

Maternal Health and the Relaxation of the  
One-Child Policy in China, 2004-2015

by

Maya Craffey  
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This success is yours as much as it is mine.

## **Abstract**

The recent termination of China's one-child policy provides a unique opportunity to analyze the maternal health effects of the draconian measures used to regulate population size. Three hypotheses are proposed: 1) the one-child policy was associated with the widespread use of coercive tactics, so the relaxation of this policy will result in improved maternal health outcomes; 2) a widespread maternal healthcare infrastructure was created to facilitate this a large-scale population control program, so the relaxation of this policy will result in reduced access to care and decreased maternal health outcomes; or 3) the strength of family planning interventions will not play a significant role in explaining maternal health outcomes. A comparative analysis of Beijing and Hebei province combined with a statistical analysis of province-level data from 2004 through 2015 showed that once province, year, percent of women with a high school or college degree, and per capita gross regional product have been accounted for, the birth rate and family planning index have no effect on maternal mortality ratios.

## CHAPTER 1: INTRODUCTION

Implemented in 1979 and in effect through the end of 2015, China's one-child policy is infamous worldwide for its strict government regulation of family planning. Aimed at decreasing the fertility rate in order to reduce the population to a perceived level of sustainability, this policy limited most Chinese couples to having only one child. As the policy evolved over time, increasing numbers of exceptions were allowed, but the formal one-child limit remained for over thirty years. In December of 2015, the Standing Committee of the National People's Congress voted to change the existing law to a two-child policy, effective January 1, 2016. While the end of this era of extremely strict government control over family planning was widely viewed as a step forward, the effects of terminating the one-child policy have yet to be seen, especially with regards to maternal health outcomes.

In September 2016, despite decades of falling maternal mortality ratios, deputy director of the National Health and Family Planning Commission Ma Xiaowei reported a maternal mortality ratio of 18.3 deaths per 100,000 women in the first half of 2016, a 30.6% increase compared to the same time period in 2015.<sup>1</sup> The reasons for this rise are unknown; some analysts believed the data was incorrect, while others attributed it to a surge of older women rushing to have a second child after the end of the one-child policy. Although the latter option is implausible because it is not possible to have a child in six months, this report emphasizes the lack of understanding of the factors that affect maternal mortality ratios.

The recent end to the one-child policy provides a unique opportunity to study the effects of its gradual weakening and eventual termination. Although the policy was a national-level initiative, it was administered exclusively at the provincial level. This enforcement varied from region to region; the one child limit was strictly imposed in densely-populated urban areas, while most rural couples were allowed to have two children. Additionally, numerous exceptions were added over time that allowed couples to have two children if they were both only children themselves or if their first-born child was a girl or had a disability. By 2007, only 35.9% of the population, largely located in urban centers, was forced to adhere to a strict one-child limit. The majority of the population, 52.9%, were allowed to have a second child if their first-born child was a girl and 9.6% of the population were permitted to have two children regardless of their sex. Ethnic minorities, for whom no limit was enforced, made up the remaining 1.6%.<sup>2</sup> Approved second children were typically born three to four years after the first child in an effort by local party officials to space out births.

Assessing the effects of the one-child policy on fertility rates and population growth is much more difficult than it seems. A claim commonly espoused by the Chinese government is that the one-child policy prevented 400 million births and played a vital role in facilitating China's modern economic success. However, the accuracy of this statement is questionable. Prior to the formal start of the one-child policy, looser government-sponsored family planning policies were already in place and fertility rates were declining. Recent demographic models show that if this trend had simply continued, fertility would have fallen to its current levels by 2010.<sup>3</sup>



Further, the implementation of this policy coincided with economic reform, which is a known cause of lower fertility rates.<sup>4</sup> Nonetheless, the fertility rate in China did decline during the time in which the one-child policy was in effect. The fertility rate, as reported by the World Health Organization in total births per woman, decreased from 2.753 when the policy began in 1979 to 1.617 when it was terminated in 2015.<sup>5</sup> In a broader context, China's fertility rate has remained significantly lower than the global average throughout this time period; it had the 56<sup>th</sup> lowest fertility rate in 1979 and the 37<sup>th</sup> lowest in 2015.<sup>6</sup>

Extensive scholarship exists regarding the history and effects of the one-child policy which will be explored in greater detail in Chapter 2. The generation of only children caused by this policy has led to serious demographic imbalance. This is exemplified by the 4-2-1 problem, a term used to refer to the fact that an only child is solely responsible for supporting a family that includes two parents and four grandparents. On a national scale, this means that a large aging population is dependent on a considerably smaller working population. Looking forward, this is a cause for significant concern as fewer workers will be responsible for supporting an increasing number of retirees. Additionally, a strong cultural preference for boys combined with the one-child limit has led to highly skewed sex ratios at birth across the country. According to the World Health Organization, the natural sex ratio at birth is approximately 105 males for every 100 females.<sup>7</sup> In China, this ratio has at times exceeded 120 boys born for every 100 girls and the country has consistently shown one of the most male-skewed sex ratios at birth in the world.<sup>8</sup> A result of sex-selective abortion, infanticide, and abandonment of infant girls, this imbalance has resulted in

millions more adult men than women. These missing women are a cause for concern in their own right, but the sex ratio inequality is also important as this male-dominated generation reaches marriage age. The shortage of women has worsened problems such as human trafficking and selling young girls as brides.<sup>9</sup> While these demographic effects of the one-child policy were largely unintentional, they have altered Chinese society for decades to come.

Beyond the effects of the one-child policy on demographics, it also had a significant impact on maternal health. By its nature as a very strict population control program, the one-child policy prevented women from making choices about their own reproductive health by imposing strict limits on when and how many children they were allowed. Additionally, the policy affected the medical care mothers received both during and after pregnancy.

The one-child policy was largely enforced through coercive measures. After having their one child, many women were forcibly sterilized. This was typically performed via tubal ligation or the insertion of modified intrauterine devices (IUDs) that required surgical removal. Women pregnant with their second child were often forced to have abortions regardless of their gestational age; there are numerous reported cases of maternal deaths resulting from involuntary late-term abortions. These examples show a clear disregard for the freedom and autonomy of women and the extremely high costs associated with government-mandated family planning.

However, despite all of its flaws, the one-child policy did not have an exclusively detrimental effect on maternal health care. In order to reduce the fertility rate, women across China had nearly universal access to contraception. While women

were not able to use this in order to make choices regarding their own reproductive health, widespread access to contraception is an indicator of a well-developed maternal health care infrastructure. Additionally, by limiting each woman to one child, the number of births overall was reduced, allowing medical professionals to focus their efforts on improving the outcomes for fewer mothers and infants. Thus, by expanding access to care, focusing on a smaller number of pregnancies and births, and maintaining the extensive infrastructure necessary to implement such an ambitious nationwide family planning program, clear maternal health benefits were provided. This is shown by the fact that the national maternal mortality ratio fell from 97 deaths per 100,000 live births in 1990 to 20.1 in 2015.<sup>10</sup>

The gradual manner in which the one-child policy was phased out and its recent termination provide an opportunity to study the maternal health effects of this long-standing piece of legislation. From the beginning, the policy was not evenly enforced, allowing exceptions for rural farmers and minority groups, for example. Additionally, the policy was loosened over time as more and more exceptions were allowed. These changes occurred at different times in each province, municipality, and autonomous region and were enforced with varying strictness. Measuring this variation is key to determining the effects of differing levels of enforcement.

To this end, a novel variable was created: the family planning index (FPI). The FPI is a measure of the strength of family planning efforts (see Equation 1). Higher numbers indicate more family planning interventions, while lower numbers indicate fewer interventions. Annual provincial-level data regarding IUD insertions,

tubal ligations, and abortions from the China Health and Family Planning Statistical Yearbooks was used to calculate this variable.

$$\text{FPI} = \frac{\text{net IUD insertions} + \text{tubal ligations} + \text{abortions}}{\text{population per 10,000}}$$

Equation 1.1: Formula for calculating family planning index (FPI).

In addition to FPI, the level of enforcement of the one-child policy can be estimated using the birth rate per 1,000 people. This method assumes that the policy was enforced more strictly in provinces with a low birth rate than in those with a high birth rate, making birth rate a useful proxy by which to measure the strength of enforcement. Provincial birth rate data was obtained from the National Bureau of Statistics of China, a government-run database.

However, this model offers a limited view because it assumes that any change in the birth rate is due to a change in enforcement of the one-child policy which is not necessarily true. A wide variety of factors influence fertility and birth rates, ranging from micro-level choices of an individual to larger-scale societal and cultural trends. Some of these factors include: income and socioeconomic status, level of gender equality and female participation in the labor force, religious values, rural versus urban setting, social support, and education.<sup>11</sup> To control for this shortcoming, the data will be compared across time within the same province where these potential confounding factors should be relatively constant. However, comparing data across provinces may not yield directly comparable results. Furthermore, several potential confounding variables, including per capita gross regional product (GRP) and percentage of women with a high school or college degree, will be analyzed.

Maternal health outcomes are traditionally measured by the maternal mortality ratio, which quantifies the risk associated with each pregnancy. Reported as the number of maternal deaths per 100,000 live births, the maternal mortality ratio accounts for “the death of a woman while pregnant or within 42 days of termination of pregnancy...from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes”.<sup>12</sup> Increasingly, the importance of considering maternal morbidity, the number of women who suffer from complications during pregnancy and childbirth that “have a negative impact on their well-being and functioning” but are not fatal, has been emphasized as an important measure of maternal health outcomes.<sup>13</sup> However, due to the lack of an agreed-upon definition and limited data availability regarding maternal morbidity, only the maternal mortality ratio will be used to measure maternal health outcomes in this study. Provincial-level data regarding maternal mortality was obtained from the China Health and Family Planning Statistical Yearbooks published annually by the state-run National Health and Family Planning Commission.

According to the World Health Organization, 75% of maternal deaths result from: severe bleeding, infection, high blood pressure during pregnancy, complications from delivery, or unsafe abortion.<sup>14</sup> These complications are largely preventable because their causes have been studied extensively. Severe bleeding after birth can be treated with surgery and transfusions, high blood pressure can be effectively managed with medication, infection after childbirth can be eliminated with proper hygiene practices and treated with antibiotics, complications from delivery can be reduced by the presence of skilled attendants, and abortions can be performed

safely in properly-equipped facilities and early in pregnancy. Thus, the maternal mortality ratio is an effective way to measure maternal health outcomes because its major contributing causes are well-understood and preventable.

As previously mentioned, data for both birth rate and maternal mortality ratios were obtained from government publications. Although the Chinese government has a history of reporting unreliable data that shows more favorable trends than comparable records from outside organizations, likely in an attempt to make their country look better, provincial-level data was not available from other sources.

To determine the effect of loosening the one-child policy on maternal health, the association between the level of enforcement, as measured by family planning index and birth rate, and maternal health outcomes, as measured by maternal mortality ratio, will be analyzed. In addition, the potential confounding effects of year, province, percentage of women with a high school or college education, and per capita gross regional product will be assessed. Three possible hypotheses exist to explain this relationship, as outlined below:

*Hypothesis 1.* Given the many detrimental effects of the one-child policy regarding maternal health, looser enforcement will result in improved maternal health outcomes. If the one-child policy is loosely enforced, the prevalence of highly invasive measures such as forced abortions is expected to be lower, resulting in a lower maternal mortality ratio. If this hypothesis is true, birth rate and mortality ratio are expected to be inversely proportional; the birth rate will increase as the maternal mortality ratio decreases. Likewise, fewer family planning interventions will

result in a decreasing maternal mortality ratio so family planning index and maternal mortality ratio will be directly proportional.

*Hypothesis 2.* Despite the coercive measures used to enforce the one-child policy, the extensive infrastructure it required greatly improved maternal health care. Thus, looser enforcement of the policy may correspond to reduced access to care and result in diminished maternal health outcomes. Strict enforcement of the one-child policy, on the other hand, requires widespread access to maternal health care, which will lead to improved maternal health outcomes. If this hypothesis is true, birth rate and mortality ratio are expected to be directly proportional; the birth rate will decrease as the maternal mortality ratio decreases. Similarly, fewer family planning interventions will result in an increased maternal mortality ratio, meaning that family planning index and maternal mortality ratio will be inversely proportional.

*Hypothesis 3.* Although the one-child policy has had significant effects on women's reproductive rights, there may be no difference observed in maternal health outcomes with looser versus stricter enforcement of the one-child policy. In this case, some variable other than birth rate, such as geographic region or economic development, will be associated with lower maternal mortality ratios. If this hypothesis is true, no significant relationship between the maternal mortality ratio and birth rate or family planning index is expected.

In order to test these hypotheses, a provincial level analysis will be conducted of China's twenty-two provinces, four municipalities, and five autonomous regions to analyze the relationship between birth rate and maternal mortality ratio from 2004 through 2015, when the one-child policy ended. These rates will be compared over

time both within each province and across provinces to understand the trends in the nation as a whole and test the three aforementioned hypotheses.

The second chapter will provide a historical overview of the one-child policy from its original implementation in 1979 through the period of gradual relaxation to its eventual termination in 2015. The evolution of the policy over time will be reviewed, especially with regards to the maternal health effects.

The third chapter will provide an in-depth look at two case studies to gain a deeper understanding of the relationship between family planning index, birth rate, and maternal mortality ratio. These case studies include Beijing, a major city where the family planning index dropped significantly during this time period, and Hebei, the surrounding rural area where the family planning index increased over time, despite decreasing maternal mortality ratios in both provinces. A comparative analysis will be used to determine the causal effects behind these diverging outcomes as well as the role of other possible confounding variables.

The fourth chapter will focus on a statistical analysis of the relationship between both family planning index and birth rate and maternal mortality ratio as measurements of the level of enforcement of the one-child policy and maternal health, respectively. Data from 2004 through 2015 will be analyzed for provincial and national-level trends.

The formal end of China's one-child policy has opened the door to a new set of questions. While some of the methods used to control the population, such as forced sterilization and abortion, were clearly detrimental, expanded access to maternal health care had positive effects as well. Given these competing factors, this



study will analyze the maternal health effects of the gradual relaxation of the one-child policy. Overall, this study will shed light on the maternal health effects of ending the one-child policy and enhance our understanding of what factors are associated with lower maternal mortality ratios, an imperative step toward continuing to make progress in improving maternal health worldwide.

## CHAPTER 2: HISTORICAL OVERVIEW

### *2.1: Pre-Communist China*

As early as the 1930s, sociologists hypothesized that massive size of China's population was contributing to the low standard of living prevalent across the country. Historically, a sizable population had been an asset to emperors and Guomindang leaders because it increased tax revenue and strengthened military power. However, the detrimental effects of overpopulation, including food shortages and poverty, were starting to come to light by the end of the pre-communist period.

### *2.2: The Beginning of Birth Planning in the People's Republic of China*

Concern about population growth has plagued the People's Republic of China since its inception in 1949. Communist Party Chairman Mao Zedong followed in the tradition of Chinese emperors who believed that a large population was advantageous for both increasing revenue generated through taxation and expanding military influence.<sup>15</sup> Birth planning was a taboo subject because Mao viewed a large, growing population as essential to his vision of "a new China with a big population and a great wealth of products, where life will be abundant and culture will flourish," so the import of contraceptives was forbidden.<sup>16</sup> However, social scientists of the time believed that many of the nation's problems, including poverty, lack of economic development, low health and education standards, and food shortages, were a direct result of overpopulation.<sup>17</sup> Due to this, discussions began among party leaders about the use of birth control as a potential solution to uncontrolled population growth.

By 1953, it became clear to many Chinese leaders that the country's large population was directly contributing to the ongoing food shortages. Although the government maintained that this was untrue, an editorial published in April in *People's Daily* declared that the problem of food scarcity would continue due to the increasing demands of a growing population, bringing the issue to widespread public attention for the first time. In this context, Mao and other high-ranking party leaders began to acknowledge the need for birth control measures, though these discussions happened behind closed doors. This problem was emphasized by the fact that the China's first census counted approximately 100 million more people than expected.<sup>18</sup> Careful to avoid raising public concern, the State Council asked the Ministry of Health to provide the government with proposals for implementing widespread birth control, which they provided in July 1954.

