The Effect of Family Size on Child Quality: Employing China's One Child Policy as a Natural Experiment

LI, Bingjing

A Thesis Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Philosophy
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Abstract

The existing quantity and quality tradeoff literature has not yet arrived at a consensus on the effect of family size on child quality, which is partly due to the identification challenge. In this paper we provide new evidence on the causal effect of child quantity on child quality by employing the regional variation in the enforcement of China's One Child Policy (OCP) as a natural experiment. We deal with the endogeneity of family size by exploiting the regional variation in the intensity of policy enforcement in China as the exogenous source of variation in child quantity. The empirical analysis utilizes the 1% sample of the 1982 and 1990 Chinese Population Census to investigate the effect of family size on the first-born child's educational attainment. We find that the households in provinces with more intense policy enforcement tend to have a larger decline in fertility between 1982 and 1990. The instrumental variable estimates show evidence that a larger sibship size depresses the first-child's educational attainment, suggesting a quantity and quality tradeoff in China.

摘要

由于内生性导致的识别上的困难，现有文献尚未在家庭规模对孩子质量的影响程度上达成一致观点。本文利用中国的独生子女政策作为自然实验，识别了家庭规模对孩子质量的负面影响。虽然中国的人口生育政策被统称为独生子女政策，在实行力度上各区域却存在差异。本文利用人口生育政策实行力度的区域差异作为工具变量，解决了家庭规模的内生性问题。在经验分析部分，文章对 1982 年及 1990 年全国人口普查百分之一抽样数据进行分析，检验了家庭规模对第一个孩子的教育程度的影响。文章发现，生育政策实行得更严格的地区，生育率于 1982 年到 1990 年期间下跌的幅度更大。运用工具变量分析及固定效应回归，本文得到家庭规模对孩子教育程度存在负面影响一结论， 并为孩子数量质量替代理论提供了一定支持。

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I. Introduction

The association between fertility and human capital investment is of great interest to economists because it sheds light on the economic development and effects of family planning programs. Becker's quantity and quality tradeoff model (1973) provides a theoretical framework supporting the idea that high fertility is detrimental to human capital accumulation. According to the model, the increasing shadow price of child quality relative to that of child quantity leads the parents under credit constraint to substitute the former for the latter. However, the testing of the tradeoff model is complicated by the endogeneity of family size as child quantity and child quality are simultaneously determined by parents. Therefore, a simple negative correlation between family size and child outcome is insufficient to conclude a negative causal effect of quantity on quality. For example, parents who value education more may prefer a smaller family size, resulting in ordinary least-squares (OLS) estimators to be biased downward. Moreover, the fertility decision for higher parities may depend on the quality of the first born, which leads to upward-biased OLS estimators (Rosenzweig and Wolpin, 2000).

To address the endogeneity problem, the existing literature instruments the exogenous variation in family size to identify the causal effect of child quantity on child quality. On the one hand, "natural" natural experiments including the multi-birth strategy (Li, Zhang and Zhu, 2008; Rosenzweig and Zhang, 2009) and sibling sex composition (Lee, 2007; Angrist, Lavy and Schlosser, 2010; Fitzsimons and Malde, 2010) are employed; on the other hand, natural experiments exploring the variation in family planning policies are also utilized (Qian, 2009). Nevertheless, the empirical evidence on the extent or even the existence of the quantity and quality tradeoff is conflicting. For example, Angrist, Lavy, and Schlosser (2010) develop an estimator that combines different instrument sets, that is, multiple births, sibling-sex composition, and boys at higher order birth. They find no evidence that sibship size has a negative effect on children's in Israeli. Using sibling sex composition and twin birth as instruments, Fitzsimons and Malde (2010) also fail to find an adverse effect of family size on a girl's schooling in the Mexican context. Another story is found in the work of Lee (2007) who instruments family size by the first child's gender. In the Korean setting, a greater number of siblings depress per child educational investment.

