McGill University

The Effects of China's One-Child Policy on Educational Attainment, Evidences from CHNS Dataset Updated in 2015

Mingjun (Anita) Hu

260826768

Advisor: Prof. Franque Grimard

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I. Introduction

China implemented its official one-child policy in 1979. The effect of the one-child policy on selected family outcomes are ambiguous to estimate, since a series of birth control campaigns in the early 1970s had effectively dropped fertility rates. In addition, China was experiencing extremely high economic development, which can also contribute to the decline of fertilities. The challenge of the estimation comes from the endogeneity problem (Besley and Case, 2000). For instance, local government might react differently to the one-child policy due to the consideration of local fertility situations or local economic development, which reflects family fertility decisions and preferences.

Ethnic minorities are the groups that usually be regarded as historically disadvantaged groups. Therefore, some policies exclude this group or relax some rules for this group to compensate for its disadvantaged positions. For example, ethnic minorities are allowed to have more than one child under the one-child policy. Ethnic minorities are permitted to get extra credits in some admissions such as college entry examination and high school entry examination. This paper replicates Liu and Pan (2016) and investigates the effect of the one-child policy, which favors ethnic minorities group, on their educational attainment. Moreover, this paper also expects to check Becker and Lewis (1973)'s quantity-quality trade-off theory (Q-Q trade-off): trade-offs between child quantity and quality. While most studies realized the difference in the implementation of the one-child policy between Han-Chinese and ethnic minorities, none except Liu and Pan (2016) directly evaluated the impact of birth control policies on this group.

I use the fines datasets from Ebenstein (2010) for the unsanctioned births as the measure of the stringency of the one-child policy. And the main findings of this paper show

that higher fines contribute to lower fertilities for both urban and rural households. For urban households, one more year-of-income fines would decrease their number of siblings by 0.09 at 1 percent of significance level. When birth year fixed effects are included, one more year-of-income fines would decrease the number of siblings by 0.03. For rural households, one more year-of income fines decrease the number of siblings by 0.14. As for educational outcomes, one more year-of-income fines reduce urban high school enrollment by 3 percent and rural high school enrollment by 1.7 percent at 5 percent of significance level, respectively. However, I do not see any salient statistically significant impact of fines on the probability of high school enrollment for ethnic minorities. It seems that the so-called "affirmative policies" that aim to compensate ethnic minorities do not increase this disadvantaged group's educational outcomes and competitiveness.

Many papers have proved that the reduction in the child quantity would improve the child quality. In other words, if a family decides to raise only one child, they are more likely to and able to invest as much as possible resources in the human capital of the only child. However, most studies focus on Han-Chinese group and ignore the impact of the birth-control policy on ethnic minorities. This paper aims to examine the effects of the one-child policy on educational attainment in China from the perspective of ethnic minorities using the most recent data by 2015 from CHNS. Since China has implemented two-child policy in 2013, I would like to see whether my results would have an apparent change from Liu and Pan (2016).

This paper was constructed as following: I start with an introduction and discussion of the evolution of the one-child policy in China covering the origins of its enactment, several major campaigns, and heterogeneity in enforcement between urban and rural areas.

I compare trends of fertility rates in China and other selected countries. Then I turn to the discussion of some empirical evidence and results. I use the most recent micro-level data from the China Health and Nutrition Survey (CHNS) and replicate the similar methodology as Liu and Pan (2016). Section IV discusses my results for the impact of the one-child policy on educational attainment and educational gap between Han-Chinese and ethnic minorities. Section V concludes.

The Evolution of the One-Child Policy

In 1949, People's Republic of China was founded, and the debate of birth control continued within the leading bodies of the country. The Chinese polity struggled and repeated ending centralization for thousand years. Birth control in China was difficult to implement under the leadership of Mao Zedong, who believes that production is the solution to the big population, and it is good to have big population. The then Vice-Chairman Liu Shaoqi was concerned about the lack of food, medical conditions, education resources due to the growing population. Scharping (2003) remarks 1949 to 1978 as a period of 'Stir and Hush'. In 1953, China conducted her first census and the population reached 600 million. The economist, President of Peking University Ma Yinchu was the first one who came up with the family planning campaign. Then, the first family planning campaign started in 1954 but activities restricted to the propagation of late marriage or the introduction to contraceptives. This campaign had limited effects, confining with major developed cities and provinces. The second birth control campaign started in 1962 did not go smoothly either. The motives of the second campaign were insufficient food, housing, and employment problem because of peasant's migration after the Great Leap Forward. The Premier Zhou Enlai suggested that birth control activities should also be imposed to

rural China. The initial activity was carried out in Shanghai in March 1962, and the introduction of benefits of two-child policy was propagated in Fall 1962 (Tian, 2009; Ebenstein 2010). The campaign and activities continued, lacking in any authorized enforcement or written documents. The road of birth control programs was suffering in the 1960s. Shanghai was the only city that remained propagating and had little interruption from inside Party. The rest of provinces like Jiangsu and Guangdong stopped the propagation in the late 1960s. The third birth planning campaign was driven by the Premier Zhou Enlai in July 1971. This campaign introduced the late-marriage age and added a rule of four-to-fives-years intervals to the first-born child and the second-born child. In 1973, a formal group responsible for all the birth-planning matters was finally set up. The theme and slogan at that times was 'Later (births), Longer (intervals), Fewer (children)'. Compared with the previous two silent campaigns, the third campaign was pushed by the government and was added much more media power like national daily support, achieving success results in natural population growth rates and fertility rates. In the 1970s, not only China, but other Asian countries like India, Indonesia, etc. also showed their respect for population controls using some coercive measures (Wang, Cai, and Gu, 2013). China was in a relatively closed position at that time; thus, it is uncertain that to which extent China perceived population pressures from global concerns (Tian, 2009; Scharping, 2003).

Deng Xiaoping took the leadership after the death of the Great Helmsman and Deng's attitude towards birth control was positive and favorable. The debate over the population growth problem got the solution, ending with Deng's declaration of decreasing population growth down to 0.5 percent (Shi, 1988). Deng raised idea that every effort should be used to lower the population growth, considering no matter political power or

economic methods. In 1978, China conducted "Open Door Policy" intending to expand the production and reform international trade. In the same year, one-child policy had had an original model: birth-control groups were founded in the countryside and the plan had been set for both rural and urban areas. American anthropologists Potter and Potter (1990) visited a county in Guangdong and reported that they saw affordable fines levied on the unsanctioned children in this county in 1979. According to Potter and Potter (1990), the implementation of the one-child policy started in June 1980. State Council's Leading Group for Birth Planning transformed to an independent office and achieved self-management in the whole country in March 1981(ZQN, 1985), which is the first professional propaganda to manage birth planning.

For the traditional and historical reasons, some families in China had the moral obligation to have at least a son especially in the countryside. It is inevitable for a woman to give birth until the family gets a son. In 1984, some voices showed up like relaxing the policy for peasants allowing for the manpower and life pressure (Peng, 1997). Document No. 7/1984 revised some provisions for ethnic minorities and rural families who meet the requirements, which declared that 'Open a small hole to close a big gap'. In late 1985, the State Birth-Planning Commission released the requirements for the flexible one-child policy, which detailed 14 cases under which can have a second birth. The most significant exception was that rural families whose first birth was a girl could have the opportunity to have a second baby. Local cadres deemed that the central government was implying the trend of the relaxation of the one-child policy (Scharping, 2003).