Scholar Shao Lizi made the first public statement in favor of birth control at the National People's Congress on September 18, 1954. His speech, which acknowledged the benefits of a large population while calling on the government to provide "practical guidance" regarding birth control in light of recent natural disasters and slow economic development, was concurrently published in *People's Daily* where it reached a much broader audience.<sup>19</sup>

In December 1954, two months after the publication of the concerning census results which showed 100 million more people than expected, a meeting was held in Beijing to discuss birth control. This conference was spearheaded by Liu Shaoqi, Mao's second-in-command, who stated that the Chinese Communist Party (CCP) was officially in favor of birth control. The first public campaign to promote family

planning lasted from 1954 to 1958 and relied on the Women's Federation and local health clinic to educate women, promote later marriage, offer access to contraceptives and counselling, and perform abortions and sterilizations in the rare cases that they were needed. This marked a turning point in the history of reproductive health in China; previously, abortion was illegal unless the mother's life was in danger, and official CCP policy penalized women for abortions or sterilization procedures.<sup>20</sup>

Mao himself became increasingly concerned about population growth, stating in 1956 that "all areas with high population densities should publicize and promote birth control" in order to alleviate food shortages.<sup>21</sup> This led the Ministry of Public Health to issue a statement in August 1956 requiring local health centers to actively promote birth control. Additionally, a major propaganda campaign was initiated. In a trend that foreshadows the regional variation in implementation of the one-child policy, this campaign began in the coastal cities of Beijing, Tianjin, Shanghai, and Zhejiang. Hebei was the only rural province to introduce a birth control program in 1954, followed by Shandong and Hunan provinces in 1956 and 1957, respectively.<sup>22</sup>

Despite the government's claim that the shift in favor of birth control was a response to "the universal demand of the masses," there was little evidence to support this theory and the campaign was met with strong resistance. This lack of public support created several layers of tension. Party leaders insisted that no coercive measures be employed to force women to use birth control, while also requiring local cadres to prove the immediate success of the campaign. Cadres, in turn, created the impression that birth control was mandatory, in some cities going so far as to hang posters on the wall with the names of factory workers who did not comply with their

requests to create a birth plan and forcing these women to swear not to have a child for at least five years.<sup>23</sup> This tension only diminished the popularity of the campaign, both among the public and the officials in charge of enforcing it.

Although birth control was promoted, abortion and sterilization were not included as acceptable forms of family planning. Abortions were only permitted if the mother's health was threatened or if the pregnancy occurred too quickly after the last birth and resulted in breastfeeding difficulties. If a woman met these criteria, she also had to obtain permission from her husband, doctor, and work unit. Government authorities attempted to remove these restrictions but were met with opposition from a variety of organizations including the Chinese Medical Association and the All-China Women's Federation. Sterilization was only available to women who already had six healthy children and were "in poor health, over 30 years of age, busy with [their] studies, and in financial difficulties".<sup>24</sup> In March 1956, the number of children necessary to qualify for sterilization was reduced to four, but the criteria remained very strict. In the spring of 1957, the government, pressured the Ministry of Public Health, loosened restrictions on both abortion and sterilization despite continued public opposition.

Several factors contributed to the failure of this first family planning campaign and prevented it from overcoming widespread public resistance. First, the official reason for the Party's sudden interest in promoting birth control was attributed to maternal and child health concerns, not the looming threat of overpopulation. This framing made the problem seem less urgent. Second, abortion and sterilization were not advocated as methods of birth control and strict regulations

rendered these procedures largely inaccessible. Third, the campaign was poorly organized, resulting in slow and uncoordinated implementation.

By 1958, the first birth control campaign had shown no clear effects on population growth. At this time, Mao announced the Great Leap Forward, an initiative that called for three years of maximum productivity in order to hasten economic development. During this time, Mao abandoned his commitment to birth control, stating that “the more people, the more views and suggestions, and the more intense the fervor and the greater the energy”.<sup>25</sup> The prevailing theory at the time posited that more people would result in more producers, increasing the amount available resources rather than exhausting a finite supply.<sup>26</sup> Even poverty, which was previously considered to be a problem related to overpopulation, was now seen as a factor contributing to widespread hunger for change and revolution.

To meet Mao’s expectations, data was fabricated that showed a doubling of grain production during 1958. These false statistics only furthered Mao’s belief that population growth was an unquestionably positive development and, as a result, birth planning efforts were neglected. However, problems arose in rural areas, where peasants were encouraged to consume excessive amounts of food, land was laid fallow, and crops were left unharvested since they believed that the severely inflated numbers regarding grain production were accurate. This mistake led to massive food shortages; by the end of the Great Leap Forward, widespread famine and malnutrition led to an estimated 30 million deaths.<sup>27</sup>

Once the famine was over in 1962, birth control efforts were resumed. As in the first campaign, this new program also obscured the real issue of overpopulation

when justifying the need for birth planning to the public. This time, the main message was that love, marriage, and child-bearing detracted from the innate revolutionary nature and strength of young husbands and wives. Accordingly, the government aimed to increase the average age at marriage in the hopes of slowing population growth. Resistance was strong, but the government responded by refuting the idea that the decision to have children is completely personal because it is the government that must supply the food, clothing, housing, education, transportation, and employment for all children. A limit of three children was advocated by party leaders.

This second campaign was more successful than its predecessor. One contributing factor was the improved infrastructure; party and government leaders were installed at all levels to take a more active role in local birth control guidance, allowing for a more cohesive and coordinated effort. Additionally, both sterilization and abortion were more widely available and more effective due to the introduction of IUDs and advances in medical technology. The government briefly tried to advocate for the use of vasectomies as a safer alternative to tubal ligation, but this idea never overcame popular resistance. A study in 1982 showed that fertility levels in urban areas began to decrease in during the early 1960s, but due to a lack of change in rural areas, where 80% of the population resided, no overall change in the national fertility rate was observed.<sup>28</sup>

The second family planning campaign was interrupted by a separate campaign intended to promote Mao's vision of a perfect Communist China. On its surface, the Cultural Revolution aimed to eliminate corrupting influences within the CCP, but Mao also used it as a way to regain power after his influence was checked as a result

of the Great Leap Forward disaster. Power was turned over from civil control to rule by revolutionary youth groups, creating widespread turmoil that was eventually ended by military intervention.

The restoration of order after the Cultural Revolution allowed for the renewal of birth planning efforts. In 1968, the Military Control Commission, an army-supported branch of the Ministry of Health, moved to distribute all contraceptives free of charge.<sup>29</sup> This announcement coincided with a new propaganda campaign which told families that “one child isn’t too few, two is just fine, three is too many”.<sup>30</sup> In July 1971, the State Council issued a document calling for a strengthened birth control campaign and a two child limit. This third campaign was more successful than the previous two. Key components including late marriage requirements, 23 to 25 years for women and 25 to 28 years for men, and a birth spacing rule of four to five years between children, were implemented in 1972 and 1973, respectively.<sup>31</sup> Birth planning was finally accepted by the national daily newspapers in 1973 after a long history of publishing articles attacking the idea. IUD insertions rose from 6 million in 1971 to 14 million in 1973.<sup>32</sup> In December 1973, the State Council established a Leading Group for Birth Planning which coined the slogan “later, longer, fewer” to emphasize the core tenets of the birth planning campaign; having children later in life, longer spacing between births, and fewer children overall. This plan introduced birth control recommendations to all rural areas, though it remained most successful in the cities. Overall, the total fertility rate was cut in half between 1971 and 1978.<sup>33</sup>

Local authorities were encouraged to incorporate birth control into the idea of class struggle and emphasize its importance in creating a socialist state that would



serve “the fundamental interests of the masses”.<sup>34</sup> While coercive measures were not endorsed by the government, leaders also acknowledged that the required results could not be achieved through a strictly voluntary program. Units that achieved the specified goals were praised and their leaders were promoted, while units that failed to reduce birth rates were strongly criticized.

Overall, China’s natural increase rate, a measure of the number of births minus deaths, dropped from 26 per thousand population in 1970 to 12.6 in 1976.<sup>35</sup> This rate levelled off at 12 per thousand in 1977-1978 as Party leaders responded to widespread discontent and specifically banned certain coercive practices.<sup>36</sup> However, demographic data showed that the population would continue to grow as long as women were allowed to have two children, setting the stage for an even stricter population control campaign.

Although the State Planning Commission came up with specific demographic targets at the end of 1977, a lack of accurate census data, reliable demographic predictions, and tangible steps to achieve the desired goals made achieving their desired results difficult. Nonetheless, the beginnings of one-child policy were emerging; the State Council predicted that future births would be comprised of 50% first births in rural areas and 80% in urban areas.<sup>37</sup>

At the end of 1978, Deng Xiaoping set the goal of quadrupling China’s per capita national income. In order to meet this goal, statisticians and economists realized that population growth would need to be reduced even further.<sup>38</sup> This combination of factors laid the foundation for a new one-child policy.

### *2.3: The One-Child Policy*

In early 1979, Deng Xiaoping called for strengthened family planning efforts and implied that fertility should be reduced below the replacement level. Thus, the anti-coercion philosophy was abandoned and all Han couples were permitted “only one child if possible, two at the most, with a period of three or four years between them”.<sup>39</sup> This two child option was quickly eliminated and the one-child policy was born. Birth planning rules were constructed at the regional level and by the end of the year, twenty-seven provinces, autonomous regions, and municipalities had passed their own family planning guidelines.<sup>40</sup>

These rules were enforced with varying levels of strictness in different places. In one village on the Guangdong Pearl River Delta, very tough coercive measures were used. These included compulsory attendance at group meetings, threats of being fired from work, forced sterilizations, forced abortions after the sixth month of pregnancy, and a devastating combination of provincial and local fines.<sup>41</sup> At the same time, another county in Guangdong did not impose any fines, even allowing some couples to have four or more children, especially if they had no male children. When fines were eventually imposed for second and higher order children, they were affordable for most families.<sup>42</sup> This shows that even though the calls for family planning came from the national government, provinces and even counties were given significant freedom in determining how to execute and enforce these policies.

Like the family planning attempts that came before it, the one-child policy was extremely unpopular. Thus, coercive measures were reinstated in order to meet the government targets. These strict rules were not well-received by the general

public, but as Vice-Premier Chen Muhua stated, the interests of the state must be prioritized over those of the individual.<sup>43</sup> Mandatory abortions for unauthorized pregnancies became increasingly common and the lack of response from the national government implied that the end result was more important than the methods used.

In an attempt to reach a population of no more than 1.2 billion people by the year 2000, Chinese demographers modeled population growth using different fertility levels and concluded that the only way to keep the population within the desired range was to strictly enforce a one child limit. Chen Yun, the Vice-Chairman of the CCP and Minister of the State Commission for Finance and Economics cited five changes necessary in order to ensure the success of the one-child policy: 1) public opinion needed to be manipulated to support the effort, 2) laws must be passed advising couples to have only one child, 3) incentives must be provided for single children, 4) eugenics and better birth planning techniques must be implemented, and 5) social security must be expanded to allow retirees to be less dependent on their children.<sup>44</sup> The strengthening of the one-child policy is shown by an increased number of abortion and sterilizations in 1979 and 1980.<sup>45</sup>

However, growing public outrage forced the government to take a step back. Another anti-coercion movement began in 1980 and warned cadres that the use of force would “only bring damage and destruction” and undermine the importance of their work.<sup>46</sup> The cadres interpreted this directive as a signal to place a lower priority on birth control work. This relaxation coincided with two influential national policy changes. First, a new marriage law was passed September 1980 that removed local restrictions on minimum age at marriage. As a result, many couples began to marry

younger and have more children. Second, the responsibility system was introduced, effectively eliminating collective farming. While this policy increased enthusiasm among peasants, it led to looser enforcement of family planning because cadres no longer conducted daily surveillance over women field workers. This change also rendered the existing incentives and sanctions ineffective. These factors all combined to lead to an increase in fertility rates.

In March 1981, the Leading Group for Birth planning was changed to a state commission with satellite offices located throughout the country. This reorganization provided the government greater vertical control of the one-child policy. Additionally, the tables turned again and concerns about population size prevailed as government authorities issued a statement calling on local organizations to enforce birth planning primarily through “ideological education and encouragement” in March 1982.<sup>47</sup> However, the reaction was mixed; some areas returned to coercive methods while others took a completely hands-off approach.

As stricter birth planning policies were implemented, an old problem began to re-emerge: female infanticide. Prior to 1949, this was very common but the practice was all but eliminated in the early 1950s. However, daughters traditionally joined their husband’s family after marriage, so the new one child limit meant that rural Chinese families with only a daughter would have no one to support them in old age. While government officials initially ignored this problem, concerns about an imbalance between the sexes and the gruesome manner in which these murders were carried out were made public by the media in November 1982. A 1982 national survey reflected this problem, showing a rate of 108.47 male births per 100 female

births.<sup>48</sup> Anhui province had the most skewed ratio, averaging 112.45 male births per 100 females, with some counties and communes reporting levels as high as 139 and 175 male births per 100 female births, respectively.<sup>49</sup> Despite these concerning figures, once international media got wind of the imbalanced sex ratios and their connection to the one child policy, the government began denying the severity of the problem. The Minister-in-Charge of the State Family Planning Commission, Qian Xinzong, noted that the problem of female infanticide predated the one-child policy and claimed that the two were unrelated.

Preliminary results of the 1982 census showed that the large generation of children born after the Great Leap Forward and famine would soon reach the age of marriage and childbearing, resulting in an increasing fertility rate. A conference was convened in November 1982 in order to plan a long-term family planning campaign. The Party officials recommended that cadres use whatever “necessary measures” were needed to ensure success.<sup>50</sup>

The State Family Planning Commission, the Central Committee of the CCP, and other national ministries and organizations announced a propaganda month program on December 6, 1982. This program would require the sterilization of one party of every couple with two or more children and the abortion of all unauthorized pregnancies. On December 19, it was added that women who already had one child must be fitted with IUDs. Central leadership emphasized the lessons learned from previous attempts: “rely on political pressure, rely on the law, and rely on technical measures”.<sup>51</sup> *China Daily* summarized the view of the government in the following statement:

Persuasion is preferable to administrative and pecuniary measures, and contraception to abortion. Compliance must be ensured, however, for the population problem in China today is of such a pressing nature that individual whims must be subject to the interest of society as a whole.<sup>52</sup>

This propaganda month was extended indefinitely by Deng Xiaoping. The effects were significant; the 20.8 million sterilizations performed in 1983 were nearly triple the previous record set in 1979, the first year of the one-child policy.<sup>53</sup>

Compulsory sterilization was viewed as the most effective form of birth control due to its permanence, which relieved local officials of the burden of regular follow ups.

During this time period, urban couples were allowed a second child if: the first was disabled and unable to work due to a nonhereditary impairment, one spouse had a child in a previous marriage but the other did not, or the couple became pregnant after adopting a child due to infertility. Rural exceptions were similar. Overall, only about 5% of Chinese couples were able to qualify for a second child.<sup>54</sup>

In December 1983, Qian Xinzong, head of the State Family Planning Commission was removed, a move widely speculated to be a result of his support for coercive birth control measures. This came just months after he was awarded one of the first United Nations (UN) population awards for his contributions to family planning. In January 1984, Wang Wei, the new leader, emphasized the importance of cadres “building a close relationship between the Party and the people” and taking local conditions into account when implementing family planning policies.<sup>55</sup>

In March 1984, a family planning conference was held in Beijing that culminated in the release of Document No. 7 by the CCP Central Committee. This

document expanded the number of couples who could qualify for a second child from 5% to 10%. It also allowed couples who were both single children themselves to have two children. This change is seen as the first major relaxation of the one-child policy. As the larger effects of an aging population were beginning to come to light, this loosened enforcement was intended to “open a small hole to close a big gap,” according to the government slogan. The idea was that opening a small hole to allow for more legitimate exceptions would lessen the number of unauthorized births and reduce public backlash, helping to close the big gap. Initially, only excerpts of the official document were published and these snippets seemed to send mixed signals. The overall ambiguity allowed for changing interpretations of the document to suit the party’s needs and enabled the CCP to attribute negative public response and the local implementation of coercive measures to a misinterpretation of the policy.<sup>56</sup>

In addition to relaxing the one-child policy and allowing for a total of fourteen different exemptions, Document No. 7 also provided for widespread regional variation in implementation. Forty-four counties were approved to experiment with different methods of enforcement, ranging from exemptions for all peasants with only a daughter to the issuing of second-child permits if a whole village was able to comply with the birth plan.<sup>57</sup> Other forms of birth planning included second child permits: only in specially-approved cases of hardship, for all who adhered to birth spacing regulations, dependent on socioeconomic status, and for couples complying with late marriage and late birth. Some areas believed that issuing more second-child permits would reduce the number of higher order births.

