birth spacing if the first birth is a girl; urban couples can have only one child.

We obtain city-level data on the rural and urban populations, the Han-nationality and minority populations, and the sex ratios of newborns from the 2010 Census, and we calculate the NIQCPF as

[22] When $W^m=Max(W^{mk}, W_0+a/2)$, we have $D_1(W^m)=D_2(W^m)=1/2$ (i.e., Claim 2: full policy compliance); when $W^m=W_0$, $D_1(W^m)=D_2(W^m)=0$ (i.e., Claim 1: full policy failure).

follows:

NIQCPF = $(1 \times P_1 + \boldsymbol{n} \times P_{\boldsymbol{n}} + 2 \times P_2 + 3 \times P_3) \times 1.06$,

where P_i is the population share of a city for which an i-child policy (i = 1, $\boldsymbol{n}$, 2, and 3) applies. Note that $\boldsymbol{n} \in [1,2]$ is city-specific in regions that apply the 1.5-child policy. Assuming that the ratio of newborn boys to girls in a city is 110:100, then the probability that a firstborn child is a girl in this city is 100/(100+110) = 0.476. Considering the impact of this newborn sex ratio on birth quotas in rural areas, $\boldsymbol{n}$ should be 1.476 in this city. Couples who are associated with remarriage, children with disabilities, martyrs, Chinese citizens returning from overseas, and specific risky occupations are allowed to have one more child; we roughly set the coefficient of correction equal to 1.06, following Gu et al. (2007). In addition, for cities with a minority population share above 5.0% (the city mean is 7.5%), we also consider the effects of minority-specific fertility policies on the NIQCPF because local governments implement relaxed fertility policies for non-Han ethnic minorities.

References

Agarwal, S., K. Li, Y. Qin, and J. Wu (2020) The impact of fertility relaxation on female labor market outcomes. Unpublished document: National University of Singapore and Tsinghua University.

Attané, I. (2016) Second child decisions in China, *Population and Development Review*, 42: 519-536.

Bar, M., M. Hazan, O. Leukhina, O. Weiss, and H. Zoabi (2018) Why did rich families increase their fertility? Inequality and marketization of child care, *Journal of Economic Growth*, 23: 427-463.

Becker, G. S. (1960) An economic analysis of fertility. In: Roberts, G. B. (Eds.), *Demographic and Economic Change in Development Countries*. New York: Columbia University Press.

Blackburn, K. and G. P. Cipriani (2002) A model of longevity, fertility and growth, *Journal of Economic Dynamics and Control*, 26: 187-204.

Bongaarts, J. and T. Sobotka (2012) A demographic explanation for the recent rise in European fertility, *Population and Development Review*, 38: 83-120.

Chen, W. and Y. Jin (2014) How well has China's family planning policy worked: A micro level analysis (In Chinese), *Population and Economy*, 205: 118-128.

Chen, W. and L. Wu (2006) The relationship between migration and fertility in China (In Chinese), *Population Research*, 30: 13-20.

Clark, W., D. Yi, and X. Zhang (2020) Do house prices affect fertility behavior in China? An empirical examination, *International Regional Science Review*, 43: 423-449.

Dettling, L. J. and M. S. Kearney (2014) House prices and birth rates: The impact of the real estate market on the decision to have a baby, *Journal of Public Economics*, 110: 82-100.

Ebenstein, A. (2010) The "Missing Girls" of China and the unintended consequences of the One-Child Policy, *Journal of Human Resources*, 45: 87-115.

Esping-Andersen, G. and F. C. Billari (2015) Re-theorizing family demographics, *Population and Development Review*, 41: 1-31.

Fernihough, A. (2017) Human capital and the quantity–quality trade-off during the demographic transition, *Journal of Economic Growth*, 22: 35-65.

Fox, J., S. Klüsener, and M. Myrskylä (2019) Is a positive relationship between fertility and economic development emerging at the sub-national regional level? Theoretical considerations and evidence from Europe, *European Journal of Population*, 35: 487-518.

Galor, O. and D. N. Weil (2000) Population, technology, and growth: From Malthusian stagnation to the

demographic transition and beyond, *American Economic Review*, 90: 806-828.
Ge, Y. and X. Zhang (2019) The effect of housing price on family fertility decision in China (In Chinese), *Population Research*, 43: 52-63.
Goldscheider, F., E. Bernhardt, and T. Lappegård (2015) The gender revolution: A framework for understanding changing family and demographic behavior, *Population and Development Review*, 41: 207-239.
Goldstein, J., T. Sobotka, and A. Jasilioniene (2009) The end of "lowest-low" fertility? *Population and Development Review*, 35: 663-699.
Goodkind, D. (2017) The astonishing population averted by China's birth restrictions: Estimates, nightmares, and reprogrammed ambitions, *Demography*, 54: 1375-1400.
Greenhalgh, S., C. Zhu, and N. Li (1994) Restraining population growth in three Chinese villages, 1988-93, *Population and Development Review*, 20: 365-395.
Gu, B., F. Wang, Z. Guo, and E. Zhang (2007) China's local and national fertility policies at the end of the Twentieth Century, *Population and Development Review*, 33: 129-147.
Guo, Z. (2010) The impacts of floating population on current fertility in China (In Chinese), *Population Research*, 34: 19-29.
Iwasaki, I. and X. Ma (2020) Gender wage gap in China: A large meta-analysis. *Journal for Labour Market Research*, forthcoming.
Iyigun, M. F. (2000) Timing of childbearing and economic growth, *Journal of Development Economics*, 61: 255-269.
Kirk, D. (1996) Demographic transition theory, *Population Studies*, 50: 361-387.
Kulu, H. and A. Vikat (2007) Fertility differences by housing type: The effect of housing conditions or of selective moves? *Demographic Research*, 17: 775-801.
Li, D. and Z. Guo (2014) Fertility level of floating population in China: An analysis based on the national floating population dynamic monitoring survey data (In Chinese), *Chinese Journal of Population Science*, 34: 17-29.
Li, H., M. Xue, S. Hellerstein, Y. Cai, Y. Gao, Y. Zhang, J. Qiao, J. Blustein, and J. Liu (2019) Association of China's universal two child policy with changes in births and birth related health factors: National, descriptive comparative study, *The BMJ*, 366: l4680.
Li, H. and J. Zhang (2003) Fines, limited liability and fertility. Unpublished document: The Chinese University of Hong Kong.
Liang, J., Y. Mu, X. Li, W. Tang, Y. Wang, Z. Liu, X. Huang, R. W. Scherpbier, S. Guo, M. Li, L. Dai, K. Deng, C. Deng, Q. Li, L. Kang, J. Zhu, and C. Ronsmans (2018) Relaxation of the one child policy and trends in caesarean section rates and birth outcomes in China between 2012 and 2016: Observational study of nearly seven million health facility births, *The BMJ*, 360: k817.
Liu, J. and W. Chen (2019) China's low fertility trends (In Chinese), *Population and Economy*, 237: 70-81.
Liu, J., C. Xing, and Q. Zhang (2020) House price, fertility rates and reproductive intentions, *China Economic Review*, 62: 101496.
Luci-Greulich, A. and O. Thévenon (2014) Does economic advancement 'cause' a re-increase in fertility? An empirical analysis for OECD countries (1960-2007), *European Journal of Population*, 30: 187-221.
Myrskylä, M., H. P. Kohler, and F. Billari (2009) Advances in development reverse fertility declines. *Nature*, 460: 741-743.
National Health Commission of the People's Republic of China (2020) The 2019 National Statistical Bulletin on the Development of Health Services. June 6, 2020.