The discrepancy among the results in various empirical works can be ascribed partially to the difference in settings. However, even in the Chinese context, there is also no consensus on either the magnitude or the direction of the effect of family size on the children's outcomes. Li, Zhang, and Zhu (2006) adopt the multi-birth strategy to address the endogeneity problem and provide evidence for the negative effect of family size on children's outcome by analyzing the 1990 Chinese Census data. Using the Chinese Child Twins Survey, Rosenzweig and Zhang (2009) also find that the occurrence of twin birth significantly decreases the well-being of the children in the family. In contrast, Qian (2009) finds that an additional child increases school enrollment for first-born children by utilizing the regional variations in the relaxation of the One Child Policy (OCP) that allows families with only one girl to have a second birth.[1]

This work attempts to extend the quantity and quality tradeoff literature in the context of China by using the 1% samples of the 1982 and 1990 Chinese Population Census. China provides an interesting context in examining the relationship between fertility and human capital accumulation. As the most populous country in the world, it launched the biggest demographic experiment in 1978, the OCP, in the hope of curbing its rapid population expansion and promoting economic development. The deceleration of population growth has

[1] The paper uses four provinces sample (Liaoning, Jiangsu, Shandong, and Henan) from the 1990 Chinese Census and 1989 China Health and Nutrition Survey, The paper points out that the positive family size effect can be a result of the scale economy that reduces the price of quality. The alternative potential explanations are the non-monotonic effect of family size on children's quality and the inexpensive public school as a substitute for childcare for parents.

accompanied China's economic success for more than three decades, arousing the question on the extent fertility control has indeed contributed to the country's human capital development and remarkable economic performance.

To cope with the endogeneity problem, the present work instruments family size by exogenous variation induced by the spatial variation in policy enforcement intensity. Although China's national population control policy is referred to as the OCP, there exists demographical and regional variation in the force of this policy's implementation. Such variation not only originates from demographic differences but also from local governments' varying commitments toward its enforcement. The identification strategy exploits the fact that for the provinces with the same socioeconomic attributes, the households in the provinces with stronger policy enforcement tend to have a larger decline in fertility over the period of 1982-1990. Following Duflo (2001), we measure the spatial variation in policy enforcement intensity using the differences in first-birth rates (that is, the percentage of first-parity births among total births) across provinces that cannot be explained by the pre-existing fertility preference and socioeconomic characteristics. This strategy allows our analysis to identify exogenous variation in family size.

By examining the first child's educational outcome, our empirical findings suggest that the fertility control policy in China contributes to the improvement of child quality. Using the entrance to junior middle school and school enrollment as educational outcome measures, we identify the negative casual effect of family size on the first child's educational attainment through two-stage least squares (2SLS) using policy enforcement intensity as an instrument for family size. The findings give supporting evidence for the adverse effect of family size on child quality.

The rest of the paper is organized as follows. In Section II, we introduce the background of China's birth control policy in the 1980s and the spatial variation in its enforcement. In Section III, the data and identification strategy are described in detail. We then discuss the empirical results in Section IV and conduct robustness check in Section V. The conclusion is provided in the last section.

II. Background

2.1 The OCP in the 1980s

After two decades of explosive population growth, China launched the OCP, its national population control program, in 1978 to curb its rapid population explosion and facilitate its economic modernization. The policy forbids second births in Han families[2] except under certain extenuating conditions. However, there existed temporal and spatial variations in the enforcement of this policy in the 1980s.