The rapid economic development in China in the 1980s after the policy of reforming and opening sucked in migrant workers and they were outside of the strict one-

child policy. The Birth-Planning Commissions realized that then policy would not help with the 1.2 billion population target for 2000 and more stringent rules should be set to avoid future issues like resources, etc. The concern came from Peng Peiyun, the then Minister of the National Family Planning Commission, that if the majority of the grass-root level did not accept the policy, the policy can be realized by no means (ZJSN, 1989). Eight thousand new cadres were assigned to help with the 1.2 billion population target at the turn of the century and the State Council decided to assign more budget to needy households who suffered from birth planning in 1989. Nevertheless, the population in twenty-five provinces had been over the seventh five-year plan from 1986-1990 in late 1988 (ZJSN, 1990).

In the 1990s, regulations and laws became sound and stable, and the one-child policy with regional implementation gradually stepped into right tracks. Government crack downed on a series of corruptions and misfeasance like misuse of medical operations, fake statistics, etc. In the early 1990s. At the same time, the Party passed the law that protected the women's and children's rights. Two major improvements were made under the joint assistance from Birth-Planning Commissions, the Ministries of Agriculture, and other national institutions: the expanding of insurance covering for one-child families and further revisions of the policies that tightened the national minorities (ZJSN, 1993). The perfections of the regulation not only put pressures on the cadres, but also the urban state-owned organizations or enterprises with the responsibility to regulate their own employees, who betrayed the policy would lose their jobs, be fined and lose some social welfares. It was certain that these new implementations did pay off since 1990. Both efforts from the Party and the reformed age structure of population contributed to the ever lowest national

fertility rates on record since then in 1991. Although the target of 1.2 billion population was definitely breached, ended by 1.294 billion, it was controlled in the new revised limit of 1.3 billion.

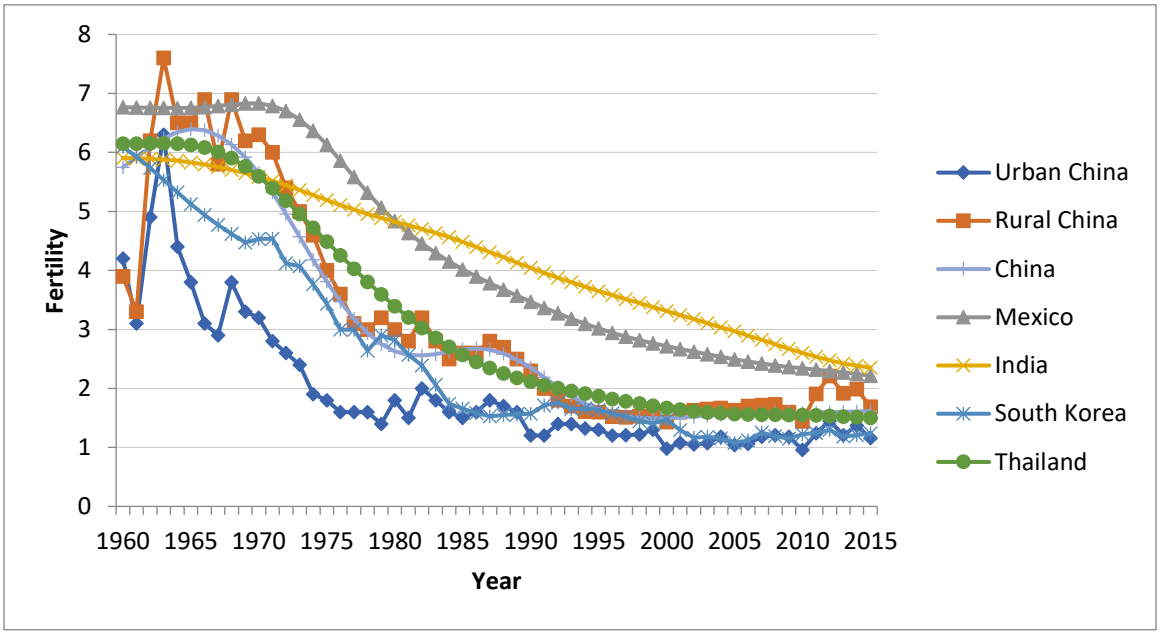
In 2000, China started to conduct the new policy that if both parents were the only child, they were allowed to have a second child, but the time varies across the country by provinces since the variation in the economic development level and socioeconomic conditions. In March 2013, a new National Health and Population Planning Commission was established, merging by the National Population and Birth Planning Commission and the Ministry of Health (Whyte, Feng and Cai, 2015). In the same year of November, the policy was revised to that if one of the parents was the only child, the couple were allowed to have a second child. The party held the Fifth Plenary Session of the 18th Communist Party of China (CPC) Central Committee in October 2015 and stressed at the maintaining of the basic national policy of family planning as well as actively reacting to the aging of the population. Two-child policy was implemented since then, allowing that each couple could have two children (Communiqué of the Fifth Plenary Session of the 18th CPC Central Committee, 2015).

Trends in Total Fertility Rates in China and Selected Countries: 1960-2015

In addition to China, some countries also experienced declines in fertility rates in the past few decades. This part exhibits a comparison of trends in total fertility rates in China and some selected countries to see whether the decline in fertilities reflects a global trend, or they share similar patterns in countries implementing similar birth control programs. All of the selected countries are representative either have similar birth control programs in the same period or have similar economic growth pattern in recent decades.

The comparison helps to explain reasons for the sharp decline in fertilities in China, exploring causes of the decline other than the one-child policy. According to Figure 1, the total fertility rates in China, Mexico, India, South Korea and Thailand all experienced a decline in the last half century and ended with approximately 2 children per woman in 2015, although they started from different points. Figure 1 also exhibits separate trends for China in urban and rural areas.

Figure 1
Total Fertility Rate in China and Selected Countries (1960-2015)



Source: The total fertility rate for these five countries are retrieved from World Bank. Rural China and Urban China's fertility rate from 1960-2010 are obtained from Zhang (2017); and China's rural and urban fertility rate from 2011-2015 are adopted from China fertility survey 2017.