Ohinata, A. and D. Varvarigos (2020) Demographic transition and fertility rebound in economic development, *Scandinavian Journal of Economics*, 122: 1640-1670.

Öst, C. E. (2012) Housing and children: Simultaneous decisions? — A cohort study of young adults' housing and family formation decision, *Journal of Population Economics*, 25: 349-366.

People's Daily Online (2013) Social maintenance fee payments in 24 provinces exceed 20 billion *yuan*. December 5, 2013.

Qiao, X. (2015) The effect of the Two-Child Policy and the choice of future fertility policies (In Chinese), *Chinese Journal of Population Science*, 35: 26-33.

Reuters (2014) Chinese director Zhang Yimou fined $1.2 million for violating one-child policy. January 9, 2014.

Shi, R., N. Chen, and Q. Zheng (2018) Evaluating the effect of fertility policy adjustments in China (In Chinese), *Chinese Journal of Population Science*, 38: 114-125.

Short, S. E. and F. Y. Zhai (1998) Looking locally at China's one-child policy, *Studies in Family Planning*, 29: 373-387.

Wang, X. and J. Zhang (2018) Beyond the quantity-quality tradeoff: Population control policy and human capital investment, *Journal of Development Economics*, 135: 222-234.

Weller, R. H. (1977) Wife's employment and cumulative family size in the United States, 1970 and 1960, *Demography*, 14: 43-65.

Yi, J. and J. Zhang (2010) The effect of house price on fertility: Evidence from Hong Kong, *Economic Inquiry*, 48: 635-650.

Zeng, Y. and T. Hesketh (2016) The effects of China's universal two-child policy, *Lancet*, 388: 1930-1938.

Zhang, L. (2006) A historical review on the changes of sex ratio at birth and fertility level of Chinese ethnic minorities since the 1980s (In Chinese), *Population and Economy*, 158: 66-70.

Zhou, H. (2015) The effect of migration on fertility (In Chinese), *Population Research*, 39: 14-28.

Table 1: Baseline birth rate results.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Birth rate									
	[]=ln(GDP p.c. 2008)				[]=ln(GDP p.c. mean 2008-19)		[]=ln(disp. income p.c. 2009)		[]=ln(GDP p.c. 2008)	
[] * Partial[yr 2012–15]	0.467***	0.364***			0.666***	0.415***	0.792***	0.697**	0.511***	0.414*
	(0.111)	(0.132)			(0.130)	(0.152)	(0.225)	(0.309)	(0.149)	(0.246)
[] * Universal[yr 2016–19]	0.955***	0.752***			1.235***	0.759***	1.429***	1.246***	0.999***	0.845**
	(0.187)	(0.221)			(0.218)	(0.255)	(0.335)	(0.440)	(0.215)	(0.349)
D[50th–75th%] * Partial[yr 2012–15]			0.240	0.337						
			(0.199)	(0.232)						
D[50th–75th%] * Universal[yr 2016–19]			0.102	0.187						
			(0.273)	(0.335)						
D[25th–50th%] * Partial[yr 2012–15]			0.101	0.302						
			(0.194)	(0.235)						
D[25th–50th%] * Universal[yr 2016–19]			0.165	0.518						
			(0.289)	(0.344)						
D[highest 25%] * Partial[yr 2012–15]			0.761***	0.538**						
			(0.180)	(0.225)						
D[highest 25%] * Universal[yr 2016–19]			1.640***	1.152***						
			(0.311)	(0.349)						
[] * D[yr 2009]									-0.063	-0.076
									(0.083)	(0.108)
[] * D[yr 2010]									0.126	0.013
									(0.173)	(0.182)
[] * D[yr 2011]									0.150	0.083
									(0.145)	(0.185)
Two-way fixed effects	X	X	X	X	X	X	X	X	X	X
City-specific linear time trends	-	X	-	X	-	X	-	X	-	X
Obs.	2,984	2,984	2,984	2,984	2,984	2,984	1,793	1,793	2,984	2,984
R-sq	0.170	0.509	0.178	0.510	0.177	0.508	0.201	0.508	0.171	0.509

Notes: Coefficients of the constant term are not reported. Standard errors (clustered at the city level) are shown in parentheses: *p < 0.1; **p < 0.05; ***p < 0.01.

Table 2: Robustness checks accounting for the NIQCPF.

	(1)	(2)	(3)	(4)	(5)	(6)
			Birth rate			
ln(GDP p.c. 2008) * Partial[yr 2012–15]			0.440***	0.279**	0.247	0.068
			(0.119)	(0.141)	(0.215)	(0.265)
ln(GDP p.c. 2008) * Universal[yr 2016–19]			1.028***	0.717***	1.409***	1.106**
			(0.210)	(0.245)	(0.321)	(0.460)
NIQCPF * Partial[yr 2012–15]	-0.691**	-1.166***	-0.258	-0.865**		
	(0.327)	(0.394)	(0.349)	(0.417)		
NIQCPF * Universal[yr 2016–19]	-0.378	-1.160**	0.701	-0.394		
	(0.598)	(0.563)	(0.715)	(0.616)		
Two-way fixed effects	X	X	X	X	X	X
City-specific linear time trends	-	X	-	X	-	X
Sample	Full	Full	Full	Full	NIQCPF 25th–75th%	NIQCPF 25th–75th%
Obs.	2,984	2,984	2,984	2,984	1,499	1,499
R-sq	0.138	0.509	0.173	0.511	0.223	0.518

Notes: Coefficients of the constant term are not reported. "NIQCPF 25th–75th%" refers to the subsample of cities for which the NIQCPF is greater than 1.33 and less than 1.46 (i.e., the 25th–75th%). Standard errors (clustered at the city level) are shown in parentheses: *p < 0.1; **p < 0.05; ***p < 0.01.

Table 3: Robustness checks accounting for other confounding factors.