Compared with the leniency in the policy's enforcement during its experimental stage, its implementation became stiffer since the early 1980s when almost all provinces had their own fertility regulation enacted. Only five provinces (Guangdong, Guangxi, Yunnan, Qinghai, and Ningxia[3]) allowed rural Han households to have more than one child. Fertility policy regimes categorized regions broadly into one-child and two-child regions in the early 1980s, but there existed substantial variation in policy enforcement across provinces, even among those with similar statutory fertility regulations. According to Poston and Gu (1987), the indicators for the enforcement of the family planning policy such as birth planning rate (the ratio of births with permission from the authorities to the total births), the percentage of couples holding

[2] The Han accounted for 93% of the total population according to the 1982 Census.
[3] Guangxi allowed rural Han families with only one girl to have a second child. Guangdong, Yunnan, Qinghai, and Ningxia restrict Han households to have no more than two children.

one-child certificates, and the first-birth rate (percentage of first-parity births among total births) varied across the country in the early 1980s (See Table 1 for details). The fine rates reported by Scharping (2003) also display a spatial variation among provinces during the period. These variations can be caused by provincial demographical and socioeconomic characteristics. Nevertheless, the differences in policy enforcement after controlling for these factors can be attributed mainly to local governments' varying levels of commitment, which are considered as exogenous.

The present paper utilizes the data from the 1982 Population Census of China to construct a quantitative indicator for the provincial enforcement of the OCP, the first-birth rate in 1981 that cannot be explained by existing fertility preference and socioeconomic characteristics. This indicator of enforcement contains information regarding the force of policy implementation because provinces with stronger enforcement tended to have a larger portion of first births, *ceteris paribus*. Despite the leniency in fertility control during the late 1980s,[4] our indicator also provides a good proxy for the fertility policy enforcement in the later period, as evidenced by a correlation coefficient of 0.8 between the first-birth rates for 1981 and 1989.[5] Additionally, the correlation coefficient between the first-birth rate of 1981 and the policy fertility rate of 1990, derived by Scharping (2003) using the legislated fertility policy, is estimated to be -0.80, implying that those regions with a higher first-birth rate in 1981 tended to be the ones with a lower policy-planning fertility rate in 1990. As shown in Table 1, the provincial first-birth rate has a large variation, from 24% in Guizhou to 87% in

[4] To solve the problems of public resentment, social unsettlement, and infanticides occurring in girls, the central government issued "Document 7" in 1984. It empowered the local government to enforce the family planning policy according to local circumstances in order to ease the implementation process and to harmonize the relation between cadres and the masses. In the spirit of "opening a small hole and closing up a large one," the new decree permitted parents with "practical difficulties" to apply permission for second birth (Greenhalph, 1986). Such ambiguous terms were clarified by the revisions on fertility regulations among provinces from 1987 to 1990. According to these revised regulations, the rural families in 18 provinces (Hebei, Inner Mongolia, Shanxi, Liaoning, Jilin, Heilongjiang, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Henan, Hunan, Guangxi, Guizhou, Shaanxi, and Gansu) were allowed to have a second child if the first child is a girl, and four provinces (Guangdong, Yunnan, Qinghai, and Ningxia) still allowed rural households to have two children.

[5] The first-birth rate in 1989 is derived from the China Population Statistics Year Book, 1991.

Shanghai. The distribution of first-birth rate is shown in Map I, from which the provinces on the eastern costal area can be seen to have higher first-birth rates.

2.2 Spatial Variation in Policy Enforcement Intensity

The paper employs the first-birth rate as an indicator for the enforcement of the OCP. *Ceteris paribus*, stronger policy enforcement will force households to have smaller family sizes. However, the policy enforcement intensity measured by the first-birth rate can be determined endogenously by inherent provincial fertility preferences and other socioeconomic characteristics. Table 2 presents the results for the fractional Probit regression of the provincial first-birth rate on the pre-existing fertility pattern and a number of socioeconomic covariates including adult educational level and woman's age structure. The provinces with higher total fertility rate in 1973 tended to have a lower first-birth rate in 1981.[6] Adult educational level also plays a role in determining the first-birth rate. Those provinces with a higher percentage of adults with junior middle school education or above tended to have a higher first-birth rate in 1981. Map II shows a different distribution of policy enforcement intensity across the country after the effect of anterior fertility preference and other socioeconomics characteristics are netted out. Therefore, following the strategies adopted by Duflo (2001)[7], the present paper uses the residuals of the regression in Table 2 to measure the intensity of policy enforcement. With the same fertility and education preferences as well as other socioeconomic attributes, the provinces with a higher first-birth rate are considered to face more intense policy enforcement.