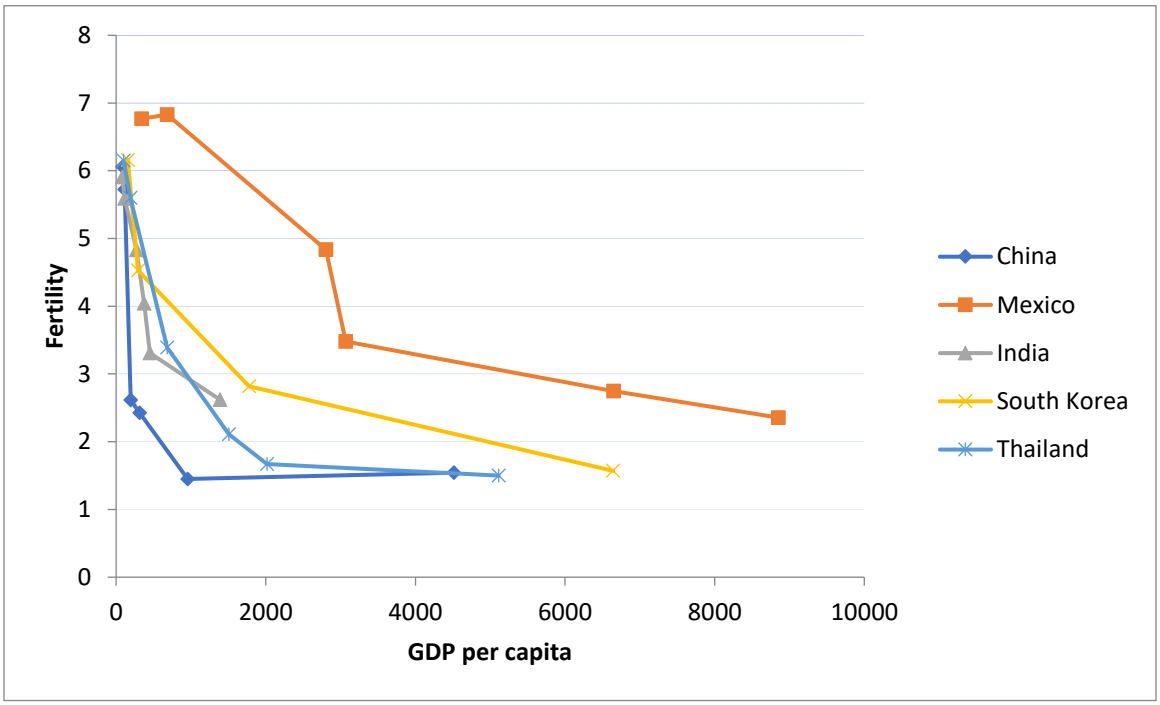
Figure 1 suggests that fertility rates in other developing countries like Mexico or other Asian countries such as India, Thailand and South Korea declined after 1970, even without related family planning campaigns. For example, Mexico had almost 7 per woman of the total fertility rate in 1960 but had a sharp decline around 1975. It is worth noting that although Mexico did not conduct strong family planning programs, its fertility rate still reached a relatively low level by 2015 as plotted in the figure. The total fertility rates in

South Korean and Thailand had similar patterns with those in urban China. These two countries experienced great economic development and had population control campaigns as well after 1970. It seems that economic development might be linked to the decline of the fertility rate. The economic development in India was not as rapid as that in South Korea and Thailand, and its population-control policy was not as strict as that in China. The total fertility rate in India was declining smoothly, although it did not exhibit a sharp decrease. Zhang (2017) remarked that since China's economic development grew so fast after 1978, that fertility rate in China would have had a large downward trend even without the family planning program.

The fertility rates of China in rural and urban areas started almost at same position, however, the initiated family planning campaign did explain the dispersion of the two lines, which reveals a stricter regulation in urban areas. Figure 1 suggests an obvious downward trend of China's total fertility rate in 1960 due to the Great Famine. However, the total fertility rate suddenly rebounded and remained at a high level of an average of 6 per woman for almost 10 years. In 1979, the fertility rate in urban China had dropped to 1.4 per woman and the fertility rate in rural China had dropped to 3.2 per women, representing the success of the one-child policy. After the implementation of the one-child policy, the fertility rate maintained at a relatively low level. The fertility rate in China had a slight rise after 2010, may partly resulting from the "two-child policy for the-only-child parents" and final two-child policy in 2015.

Figure 2

Total Fertility Rate and GDP per Capita for China and Selected Countries (1960-2010)



Source: The fertility rates are adopted from World Bank (2016) and the GDP per capita is US dollars in 2014 value.

Notes: The figure represents five countries' total fertility rate (y-axis) against GDP per capita (x-axis) from 1960-2010 (left to right) plotted for every 10 years. The first plot of China uses 1962 data rather than 1960 to avoid remarkable effect from famine according to Zhang (2017). Per Zhang (2017), South Korea's GDP per capita has exceeded $10,000, revealing a developed-country level since 2000. Since the comparison are mainly in the developing-country level, the author dropped two plots (2000 and 2010).

Since economic development might cause the decline of the fertility rate. Figure 2 plotted five countries' total fertility rate (y-axis) against GDP per capita (x-axis) from 1960-2010 (left to right) for every 10 years. Clearly, there exists a negative correlation between GDP per capita and the total fertility rate in these developing countries. Except Mexico, the total fertility rates in the rest four countries had dropped sharply when their GDP per capita reached $2,000. The similar remarks from Mauldin (1982) concluded that the population-control policy significantly reduced the fertility rates in China, India, South Korea and Thailand from 1960-1980, in which period their economic level had not reached

a relatively high level. In the contrast, the fertility rate in Mexico did not decline as rapid as that in those four countries due to a weaker population-control program.

It is worth noting that the pace of the decline in China's total fertility rate was slower starting from the third plot (after 1980). A significant drop was from 5.725 per woman in 1970 to 2.613 per woman in 1980, and the total fertility rate in 2000 reached 1.45 owing to the one-child policy. Noticing that China's GDP per capita remained stagnant in the 1970s, economic development could not explain the decline of the fertility rate at that period since economic development does reduce fertilities as proved above. Rather, the one-child policy was the main reason to the control of the fertility rate to the vast of the literatures. The one-child policy has proved to successfully control China's population. However, aging population becomes another inevitable problem China is facing, and the two-child policy comes into effect.

II. Background literature

Researchers used different approaches to identify the effect of the one-child policy on the fertility rates, educational attainment, and other family outcomes like divorce rate, labor supply, migration and so on. I will discuss several empirical approaches to examining the effects of the one-child policy on fertilities, child education and other family outcomes.

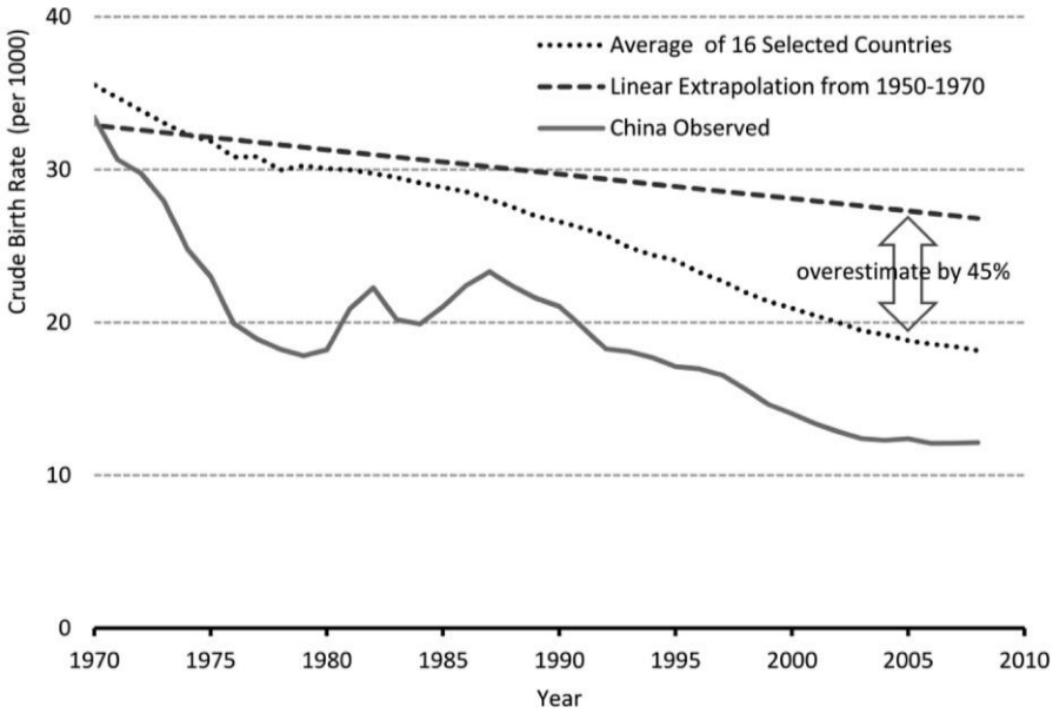
Whyte et al. (2015) attributed the decline of the fertility rate in China after 1970 to economic development to a large extent, rather than the enforcement of the family planning programs. They examined four myths about China's family planning program and concluded four revised versions by comparing fertility patterns in China before and after 1979 birth-control policy. The Great Helmsman of China, Mao Zedong, proclaimed