	(1)	(2)	(3)	(4)	(5)	(6)
	Birth rate					
Panel A: Two-way fixed effects are included.						
ln(GDP p.c. 2008) * Partial[yr 2012–15]	0.406***	0.392***	0.182	0.383**	0.426**	0.427**
	(0.118)	(0.142)	(0.167)	(0.190)	(0.185)	(0.187)
ln(GDP p.c. 2008) * Universal[yr 2016–19]	0.976***	0.809***	0.673**	1.164***	1.181***	1.171***
	(0.204)	(0.254)	(0.296)	(0.311)	(0.310)	(0.322)
Obs.	2,972	2,785	2,739	2,739	2,739	2,739
R-sq	0.193	0.210	0.259	0.282	0.283	0.283
Panel B: Two-way fixed effects & city-specific linear time trends are included.						
ln(GDP p.c. 2008) * Partial[yr 2012–15]	0.258*	0.278*	0.172	0.151	0.194	0.178
	(0.139)	(0.145)	(0.190)	(0.228)	(0.227)	(0.223)
ln(GDP p.c. 2008) * Universal[yr 2016–19]	0.676***	0.570**	0.596*	0.676*	0.706*	0.673*
	(0.238)	(0.281)	(0.350)	(0.378)	(0.380)	(0.390)
Obs.	2,972	2,785	2,739	2,739	2,739	2,739
R-sq	0.512	0.520	0.524	0.527	0.528	0.529
$\mathbf{X}_i$ contains:						
NIQCPF	X	X	X	X	X	X
a	X	X	X	X	X	X
b, c, d	-	X	X	X	X	X
e, f, g, h	-	-	X	X	X	X
i	-	-	-	X	X	X
j	-	-	-	-	X	X
k	-	-	-	-	-	X

Notes: The coefficients of the constant term and the interactions between $\mathbf{X}_i$ and the time dummies (i.e., $\mathbf{X}_i'\mathbf{Partial}_t$ and $\mathbf{X}_i'\mathbf{Universal}_t$) are not reported. $\mathbf{X}_i$ contains the NIQCPF and ***a-k*** in turn: ***a***) the proportion of the ethnic minority population; ***b***) the proportion of the population of childbearing age; ***c***) the degree of gender balance; ***d***) population growth during 2008–2011 and 2011–2015; ***e***) the logarithm of the de jure population per square kilometer; ***f***) the logarithm of the number of full-time primary school teachers per 1,000 people, defined as the de jure population; ***g***) the logarithm of the number of hospital and health center beds per 1,000 people, defined as the de jure population; ***h***) the city's de jure population relative to its registered population; ***i***) the growth in GDP per capita during 2008–2011 and 2011–2015; ***j***) the logarithm of the minimum wage standard per month; and ***k***) the growth in house prices during 2008–2011 and 2011–2015. Standard errors (clustered at the city level) are shown in parentheses: *p < 0.1; **p < 0.05; ***p < 0.01.

Table 4: Robustness checks excluding the observations with high OCP-related fine payments.

	(1)	(2)
	Birth rate	Birth rate
	(Fine payments/Fiscal revenue)<0.01	(Fine payments/Fiscal revenue)<0.005
ln(GDP p.c. 2008) * Partial[yr 2012–15]	0.472***	0.485***
	(0.152)	(0.179)
ln(GDP p.c. 2008) * Universal[yr 2016–19]	0.814***	0.919***
	(0.287)	(0.335)
Two-way fixed effects	X	X
City-specific linear time trends	X	X
Obs.	2,123	1,448
R-sq	0.499	0.499

Notes: Coefficients of the constant term are not reported. In column 1, only cities in provincial administrative units whose OCP-related fine payments are less than 1% of total fiscal revenue in 2012 (21 of the 24 provincial units for which OCP-related fine payments in 2012 are reported; see Footnote 18) are included in the regression. The estimations in column 2 further restrict the sample to cities in the 15 provincial administrations whose fine payments are less than 0.5% of total fiscal revenue. Standard errors (clustered at the city level) are shown in parentheses: *p < 0.1; **p < 0.05; ***p < 0.01.

Table 5: Impacts of the TCP on the RCFP and birth rates: County-level evidence.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	RCFP				Birth rate			
ln(GDP p.c. 2012) * Universal[yr 2016–19]	-1.641**	-3.181***			0.959***	0.789***		
	(0.652)	(0.544)			(0.152)	(0.159)		
NIQCPF * Universal[yr 2016–19]		0.608	1.635	1.177		0.877	0.533	0.766
		(2.376)	(2.310)	(2.115)		(0.849)	(0.857)	(0.910)
% minority * Universal[yr 2016–19]		-0.102***	-0.118***	-0.097***		-0.015***	-0.012**	-0.015**
		(0.014)	(0.014)	(0.013)		(0.005)	(0.005)	(0.006)
ln(disp. income p.c. 2012) * Universal[yr 2016–19]			-8.700***				1.803***	
			(1.656)				(0.470)	
D[lowest 25%] * Universal[yr 2016–19]				5.081***				
				(1.057)				
D[50th–75th%] * Universal[yr 2016–19]				4.462***				0.424
				(1.129)				(0.293)
D[25th–50th%] * Universal[yr 2016–19]				4.361***				0.377
				(1.048)				(0.294)
D[highest 25%] * Universal[yr 2016–19]								1.365***
								(0.339)
Two-way fixed effects	X	X	X	X	X	X	X	X
County-specific linear time trends	X	X	X	X	X	X	X	X
Obs.	868	854	854	854	954	939	939	939
R-sq	0.912	0.933	0.931	0.933	0.792	0.792	0.790	0.792

Notes: Coefficients of the constant term are not reported. Standard errors (clustered at the county level) are shown in parentheses: *p < 0.1; **p < 0.05; ***p < 0.01.

Table 6: Wealth levels and total OCP-related fine payments.

	(1)	(2)
	ln(fine payments p.c.)	Birth rate
ln(GDP p.c.)	-1.711**	-1.883*
	(0.781)	(1.033)
NIQCPF	-3.272***	4.072**
	(1.077)	(1.544)
% minority	-0.015	0.026
	(0.022)	(0.026)
Obs.	24	24
R-sq	0.311	0.428

Notes: Coefficients of the constant term are not reported. Our regressions include 24 provincial administrative units for which OCP-related fine payments in 2012 are reported; see Footnote 18. Robust standard errors are shown in parentheses: *p < 0.1; **p < 0.05; ***p < 0.01.

Table A1: Summary statistics.