When Party Document No. 7 was initially released, officials made clear that it was only intended to spur a limited relaxation of the existing birth planning policies; it should still be the norm for families to have only one child and unauthorized higher order births should be prohibited. At a March 1984 gathering of provincial family planning directors, CCP officials claimed that the strict policies of the past were “consistent and entirely correct” and specifically praised the achievements of the 1983 campaign which relied heavily on coercive measures.<sup>58</sup> Nonetheless, cadres and the general public viewed Party Document No. 7 as a signal that family planning restrictions were being loosened and rumors that all couples would now be allowed to have two children spread quickly. Provincial responses varied greatly; in Guizhou and Heilongjiang, cadres were told to continue using coercive measures to strictly enforce the one-child policy, while cadres in Guangxi were hesitant to enforce it under the belief that it would soon be abandoned.<sup>59</sup> The extent of this relaxation in enforcement was not immediately clear because national-level statistics for 1984 were not published until 1986. These showed that IUD insertions and abortions had dropped to 66% and 62%, respectively, of their 1983 levels.<sup>60</sup>

Even before gaining access to these data, officials were aware that the enforcement of birth planning measures had loosened far more than they had intended and instructed cadres to strengthen their efforts in the summer and fall of 1984. This commitment is demonstrated in a report from Guangdong Province which stressed the need for strengthened party and government leadership, firm and consistent enforcement of birth control measures, and to combine existing Party duties with education and the use of economic sanctions.<sup>61</sup>



By December 1984, the policy shifted again toward “work style” reform, a euphemism for reducing the use of coercive measures to meet birth planning and population growth goals. Accordingly, the focus of family planning cadres would now be on “serving the masses” not “controlling the masses,” as was previously the case.<sup>62</sup> This move to appease the general public was widely interpreted as a softening of the one-child policy and was the extension of a move to reform the CCP administration as a whole. This effort was embraced in some provinces, but no widespread effects were observed.

Like the other periods of policy relaxation, this loosening was short-lived and by the spring of 1985, the government had returned to its goal of fulfilling population growth targets. Wang Wei, leader of the State Family Planning Commission, declared the relaxation period a success and claimed that participation in the one-child policy was increasingly voluntary and that complaints about the “work style” used to achieve the population goals had decreased 43% from 1983.<sup>63</sup> Despite this victory, cadres throughout the country grew disheartened with the difficulties posed by enforcing the policy and their slow progress. In several provinces, birth rates began to rise and in some as many as a third of births were not authorized, causing serious concern among government officials. Further, increasing numbers of migrants, known as the “floating population”, moved from place to place to avoid surveillance by local birth planning cadres. By April 1985, millions of migrants fell into this category.

As fears of excessive population growth re-emerged, the government took tighter control over family planning. However, public resistance remained strong and birth rates continued to increase in many areas. Surveys, even those designed to bias

the results in favor of the one-child policy and given in a political climate in which disagreement with official policies could have serious consequences, showed that as many as 80% of residents in the rural outskirts of Tianjin municipality and 28% of residents in urban Zhejiang wanted to have two children.<sup>64</sup> These results aligned with similar surveys conducted in Beijing and Sichuan province. Furthermore, the CCP found that collecting accurate data to compare the current situation with their goals proved increasingly difficult; cadres edited the birth statistics to more favorably reflect their efforts and women did not always disclose higher order pregnancies and births. Results of a national survey of self-reported data from citizens themselves showed differences of greater than 10% for all but four provinces when compared to cadre-reported data, emphasizing its inaccuracy.<sup>65</sup> These factors all contributed to growing government concern regarding population control.

On June 13, 1986, an article by the State Family Planning Commission called for the adherence to Document No. 13. Like Document No. 7 before it, this document outlined the next steps in China's birth planning campaign. Six goals were listed: 1) to strictly limit fertility in the following five years, 2) to focus birth planning efforts on rural areas and other places where progress was lagging, 3) to create policies that are accepted by the general public, 4) to strengthen research and statistics, 5) to strengthen local organizations and the quality of cadres, and 6) to reinforce ties between departments involved in family planning. The "three-no-change" rule was emphasized as well; there would be no change in birth control as the official policy, no change in the one-child policy, and no change in the long-held population goal of 1.2 billion by 2000.

Despite Document No. 13 and the increased priority placed on birth planning, one million more babies were born in 1986 than in 1985.<sup>66</sup> One contributing factor was the shift back toward early marriage. Although advocating for late marriage was initially an important part of birth planning, adherence tapered off in the mid-1980s; the percentage of marriages after age 23 for women and after age 25 for men decreased from 59% in 1984 to 39% in 1986.<sup>67</sup> Further, marriages below the minimum legal age of 20 for women and 22 for men increased. These marriages made up as much as 15-20% of marriages in rural areas.<sup>68</sup> The trend of living together without proper marriage registration was also becoming more common and contributed approximately 2.5 million unplanned births every year according to the Chinese Civil Affairs Ministry.<sup>69</sup>

In 1986, as the long-term effects of China's increasingly unbalanced demographic structure were beginning to appear, two opposing viewpoints emerged regarding the future of the one-child policy. Some believed that birth control in its current state was both unrealistic and unnecessary to achieve China's population goals and pushed for an extension of second child permits in rural areas. Others warned against the dangers of an expanding population and called for restricting access to second child permits. This controversy largely took place among party leaders, but it highlighted the lack of support for strict birth planning measures from both peasants and the cadres responsible for enforcement. These conflicting signals from the national level led to widespread confusion, which was not helped by an increasing number of falsified statistical reports.<sup>70</sup>

During the period of more relaxed family planning, some regions were allowed to experiment with letting rural families with only a daughter have a second child. However, this led to a loosening of second-child restrictions as a whole; in Jilin Province, the percentage of couples having a second child increased from 5% in 1984 to 60% in 1986, compared to national averages of 10% and 50%, respectively.<sup>71</sup> In response many provinces voiced their discontent at this unfair treatment. To solve this problem, the strict measures of 1983 were implemented again; IUDs insertion was mandatory for all women with one child, sterilization was performed on women with two children, and unauthorized pregnancies were forcefully aborted. Even minorities, who had historically been exempt from the strict birth regulation, were forced to comply. Tibetans in Qinghai province reported forced abortions, often performed without the mother's knowledge or consent, severe fines, and refusal of food ration cards for unauthorized children.<sup>72</sup>

By September 1989, 17 of the 30 provincial-level units had passed stricter rules regarding family planning. These included ongoing monthly fines for unauthorized pregnancies until an abortion was performed, crippling fines for higher order births, and threats to cut off access to electricity and food rations in the case of noncompliance.<sup>73</sup>

By the late 1980s, the aforementioned "floating population" was becoming an increasingly pressing issue. The cities of Beijing, Shanghai, and Guangzhou all had populations over a million and the national total was estimated to be close to 50 million.<sup>74</sup> Most provinces instituted heavy financial, employment, and administrative consequences for migrant parents with unauthorized children.

The policy of allowing a second child in rural only-daughter families, first introduced in 1984, widely adopted in 1986, and formally adopted in 1988, was intended to increase public support for family planning. Since most rural women had two children anyway, officials hoped this change would actually result in a tightening of the policy.<sup>75</sup> Further, some areas further narrowed this exception by adding a minimum income requirement to apply for a second child.

While exemptions expanded, enforcement tightened. January 1988 Deputy Director of the State Family Planning Commission Chang Chongxuan called for the use of “all measures and methods which are favorable to population control,” implying that coercion was acceptable.<sup>76</sup> Several articles were published in 1988 and the start of 1989 similarly endorsing the idea that the end result of family planning is more important than the means.

Internationally, the response to the one-child policy was mixed. Demographers and experts on poverty were impressed by the success of China’s plan to reduce population growth. Human rights advocates, on the other hand, were horrified by the stories of harsh tactics and coercion that were emerging. As previously mentioned, Qian Xinzong received an award from the United Nations for his role in China’s family planning efforts. This was criticized by many, including Theodore W. Schultz, a Nobel prize-winning economist and an advisor to the selection committee, who criticized the use of coercion and the increase in female infanticides. Rafael Salas, director of the UN Population Fund (UNPF), countered this by reiterating that female infanticide was illegal in China and claiming that it was “an inference” to associate this practice with the one-child policy.<sup>77</sup>

Beginning in 1980, the United Nations Population Fund donated \$10 million a year to support China's population control efforts. In January 1989, the UNPF agreed to fund a third five-year multimillion dollar program to aid China's population control efforts. Although changes were made to convince the U.S. to resume funding, the proposal was heard the week after the student massacres at Tiananmen Square in Beijing. As a result of this timing and growing discomfort with China's coercive family planning measures, the U.S. refused to give funds to the UNPF.

In an effort to reassert control following the humiliation of Tiananmen Square, the CCP tightened control over local birth planning policies. Rural families with one daughter were still allowed to have a second child, but the restrictions on second children were increased and stricter rules were laid out for ethnic minorities. A mass propaganda campaign was launched in the countryside during the fall of 1989 to increase awareness about the urgency of the population control situation and to mobilize women to comply with sterilization and abortion requirements. In order to ensure proper implementation of the policy at the village level, a more formal organized structure was introduced. Leaders were paid a stipend which provided the CCP with a direct source of accountability and control. Additionally, more full-time birth planning cadres were hired. Family planning associations also joined forces with local people's militias in order to get reluctant villagers on board. A degree of self-rule was also allowed in that villages wrote their own local rules for birth planning enforcement. Further, the expansion of rural birth planning service stations allowed IUD insertions and removals and sterilizations to be performed locally. By 1995, such centers were established in 80% of counties and 60% of townships.<sup>78</sup> This

strengthening of birth planning was largely facilitated by the political climate, in which the government was not afraid to take a hardline stance on family planning in order to assert control.

### *2.3: The End of the One-Child Policy*

Following the fall of communism in eastern Europe, leader of the National Population and Family Planning Commission Peng Peiyun noted that the lesson to be learned was “the Party should never be divorced from the masses”.<sup>79</sup> As the one-child policy remained highly unpopular, this notion foreshadowed the relaxation and eventual end of the policy. Numerous exceptions were added over time, such as provisions for couples who were both only children themselves or whose first-born child was a girl or had some form of disability allowing them to have two children.

In December 2001, China became a member of the World Trade Organization. This inclusion marked a significant turning point for China by giving it a prominent place in the global economy. This development aligned with major economic reform in China. Beginning in the late 1990s, large-scale privatization occurred and almost all state-owned enterprises were sold to private investors. From 2001 to 2004, the number of state-owned enterprises decreased by 48%.<sup>80</sup> Furthermore, tariffs and other trade restrictions were reduced, facilitating China’s move to open up to global markets. As measured by GDP, China became the world’s third largest economy in 2009 and the second largest in 2011, reflecting over 30 years of growth rates close to 10%.<sup>81</sup>

China's integration into the global economy made the government increasingly cognizant of international opinion and enforcement of the one-child policy began to relax despite a lack of formal legal changes. Additionally, during this period of rapid economic expansion, party leaders grew more concerned about the aging population and its potential role in slowing economic growth. The low birth rate which had seemed so desirable to improve quality of life and lift citizens out of poverty was now becoming a liability; party leaders worried that a smaller population with fewer workers would be unable to sustain the same levels of economic success.<sup>82</sup> As a result, the one-child policy was markedly relaxed both by expanding the number of couples who were allowed exceptions and by weakening the enforcement.

By 2007, only 35.9% of the population, largely located in urban centers, was forced to adhere to a strict one-child limit. The majority of the population, 52.9%, were allowed to have a second child if their first-born child was a girl and 9.6% of the population was permitted to have two regardless of their sex. Ethnic minorities, for whom no limit was enforced, made up the remaining 1.6%.<sup>83</sup> Approved second children were typically born three to four years after the first child in an effort to space out births.

In November 2013, a major relaxation of the one-child policy was announced. Under the new guidelines, families could have two children as long as one parent was an only child, an exception that applied to eleven million couples, predominantly those living in urban areas. This change was first introduced in Zhejiang province in January 2014 and the rest of the country quickly followed suit.



In 2014, a survey conducted by the National Health and Family Planning Commission found that only half of the couples who qualified for a second child wished to have one, a departure from previous times in which many couples wanted a second child but were not permitted to do so.<sup>84</sup> According to the survey results, this hesitance is largely due to the financial burden of raising a second child. In 2014, nearly one million couples applied to have a second child, significantly fewer than the expected two million expected applications.<sup>85</sup> This shows that although the one-child policy was never embraced by the Chinese people to the extent that the government might have hoped, the expectation of having only one child became the cultural norm, especially in densely populated, expensive urban areas. Combined with increasing economic development and urbanization, the solution to raising China's low fertility rate may not be as simple as lifting the restrictions of the one-child policy.

On December 27, 2015, the Standing Committee of the National People's Congress passed a law ending the one-child policy, effective January 1, 2016. The CCP communication noted that it was part of an effort "to improve the balanced development of population," a reference to the skewed sex ratio at birth, aging population, and fertility rate that is significantly below the replacement rate.<sup>86</sup>

Although the one-child policy is often viewed as a monolithic and rigid population control policy, its history clearly shows that this is not the case. Birth planning efforts did begin in Mao's China, but the infamous one child limit was not implemented until Deng Xiaoping came to power. And while its enforcement often required the use of force and coercion, the policy and its interpretation were constantly in flux and responsive, to a degree, to both public opinion and the broader

political climate. Instead of being a single unchanging national law, the one-child policy was actually a series of area-specific provincial-level laws that resulted in geographic differences in enforcement across China.

In spite of the coercive measures used to enforce the one-child policy, it vastly expanded access to maternal health care. As previously noted, as many as 80% of counties and 60% of townships had birth planning centers that, in addition to their role in performing abortions and sterilizations, gave the majority of women in China access to contraception and prenatal health care. Given this large-scale expansion of the healthcare infrastructure, it is conceivable that the one-child policy had some beneficial effects on maternal health in China. As such, it is possible that the end of the one-child policy could result in some women losing access to family planning resources. Thus, the question of whether the end of the one-child policy has had a beneficial or detrimental effect on maternal health outcomes in China remains open.

### CHAPTER 3: CASE STUDIES, BEIJING AND HEBEI

As previously discussed, implementation of the one-child policy varied greatly by region. In order to better understand the effects of different family planning strategies on maternal health outcomes, two cases will be compared: Beijing and Hebei (see Figure 3.1). In Beijing, China's capital city, the family planning index (FPI) dropped significantly from 2004 to 2015, while in Hebei, the surrounding rural province, the FPI increased during this period. However, the maternal mortality ratio decreased over time in both Beijing and Hebei.



Figure 3.1: Location of Beijing municipality (blue) and Hebei province (red).

The geographic proximity of Beijing and Hebei makes them an interesting pair to consider. While Hebei is mostly rural, the capital city of Beijing is located entirely within the province. Their adjacent locations mean that Beijing and Hebei are both a part of the same economy. Further, these two areas were among the first to implement population control measures, predating the one-child policy. This long-term commitment to family planning makes them apt case studies.

### *3.1: Beijing*

In 2004, Beijing had an FPI of 192.99 interventions per ten thousand people. This FPI is extremely high compared to the rest of the country; it is second only to Chongqing, another major municipality, which had 294.97 interventions per ten thousand residents. By 2015, the last year that the one-child policy was in effect, the FPI had dropped to 76.57. Overall, the net change in FPI from 2004 to 2015 was -116.42, the largest change of any of the province-level divisions during this time period. Meanwhile, the maternal mortality ratio decreased from 18 deaths per hundred thousand live births in 2004 to 8.5 in 2015.

As the capital city, Beijing was at the heart of nationwide population control efforts from the very beginning. As early as 1954, decades before the implementation of the one-child policy, propaganda campaigns to promote birth planning and small family sizes were enacted in Beijing.<sup>87</sup> Once the one-child policy was introduced, enforcement in Beijing, along with other major urban areas, was very strict in an effort not to exacerbate the already high population density. Furthermore, due to its role as the central city in Chinese politics, Beijing's family planning operations served as an example for other provinces and municipalities.