III. Data and Identification Strategy

[6] The paper also tests the effect of other provincial socioeconomic characteristics (ethnic composition and income per capita) on determining the first-birth rates, and found that they have little explanatory power after the anterior fertility and educational preferences are controlled for.

[7] The paper investigates the exogenous variation in children's schooling induced by the school construction program in Indonesia in the 1970s, and estimates the economic return to education. It measures the program intensity by the number of schools constructed, which cannot be explained by the number of children in the region.

3.1 Data

The present paper uses the 1% sample of the 1982 and 1990 China Population Census, which not only collect household information on the location, type, and family composition but also individual information including demographic characteristics, occupation, industry, educational level, ethnicity, marital status, and fertility.

The sample consists of first-born children aged between 14 and 16 in the census years. Therefore, children from the 1982 Census were born between 1966 and 1968, and their sibship sizes were unlikely to be affected by the OCP. These cohorts form the reference group in our analysis. The children from the 1990 census were born between 1974 and 1976. Their sibship sizes were exposed to fertility policy enforcement mostly in the early part of the 1980s, which could be captured by the first-birth rate in 1981. The family size effect can be more discernable for these cohorts as older children are more vulnerable to drop out of school when family size increases. Additionally, children aged 16 or below were unlikely to leave the household in our sample because migrant labor was uncommon in China during the 1980s.

To enhance the robustness of the results, the children's outcome is measured by two variables:

a) Entrance to junior middle: an indicator of whether the child is attending or has ever attended junior middle school, which equals 1 if the child has an educational level of secondary middle or above and 0 otherwise.

b) School enrollment: an indicator for the enrollment status which equals 1 if the child is in school and 0 otherwise.

Due to the data limitation, the paper further restricts the sample to children aged 15 to 16 when school enrollment is used to measure educational attainment because school enrollment status is only available for children aged 15 or above in the 1982 Census.

The final sample consists of 109,197 households from the 1990 Census and 63,191 from the 1982 Census. The descriptive statistics of these restricted samples are shown in Table 3. There is no significant distinction between the two samples with regard to average age and the sex ratio of the first-born child, as well as the father's average age; meanwhile, the mothers are slightly younger in the 1982 sample. The average number of children is 2.47 in 1990 compared with 3.49 in 1982. Between 1982 and 1990, the proportion of families having two or more children experienced a drop of 6.57 percentage points, which is not as remarkable as the fall in the proportion of families with three or more children, decreasing by almost half from 83.81 to 41.35. The "entrance to junior middle" is lower in 1990 compared with that in 1982, reflecting a drawback in the secondary education over the period. These findings are consistent with the existing literature (Hannum, 2002; Wu, 2009). The phenomenon can be explained by the contemporary fiscal[8] and economic reforms occurred in China over the period (Qian, 2009; Wu 2009). For example, the Household Responsibility System introduced during the economic reform induced an increase in dropout rate as households were in need of labor input to boost agricultural production (Wu 2009). Therefore, children aged 14 to 16 in our study faced higher physical costs, as well as opportunity costs, in obtaining education. As a result, their educational outcome can be more sensitive to the family size.

Provinces are categorized into "strict" region and "non-strict" according to signs of the residuals of the regression in Table 2. The statistics corresponding to the two regions show that the fertility tends to be higher in the non-strict region in both census years. Moreover, for the children born in the non-strict region, the chance to receive education is lower compared with the children in strict region in both census years.

[8] The fiscal reform devolved education expenditure responsibilities from the central government to local governments, which increased the pecuniary cost for children to obtain secondary education in China during the 1980s.