Variable	Obs.	Mean	S.D.	Min.	Max.
City-level data					
Birth rate (# in 1,000 de jure pop)	2,984	11.10	2.76	3.40	27.00
GDP p.c. 2008 (yuan)	261	25,307	17,829	3,602	102,741
GDP p.c. (mean 2008–19) (yuan)	261	46,133	27,353	9,187	172,218
Disposable income p.c. 2009 (yuan)	156	10,252	4,038	3,415	26,906
NIQCPF 2010	261	1.40	0.20	1.06	2.41
% minority 2010	260	7.47	15.21	0.01	85.05
Pop growth 2008–11 (%)	244	2.39	10.05	-18.67	70.73
Pop growth 2011–15 (%)	244	2.14	8.67	-16.07	118.35
% (pop aged 15–29) 2010	244	31.01	4.80	21.74	57.87
Gender balance 2009	244	0.01	0.01	0.00	0.05
De jure pop relative to registered pop 2009	240	1.01	0.31	0.74	4.25
De jure population per sq.km 2009	240	420	325	5	2,474
Hospital and health center beds 2009 (# in 1,000 de jure pop)	240	3.30	1.14	1.18	10.70
Full-time primary school teachers 2009 (# in 1,000 de jure pop)	240	4.42	0.85	2.07	6.72
GDP p.c. growth 2008–11 (%)	240	60.64	21.64	5.32	150.78
GDP p.c. growth 2011–15 (%)	240	35.6	19.57	-27.95	117.00
Minimum wage per month 2015 (yuan)	240	1,388	179	1,030	2,030
House price growth 2008–11 (%)	240	47.99	17.71	8.79	110.93
House price growth 2011–15 (%)	240	20.24	14.96	-29.36	87.75
County-level data (Hunan Province)					
RCFP (%)	868	89.41	6.46	66.06	99.88
Birth rate (# in 1,000 de jure pop)	954	13.00	2.14	6.99	20.97
GDP p.c. 2012 (yuan)	124	35,664	29,776	8497	158789
Disposable income p.c. 2012 (yuan)	122	19,108	4,669	11954	32885
% minority 2010	122	15.76	29.76	0.02	97.65
NIQCPF 2010	122	1.46	0.13	1.38	1.94
Provincial data					
Fine payments p.c. 2012 (yuan)	24	16.74	19.66	0.61	75.18
Birth rate 2012 (# in 1,000 de jure pop)	24	11.34	2.66	5.73	15.32
GDP p.c. 2012 (yuan)	24	42,889	18,118	19,710	87,475
NIQCPF 2010	24	1.42	0.25	1.06	1.96
% minority 2010	24	9.18	12.65	0.40	53.07

Notes: Data sources: The NIQCPF, minority population ratio, and proportion of the population aged 15–29 are calculated based on 2010 Census data and government documents on fertility policy. The registered population is taken from the Urban China Database, published by the Urban China Initiative. The minimum wage comes from government documents on minimum wage standards. House prices come from CEIC Data. Fine payments are taken from People's Daily Online (2013). In addition to these data, other city-level data come from the Statistics Bureaus of provincial governments and the Economic and Social Development Statistical Bulletins of city governments. Other county-level data are obtained from the Hunan Provincial Bureau of Statistics and the Economic and Social Development Statistical Bulletins of county governments. Other provincial data come from the China Statistical Yearbook.

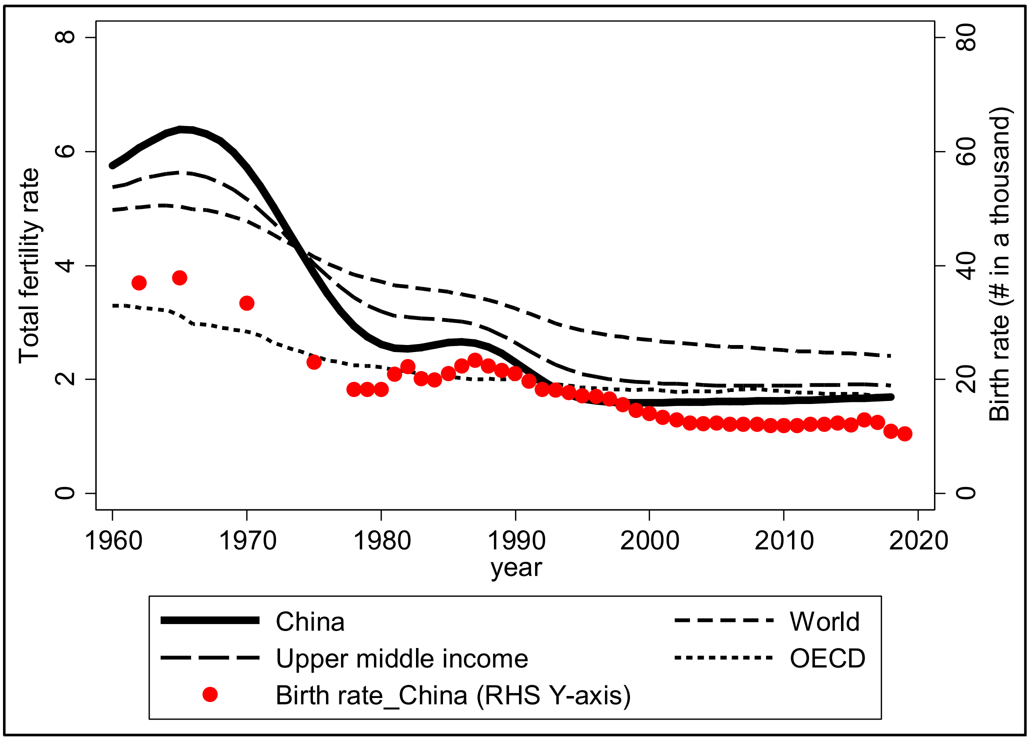


Figure 1: TFRs and birth rates in China in the period from 1960 to 2019.

Notes: TFR data come from the World Bank Databank (annually from 1960 to 2018). The World Bank classifies 56 countries as upper-middle-income countries, including China. Data on birth rates are available from 1962 to 2019 (with missing values) and are obtained from the China Statistical Yearbook (various issues).