The one-child policy was gradually relaxed as birth rates began to fall and population growth slowed. By 2013, the Beijing municipal government allowed several exceptions to the one-child limit, though these applied predominantly to people living in rural areas. Couples were allowed to have a second child if:

- The couple had just one child who was handicapped or unable to work
- Both parents were only children themselves

- Their first child was adopted due to infertility
- The couple remarried but had only one child total
- The couple were ethnic minorities who were granted permission for a second child before they moved to the city
- Only one of the husband's brothers was able to give birth and the others promised not to adopt
- The husband was a farmer who married a woman with a daughter and pledged to care for the woman's parents
- The couple were rural farmers and one of them was a handicapped soldier and could not work
- The couple were poor farmers with only a daughter.<sup>88</sup>

A nationwide softening of the one-child policy was announced in November 2013 and on February 21, 2014, the Standing Committee of the Beijing Municipal People's Congress approved an amendment to the Beijing Population and Family Planning Regulations allowing couples to have a second child if either parent was an only child. Taken together, these moves to loosen the stringent one-child policy reflected growing government concern regarding the low fertility rate in the city. These policy changes were expected to result in approximately 54,000 new births per year in the first five years and 40,000 per year afterwards.<sup>89</sup> While acknowledging that an increased population would place more pressure on kindergartens, primary schools, and hospitals, the government reiterated that concern over a shrinking working population necessitated the change.

Within Beijing, the one-child policy had the important effect of changing societal norms regarding family structures. This worked perhaps too well; the fertility rate in 2015 was below replacement rate, causing concerns that population growth should be encouraged in order to maintain economic production. A 2007 survey showed that 52% of adult only children in Beijing did not want more than one child, and over 25% said they did not want any children, often citing the financial burden of raising a child as the reason for their hesitance. Although the municipal government could provide subsidies or increased public services to offset these costs, government leaders worry that too much social support could spur excessive population growth. This concern is not without cause; in 1983, public discussions about potential changes to the family planning regulations reportedly caused 30 million extra births the following year.<sup>90</sup> Given the economic progress that China has experienced in the past few decades, officials are loath to endanger this financial security by significantly expanding the population. Instead, Beijing officials plan to expand home-care services for the elderly to include house calls, meals, and volunteers to help with chores in the hopes that state support can fulfill caretaking responsibilities formerly completed by their children.<sup>91</sup> In this way, the legacy of the one-child policy has shaped not only the demographics of Beijing, but the social and cultural expectations of its citizens as well.

Overall, Beijing experienced a decline in both maternal mortality ratio and family planning interventions, an increase in both per capita gross regional product and percent of women with a high school or college degree, and a slight increase in birth rate (see Figures 3.2-3.6). This implies that the change in maternal mortality

ratio is correlated with the year, per capita gross regional product, and percent of women who are high school or college graduates, but not birth rate or FPI.

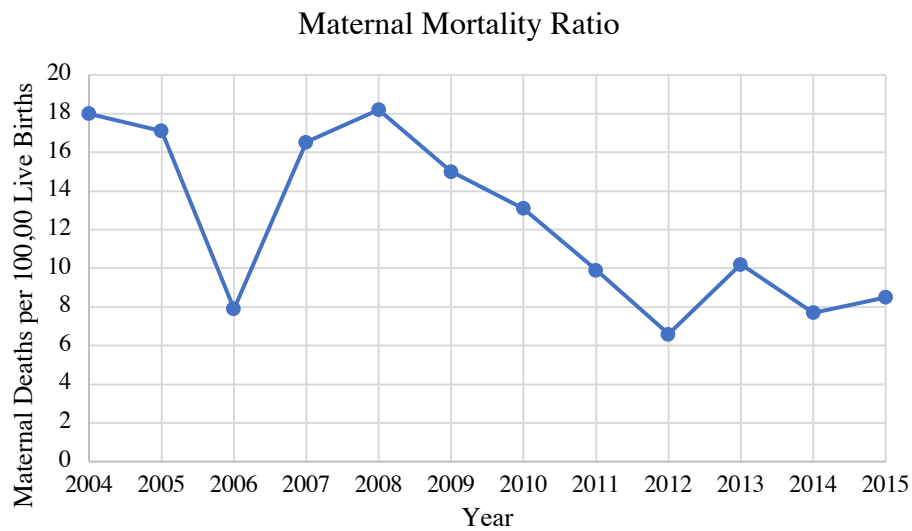


Figure 3.2: Change in maternal mortality ratio in Beijing, 2004-2015.

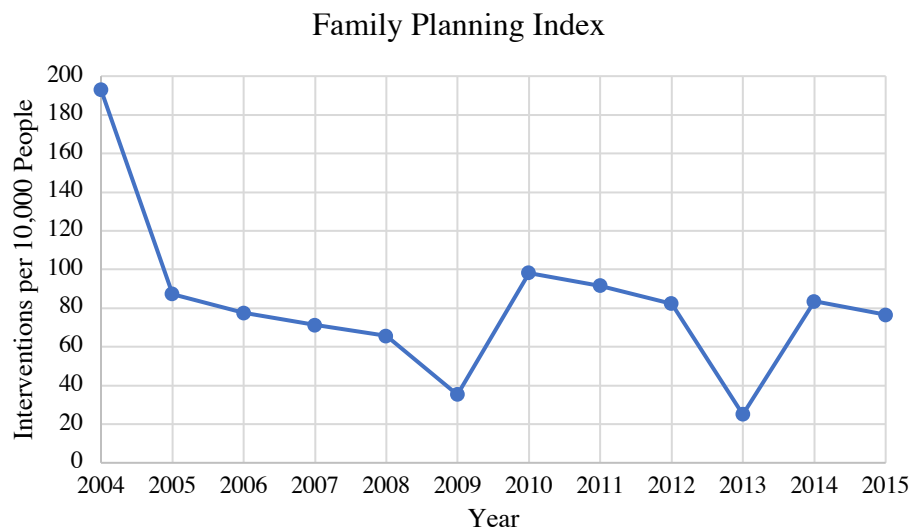


Figure 3.3: Change in family planning index in Beijing, 2004-2015.

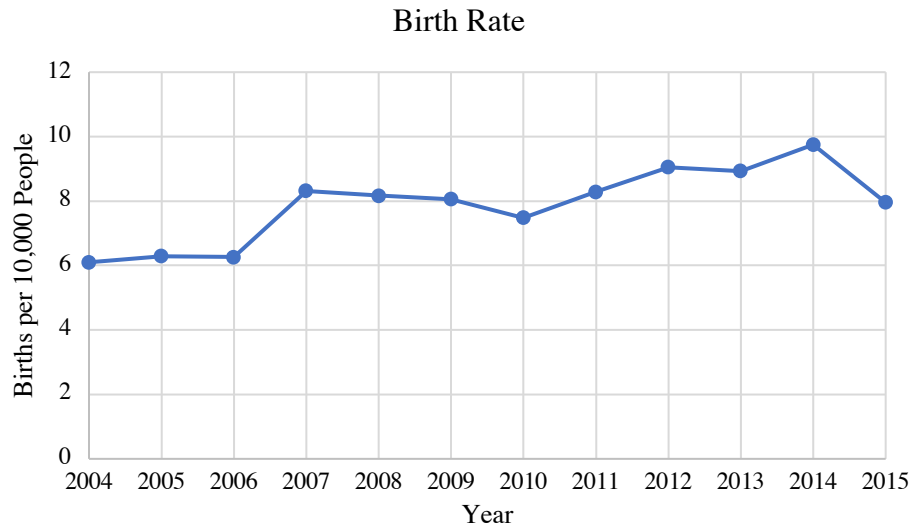


Figure 3.4: Change in birth rate in Beijing, 2004-2015.

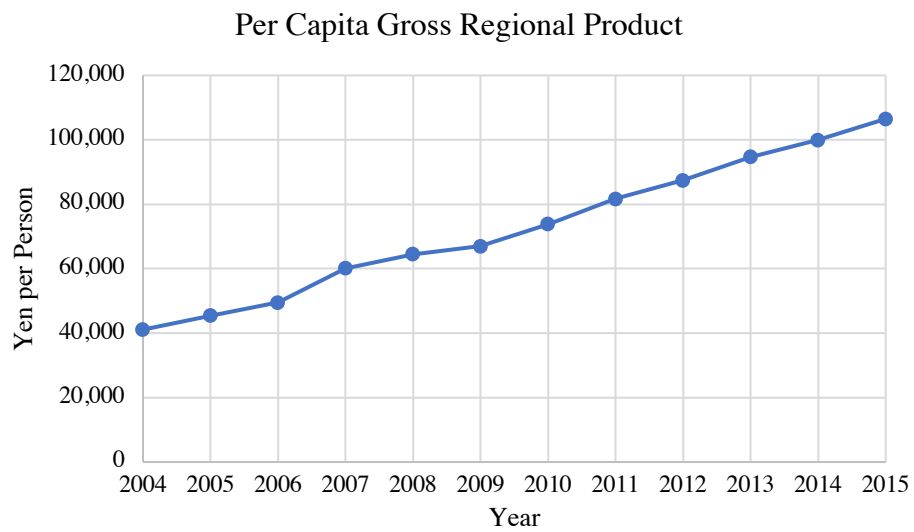


Figure 3.5: Change in per capita gross regional product in Beijing, 2004-2015.



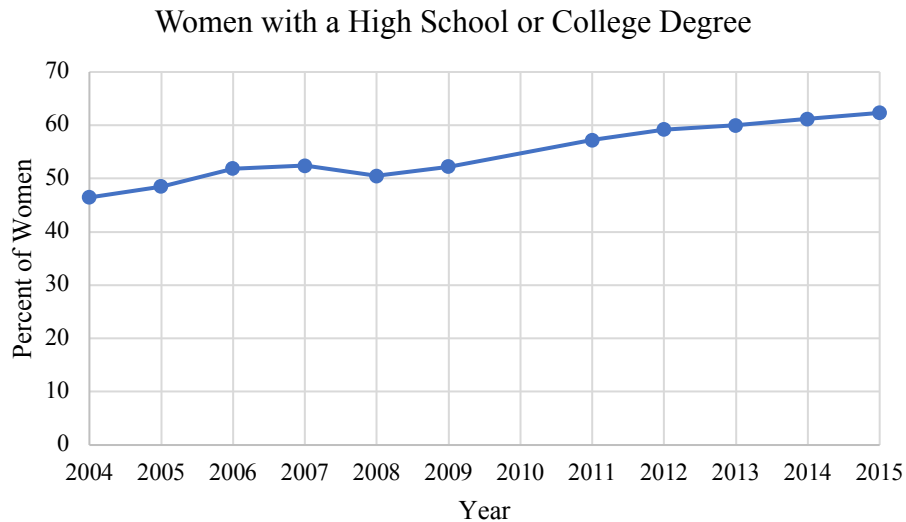


Figure 3.6: Change in percent of women with a high school or college degree in Beijing, 2004-2015.

### 3.2: Hebei

In 2004, Hebei had an FPI of 51.71 interventions per ten thousand people. This was the second lowest FPI in the country, just ahead of Sichuan, the province surrounding Chongqing. By 2015, the FPI increased to 131.47 giving a net change of 73.76 interventions per ten thousand people from 2004 to 2015. Interestingly, more family planning interventions were performed in 2015 than in 2004 despite the fact that enforcement of the one-child policy was relaxed nationwide during this time. The maternal mortality ratio was 29 deaths per 100,000 live births in 2004, which dropped to 8.8 in 2015.

Likely due to its close geographic and political ties to Beijing, Hebei was the first of the rural provinces to implement a population control program in 1954. Although this first campaign did not achieve much success in Hebei or the nation as a whole, it set the stage for the family planning policies that would follow.

When implementation of the one-child policy began, enforcement in Hebei was relatively relaxed. In fact, between 1980-1988 only 48% of babies were born with a birth permit.<sup>92</sup> Although all couples were permitted to have one child, local family planning officials encouraged couples to wait until they received an official permit in order to keep track of the number of births and ensure that birth rates were within range to meet the desired targets. While most couples complied, one in seven first-born children were born without a permit during this period.<sup>93</sup> Furthermore, 51% of infants born from 1980 to 1988 were second or higher-order births.<sup>94</sup> Additionally, less than half of women used contraception after the birth of their first child and more than 75% refused to terminate higher-order pregnancies, emphasizing the lack of compliance with the one-child policy in Hebei during its first decade.<sup>95</sup>

Within Hebei, clear divides were evident between women with peasant versus worker registration; most peasant women did not have birth permits and more than half of their births were second or higher-order, while the majority of worker women had birth permits and were less likely to have multiple children.<sup>96</sup> These differences can be attributed to the fact that women with worker registration were guaranteed employment, pensions, food, insurance, and other governmental benefits while peasant women were not.<sup>97</sup> This created a system in which working women are subject to much more government control than peasant women, making it easier to convince or coerce them to abide by official policy. Some of this difference may also be attributable to differences in housing; on average, rural women had more space available, while worker women typically lived in smaller spaces which were often controlled by their employers, providing another sphere of government control.

Although incentives were put in place for couples who agreed to accept a one-child certificate, only 22% of women agreed.<sup>98</sup> Differences by registration type were again significant; only 12% of peasant women accepted a one-child certificate, as compared to 88% of worker women.<sup>99</sup>

However, not all couples faced consequences for failing to comply with the one-child policy. The vast majority of the couples who did receive fines were peasants, who were faced an average fine of 451 yuan between 1980 and 1987. This sum is more than 25% of the average annual income of 1,651 yuan, a crippling fee.<sup>100</sup> Thus, although structures were put in place to induce compliance with the one-child policy, the incentives provided were not enough to convince rural women to comply and the punishments given for noncompliance were not severe enough to deter them. For worker women, existing social structures and the threat of sanctions provided stronger motivation to comply with population control efforts.

Overall, peasant women in Hebei province had an average of 2.7 children, compared to 1.9 for workers.<sup>101</sup> Including only women who had children after 1979, when the one-child policy began, the numbers dropped to 1.6 for peasants and 1.1 for workers between 1980-1988.<sup>102</sup> Thus, in its initial years, the one-child policy did lower birth rates in Hebei province, but enforcement was far from strict or uniform.

This pattern of relaxed family planning enforcement is consistent across other methods of measurement as well. For example, government officials discouraged population growth by enforcing longer intervals between births, a technique known as birth spacing. Despite decreasing birth rates in Hebei in the 1980s, second births remained common and the interval of time between first and second births

decreased.<sup>103</sup> Analysis of the 1985 China In-Depth Fertility Survey showed that women were more likely to have a second child if their first child was a girl or if their first child died.<sup>104</sup> These observations speak to the prevalence of traditional familial relationships in Chinese culture. The strength of son preference is shown by the fact that couples whose first child was a girl were likely to have a shorter interval between first and second births. Prior to implementation of the one-child policy, couples in Hebei with a firstborn daughter were 9 to 16% more likely to have a second child than couples with a son.<sup>105</sup> Once the one-child policy was in effect, this difference increased to 38%, emphasizing the relationship between strict birth planning and cultural preference for sons.<sup>106</sup> Likewise, the birth spacing interval was shorter for couples whose first child died, reflecting the strength of Chinese pronatalist values.

Another factor found to have an effect on the number of children a couple had is the level of parental education, especially that of the mother. Interestingly, women in Hebei with a primary education were more likely than those with no education to have a second child, those with a secondary education were found to be 15% less likely to have a second child, and those with education beyond the secondary level had a 29% lower probability.<sup>107</sup> The husband's level of education shows a similar, though less pronounced effect. The fact that education level has such a significant effect on a woman's likelihood to have a second child questions the idea that changes in family planning can be attributed to enforcement of the one-child policy. Instead, this trend supports the idea that declining birth rates can also be the result of increased education and changes in social and cultural norms.