that "It is a very good thing that China has a big population."[1], which is one of his most famous statement. However, Mao did not stop the imposition of family planning campaigns, and campaigns lasted till the implementation of the one-child policy. Most scholars remarked the post-1970 campaigns as voluntary campaigns, while Whyte et al. (2015) suggested that the operations and the approaches the government used were coercive and heavy, which should not be archived as voluntary campaigns. According to the fertility rate trends, Whyte et al. (2015) noticed that fertility rates did not decline a lot during the post-Mao era (after 1980), but they did realize a sharp decline in the 1970s. Although the one-child policy was mandatory and enforced with larger power, it did not contribute to the further sustain decline in fertility. The most famous myth was that 400 million extra births were prevented by the one-child policy. The estimated overpopulation was plotted in the Figure 3. Linear extrapolation line was extrapolated given the absence of the one-child policy and the actual birth rate was plotted as the solid line. The distance between the two lines led to the result of 338 million births prevented from 1970 to 1998. However, in the following decades after this study, myth expanded as 400 million births prevented from 1970 to 1980 to underline the success of the one-child policy. Authors plotted the average level of 16 selected countries and concluded that the trajectory of China's line should be steeper than that of the average of the 16 countries due to the rapid economic development

[1] The full paragraph of the claim is: It is a very good thing that China has a big population. Even if China's population multiplies many times, she is fully capable of finding a solution; the solution is production. The absurd argument of Western bourgeois economists like Malthus that increases in food cannot keep pace with increases in population was not only thoroughly refuted in theory by Marxists long ago, but has also been completely exploded by the realities in the Soviet Union and the Liberated Areas of China after their revolutions. ("The Bankruptcy of the Idealist Conception of History", 1961, in Selected Works of Mao Tse-tung, Vol. IV. Peking: Foreign Language Press, p. 453.)

in China. Thus, it was hard to say how much births prevented was explained by the one-child policy.

Figure 3
Calculation behind "400 Million Births Prevented"



Note: Observed crude birth rates for China are taken from China National Bureau of Statistics, *Zhongguo tongji nianjian* (China Statistics Yearbook [2012]) (Beijing: China Statistical Press, 2013). Linear extrapolation from 1950 to 1970 is from Yang Kuifu, Chen Shengli and Wei Jinsheng (eds), *Zhongguo jihua shengyu xiaoyi yu touru* (The Costs and Benefits of China's Birth Planning) (Beijing: People's Press, 2000). The average for selected "comparable" countries is calculated using data from the World Bank's World Development Indicator database.
Source: Whyte et al. (2015) retrieved from https://doi-org.proxy3.library.mcgill.ca/10.1086/681664

Liu (2014) used an instrumental quantile regression to examine the relationship between child quantity and quality in the households, which supported the Q-Q trade-off theory (Becker and Lewis, 1973). This approach requires an exogenous variable that is uncorrelated with parents' preference for child quality. Liu (2014) chose the fine imposed for unsanctioned children as the measure of the stringency of the one-child policy as well

as a valid instrument. McElroy and Yang (2000) raised concerns about the exogeneity of the instrument since the local government set their fines accordingly depending on local fertility situation. Liu (2014) took the responses from the question that whether the couple want to have another child at times. Given the child quantity the couple already had, the couple who said yes to the question had a stronger preference to child quantity. In other words, if the instrument is correlated with child quantity, there should be more couples or mothers who are willing to have more children in communities with heavier fines. However, the share of mothers who said yes to this question was 7.4 percent in communities with lower fines verses 6.2 percent in communities with heavier fines, revealing an insignificant result. Liu (2014) proved that the fine values was orthogonal to child quantity at community level. Another concern for the validity of the instrument is that abortions due to gender selective might violate the assumption that the exogeneity of the possibility to have two children. Liu (2014)'s calculation implied that even though couples might control the sex of their children by some medical operations, their possibility to have two children would not be change no matter in communities with relaxed policy or not. Height were used as the measure of child quality, supplementary with three other educational outcomes. His study suggested that child height should be negatively correlated with child quantity. Interestingly, the Q-Q trade-off theory became weaker when child quality was measured by educational outcomes. This paper confirms the Q-Q trade-off theory and reveals that the one-child policy improve child quality in terms of child height.

Another approach of identifying the impact of the one-child policy is to compare the fertility rate in Han (major nationality in China) women verses that in ethnic-minority women before and after the implementation of one-child policy based on the differences-

in-differences approach. The main assumption of this approach in Li, Zhang, Zhu (2015) is that Han women would have experienced same scenarios and react the same to the changes between 1979 to 1990, holding the same possibility to give another birth in the absence of the one-child policy. The reality is that Han women were regulated to have only one child, while ethnic-minority women were allowed to follow a relatively relaxed policy with two children. In this case, Han women took the role of the treatment group and ethnic-minority women acted as the control group experiencing little impact from the family planning program. The identification approach is to examine the coefficient of the interaction of age and the Han dummy to see how much changes in the fertility rate can be explained by the one-child policy. DD was given by:

$$\mathrm{DD} = [\mathrm{E}(Y_{1i}|H) - \mathrm{E}(Y_{0i}|H)] - [\mathrm{E}(Y_{1i}|M) - \mathrm{E}(Y_{0i}|M)] \quad (1)$$

where Y_1 and Y_0 refer to the second birth dummy before and after the treatment. And H represents Han women while M represents ethnic-minority women. They concluded that cohorts after the treatment (one-child policy) had 11 percent lower probability to have a second birth. According to their robustness test, this result might not be caused by other policies or economic changes to a large extent, implying a success of the one-child policy.

Li and Zhang (2017) used differences-in-differences framework to test the impact of the differential stringency of the one-child policy in different regions on child quality. They introduced excess fertility rate (EFR) at county level to measure the degree of local relaxation of the one-child policy due to the variation in local economic development, regulations, etc. They then proxied the one-child policy's enforcement by controlling for differentials in ex-ante birth behaviors and socioeconomic characteristics in order to exploit how local government react to the local fertility conditions. The main assumption of this

approach is strong, requiring that household in the strict and non-strict prefectures would share the same family characteristics without the one-child policy. In addition, this assumption underlined that any implicit regional shocks were orthogonal to the intensity of the one-child policy enforcement. Nevertheless, this powerful assumption is weaker for non-Han women. Compared with the aggregated effects of the one-child policy, this approach estimates the differential effects of the intensity of the one-child policy in each cross-section prefectures. Their regression examined the effects of the Q-Q trade-off theory, where family size measured quantity and education level measured child quality. Their results revealed a salient trade-off between quantity (family size) and child quality (education level). However, although they confirm the trade-off between child quantity and child quality, their quantitative results suggest that the one-child policy does not have a large contribution to the investment in human capitals. In this paper, Li and Zhang (2017) used junior secondary school attendance as the measure of child quality. I might use high school enrollment as the measure instead since the nine-year compulsory education system in China.