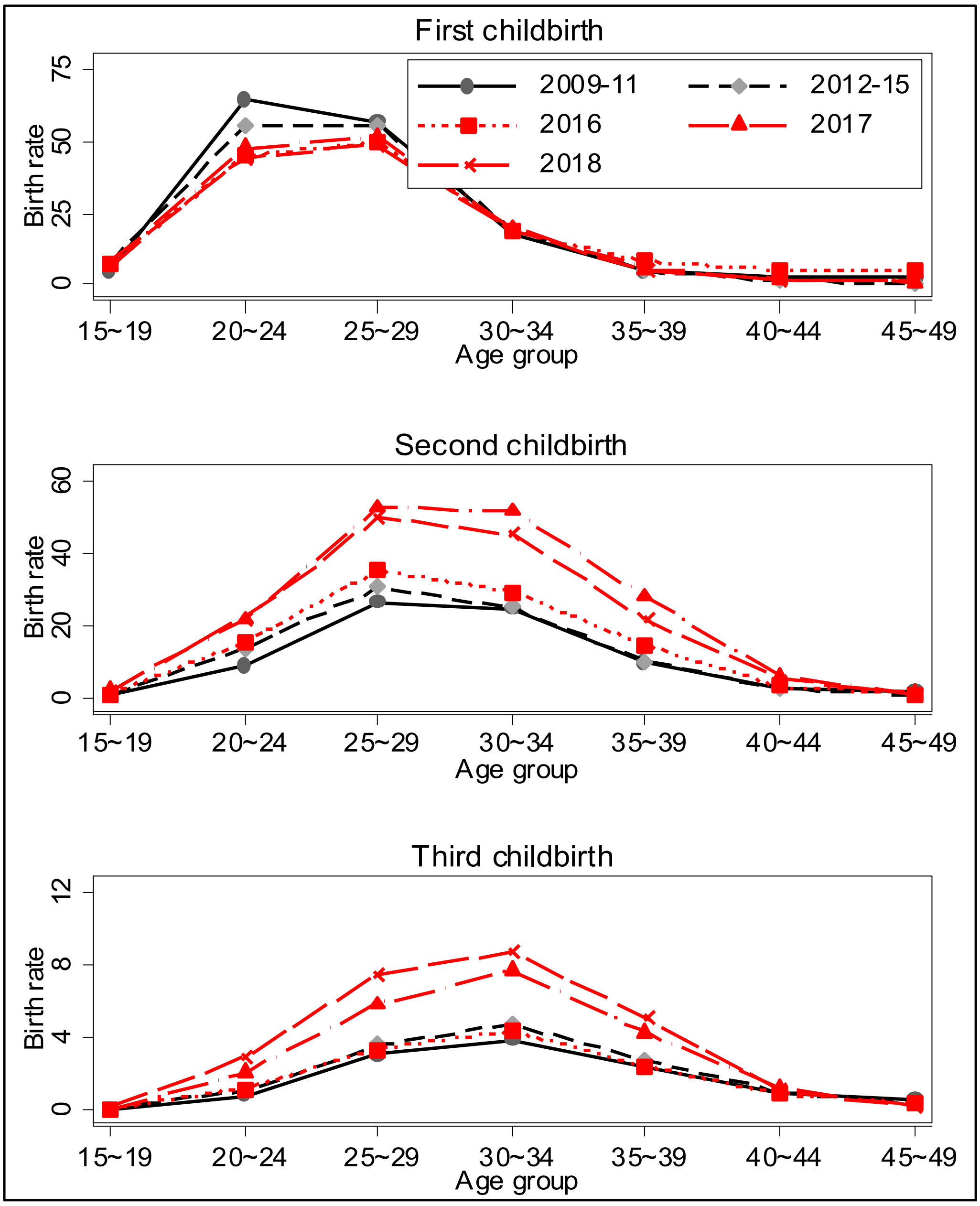
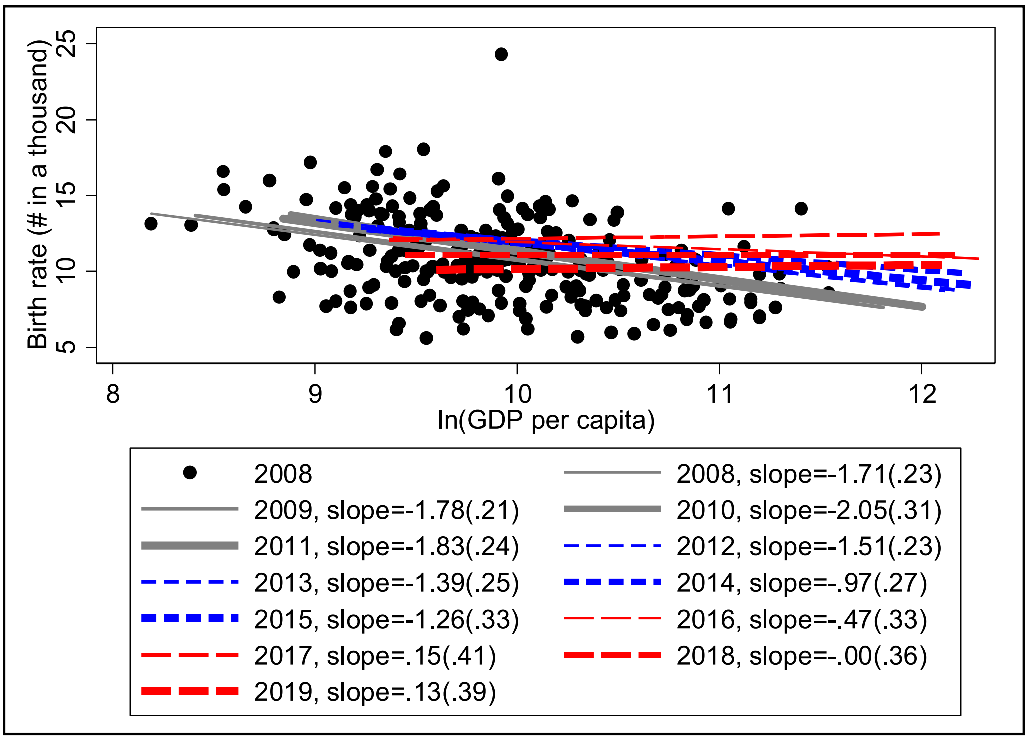
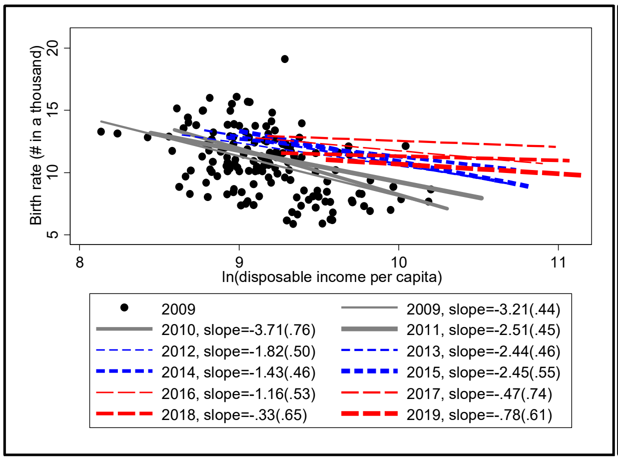


Figure 2: Birth rates by birth order and mother's age.

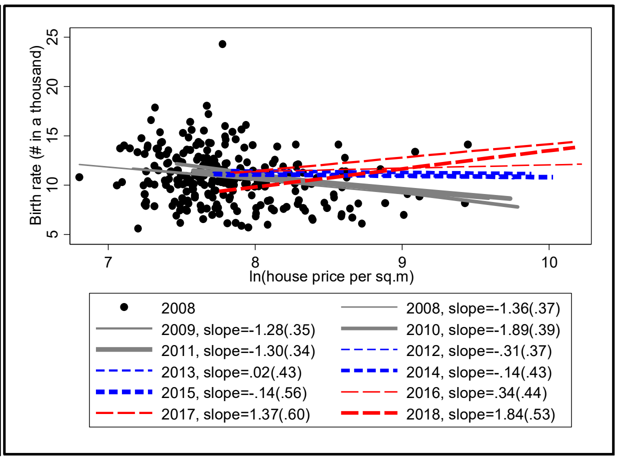
Notes: Here, the birth rate (per one thousand) refers to the number of newborns of the specified birth order born to women in the specified age group relative to the total female population in this age group. Data source: WIND Economic Database.