The increase in FPI Hebei over this time period is a reflection of the fact that this measure accounts for all IUD insertions, tubal ligations, and abortions, regardless of whether they were coerced by the government as a result of the one-child policy or sought out by women of their own volition. During this time period, an increasing percentage of women graduated from high school or college (see Figure 3.11). This aligns with the trend observed worldwide that better educated women tend toward smaller family sizes in order to increase their economic standing.<sup>108</sup>

Overall, Hebei experienced a decline in maternal mortality ratio and an increase in family planning interventions, per capita gross regional product, and percent of women with a high school or college degree from 2004 to 2015, while the birth rate varied over time (see Figures 3.7-11). This implies that the change in maternal mortality ratio is correlated with the year, per capita gross regional product, and percent of women with a high school or college degree, but not birth rate or family planning index, which aligns with the trends seen in Beijing.

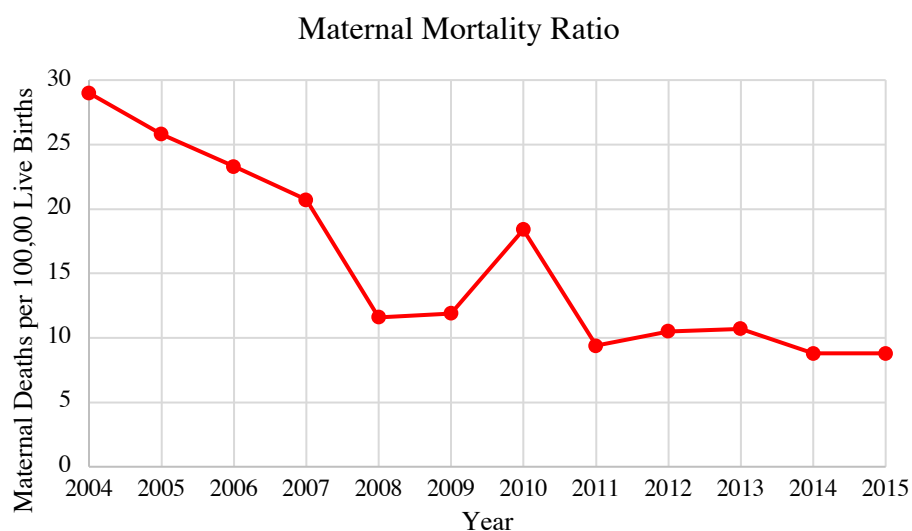


Figure 3.7: Change in maternal mortality ratio in Hebei, 2004-2015.



Figure 3.8: Change in family planning index in Hebei, 2004-2015.

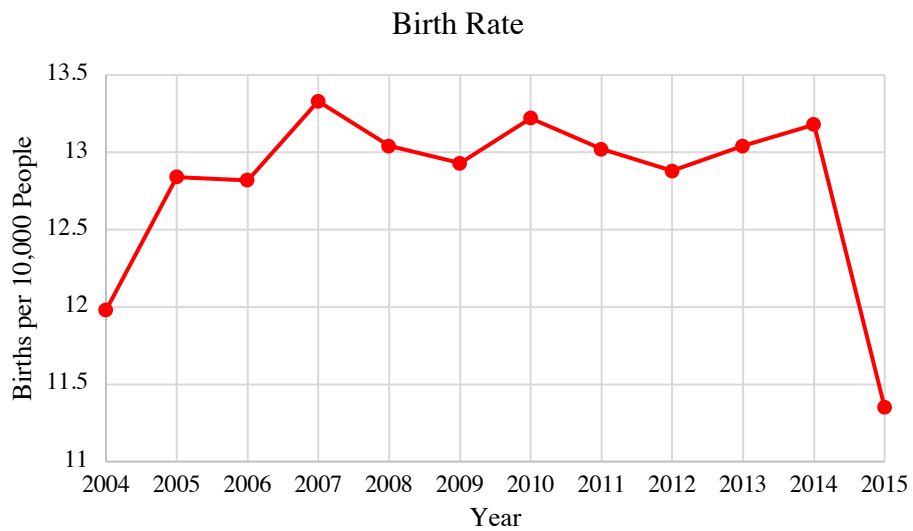


Figure 3.9: Change in birth rate in Hebei, 2004-2015.

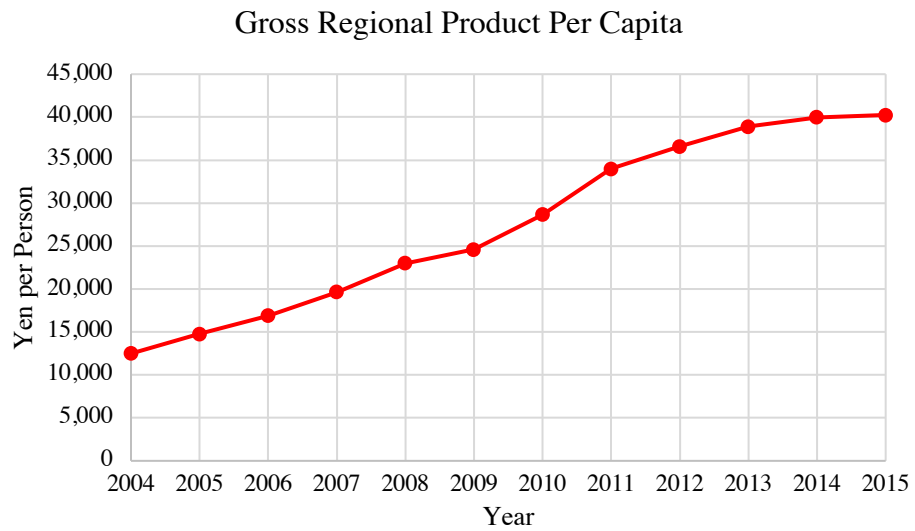


Figure 3.10: Change in per capita gross regional product in Hebei, 2004-2015.

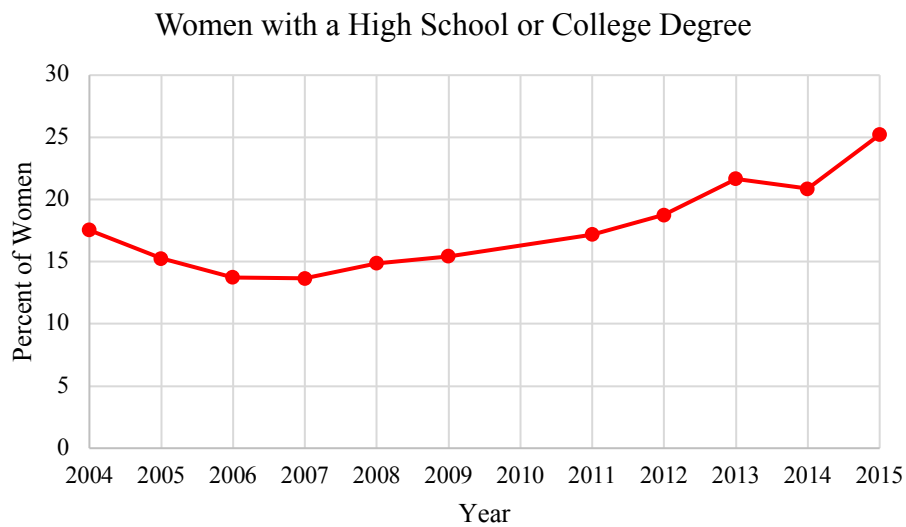


Figure 3.11: Change in percent of women with a high school or college degree in Hebei, 2004-2015.

### 3.3: Discussion and Conclusions

The maternal mortality ratio in both Beijing and Hebei decreased markedly in a relatively linear, consistent manner from 2004 to 2015 (see Figure 3.12). This trend likely reflects increased access and medical improvements in maternal health care.

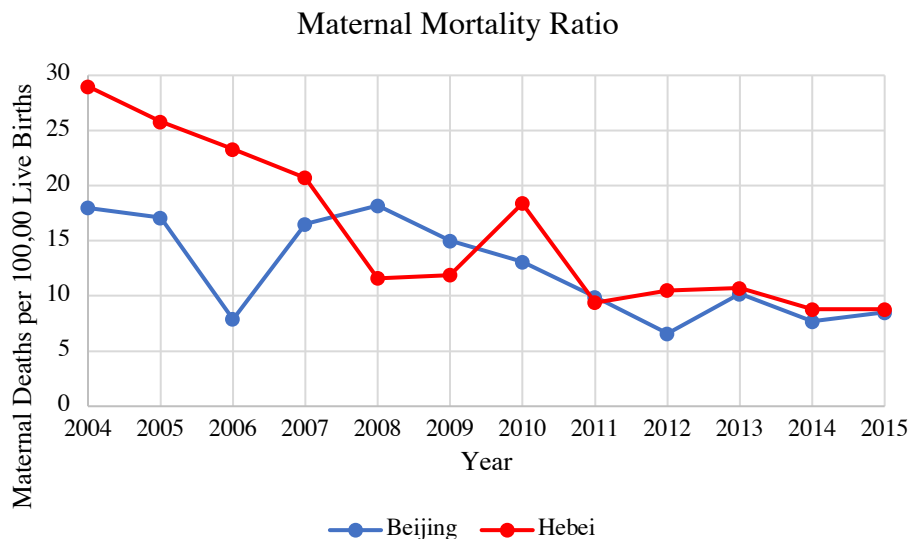


Figure 3.12: Change in maternal mortality ratio, 2004-2015.

Between 2004 and 2015, the FPI decreased in Beijing and increased in Hebei (see Figure 3.13). This means that more family planning interventions, including sterilizations, IUD insertions, and abortions, occurred in Beijing in 2004 than in 2015, while the opposite is true in Hebei. This is partly due to the fact that both Beijing and Hebei had extreme FPI values in 2004; Beijing had the second highest FPI in the country and Hebei had the second lowest FPI. Thus, over time the FPI of both locations reverted toward the mean. For Beijing, this decrease in FPI is reflective of the relaxation of the one-child policy as more and more exceptions to the rule were permitted. Thus, the number of interventions performed decreased. In Hebei, on the other hand, enforcement of the one-child policy was relatively weak, explaining why



the FPI is so low in 2004. As previously noted, the increase in the number of IUD insertions, tubal ligations, and abortions is likely due to increasing numbers of better-educated women seeking out these procedures and not a reflection of changes in government policy.

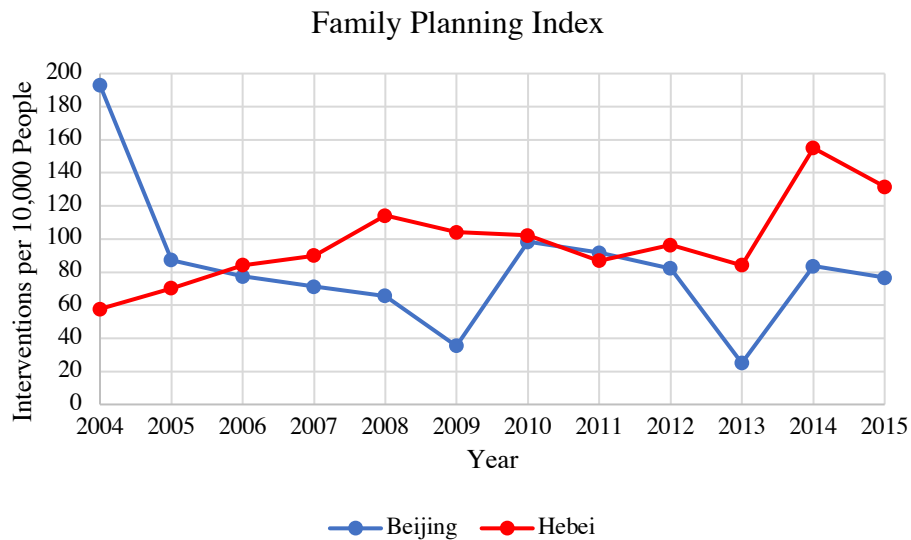


Figure 3.13: Change in family planning index, 2004-2015.

The birth rate in both Beijing and Hebei remained relatively constant from 2004 to 2015 (see Figure 3.14). The lack of change in the birth rate while other variables, such as maternal mortality ratio and per capita gross regional product, show clear trends over time implies that birth rate does not have a significant effect on changes in other variables of interest.

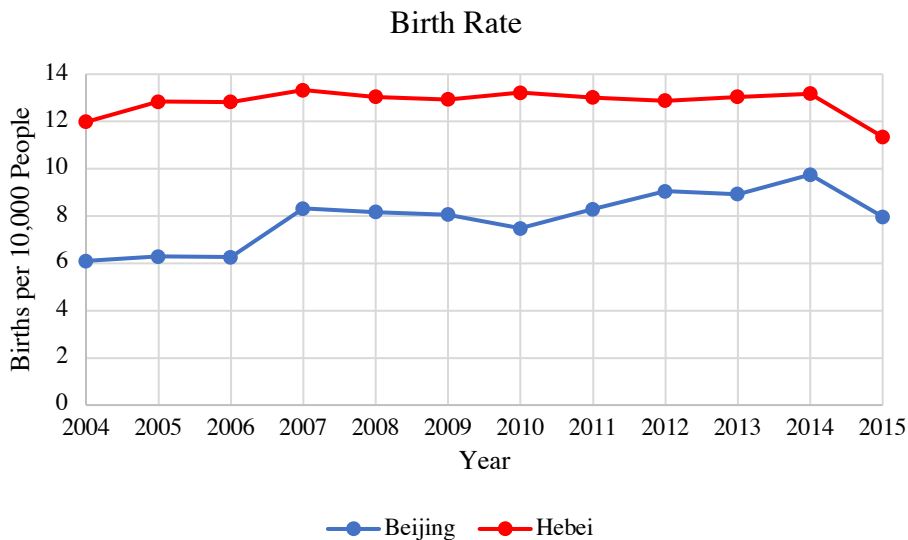


Figure 3.14: Change in birth rate, 2004-2015.

The per capita gross regional product increased in both Beijing and Hebei from 2004 to 2014 (see Figure 3.15). The rate of increase was faster in Beijing than in Hebei, but both show a strong, positive linear correlation between gross regional product per capita and time. These trends make sense in light of China's economic growth throughout this time period.

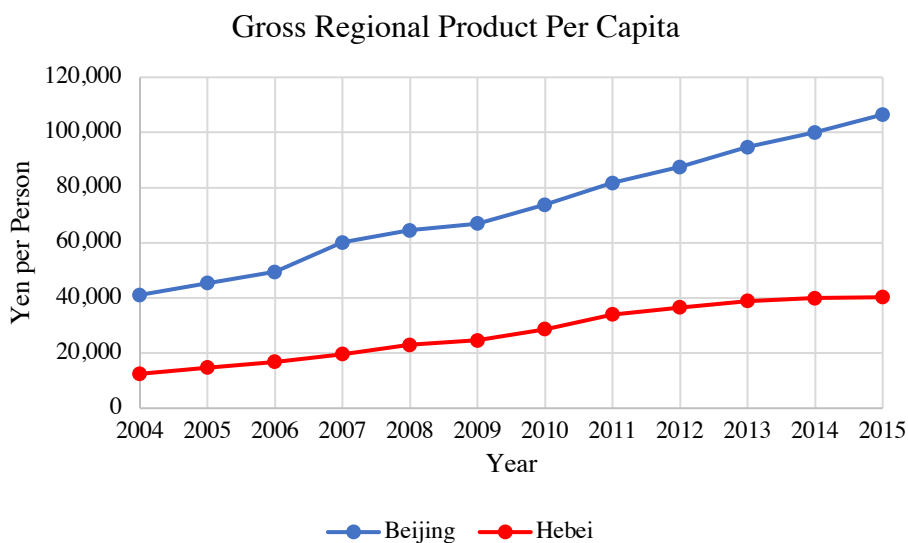


Figure 3.15: Change in per capita gross regional product, 2004-2015.

The percent of women with a high school or college degree increased in both Beijing and Hebei from 2004 to 2015 (see Figure 3.16). The rate of increase was relatively slow in both provinces, but both show a strong, positive linear correlation between percent of women with a high school or college degree and time. The inverse trends in both the percent of women with a high school or college degree and GRP per capita compared to maternal mortality imply that these factors have the most significant impact on the maternal mortality ratio.