III. Data and Methodology

I retrieved data from the China Health and Nutrition Survey (CHNS)[2], an international survey collaboratively designed by the Carolina Population Center, at the University of North Carolina at Chapel Hill and the Chinese Academy of Preventive

[2] "This research uses data from China Health and Nutrition Survey (CHNS). We thank the National Institute of Nutrition and Food Safety, China Center for Disease Control and Prevention, Carolina Population Center, the University of North Carolina at Chapel Hill, the NIH (R01-HD30880, DK056350, and R01-HD38700) and the Fogarty International Center, NIH for financial support for the CHNS data collection and analysis files from 1989 to 2006 and both parties plus the China-Japan Friendship Hospital, Ministry of Health for support for CHNS 2009 and future surveys."
Retrieved from https://www.cpc.unc.edu/projects/china

Medicine, to examine the outcomes after the implementation of some national or local polices in China. It is a follow-up survey first started in 1989 randomly covering 3,795 households in Guangxi, Guizhou, Henan, Hubei, Hunan, Liaoning, Jiangsu, and Shandong. Three mega cities joined the survey since 2011. I used data in1989, 1991, 1993, 1997, 2000, 2004, 2006, 2009, 2011, and 2015 which is the most recent year including 7,319 households and 20,914 individuals in 360 communities. The diverse sample collected information of households in a wide-ranging set of socioeconomic aspects like income, employment, education, etc., and other health and demographic conditions. The datasets obtained detailed demographic information on both individual and household level, providing basic personal information such as gender, birth year, type of Hukou (urban/ rural), province, community, ethnicity (Han/minorities), educational attainment, and individuals' parental information as well. What is more, CHNS datasets also obtained the scores that measures the development of the communities such as urbanization index, communication component score, diversity score, economic component score, sanitation score, etc. I construct a panel dataset including education level, fine rates at community level to measure the stringency of one-child policy at community level, and a wide set of controls at individual, household and community level. Although not everyone participated in the follow-up surveys, this did not affect the analysis of the impact of the one-child policy. I can still use the fixed effects approach to estimate the effect of the one-child policy on educational attainment independent of time. Some existing literature has proved that the one-child policy in China has resulted in a success in population control and improved educational outcomes in China, but most studies focus on Han-Chinese since ethnic minorities are regulated by a more relaxed one-child policy. This paper examines the

effects of the one-child policy on ethnic minorities' educational attainment, as well as the educational gap between Han-Chinese and ethnic minorities.

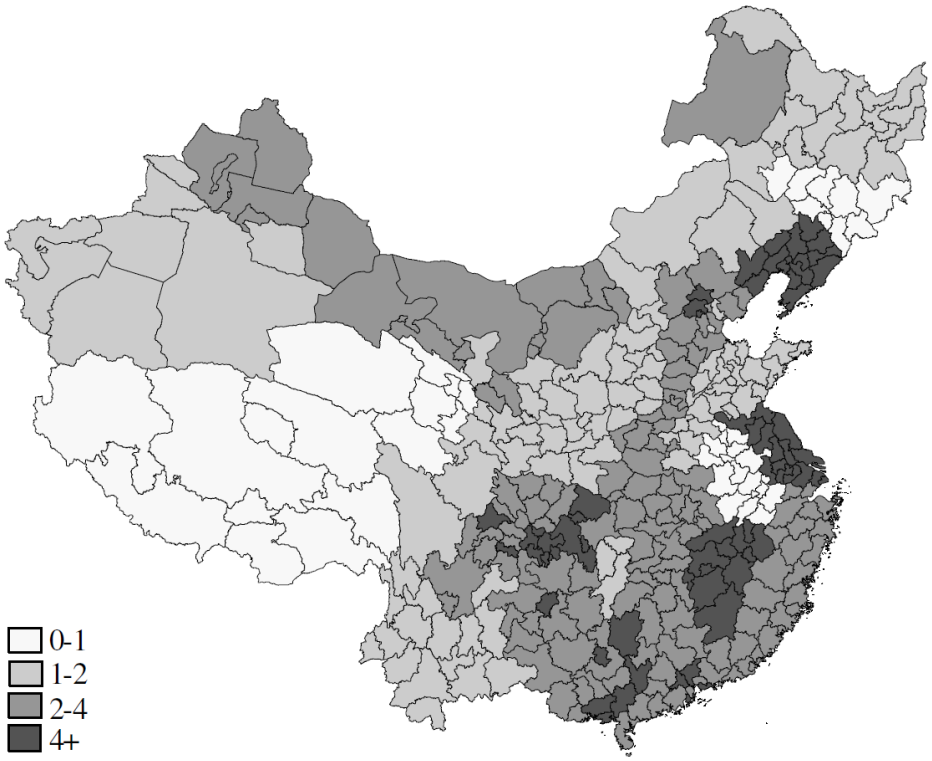
Following Liu and Pan (2016), since the one-child policy was implemented in 1980, I exclude the households whose oldest child was born before 1976. The four-year space is due to the four-year birth interval in the 1970s as introduced in part I. And officially, for the households whose oldest child was born in 1976, they were not allowed to have a second child. These households are constrained by the one-child policy. In addition, individuals under 15 years old are excluded from my sample, for that China has nine-year compulsory education and 15 years old is the official entry age to high schools. The high school enrollment is regarded as the vital measurement of the education attainment. Apart from years of completed schooling, I also replicate Rosenzweig and Wolpin (1980)'s process of calculating the normalized years of schooling for a robustness check, which is another measure of educational attainment. The normalized years of schooling is to divide individual's years of schooling by the average years of schooling for individuals with the same birth year. This handles the issue that many children might still in school during the most recent survey, which will underestimate the education level. The resulting sample covers around 4,000 individuals in each survey year, among which 85 percent are Han majority.

Following Liu (2014), I use the local fine rates imposed on each household for any unsanctioned births to measure the stringency of one-child policy. The local fine is called "social child-raising fee" in China and such information is collected in CHNS community-level survey in 1989, 1991, and 1993. Liu and Pan (2016) took the average of the fines for these three years, but I failed to access the dataset. Therefore, I retrieve provincial fine rates

from Ebenstein (2010) and recode them to a community level as the exogenous measure of punishment. Figure 4 represents a visual dispersion of the fines in mainland China, showing the average fines on a third birth in China's 345 prefectural zones. The fine rates are in years of household income. Prefectural zones with higher level of punishment are covered by darker shades. Intuitively, the level of punishment is higher in areas with higher intension to have unsanctioned births such as Liaoning, Shandong, Jiangxi, and Chongqing. Additionally, fine rates vary due to provincial regulations, urbanizations, ethnic compositions, etc. Since Ebenstein (2010) provided provincial fine rates, I create predicted-community-level fine rates using average provincial fine rates multiplies the population density index for each community retrieved from CHNS datasets. It is worth noting that fines in Ebenstein (2010) are in years of household income. Gu et al. (2007) categorized each of the 31 provinces and autonomous regions of China into one-child, 1.5-child, or two-child zones meeting the maximum number of children each couple can have according to the local policy. Following Ebenstien (2010), I impose the entire fines on a second birth for couples in the one-child zones. For parents in 1.5-child zones, I put one-fourth of the base line fines on their second births. For parents in two-child zones, 10 percent of the base line fines are levied on them to capture a natural and closer impact on these parents. The weights add on the third birth also vary for these three policy zones. I apply a 100 percent premium to a third birth for parents in one-child zones. 50 percent premium is added to a third birth for parents in 1.5-child zones, because this tends to be the first unsanctioned child in many families in such zones. For parents in 2-child zones, 50 percent of the fines are imposed on their third child. For parents with more than three children, I simply multiply their fine rates by the number of children they have. Particularly, an extra 50

percent spike is added to individuals with urban Hukou in all zones, since they have stricter regulations. This predicted-fine-rates assignment is reasonable since fine rates imposed on the second and the third child are different, and fine rates in the different policy-zones (Gu et al., 2007) also varies by provinces resulted from local development level.