(a) Birth rates plotted against GDP per capita.



(b) Birth rates plotted against disposable income per capita.



(c) Birth rates plotted against house prices.

Figure 3: Birth rates plotted against cities' wealth levels.

Notes: We depict scatterplots of the data only for the first year owing to space constraints; for the other years, we only show the fitted line and the corresponding slope and standard error. Data on disposable income per capita in 2008 and house prices in 2019 are not available.

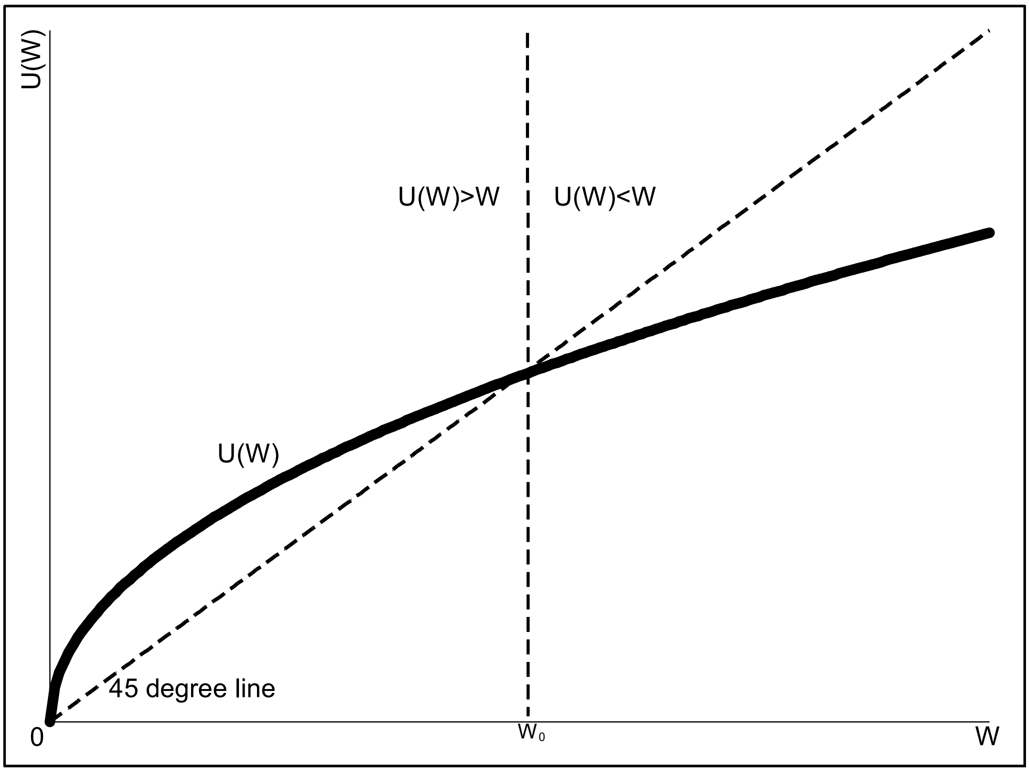


Figure 4: Household wealth and the net value of an above-quota child.

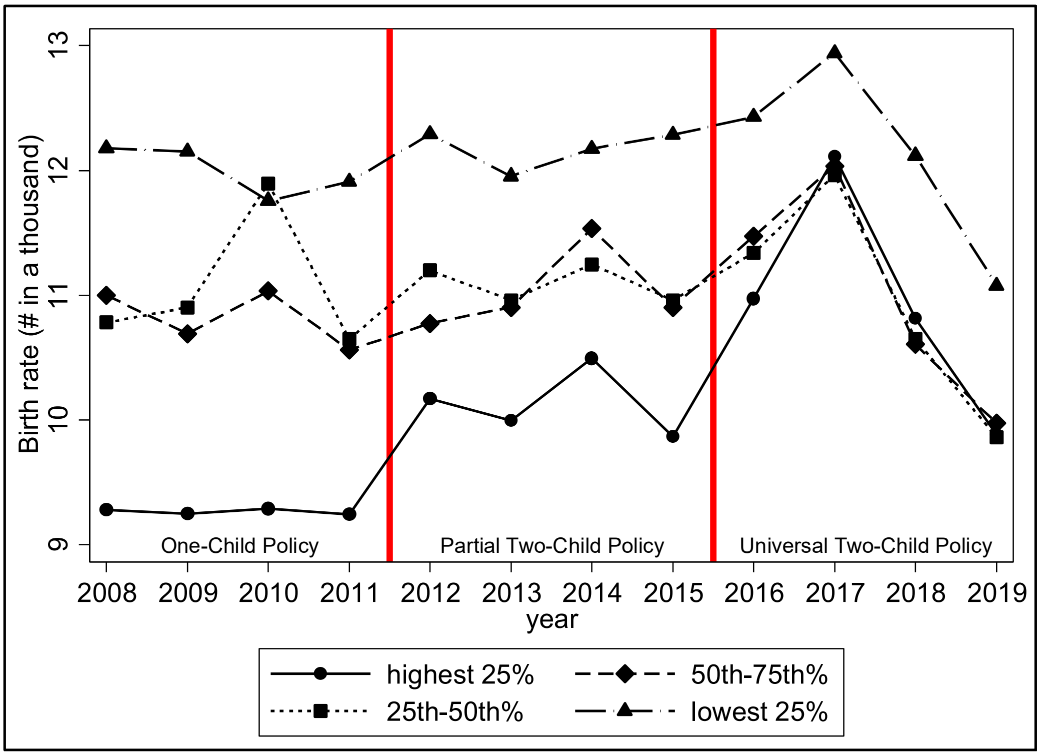


Figure 5: Changes in birth rates by city wealth level.

Notes: Each quartile contains 65 cities, where quartiles are defined based on GDP per capita in 2008. The jump in the birth rate for the second quartile (25th–50th%) in 2010 is partially caused by missing values, as our city sample size is reduced to 183 in this year.