3.2 Identification Strategy

In our analysis, the year of birth and the policy enforcement intensity for the region of birth jointly determine the exposure of the first child's family size to the OCP. The sample includes individuals born well before the commencement of the OCP (between 1966 to 1968 and from the 1982 Census) which consist the control group, and individuals born just before the commencement of the OCP (individuals born between 1974 to 1976 and from the 1990 Census) which consist the treatment group. In the region with more intense policy enforcement, the decrease in fertility over this period is assumed to be larger than that in the region facing a more lenient policy. Such difference in the change of fertility across regions can be regarded as the exogenous effect of the OCP on family size. If the quantity and quality tradeoff exists, the first child's educational attainment should improve more or decline less in regions with a more intense policy than that in regions facing a less intense policy. The underlying identification assumption is that there are no omitted time-varying provincial-specific determinants of educational attainment that are correlated with the policy enforcement intensity.

Table 4 further illustrates the basic idea behind the identification strategy. The provinces with different policy enforcement intensities are categorized into "strict regions" and "non-strict regions". In the table, we compare the average family size and educational attainment of the first child whose sibship size had little or no exposure to the OCP (individuals from the 1982 Census) to those whose family size were exposed to the fertility control (individuals from the 1990 Census) in both types of regions. The average family size declined over time in both types of regions. However, it was reduced more in regions with more intense policy enforcements. The difference in these differences can be interpreted as the causal effect of the OCP, assuming that in the absence of the family planning campaign, the reduction in family size would not have been significantly different in both strict and non-strict regions. The first child from the 1990 Census born in strict regions had a 0.10 smaller family size, and the difference in difference is significantly different from 0.

For entrance to junior middle school as an educational outcome measure, the first child experienced deterioration in educational attainment to a certain extent in both regions. Nevertheless, the downward trend for educational attainment is less noticeable in the strict region compared with that in the non-strict region. Such difference can be attributed to the more significant decline in family size in the strict region assuming that the first child's average educational attainment for the two regions would have followed parallel paths over time in the absence of the family size effect. The first child from the 1990 Census and born in the strict region was assumed to have 0.5 percent higher chances to obtain some lower secondary education because of the strict enforcement of OCP. For school enrollment as an educational outcome measure, the first child from the 1990 Census and born in the strict region enjoyed a 1.6-percentage-point higher probability to enroll in school. The effect of family size on the first child's educational attainment can be deduced by estimating the change in educational attainment caused by the exogenous change in family size. The Wald estimators for entrance to junior middle and school enrollment are -0.050 and -0.171, respectively, indicating a negative quantity and quality tradeoff for the first child.

IV. Empirical Results

4.1 Effect of Policy Enforcement Intensity on Family Size

The strategy to exploit the variation in policy enforcement intensity to account for the exogenous variation in family size can be extended to a regression framework. If the OCP reduced the family size effectively in those provinces with intense policy enforcement, the family size for the households in the strict region would experience a larger decline on the average compared with the households in the non-strict region over the period.

This result suggests running the following regression:

$$N_{ijk} = \alpha_{1j} + \beta_{1k} + (F_j \times T_i)\gamma_1 + X_i\delta_{1l} + \varepsilon_{ijk} \quad (1)$$

where N_{ijk} is the family size of the individual i born in region j in year k. T_i is a dummy indicating whether the individual belongs to the 1990 Census in the sample. α_{1j} is a province of birth fixed effect, β_{1k} is a year of birth fixed effect, F_j denotes the intensity of policy enforcement in the province of birth, and X_i is the vector of individual control variables (including the gender of the first child, the dummy of the mother's age at first birth, the mother's educational level, and the father's educational level).

Table 5 presents the estimates of regression. We compare the first child from the 1990 Census with the first child from the 1982 Census. The estimates in Column (1) suggest that given the same pre-existing fertility preference and socioeconomic characteristics, the average family size will be 0.023 smaller in the provinces with a one percentage point higher first-birth rate. The effect is substantial given the large variation in policy intensity among the provinces, which ranges from -9.36 to 12.84. It suggests that the first child in the province with the most intense policy enforcement on the average had 0.51 less siblings compared with the first child in the provinces with the least intense policy. Such variation in family size resulting from the spatial variation in policy enforcement is considered to be exogenous in our analysis. Column (4) presents the regression result for the restricted sample of children aged between 15 and 16. Similar to the full sample, the effect of policy enforcement intensity on family size is estimated to be 0.023.