Figure 4
Fine Rates in Mainland China



Source: Scharping (2003). Fine rates in years of household income. Prefectural zones with higher leve of punishment are covered by darker shades.

The number of siblings for each individual is constructed using two files: birth history information of ever-married women (SEMW) and birth relationship file. I exclude children who died before five (2.43% of all children ever born), because these children would not take up the household education resources. And the birth relationship file fills the missing information from SEMW, which records brother-sister relations for all the individual in the household.

Table 1 shows the descriptive statistics for the estimation samples on both individual and community level. Since urban individuals were under stricter regulations than rural individuals, I will examine the effects of the one-child policy on their educational attainment separately. In addition to the difference in the relaxation of the policy, urban households and rural households share different resources, which might affect the results of the educational attainment. It is clear that the sample size in these two pools has a relatively large difference, thus separate regressions help to see how one-child policy affect urban and rural households. Since I use the panel dataset rather than the cross-sectional dataset, some variables may not be observed in several years, or some interviewees may not participate in follow-up surveys, the dataset is unbalanced.

Panel 1 presents individual characteristics like education level, income, gender, etc., while Panel 2 presents a set of community characteristics including sanitation score, social service score, Modern market component (number of supermarkets, cafés, restaurants, etc. within the community boundaries), Transportation component score, and quality of health score, all of which help to measure the development level of the community. On average, urban individuals have 0.793 siblings, whereas rural individuals have 1.333 siblings, which reveals that one-child policy are stricter in urban areas. There is a difference of 8.5 percent in high school enrollment between urban and rural children. The average normalized years of schooling for the urban sample is 0.903 which is 22 percent higher than 0.742 for the rural sample. Since the normalized years of schooling is to use individual's years of schooling divided by the average years of schooling for individuals with the same birth year. The observation number of normalized years of schooling is smaller than high school enrollment due to the missing information of individual's years of schooling. Total

individual annual income is substantially higher than per capita household annual income, and the observations of total individual income are lower than per capita household income. The reason might be: (1) individuals under 18 are not able to report their income; (2) individuals under 18 are included in the household number, which underestimated the per capita household income. I tried to control for these two variables separately, and finally I found that when controlling for total individual income, the observation group became extremely small. Therefore, I used per capita household income as the measure of one's annual income. I use the TV ownership to capture the wealth effect following Liu (2014). Ethnic minorities with urban Hukou is 11.6 percent verses 16 percent with rural Hukou. At the community level, the predicted fines for unsanctioned children are equivalent to 147 percent of average annual household income.

Table 1
Descriptive Statistics

Panel 1: Individual characteristics (observations at individual level)						
	Urban sample			Rural sample		
Variable	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
Number of siblings	4,404	0.793	0.851	12,100	1.333	1.030
High school enrollment	4,404	0.404	0.491	12,100	0.319	0.466
Normalized years of schooling	3,380	0.903	0.560	9,063	0.742	0.444
Father's schooling (years)	4,404	10.537	3.574	12,100	9.257	2.976
Mother's schooling (years)	4,404	9.493	3.998	12,100	7.584	3.617
Total individual income inflated to 2015	366	10,594.38	15,627.38	12,62	5,489.128	7,831.793
Per capita household income inflated to 2015	4,404	26,107.7	26,998.78	12,100	17,601.18	18,809.2
Gender (male=1)	4,404	0.522	0.500	12,100	0.545	0.498

Ethnic minority status (Han=0)	4,404	0.119	0.323	12,100	0.143	0.350
Own a TV set in the household (1=yes)	4,404	0.303	0.460	12,100	0.480	0.500

Panel 2: Community level characteristics (observations at community level)

Variable	Obs	Mean	Std. Dev.
Calculated fines (multiples of annual household income)	316	1.465	0.969
Sanitation score (0-10, with 10 being the best)	316	5.709	3.054
Social service score (0-10)	316	2.185	2.746
Moden market component (0-10)	316	4.179	3.036
Transportation component score (0-10)	316	5.200	2.519
Quality of health score (0-10)	316	5.289	2.372

Source: author's calculation.

I use the fine rates for unsanctioned births, a widely used measure as an exogenous variation in previous studies, to measure the stringency of the one-child policy and identify its impact. Households facing a higher fine are less likely to have unsanctioned births, thus imposing higher fines is an effective way to restrict fertility. One concern of this methodology is that other factors other than the stringency of the policy might correlated with the implementation of the policy and affect the local educational attainment level like the variation in the development level among communities. A more developed area is able to invest more in local human capital and meanwhile, it has more reasons to be stricter on the regulation of the one-child policy for that economic development attracts more migrations. I include five county-level variables to control for local development level and reduce the impact from it. I estimate the following equation for urban and rural samples separately:

$$Y_{itcp} = \beta_0 + \beta_1 F_{cp} + \alpha_1 M_{itcp} + \beta_2 \left(F_{cp} * M_{itcp}\right) + X'_{itcp}\delta + Z'_{cp}\theta + \gamma_t + \varphi_p + \epsilon_{itcp} \quad (2)$$

where Y_{itcp} is either the number of siblings including the individual's brothers and sisters (fertility outcomes) or years of schooling the individual taken (educational outcome) variable of individual i born in year t living in community c and province p; F_{cp} is the fine rates measuring the stringency of the one-child policy (in years of household annual income) in community c of province p for unsanctioned births; and M_{itcp} is an ethnic minorities dummy variable that equals one if individual i is an ethnic minority and zero for Han-Chinese. X'_{itcp} is a vector of individual characteristics including individual i's gender, annual income, asset ownership, and parents' education level. Z'_{cp} is a vector of community-level controls including sanitation score, social service score, etc. as in Table 1 Panel 2. I also include birth year fixed effects γ_t, and a set of province dummies φ_p to control for time trend and regional characteristics. This paper aims to estimates the two key coefficients: β_1 and β_2. The coefficient β_1 explains the impact of the stringency of the one-child policy on fertility or educational attainment for Han-Chinese, accordingly. The coefficient of the interaction term, β_2, captures the difference in impacts of the one-child policy on Han-Chinese and ethnic minorities. The sum of β_1 and β_2 estimates the effects of the one-child policy on educational attainment for ethnic minorities. I also cluster the standard error at the community level, allowing for any arbitrary correlation within community. This paper replicates the methodology from Liu and Pan (2016) using the most recent panel dataset updated in 2015 from CHNS, while Liu and Pan (2016) uses a cross-sectional dataset from 2011.

IV. Results and discussion

In this part, I will first discuss the impact of the one-child policy on the fertility rate by using the fine rates for unsanctioned births as the measure of the stringency of the birth-control policy. I will do comparisons between urban sample and rural sample. Then, I will examine the impacts of the relaxation of the birth-control policy on educational attainment as well as the educational gap between Han-Chinese and ethnic minorities.