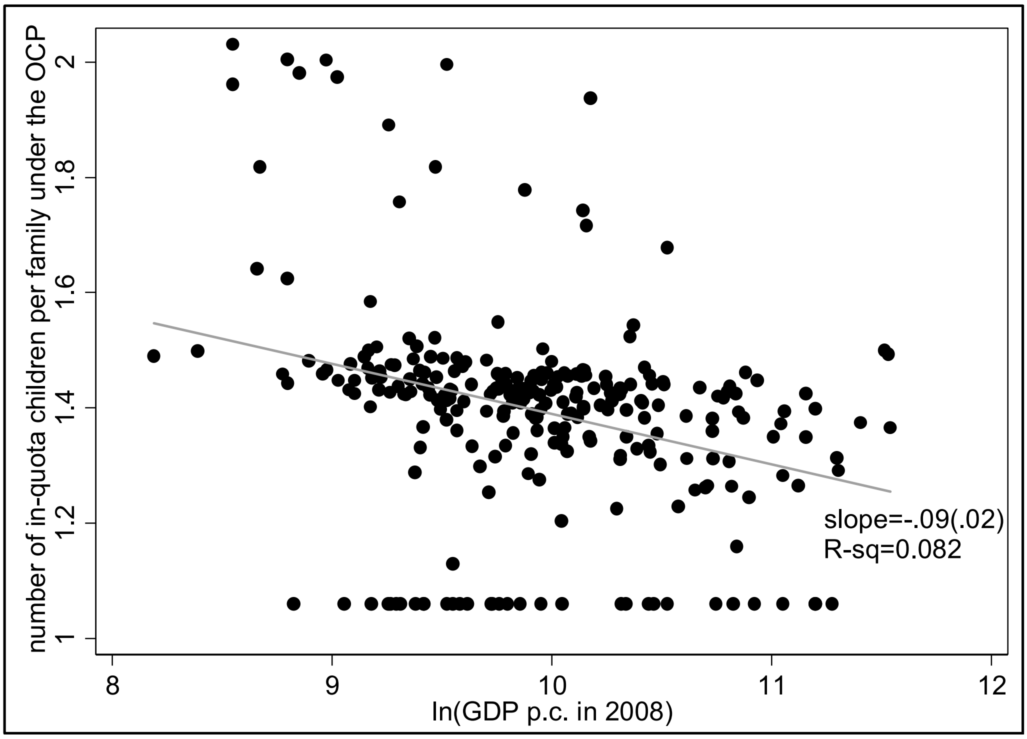
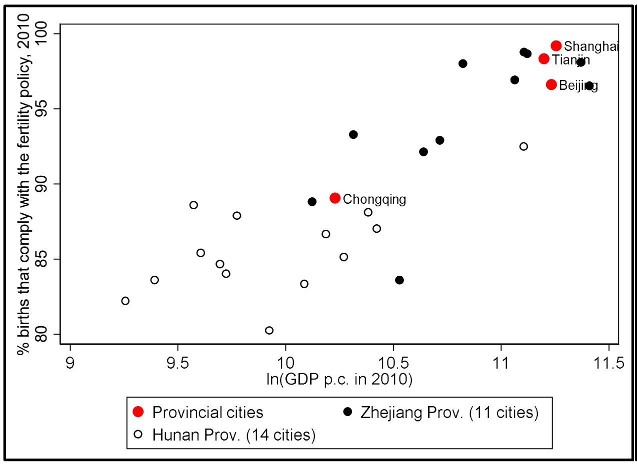
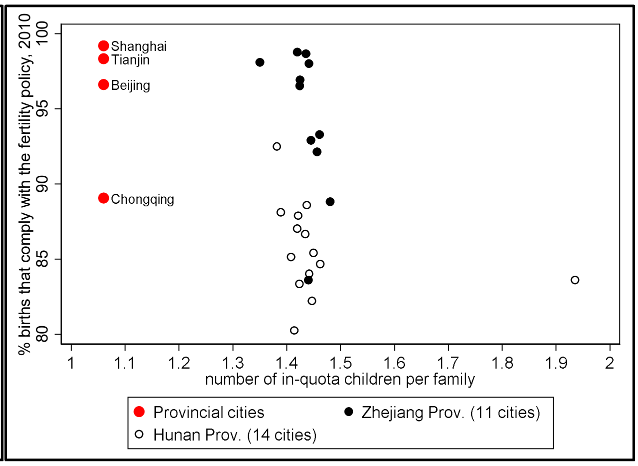


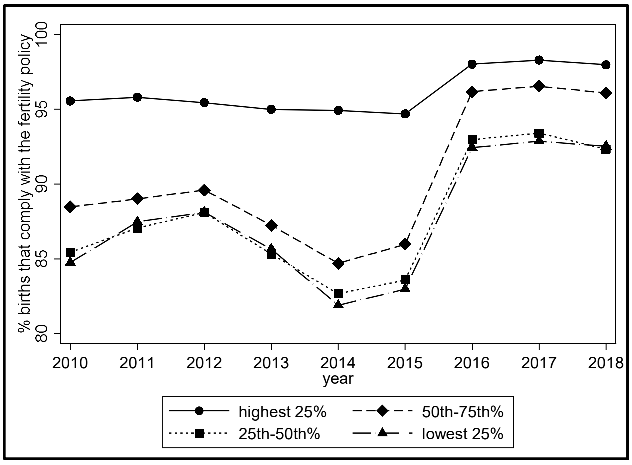
Figure 6: NIQCPF plotted against GDP per capita.



(a) RCFP plotted against GDP per capita.



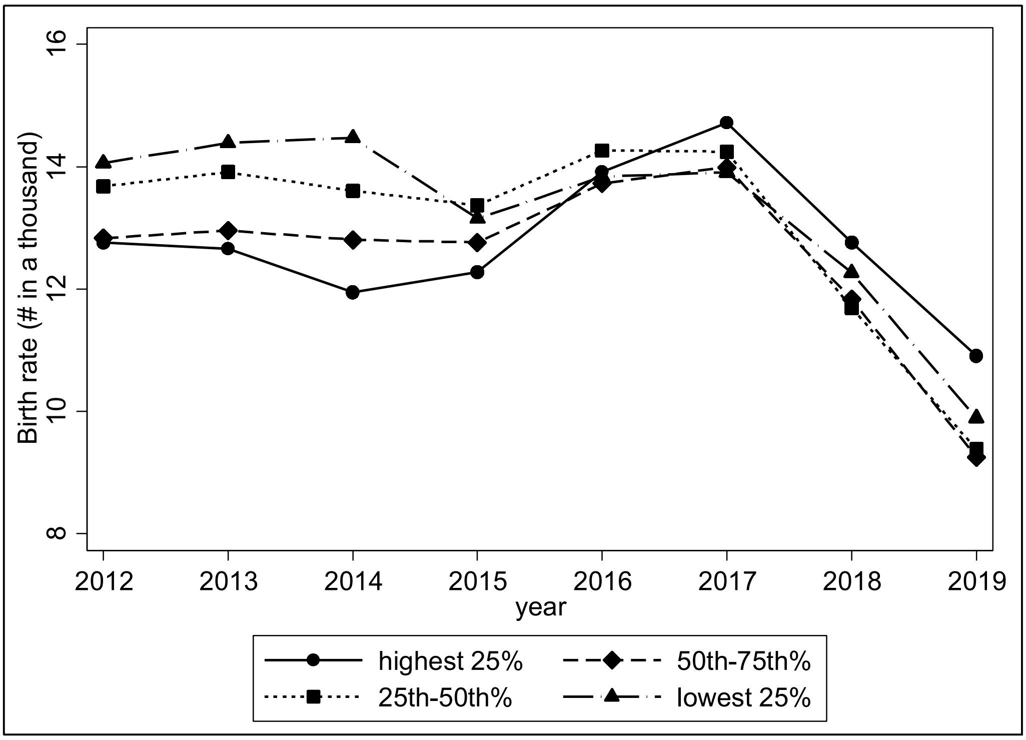
(b) RCFP plotted against the NIQCPF.