The regression model (1) can be augmented with the introduction of additional interaction terms of policy enforcement intensity and age dummy. Consider the following relationship between the family size (N_{ijk}) of an individual i, born in province j in year k:

$$N_{ijk} = \alpha_{1j} + \beta_{1k} + (F_j \times T_i)\gamma_1 + \pi_1(F_j \times d_{i,1}) + \pi_2(F_j \times d_{i,2}) + X_i\delta_{1l} + \varepsilon_{ijk} \quad (2)$$

where $d_{i,1}$ is a dummy that indicates whether individual i was aged 15 and $d_{i,2}$ is a dummy that indicates whether individual i was aged 16. Taking the 14-year-olds as the base group, π_1 (π_2) measures to what extent the difference family size in the first-stage between the 15-year-olds (16-year-olds) and the 14-year-olds in the same province in the 1982 census varies with the policy intensity F_j at that province. Furthermore, the regression can be extended to allow varying effect of policy enforcement intensity on family size for different cohorts in the 1990 Census, which can be captured by the parameters θ_1 and θ_2.

$$\begin{aligned} N_{ijk} &= \alpha_{1j} + \beta_{1k} + (F_j \times T_i)\gamma_1 + (F_j \times T_i \times d_{i,1})\theta_1 + (F_j \times T_i \times d_{i,1})\theta_2 \\ &+ \pi_1 F_j \times d_{i,1} + \pi_2 F_j \times d_{i,2} + X_i\delta_{1l} + v_{ijk} \quad (3) \end{aligned}$$

Column (2) and (3) presents the regression results of specification (2) and (3) respectively for the full sample. Compared with Column (1), the estimates are commeasurable, implying that the estimated effect of policy enforcement intensity remains robust for different model specifications. Additionally, in Column (3) both θ_1 and θ_2 are statistically insignificant, suggesting that there is no strong age-specific effect of policy enforcement intensity on family size for the children from the 1990 Census. A similar result can be found in the subsample of first-born children aged 15-16.

4.2 Effect of Policy Enforcement Intensity on Educational Attainment

In this subsection, we evaluate the effect of policy enforcement intensity on the first child's educational outcome by estimating the following equation:

$$y_{ijk} = \alpha_{2j} + \beta_{2k} + (F_j \times T_i)\gamma_2 + X_i\delta_{2l} + v_{ijk} \quad (4)$$

where y_{ijk} is the educational outcome of the individual i born in region j in year k (it includes the variables of entrance to junior middle school, and school enrollment in order to measure a different dimension of educational attainment). T_i is a dummy indicating whether the individual belongs to the 1990 Census in the sample. α_{2j} is a province of birth-fixed effect, β_{2k} is a year of birth-fixed effect, F_j denotes the intensity of policy enforcement in the province of birth, and X_i is the vector of individual control variables (including the gender of the first child, the dummy of the mother's age at first birth, the mother's educational level, and the father's educational level).

Again, we compare the educational outcome of the first child from the 1990 Census to that of the first child from the 1982 Census. The results are presented in Table 6 [Columns (1) and (4)]. In Column (1), the interaction coefficient which measures the effect of OCP on the chance to enter junior middle school for the first child is positive, and it is insignificantly different from 0. In addition, as shown in Columns (4), the first child is estimated to enjoy 0.20 percent higher chance to stay in school when the policy enforcement intensity of the province of birth is 1 unit higher.