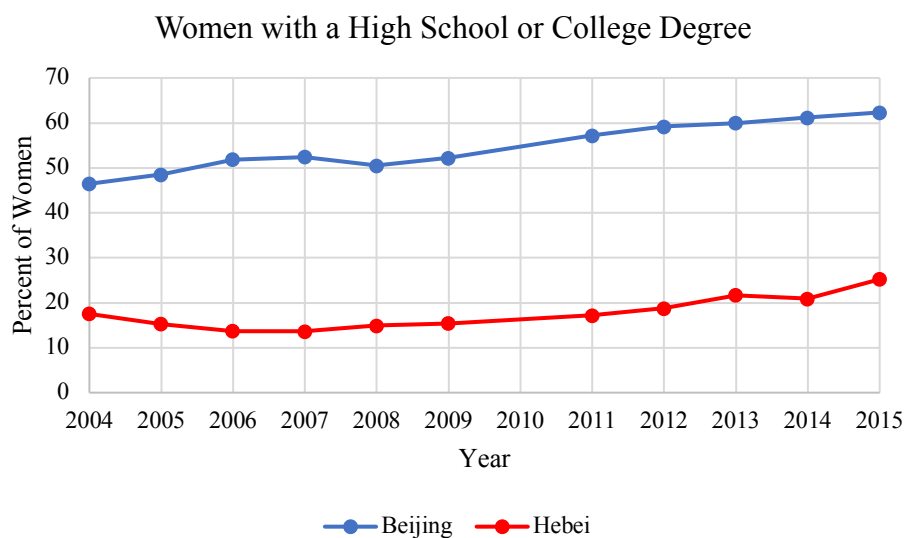


Figure 3.16: Change in percent of women with a high school or college degree, 2004-2015.

Thus, despite differences in the strength of family planning interventions, decreased maternal mortality ratios were observed in both Beijing and Hebei by 2015. This implies that the extent of family planning interventions and birth rate do not have a significant effect on maternal health. The trends for these two provinces, especially the correlations between per capita GRP and women's education with maternal mortality ratio, will be expanded and analyzed at a national level.

## CHAPTER 4: STATISTICAL ANALYSIS

To determine whether ending the one-child policy in China has had a positive or negative effect on maternal health outcomes, several statistical analyses will be conducted. Descriptive statistics and heat maps will be used to show the distribution of data across both time and space. Bivariate analysis will consider the relationships between each factor hypothesized to affect maternal health outcomes, while multivariate analysis will create a model to determine which of these factors have the most significant effect when they are all taken into account simultaneously.

In order to explore the factors that are hypothesized to influence maternal health outcomes, as measured by the maternal mortality ratio per hundred thousand live births, the effects of province, year, socioeconomic status, literacy rate, birth rate, and strength of family planning interventions will be analyzed. Each of these variables will be considered both separately and all together to elucidate which ones have a statistically significant effect on maternal mortality ratio.

These statistical analyses will be compared to the three initial hypotheses: 1) the relaxation of the one-child policy will result in fewer coercive family planning interventions, improving maternal health outcomes; 2) the maternal healthcare infrastructure put in place to implement the one-child policy was beneficial to women's health so loosened enforcement will reduce access to care, resulting in decreased maternal health outcomes; 3) changes in enforcement as measured by birth rate and FPI are not as influential as other factors in explaining maternal health outcomes, so no correlation will be observed.

Data from thirty of China's provincial-level divisions, including twenty-two provinces, four municipalities, and four autonomous regions was collected from the China Health and Family Planning Statistical Yearbooks, published annually by the National Health and Family Planning Commission, and the National Bureau of Statistics of China, a government database, for the years 2004 through 2015. Tibet was excluded from this analysis because it was a clear outlier, both with regards to these data and its political setting within China. Provincial-level data from thirty divisions across twelve years gave a sample size of  $N=360$  province-years for: birth rate, family planning index, per capita gross regional product, percentage of women with a high school or college degree, and maternal mortality ratio.

#### 4.1: Descriptive Statistics and Heat Maps

Birth rate, defined as the number of births per ten thousand people per year, shows an approximately normal distribution with a mean of 11.22 and standard deviation of 2.65 (see Figure 4.1). The minimum is 5.36 and the maximum is 16.79 with an interquartile range spanning from 9.35 to 13.22 with a median of 11.51. There are no provincial-year outliers in the birth rate data set.

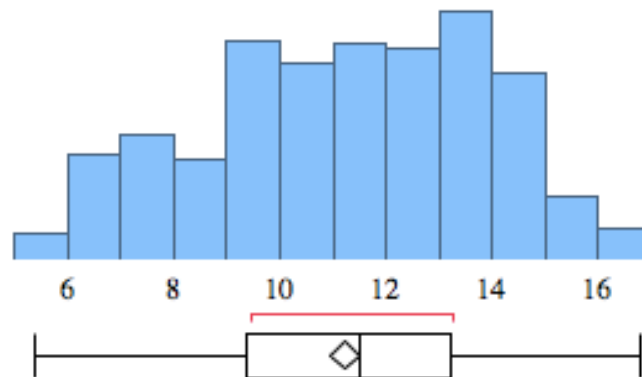


Figure 4.1: Distribution and box plot of birth rate by province, 2004-2015.

The strength of family planning intervention in each province was measured using a new variable, family planning index (FPI), defined as the net number of IUD insertions, tubal ligations, and abortions per ten thousand people per year. This data is published annually in the publicly available China Health and Family Planning Statistical Yearbooks by the National Health and Family Planning Commission. The FPI shows a skewed distribution with a mean of 99.33, standard deviation of 33.16, a minimum of 25.01, and a maximum of 294.97 (see Figure 4.2). The interquartile range spans from 76.03 to 116.83 with a median of 93.44. The high outliers are mostly from 2004, the first year from which data was available, implying that the FPI decreased over time. The point at nearly 300 represents the 2004 FPI of Chongqing, a large municipality where high levels of family planning intervention are expected.

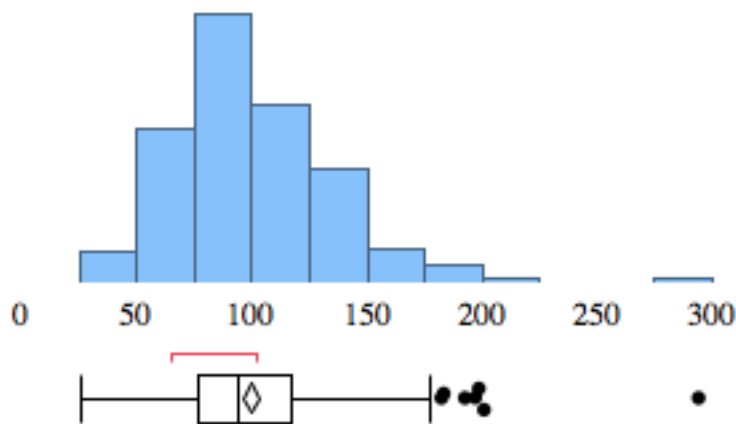
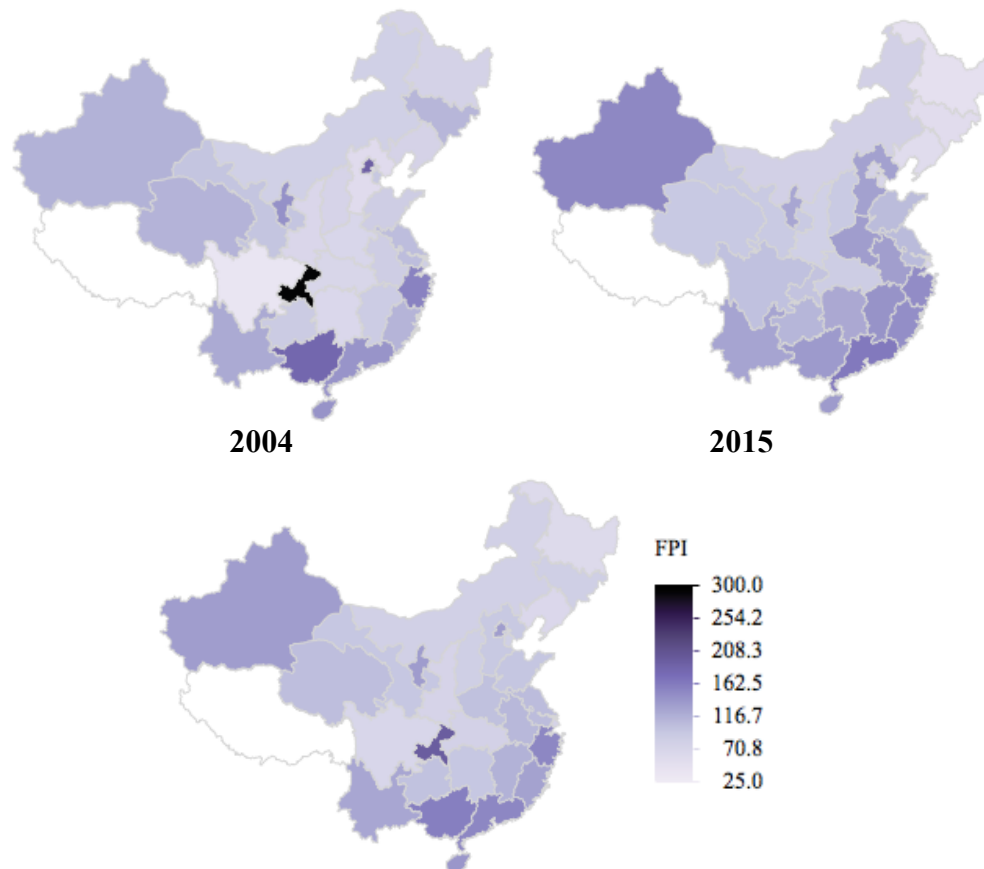


Figure 4.2: Distribution and box plot of FPI by province, 2004-2015.

The change in FPI from 2004 to 2015 can be visualized using heat maps (see Figure 4.3). In 2004, the FPI varied significantly across the country, ranging from 38.40 to 294.97 with a mean value of 108.67. By 2015, the FPI had increased in some areas and decreased in other areas, generating a much narrower distribution from 46.35 to 165.81 with a mean value of 108.26. Surprisingly, the average FPI was

almost the same in 2004 and 2015, though the smaller range in 2015 reflects the relaxation of enforcement of the one-child policy over time.



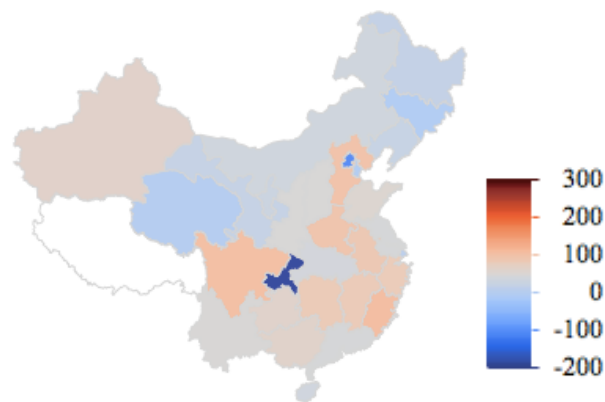
**Average Maternal mortality ratio (2004-2015)**

Figure 4.3: Change in FPI by province, 2004-2015.

The  $\Delta$ FPI is a measurement of the change in family planning intervention from 2004 to 2015 by province (see Figure 4.4 and Table 4.1). Some parts of the country experienced a weakening of family planning intervention from 2004 to 2015, leading to a  $\Delta$ FPI value less than zero and shown in blue. Other provinces showed a strengthening of intervention, resulting in  $\Delta$ FPI greater than zero and shown in red. Overall, these values range from -199.13 to 70.92 with an average of 1.69, implying

that most provinces actually strengthened family planning efforts from 2004 to 2015.

There is no clear trend in the  $\Delta$ FPI values by region, with several provinces with trends of weakened enforcement adjacent to provinces where enforcement was strengthened. To better understand the causes behind changing enforcement of the one-child policy, two case studies will be discussed in the next chapter: the capital city Beijing and Hebei, its surrounding province.



**$\Delta$ FPI (2015-2004)**

Figure 4.4: Change in FPI by province, 2004-2015.

Table 4.1: FPI by province, 2004 to 2015

Province	2004	2015	$\Delta$ FPI	Province	2004	2015	$\Delta$ FPI
Beijing	193.00	76.57	-127.17	Henan	70.48	134.71	56.80
Tianjin	95.65	69.26	-40.55	Hubei	70.53	87.43	3.93
Hebei	57.71	131.48	61.29	Hunan	67.19	124.56	45.50
Shanxi	74.65	93.23	11.17	Guangdong	142.65	165.81	7.93
Nei Mongol	82.52	80.40	-2.81	Guangxi	183.78	137.73	25.95
Liaoning	76.33	57.25	-14.49	Hainan	143.76	136.96	-2.43
Jilin	112.09	56.32	-42.16	Chongqing	294.97	99.78	-199.13
Heilongjiang	77.00	46.35	-19.81	Sichuan	38.40	102.22	68.39
Shanghai	83.42	66.42	-29.39	Guizhou	91.09	112.23	24.83
Jiangsu	105.36	108.15	7.67	Yunnan	123.31	128.62	13.50
Zhejiang	158.14	149.00	42.91	Shaanxi	67.75	81.89	11.03
Anhui	86.79	134.43	50.60	Gansu	98.13	93.85	-16.39
Fujian	113.84	147.88	70.92	Qinghai	114.65	94.45	-37.55
Jiangxi	88.68	143.76	44.77	Ningxia Hui	145.26	126.00	-8.72
Shandong	86.74	107.58	17.93	Xinjiang	116.23	153.36	26.16



Maternal mortality ratio, defined as the number of maternal deaths per hundred thousand live births per year due to causes related to pregnancy, shows a skewed distribution (see Figure 4.5). The mean is 25.09 and the standard deviation is 20.10 with a minimum of 1.2 and a maximum of 123.7. The interquartile range spans from 11.43 to 32.15 with a median of 18.45. The high outliers are predominantly from the years 2004-2006, emphasizing the trend of decreasing maternal mortality ratio.

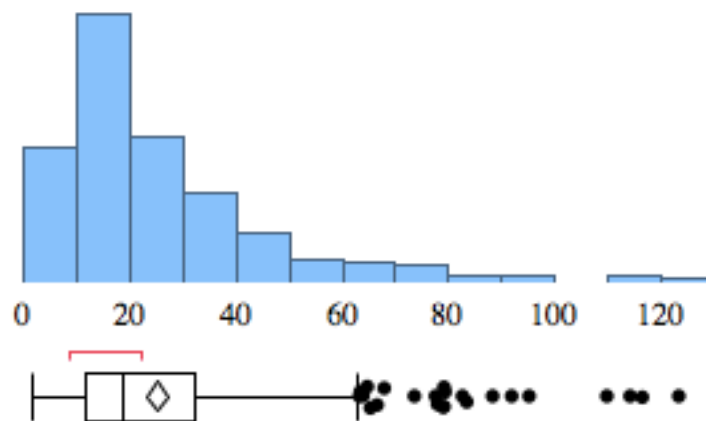
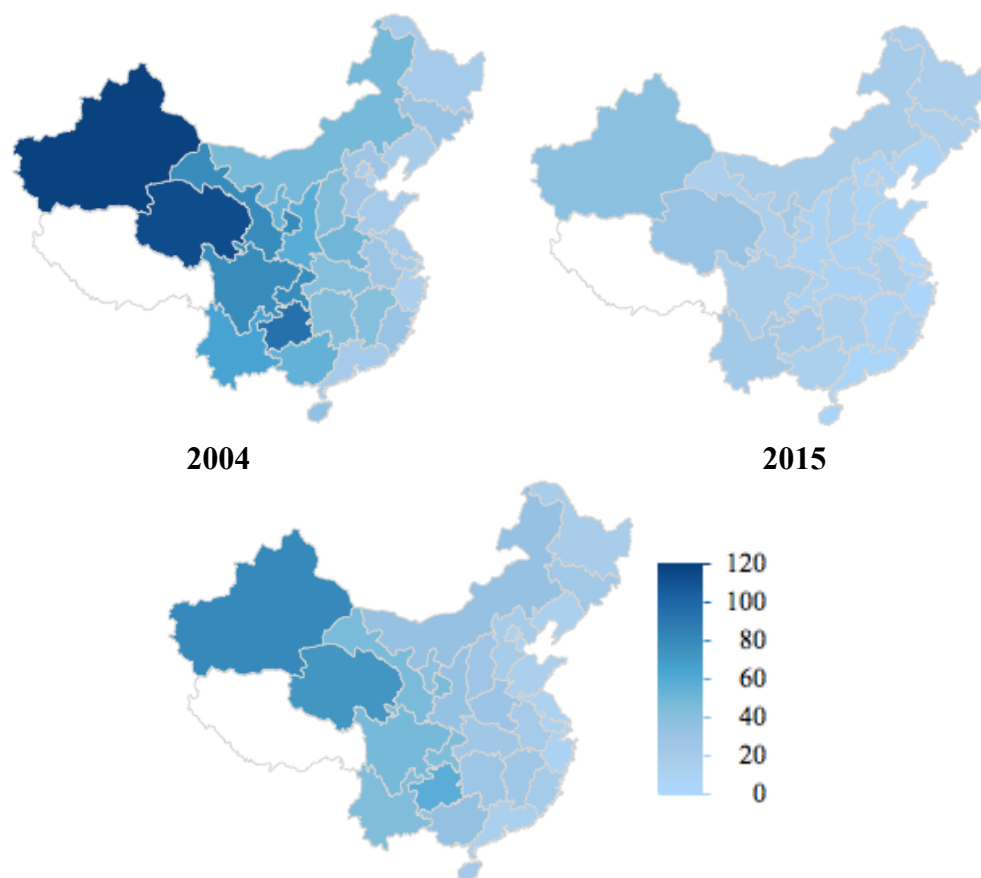


Figure 4.5: Distribution and box plot of maternal mortality ratio by province, 2004-2015.