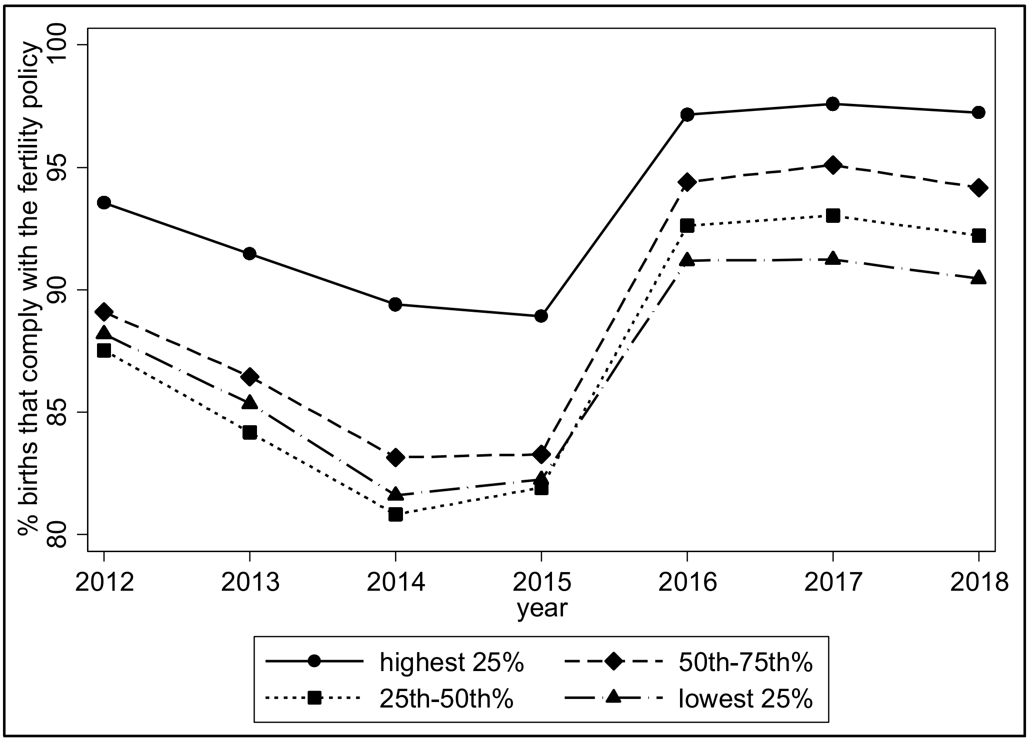
(c) Changes in the RCFP by wealth level.

Figure 7: RCFP patterns at the city level.

Notes: The city-level RCFP is only available for Hunan and Zhejiang Provinces and four provincial cities.



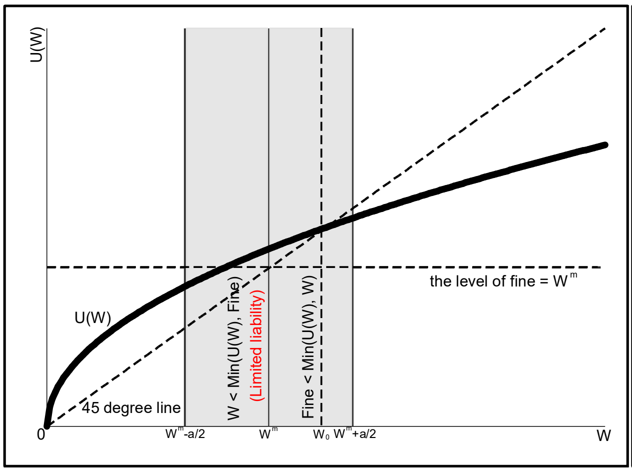
(a) Changes in birth rates by wealth level.



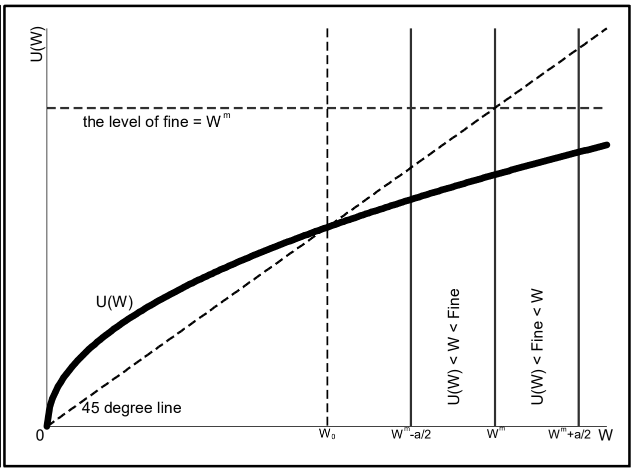
(b) Changes in the RCFP by wealth level.

Figure 8: Changes in birth rates and the RCFP at the county level.

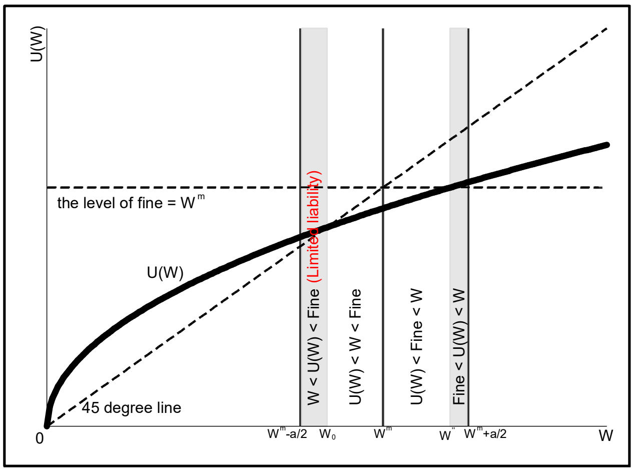
Notes: Each quartile contains 31 counties, where quartiles are defined based on GDP per capita in 2012.



(a) Full policy failure (low-income cities).



(b) Full policy compliance (wealthy cities).



(c) Partial policy effectiveness (other cities).

Figure A1: Cities' wealth levels and households' fertility decisions.

Notes: The parts marked in gray refer to the households that choose to violate the OCP.