The paper also incorporates the interaction terms of policy enforcement intensity and age. dummy by running the regression

$$y_{ijk} = \alpha_{2j} + \beta_{2k} + (F_j \times T_i)\gamma_2 + \rho_1 F_j \times d_{i,1} + \rho_2 F_j \times d_{i,2} + X_i \delta_{2l} + v_{ijk} \quad (5)$$

where $d_{i,1}$ is a dummy that indicates whether individual i was aged 15 and $d_{i,2}$ is a dummy that indicates whether individual i was aged 16. The parameters ρ_1 and ρ_2 can capture the effects like school entry age for children from the 1982 census that correlates with the policy enforcement intensity. The regression model can be further generalized to be

$$\begin{aligned} y_{ijk} &= \alpha_{2j} + \beta_{2k} + (F_j \times T_i)\gamma_2 + (F_j \times T_i \times d_{i,1})\lambda_1 + (F_j \times T_i \times d_{i,1})\lambda_2 \\ &+ \rho_1 F_j \times d_{i,1} + \rho_2 F_j \times d_{i,2} + X_i \delta_{1l} + v_{ijk} \end{aligned} \quad (6)$$

The time dimension of exposure to the policy enforcement intensity is measured by λ_1 and λ_2.

Column (2) and (3) of Table 6 displays the regression results of specification (5) and (6) when entrance to junior middle school is adopted to measure educational attainment. The parameter of interest γ_2 is estimated to be 0.0018 and significantly different from 0, implying that the policy enforcement intensity has a positive effect on the children's chance to enter into a junior middle school. In addition, as is shown in Column (3), the estimates of λ_1 and λ_1 are close to 0 and statistically insignificant. Therefore, there is no evidence showing that the effect of policy enforcement on entrance to junior middle school is age specific. For school enrollment as an educational outcome measure, the regression results are shown in Column (5) and (6). It is estimated that the first-born children enjoy 0.21 percent and 0.14 percent higher chance to stay in school when the policy enforcement intensity is 1 unit higher.

4.3 Causal Effect of Family Size on Children's Educational Attainment

We consider the following equation estimating the causal effect of child quantity on child quality:

$$y_{ijk} = \alpha_j + \beta_k + N_{ijk}b + X_{ijk}\pi + \eta_{ijk} \quad (7)$$

where α_j and β_k denote the province of birth and year of birth-fixed effects, respectively. OLS estimates of Equation (9) may be biased as the variable N_{ijk} and η_{ijk} are correlated in the sense that both family size and children's educational outcome are endogenously determined by certain unobservable parental and household characteristics. However, under the identification assumptions that (a) the outcome dynamics of fertility and educational attainment would not have varied systematically from one province to another in the absence of the variation in policy enforcement intensity, and (b) policy enforcement intensity had no effect on the first child's educational attainment other than the channels of decreasing the sibship size, we can utilize the intensity of the policy enforcement as an instrumental variable to estimate the effect of family size on the first child's educational outcome. These instruments have good explanatory power in the first stage as we have shown through the estimates of Equations (1) to (3). Therefore, the present paper estimates the causal effect of family size on the first child's educational outcome using Equation (7) and estimates the exogenous variation in family size N_{ijk} using Equations (1) to (3).

The results are presented in Table 7. Column (1) and (2) displays the OLS estimates for different educational outcome measures. Having one additional sibling reduces the chance to enter junior middle school and stay in school by 6.75, and 5.33 percentage points, respectively. However, the results obtained by OLS should be taken with caution as mentioned, given that the unobserved heterogeneous parental and household characteristics may lead to biased estimates.

In Columns (3) to (6), the 2SLS estimates of Equation (9) are presented, with the first stage regression being Equations (1) to (3), respectively. When entrance to junior middle school is employed as an outcome measure, the 2SLS estimates are more negative than the OLS estimate. The 2SLS estimates show that for the first child, the chance to enter a junior middle school will decrease by 7.67 to 7.74 percent when having one more sibling. The 2SLS estimates are all significantly different from 0. As for school enrollment as an outcome measure, the 2SLS estimates are of larger magnitude than the OLS estimates. A larger family size will depress the first child's educational outcome as well, with the effect estimated to be around 8.94 to 9.15 percent and significantly different from 0. In summary, the 2SLS estimates for three outcome measures provide supporting evidence for the hypothesis that a larger family size depresses the first child's educational attainment.