The change in maternal mortality ratio from during this time period can also be visualized using heat maps (see Figure 4.6). In 2004, maternal mortality ratios were relatively high nationwide, ranging from 10.80 to 123.7 with a mean value of 46.49. By 2015, maternal mortality ratios had decreased markedly nationwide, ranging from 2.30 to 38.50 with a mean value of 13.50. The average maternal mortality ratio graph shows the declining maternal mortality ratios across the nation.



**Average Maternal mortality ratio (2004-2015)**

Figure 4.6: Maternal mortality ratio by province, 2004 to 2015.

Table 4.2: Maternal mortality ratio by province, 2004 to 2015

Province	2004	2015	Avg	Province	2004	2015	Average
Beijing	18.00	8.50	13.25	Henan	50.70	10.50	30.60
Tianjin	12.20	8.10	10.15	Hubei	42.10	9.10	25.60
Hebei	29.00	8.80	18.90	Hunan	44.20	14.20	29.20
Shanxi	44.60	13.10	28.85	Guangdong	20.30	6.10	13.20
Nei Mongol	48.90	18.30	33.60	Guangxi	55.20	14.20	34.70
Liaoning	18.20	8.50	13.35	Hainan	36.30	8.30	22.30
Jilin	32.20	15.40	23.80	Chongqing	79.10	11.10	45.10
Heilongjiang	19.40	16.80	18.10	Sichuan	79.30	17.80	48.55
Shanghai	10.80	5.70	8.25	Guizhou	95.40	20.50	57.95
Jiangsu	21.70	2.30	12.00	Yunnan	65.40	23.60	44.50
Zhejiang	14.40	5.30	9.85	Shaanxi	58.80	9.20	34.00
Anhui	29.40	14.00	21.70	Gansu	79.50	15.10	47.30
Fujian	32.20	10.10	21.15	Qinghai	114.50	31.90	73.20
Jiangxi	42.80	8.30	25.55	Ningxia Hui	54.50	23.10	38.80
Shandong	21.80	8.50	15.15	Xinjiang	123.70	38.50	81.10

The decreasing maternal mortality ratio during the period from 2004 to 2015 is evident in the one-way analysis of maternal mortality ratio by year (see Figure 4.7, Table 4.3). The successive box plots show a decline in the maternal mortality ratios nationwide and a decrease in variation between provinces.

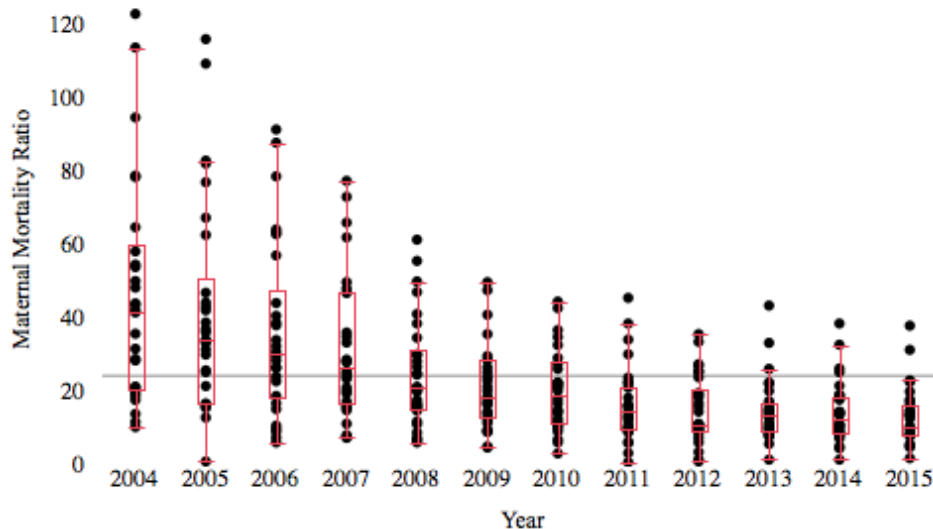


Figure 4.7: One-way analysis of maternal mortality ratio by year.

Table 4.3: Maternal mortality ratio quartiles by year

<b>Year</b>	<b>Minimum</b>	<b>25%</b>	<b>Median</b>	<b>75%</b>	<b>Maximum</b>
2004	10.8	21.35	42.45	60.45	123.7
2005	1.4	17.18	34.5	51.45	116.8
2006	6.6	18.80	30.85	47.95	92.1
2007	7.86	17.47	27.26	47.72	78.07
2008	6.6	15.82	21.5	31.83	62
2009	5.2	13.48	18.85	29.35	50.4
2010	3.6	11.95	19.55	28.5	45.1
2011	1.2	10.13	14.95	21.9	46.1
2012	1.4	9.73	11.6	21.18	36.2
2013	1.9	10	13.95	17.3	44
2014	1.9	9	12.85	18.83	39.1
2015	2.3	8.45	10.8	17.05	38.5

Likewise, an analysis of means during this time period clearly shows that the maternal mortality ratios from 2004 through 2006 were above average and those from 2012 through 2015 were below average, emphasizing the trend (see Figure 4.8).

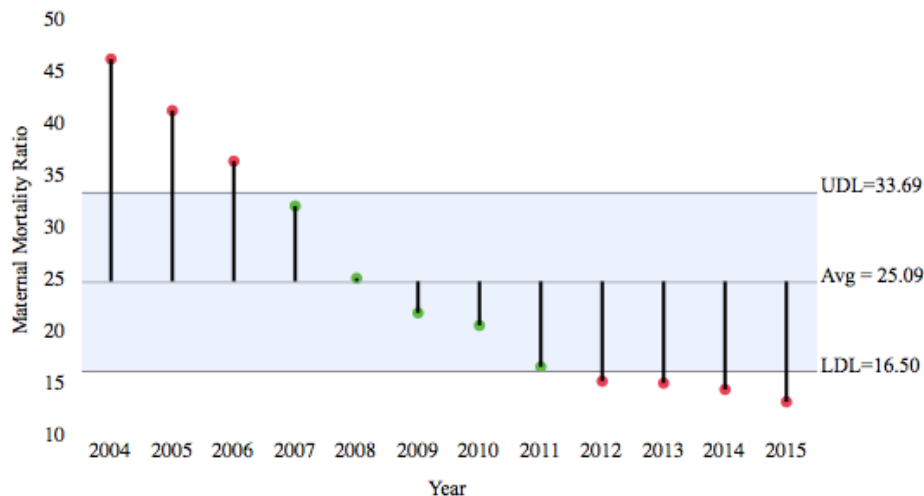


Figure 4.8: Analysis of means for maternal mortality ratio.

The socioeconomic status of each province can be approximated by the per capita gross regional product, measured in yen per person per year, which shows a skewed distribution (see Figure 4.9). The mean is 33,215 and the standard deviation is 21,617 with a minimum of 4,317 and a maximum of 107,960. The interquartile range spans from 16,392 to 41,727 with a median of 28,665. The majority of the high outliers represent the large, affluent cities of Beijing, Tianjin, and Shanghai.

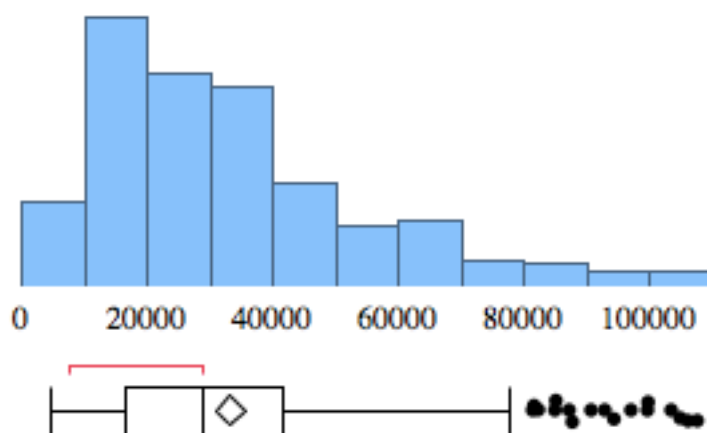


Figure 4.9: Distribution and box plot of per capita gross regional product by province, 2004-2015.

The education level of each province can be measured using the percentage of women over age 6 who have graduated from high school or college, which shows a skewed distribution (see Figure 4.10). The mean is 22.73% and the standard deviation is 9.86% with a minimum of 7.64% and a maximum of 62.32%. The interquartile range spans from 16.16% to 25.83% with a median of 20.69%. The high outliers are all from Beijing, Shanghai, and Tianjin, meaning that women are more educated in these major municipalities.

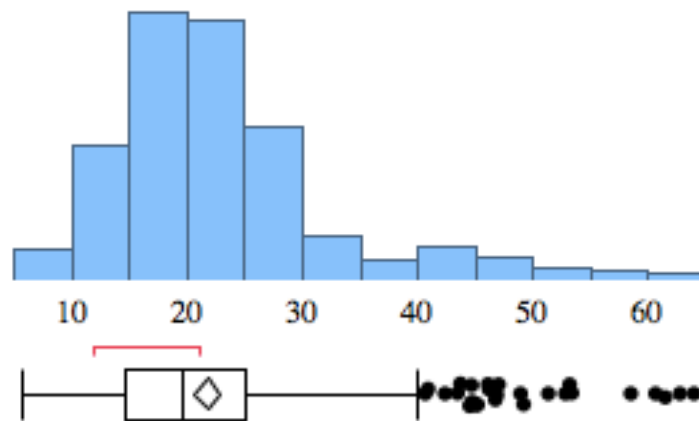


Figure 4.10: Distribution and box plot of women's education by province, 2004-2015.

#### 4.2: Bivariate Analysis

The relationships between maternal mortality ratio and birth rate, family planning index, per capita gross regional product, and percentage of women with high school or college degrees can each be considered separately using bivariate analysis.

The positive correlation between maternal mortality ratio and birth rate is best explained by a quadratic model (see Figure 4.11). Although the trend is relatively weak, as the birth rate increases, the maternal mortality ratio increases as well. This fit shows that the change in birth rate explains 25.1% of the change in maternal mortality ratio.

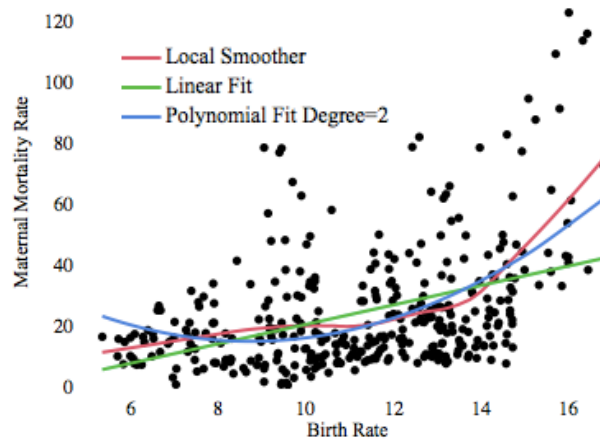


Figure 4.11: Bivariate fit of maternal mortality ratio by birth rate.

Model	R <sup>2</sup>	Equation
Smoother	0.311324	N/A
Linear Fit	0.177892	Maternal mortality ratio = -10.86 + 3.20*Birth Rate
Quadratic Fit	0.251059	Maternal mortality ratio = -20.14 + 3.58*Birth Rate + 0.72*(Birth Rate-11.2215) <sup>2</sup>

There is no clear relationship between maternal mortality ratio and family planning index (see Figure 4.12). This is made clear by the fact that both linear and quadratic fits do not represent trends seen in the data and are not able to explain the change in maternal mortality ratio with a useful degree of accuracy.

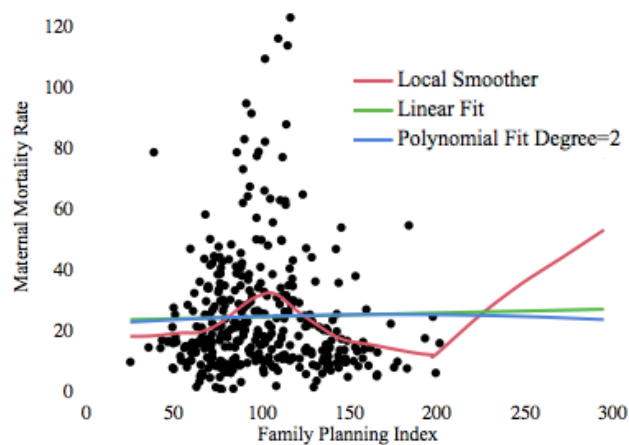


Figure 4.12: Bivariate fit of maternal mortality ratio by family planning index.

Model	R <sup>2</sup>	Equation
Smoother	0.103547	N/A
Linear Fit	0.000447	Maternal mortality ratio = 23.82 + 0.013*FPI
Quadratic Fit	0.000595	Maternal mortality ratio = 23.54 + 0.017*FPI - 0.00011*(FPI-99.33) <sup>2</sup>

The relationship between maternal mortality ratio and per capita gross regional product is best represented by a quadratic model (see Figure 4.13). As the per capita gross regional product increases, the maternal mortality ratio declines rapidly; areas with lower economic indicators have much higher mortality rates than areas with more developed economies. This fit shows that the change in birth rate explains 51.8% of the change in maternal mortality ratio.

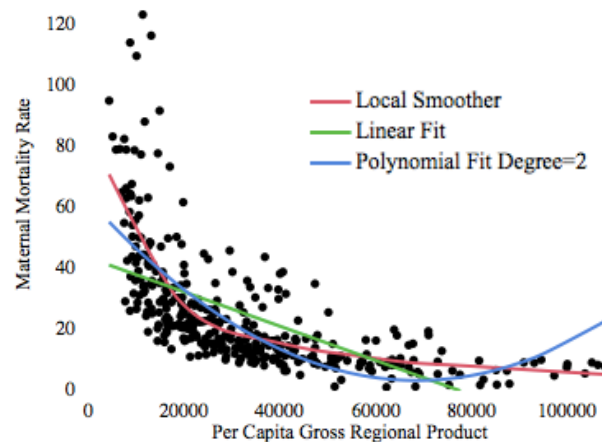


Figure 4.13: Bivariate fit of maternal mortality by per capita gross regional product.

Model	R <sup>2</sup>	Equation
Smoother	0.596482	N/A
Linear Fit	0.367283	Maternal mortality ratio = 43.81 - 0.00056*Per Capita Gross Regional Product
Quadratic Fit	0.517855	Maternal mortality ratio = 48.88 - 0.00089*Per Capita Gross Regional Product + 1.26*10 <sup>-8</sup> *(Per Capita Gross Regional Product-33215.4) <sup>2</sup>

The weak negative correlation between maternal mortality ratio and percent of women with a high school or college degree is best explained by a quadratic model (see Figure 4.14). Although the trend is fairly weak, as the percent of women with a high school or college degree increases, the maternal mortality ratio decreases. This fit shows that the change in the percent of women with a high school or college degree explains 32.2% of the change in maternal mortality ratio.