Effect of the One-Child Policy on Fertility

Urban and rural household living in the same county might react differently towards the fine rates for unsanctioned births. Regarding the impact of the wealth effect, urban households tend to be richer, thus they would have had lower fertility rates without any birth-control policy. In addition, birth control campaigns were consistent and stricter in urban areas since its early implementation. In contrast, rural households experienced a relaxed one-child policy for the obligation to have a son (Scharping, 2003) and the inability to afford the fine (Liu, 2014). Anh (1994) once examined the effects of the one-child policy on second and third births in China and found that rural families were more likely to have unsanctioned births than urban families. Urban-rural fertility gap was even wider after the implementation of the one-child policy: almost all the households in Shanghai with urban Hukou have only one child after the implementation of the one-child policy. McElroy and Yang (2000) attributed the smaller family size to higher fines. Given the differences above, I run separate regressions for urban and rural samples.

Table 2 reported the estimated effects of fine rates on the number of siblings for both urban and rural sample. All of my estimates use the panel dataset with birth year fixed

effects. I run the Hausman specification test to find the optimal model. The final result rejects the null hypothesis and I choose to use fixed-effect model rather than random-effect model. Fine rates were extracted from Ebenstein (2010) in years of income. One more year-of-income fine for urban households would decrease their number of siblings by 0.09 with 1 percent of significance. When birth year fixed effects are included, one more year-of income fine would decrease the number of siblings by 0.03. For rural households, one more year-of income fines decrease the number of siblings by 0.14. It is interesting to see a positive effect of 0.05 siblings increase when including birth year fixed effects. The reason might come from the relatively relaxed policy in rural areas (if the first birth is a girl, rural parents were allowed to have a second birth), and I do not introduce the gender of the first child in the households. But overall, the results confirm the impacts of fines on fertilities.

A sharp decline of the effect of the one-child policy on fertilities in both urban and rural areas for ethnic minorities, confirmed a less restricted birth-control program for ethnic minorities in China. However, the results are not significant. Chang et al. (2005) has documented that although ethnic minorities were regulated by a less restricted policy, local fertility rates were under control in dense minority regions under local governments' efforts. The comparable impact of the one-child policy between urban and rural ethnic minority subsamples induces potential similarities in the effects of the one-child policy on educational outcomes between them. Thus, I do not expect to see a significant Q-Q trade-off effects for urban and rural subsamples on educational outcomes.

It is worth noting that parents' education level and per capita household annual income have strong significant effect on fertilities. Parents with higher education level decreases the number of siblings the individual has in both urban and rural areas. Richer

families tend to have smaller family size. For urban families, a 10 percent increase in annual household income leads to 0.005 decrease in fertility. For rural families, a 10 percent increase in annual household income leads to 0.004 decrease in fertility.

Table 2
Estimated Effects of the One-Child Policy on the Number of Siblings

Dependent variable: number of siblings				
	Urban sample (OLS)	Urban sample (FE)	Rural Sample (OLS)	Rural Sample (FE)
Fine	-0.0915 (0.0273) ***	-0.0313 (0.0175) *	-0.1367 (0.0350) ***	0.0488 (0.0139) ***
Ethnic minorities	(0.2064) (0.1664)	0.2218 (0.0799) ***	-0.0986 (0.1501)	-0.0337 (0.0440)
Fine*minorities	-0.0629 (0.0636)	-0.0710 (0.0476)	0.0313 (0.0487)	-0.0169 (0.0219)
Father's education	-0.0115 (0.0091)	-0.0128 (0.0037) ***	-0.0264 (0.0082) ***	-0.0250 (0.0032) ***
Mother's education	-0.0397 (0.0124) ***	-0.0352 (0.0036) ***	-0.0462 (0.0078) ***	-0.0352 (0.0028) ***
Log per capita HH income	0.0464 (0.0189) **	0.0453 (0.0121) ***	0.0440 (0.0191) **	0.0418 (0.0094) ***
Community controls	Y	Y	Y	Y
Birth year FE	N	Y	N	Y
R-squared	0.3825	0.3774	0.2413	0.2103
Obs	4,404	4,404	12,100	12,100

Note: Fines are in years of income from Ebenstein (2010). Standard errors are robusted at community levels in the parentheses. Community controls including province controls, sanitation score (0-10, with 10 being the best), social service score (0-10), modern market component (0-10), transportation component score (0-10), quality of health score (0-10). Coefficients significance: *10%, **5%, and ***1%.
Source: author's calculation.

Effect of the One-Child Policy on Education

The one-child policy may be expected to affect other family outcomes besides fertilities, for example education. In the theory of Q-Q trade-off, child education is an important and widely used measure of child quality in existing literatures. Liu (2014) examined the effects of the one-child policy on child height, school enrollment, completion

of middle school, and normalized years of schools, and found that the effects on education were mostly statistically insignificant. Li and Zhang (2017) conducted a model using the extent of local violation of the one-child policy as an instrumental variable and did confirm a trade-off between family size and child education, but the magnitude was small. I use high school enrollment and normalized years of schooling as the measure of education to evaluate the effect the one-child policy, and the results are shown in Table 3 and Table 4.

According to Table 3, Row 1, one more year-of-income fine reduces urban high school enrollment by 3 percent and rural high school enrollment by 1.7 percent at 5 percent of significance level, respectively. However, I do not find statistically significant impact of fines on the probability of high school enrollment for ethnic minorities as shown in Row 3. The first cell of Row 3 reveals a 6 percent increase in the likelihood of high school enrollment for one more year-of income fine for rural ethnic minorities at 10 percent level of significance. One possible explanation is that the reduction in fertilities induced by high fines has improved child education through Q-Q trade-off theory, which offsets the negative impacts from the reduction in wealth due to high fines. And the explanation for muted Han-ethnic minorities gap is that the government has made some affirmative policies for ethnic minorities to encourage them to accept more education, such as score-added on the college or high school entrance examinations. As noted in Row 4 and Row 5, father's education level does not play an important role in child education as mother's education level in both urban and rural samples. Although I get somewhat statistically significant results, the R-square is low as no more than 10 percent. In this case, this regression may not be expected to provide precise predictions. I try to add some new variables like the working status or occupation types to increase the R-square, and it did

work to increase R-square to around 20-30 percent. However, to make my regressions consistent and have a better comparison with Table 2 and Table 4, I keep the original results without adding new controls.

Table 3
Estimated Effects of the One-Child Policy on High School Enrollment

Dependent variable: high school enrollment				
	Urban sample (OLS)	Urban sample (FE)	Rural Sample (OLS)	Rural Sample (FE)
Fine	-0.0129 (0.0168)	-0.0301 (0.0124) **	0.0698 (0.0097) ***	-0.0171 (0.0068) **
Ethnic minorities	-0.1114 (0.0772)	-0.0732 (0.0542)	0.01336 (0.0336)	-0.0002 (0.0217)
Fine*minorities	0.0595 (0.0336) *	0.0460 (0.0313)	-0.0081 (0.0164)	0.0015 (0.0108)
Father's education	-0.0006 (0.0033)	-0.0014 (0.0026)	0.0048 (0.0022) **	0.0034 (0.0016) **
Mother's education	0.0066 (0.0029) **	0.0069 (0.0025) ***	0.0114 (0.0017) ***	0.0058 (0.0014) ***
Log per capita HH income	0.0007 (0.0101)	0.0013 (0.0085)	-0.0181 (0.0071) **	-0.0170 (0.0046) ***
Community controls	Y	Y	Y	Y
Birth year FE	N	Y	N	Y
R-squared	0.0602	0.0586	0.0684	0.0350
Obs	4,435	4,435	12,172	12,172

Note: Fines are in years of income from Ebenstein (2010). Standard errors are robusted at community levels in the parentheses. Community controls including province controls, sanitation score (0-10, with 10 being the best), social service score (0-10), modern market component (0-10), transportation component score (0-10), quality of health score (0-10). Coefficients significance: *10%, **5%, and ***1%.
Source: author's calculation.