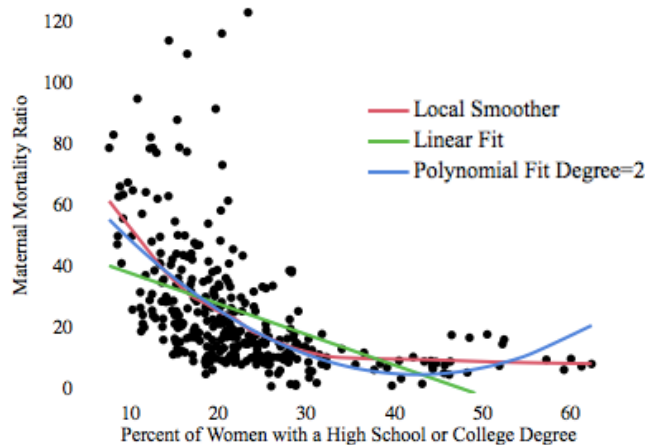


Figure 4.14: Bivariate fit of maternal mortality ratio by women's education.

Model	R <sup>2</sup>	Equation
Smoother	0.330744	N/A
Linear Fit	0.23017	Maternal mortality ratio = 48.363602 - 1.006744*(% of Women with High School or College Degree)
Quadratic Fit	0.322405	Maternal mortality ratio = 56.982354 - 1.5647238*(% of Women with High School or College Degree) + 0.041458*(% of Women with High School or College Degree) <sup>2</sup>

#### 4.3: Least Squares Regression Model

To determine the relative strengths of the effects of birth rate, family planning index, per capita gross regional product, percent of women with a high school or college degree, year, and province on the maternal mortality ratio, a least squares



regression model was used (see Figure 4.15). The logarithm of maternal mortality ratio was used in this analysis to correct for the highly skewed nature of the maternal mortality ratio data. The least squares regression model shows a clear positive correlation between the independent variables in question and maternal mortality ratio. This fit shows that the change in birth rate, family planning index, per capita gross regional product, percent of women with a high school or college degree, year, and province together explain 90% of the change in maternal mortality ratio with a P-value less than 0.0001.

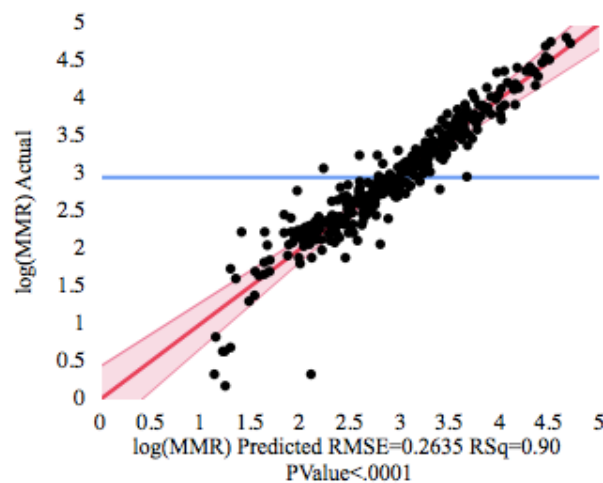


Figure 4.15: Least squares regression model of log(maternal mortality ratio).

To ascertain which of the independent variables are contributing to this significant result, the effects of each was tested (see Table 4.4). This showed that that only province, year, percent of women with a high school or college degree, and per capita gross regional product have a statistically significant impact on the maternal mortality ratio, while birth rate and FPI do not. This means that once province, year, percent of women with a high school or college degree, and per capita GRP have been accounted for, birth rate and FPI have no effect on maternal health outcomes.

Table 4.4: Least squares regression model effect summary

Source	LogWorth	PValue
Province	62.017	<0.0001
Year	19.597	<0.0001
Per Capita GRP	2.504	0.00313
HS or College	2.215	0.00609
FPI	0.583	0.26103
Birth Rate	0.448	0.35656

These effects can be visualized using the prediction profiler (see Figure 4.16).

These graphs show that there is a strong negative correlation between maternal mortality ratio and both year and percent of women with a high school or college degree, but no correlation between maternal mortality ratio and birth rate or FPI. Interestingly, there is a positive correlation between maternal mortality ratio and per capita gross regional product, implying that there is a higher mortality rate in regions of higher economic development. This graph emphasizes the significance of province on the maternal mortality ratio, as outcomes vary greatly between different provinces.

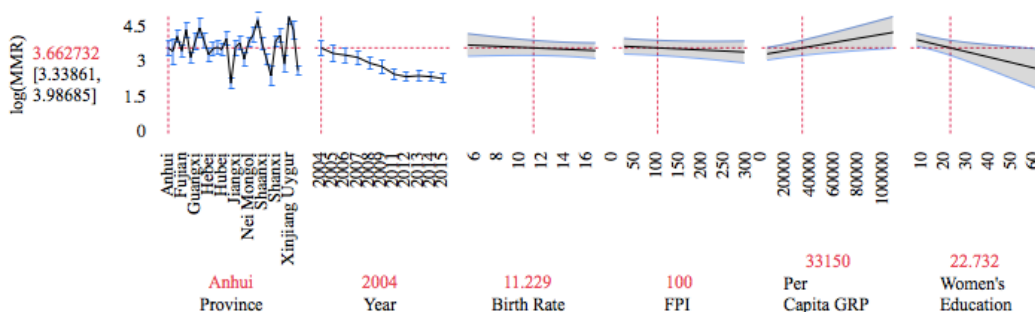


Figure 4.16: Least squares regression model prediction profiler.

The least squares regression model can be used to predict maternal health outcomes using Equation 4.1 and parameter estimates for year, birth rate, FPI, per capita gross regional product, percent of women with a high school or college degree, and province (see Table 4.5).

$$\text{Log}(MMR) = 3.51 - 0.02(\text{Birth Rate}) - 9.18 \times 10^{-4} (FPI) + 8.91 \times 10^{-6} (\text{Per Capita GRP}) - 0.02(\text{Percent HS or College}) + \text{Year Parameter} + \text{Province Parameter}$$

Equation 4.1: Least squares regression model prediction expression.

Table 4.5: Lest squares regression model prediction parameter estimates

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	3.5119861	0.323414	10.86	<.0001*
Province[Anhui]	-0.067873	0.113446	-0.60	0.5501
Province[Beijing]	-0.212822	0.312775	-0.68	0.4968
Province[Chongqing]	0.4284673	0.086784	4.94	<.0001*
Province[Fujian]	-0.200852	0.093309	-2.15	0.0322*
Province[Gansu]	0.7050397	0.113281	6.22	<.0001*
Province[Guangdong]	-0.474097	0.097391	-4.87	<.0001*
Province[Guangxi]	0.1958608	0.127747	1.53	0.1263
Province[Guizhou]	0.7885808	0.143502	5.50	<.0001*
Province[Hainan]	0.2392192	0.122861	1.95	0.0525
Province[Hebei]	-0.351208	0.099069	-3.55	0.0005*
Province[Heilongjiang]	-0.103621	0.123684	-0.84	0.4029
Province[Henan]	-0.047831	0.096241	-0.50	0.6196
Province[Hubei]	-0.129388	0.087572	-1.48	0.1406
Province[Hunan]	0.32304	0.093753	3.45	0.0007*
Province[Jiangsu]	-1.58618	0.108673	-14.60	<.0001*
Province[Jiangxi]	-0.059712	0.110508	-0.54	0.5894
Province[Jilin]	0.1499336	0.133825	1.12	0.2635
Province[Liaoning]	-0.541525	0.148492	-3.65	0.0003*
Province[Nei Mongol]	0.1818361	0.097913	1.86	0.0643
Province[Ningxia Hui]	0.5019794	0.11619	4.32	<.0001*
Province[Qinghai]	1.1274298	0.127167	8.87	<.0001*
Province[Shaanxi]	0.1195208	0.088879	1.34	0.1798
Province[Shandong]	-0.567461	0.088401	-6.42	<.0001*
Province[Shanghai]	-1.256172	0.242348	-5.18	<.0001*
Province[Shanxi]	0.2165229	0.085634	2.53	0.0120*
Province[Sichuan]	0.464827	0.102763	4.52	<.0001*
Province[Tianjin]	-0.761405	0.222638	-3.42	0.0007*
Province[Xinjiang Uygur]	1.264699	0.138176	9.15	<.0001*
Province[Yunnan]	0.6919242	0.133525	5.18	<.0001*
Province[Zhejiang]	-1.038735	0.112174	-9.26	<.0001*
Year[2004]	0.7749822	0.076757	10.10	<.0001*
Year[2005]	0.537039	0.079141	6.79	<.0001*
Year[2006]	0.4636722	0.069548	6.67	<.0001*
Year[2007]	0.3663075	0.061001	6.00	<.0001*
Year[2008]	0.1214929	0.05515	2.20	0.0284*
Year[2009]	-0.027606	0.051686	-0.53	0.5937
Year[2011]	-0.355135	0.053647	-6.62	<.0001*
Year[2012]	-0.458338	0.060615	-7.56	<.0001*
Year[2013]	-0.419011	0.071295	-5.88	<.0001*
Year[2014]	-0.45971	0.082156	-5.60	<.0001*
Year[2015]	-0.543695	0.093185	-5.83	<.0001*
Birth Rate	-0.021081	0.022829	-0.92	0.3566
Family Planning Index	-0.000918	0.000815	-1.13	0.2610
Per Capita GRP	8.9057e-6	2.989e-6	2.98	0.0031*
% Women HS or College	-0.023011	0.008327	-2.76	0.0061*

#### *4.4: Conclusions*

Overall, the change in enforcement of the one-child policy from 2004 to 2015 varied across China. Although this period before its official termination is generally seen as a time of increasingly relaxed enforcement of the one-child policy, several provinces actually experienced an increase in the number of family planning interventions including IUD insertions, sterilizations by tubal ligation, and abortions during this time period. In fact, the average  $\Delta$ FPI was greater than zero, meaning that most provinces had more interventions in family planning in 2015 than in 2004. As noted in the Hebei case study, this increase in family planning interventions can likely be attributed to the fact that some women willingly choose to undergo procedures including IUD insertion, sterilization, and abortion. Although there was no uniform change in the extent of family planning interventions during this time period, a clear trend was observed regarding maternal health outcomes, which improved nationwide; in every province, the maternal mortality ratio in 2015 was lower than in 2004.

The fact that the maternal mortality ratio decreased uniformly across China while family planning enforcement was strengthened in some provinces and weakened in others shows that there is no strong correlation between the two. This was confirmed by the least squares regression model, which showed that only province, year, percent of women with a high school or college degree, and per capita gross regional product have a statistically significant impact on the maternal mortality ratio, while birth rate and FPI do not. This was a surprising result given the fact that the enforcement of China's one-child policy has been widely understood to have detrimental effects on maternal health, as demonstrated by the accounts of numerous

women who were forced into unwanted and unnecessary medical procedures, some of whom did not survive. However, this data implies that changes in maternal health are better explained by changes in healthcare over time and socioeconomic indicators such as per capita gross regional product and education level.

## CHAPTER 5: CONCLUSION

Surprisingly, the relaxation of the one-child policy, which was infamous worldwide for its use of coercive measures such as forced abortions and sterilizations to curb population growth, did not have any significant effect on maternal health outcomes. Only province, year, the percent of women with a high school or college degree, and per capita gross regional product were found to have substantial effects on the maternal mortality ratio. Both the birth rate and family planning index, used as proxies to measure the strength of enforcement of the one-child policy, were found to have no significant effect.

Three hypotheses were initially proposed: 1) implementation of the one-child policy was associated with coercive and invasive measures, so the relaxation of the policy would result in improved maternal health outcomes; 2) a widespread maternal healthcare infrastructure was necessary to facilitate such a large-scale population control program, so the relaxation would result in reduced access to care and decreased maternal health outcomes; or 3) the strength of family planning interventions will not play a significant role in explaining maternal health outcomes and other factors will be more influential.

These hypotheses were tested on the province level to account for the fact that the one-child policy was not uniformly enforced between regions. Further, as the policy was relaxed over time, changes were implemented using a variety of methods and at different times in each province, municipality, and autonomous region. This variation in enforcement of the one-child policy was measured using the birth rate

and the number of family planning interventions by province from 2004 through 2015, a time period that includes several major legal changes that resulted in loosened enforcement and culminates in the termination of the policy entirely.

The first two hypotheses were rejected; enforcement of the one-child policy, as measured by changes in birth rate and FPI, is not correlated with changes in maternal health outcomes, as measured by the maternal mortality ratio. Comparative analysis of case studies from Beijing and Hebei combined with a national-level statistical evaluation showed that a combination of year, per capita GRP, and percent of women with a high school or college degree were the most influential factors associated with improving maternal health outcomes.

Year was an important variable in explaining changes in maternal health; maternal mortality ratios decreased nationwide during the time period from 2004 through 2015. This is likely due to increased access to care and advances in medicine to better treat mothers. This observation reflects a global trend; in China the maternal mortality ratio dropped from 50 deaths per 100,000 live births in 2004 to 27 in 2015 as compared to a worldwide decrease from 299 maternal deaths per 100,000 live births in 2004 to 216 in 2015.<sup>109</sup> If data were accessible, it would be interesting to compare the results over a longer period of time. While this study only considers the end of the one-child policy, other periods of interest include the transition period from more informal family planning guidelines to the start of the one-child policy and during the height of the one-child policy when government coercion was more prevalent. Comparing data over a longer time period could help determine whether it was just during the final period of relaxation that family planning interventions and

birth rates were not associated with maternal death or whether this trend holds true throughout periods of stricter family planning regulation as well.

Increasing per capita gross regional product is associated with improved maternal health outcomes, emphasizing the effect of socioeconomic status on maternal mortality ratios. This finding supports the broader trend that wealthier nations tend to be healthier, as measured by infant and child mortality.<sup>110</sup> A closer province-level analysis including other measures of health, such as life expectancy and infant and child mortality would be useful to confirm this result.

The percentage of women who graduated from high school or college is another important explanatory factor for changes in maternal health; more educated women are less likely to die from causes related to pregnancy and childbirth. This finding supports the idea that education of women and girls is highly important. The World Bank and the Grameen Bank have shown that increased education of women is correlated with lower birth rates.<sup>111</sup> In combination with the finding that increased education is also correlated with improved maternal health outcomes, this implies that two of the major effects of China's one-child policy – decreasing birth rates and maternal mortality ratios – could have been achieved simply by investing in the education of women and girls.

More research is necessary to thoroughly examine the effects of women's education on maternal health outcomes. While a high school or college diploma was shown to play a significant role in decreasing maternal mortality ratios, the level of education necessary to effect change is unknown. In the case studies considered here, the percent of women who graduated from high school or college were quite



different, increasing from 46% in 2004 to 62% in 2015 in Beijing and from 18% to 25% in Hebei. Despite the difference in magnitude, in both cases increased women's education was associated with declining maternal mortality ratios. It is possible that a certain level of education is necessary in order to produce observable maternal health effects or that there is a threshold percent of women who must achieve this level of education. These are both areas for future exploration.

In addition to examining the influence of per capita GRP and education more closely within China, it would be interesting to see how these results compare to other countries. For example, are the same trends seen in other countries with a history of government regulation of family planning? Is it broadly true that birth planning policies have little effect on maternal health? If so, should we reconsider the value of family planning programs? While clearly wrong in that they violate the autonomy of women and couples by preventing them from making their own reproductive decisions, are such policies worth enacting if they are effective and there are negligible detrimental health effects? Additionally, how does China compare to countries that do not have government-mandated family planning programs?

The one-child policy was China's solution to the problem of excessive population growth. Despite the use of draconian measures to ensure compliance, the relaxation of this policy did not have any significant effects on maternal health outcomes. Today, the Chinese government faces the opposite problem; with fertility levels below replacement rate and a rapidly aging population, the government is now interested in increasing birth rates. As previously noted, data and public opinion surveys both show that this will not be as simple as eliminating the one-child policy;

a combination of economic development and changing societal norms have created a culture that has largely accepted only child families. Looking forward, it will be interesting to see the maternal health effects of any future government campaigns to reverse the declining fertility rates that resulted from the one-child policy.

## Notes

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- <sup>26</sup> Scharping, 31.
- <sup>27</sup> Banister, *China’s Changing Population*, 85.
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- <sup>29</sup> Scharping, 49.
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