I also exhibit the impact of the one-child policy in Table 4 using another measure of education, normalized years of schooling (individual's years of schooling divided by the average years of schooling for individuals with the same birth year),to eliminate the impact from the possibilities that some students might still in the last year of their studies. The impact of the fines is even salient comparing with Table 3. Higher fines lead to lower

educational attainment. I do not find significant Han-ethnic minorities educational gap resulting from the one-child policy induced by fines, which is similar with that of Table 3. The only significant result at 10 percent level of significance in Row 3, Table 4 indicates that ethnic minorities are benefit from the implementation of the one-child policy, since they were facing a weaker policy.

The overall education level in China has been rising. Nonetheless, I found little evidence from the existing literatures that child education has been improved directly through the implementation of the one-child policy. My results imply a weak Q-Q trade-off between number of siblings and educational levels, which is consistent with Liu (2014) using same dataset. Unfortunately, I do not get many significant results to confirm the Han-ethnic minorities education gap as Liu and Pan (2016). They also used normalized years of schooling as the dependent variable; however, they concluded that higher fines reduced ethnic minorities' educational level in the urban areas, which might result from the spillover effect from the increasing educational level of Han-Chinese. One possible explanation is that I was not able to touch the same fine rates as they did, instead using the predicted fine rates. The spillover effects from Han-Chinese to ethnic minorities are not all statistically significant, but it can potentially be explained by the rising competition in education resources. Liu and Pan (2016) further estimated the spillover effects due to the regional difference in educational competition. They further split their samples by the per capita provincial public educational expenditures to reflect the extent of the competition level. A province with high educational expenditures per capita is deemed to have lower competition in educational resources. I did not replicate this process since CHNS datasets do not have the information at community level. Their results suggested that the one-child

policy might do harm to ethnic minorities' educational attainment due to the increased level of competition in the school admission process.

Table 4
Estimated Effects of the One-Child Policy on Normalized years of Schooling

Dependent variable: normalized years of schooling				
	Urban sample (OLS)	Urban sample (FE)	Rural Sample (OLS)	Rural Sample (FE)
Fine	-0.2418 (0.0242) ***	-0.0249 (0.0137) *	-0.1594 (0.0106) ***	0.0188 (0.0074) **
Ethnic minorities	-0.0632 (0.0600)	-0.0624 (0.0619)	0.0171 (0.0365)	0.0133 (0.0220)
Fine*minorities	0.0458 (0.0373)	0.0645 (0.0377) *	0.0270 (0.0165)	0.0141 (0.0126)
Father's education	-0.0014 (0.0039)	-0.0042 (0.0026)	-0.0008 (0.0024)	0.0012 (0.0015)
Mother's education	-0.0120 (0.0038) ***	0.0005 (0.0024)	-0.0068 (0.0023) ***	0.0031 (0.0013) **
Log per capita HH income	0.0576 (0.0114) ***	0.0603 (0.0083)	0.0882 (0.0071) ***	0.0893 (0.0044) ***
Community controls	Y	Y	Y	Y
Birth year FE	N	Y	N	Y
R-squared	0.3016	0.1977	0.2065	0.1154
Obs	3,401	3,401	9,105	9,105

Note: Fines are in years of income from Ebenstein (2010). Standard errors are robusted at community levels in the parentheses. Community controls including province controls, sanitation score (0-10, with 10 being the best), social service score (0-10), modern market component (0-10), transportation component score (0-10), quality of health score (0-10). Coefficients significance: *10%, **5%, and ***1%.
Source: author's calculation.

V. Conclusion and Extension

This paper estimates the effect of the one-child policy in China on the educational outcomes using the most recent dataset from CHNS. I also examine the educational gap between Han-Chinese and ethnic minorities induced by the one-child policy. I use the fines dataset from Ebenstein (2010) for the unsanctioned births as the measure of the stringency of the one-child policy and find that higher fines lead to lower fertilities and lower

educational attainment for both urban and rural households. Although the existing literatures have generally found a statistically significant effect of the one-child policy on the reduction in fertilities, most of the studies proved the impact to be small, which is consistent with my results. China's fertility rate did not decline after 1979 as the speed of that in the 1970s, which was similar with the fertility patterns in other East Asian countries (Zhang, 2017). The decline of fertilities should not be fully attributed to the one-child policy, but the high economic growth in China after 1979. Feng et al. (2013) studied the counterfactual scenario in China without the one-child policy using a Bayesian model, and published that "fertility in China would have continued to decline if the country's rapid fertility decline in the 1970s offers any hint about the country's future fertility trajectory."

In addition to the effect on fertilities, I show that the one-child policy may benefit urban ethnic minorities' educational attainment at 10 percent level of significance. Some affirmative policies may be accounted for the increased high school enrollment and normalized years of schooling for urban ethnic minorities. Another point might be that: I use years of schooling as the measure of educational attainment rather than degree. Affirmative policies help ethnic minorities to get into the high school or college easier, but they can not help with the degree completion. For rural ethnic minorities, I do not prove the significant impact of the fines on their educational outcomes. This result is consistent with Liu and Pan (2016) and the existing studies: a modest effect of the variation in fertility induced by birth control policies on child education (Li and Zhang, 2017; Liu, 2014; Zhang, 2017). The results suggest that the existing policies do not have significant impact on closing the Han-ethnic minorities educational gap, thus further alternatives should be raised

to improve the educational resources in dense ethnic minorities areas rather than directly lowering the admission criteria.

China has been experiencing a relative low fertility rate for around 30 years, and the challenge of a decline and aging population problem are at the corner. China seems to face a negative population growth in the near future. In October 2015, the two-child policy has officially become effective, but the replacement of the two-child policy seems not to contain the decline of the population. Wang et al. (2017) predicted that China would peak about 1.46 billion of population around 2030. Their simulation also showed that the two-child policy did not tackle the aging population in China for the next thirty years, and the effect of the two-child policy made small difference from the one-child policy. Their analysis and discussion implicate that although urban and coastal areas are regulated by stricter one-child policy, the aging population problem is more severe in rural and inland areas due to internal migration. Therefore, given their analysis is accurate and plausible, it might be the time for the government to consider speeding up the process of removal the Hukou status system. Given that the implementation of the new policy is not expected to solve the decline of population and aging population (Wang et al., 2017) and the child education is not getting improved through the one-child policy, China has to find altered approaches to adapting to the predicted population problem. For instance, it is the time for China to speed up the process of officially postponing the retirement age. Meanwhile, the pension system must be further improved to adapt to the aging population and the reform of the retirement system.

I have concentrated on the effects of the one-child policy in China on fertilities and educational outcomes. It would be worthwhile to explore some unexplored areas in the

future studies. For example, how does the implementation of the new two-child policy affect housing prices or living expenditures? Since internal migration and aging population are the two severe situations China is facing, the cost of living might affect family fertility decisions and ultimately family outcomes. Or, it is interesting to see how much educational migration and working migration are explained by the one-child policy. Analysing the quantitative impact of the one-child policy on internal migration helps to adjust current educational or industrial policies accordingly.

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