V. Robustness

5.1 Sex Selection

Table 2 shows that the male fractions for the first parity birth remain stable during the period and do not demonstrate sex selection for boys neither in 1982 or 1990, when taking 1.059 as the natural sex ratio (implying that the male fraction is 51.43). This is expected as the first-born children in the 1990 sample were born between 1973 and 1975 when the nationwide birth plan campaign had not yet commenced, and modern sex selection technologies had not been introduced (Zeng et al. 1993; Li and Zheng 2009; Meng 2009)[9], rendering it less necessary and less accessible to sex selection. Therefore, our sample may be free from pre-natal sex preference for first-born children. As shown in Panel A of Table 8, the fraction of males for the second child for the 1982 Census was insignificantly different from the fraction without sex selection; however, the fraction increased to 51.93 percent for the 1990 sample, significantly different from 51.43 percent, indicating a potential problem of sex selection at the second parity. These findings are consistent with those of Ebenstein (2010) who also detects an imbalanced sex ratio based on a sample of the 1990 Census. As shown above, the family size in the region with intense policy enforcement experienced a larger decline over the period of 1982 and 1990 compared with that in the lenient policy region. Nevertheless, the contemporaneous adoption of sex selection possibly became more prevalent in the provinces with strict enforcement relative to the non-strict ones (Ebenstein, 2010). If having a younger brother has a larger dilution effect than having a younger sister, other than the family size, the policy intensity may affect the children's outcome through the channel of sibling sex, which potentially threatens our identification strategy.

[9] Ultrasound machines were not introduced in large scale until 1982, and they first emerged in more advanced areas of the city. Moreover, the quality of devices at the township level made accessibility to sex detection unlikely in the early 1980s. Therefore, prenatal sex selection facilitated by ultrasound machines was difficult, if not impossible, for the cohorts born before 1982.

The fraction of male by census year and policy enforcement intensity is shown in Panel B of Table 8. Although the fraction of males increased for both regions over the period, the increments are insignificantly different from 0. Moreover, the first child from the 1990 Census born in the non-strict region was only 0.3 percent more likely to have a male sibling, and the difference in difference is insignificantly different from 0. The analysis can be further generalized into the regression framework. Panel C displays the regression results. The estimated effect of policy enforcement intensity on the probability of having a second boy is minimal and insignificantly different from 0. The paper also investigates the effect of policy enforcement on sibling sex composition. The column (2) of Panel C shows that the fraction of younger brothers tends to be larger in the regions with more intense policy enforcement. However, the estimate is statistically insignificantly. Therefore, we exclude the possibility that policy intensity can affect the first child's educational outcome through the channel of sibling sex.

5.2 Region-Specific Changes in Educational Provision

The identification strategy in our analysis is based on the assumption that in the absence of family size effect, the first child's outcome dynamics would have followed a similar path over time. One concern is that our estimates will be contaminated if there were contemporaneous region-specific changes in the educational provision from 1982 and 1990. To explore this possibility, the paper compares the student-teacher ratio in the regular secondary school by regions and cohorts. As shown in Table 9, the provinces in non-strict regions had a larger decrease in the student-teacher ratio relative to those in the strict regions on the average. However, the difference is minimal and insignificantly different from 0. Therefore, when using the number of full-time teachers to proxy the educational provision in different education sectors, we fail to observe region-specific changes in the educational provision which can render our identification assumption invalid.

VI. Conclusion

The present paper investigates the effect of family size on child quality using data from the 1982 and 1990 Census. Realizing that family size can be endogenously determined, we adopt a provincial fixed-effect strategy and employ the provincial policy enforcement intensity as an instrument for family size. The educational outcome of the first child is examined, and the results of 2SLS regression using fixed effect IV analysis suggest that there exists a negative effect of family size on the first child's educational outcome as measured by the variables of entrance to junior middle school and school enrollment.

In summary, our findings support evidently the negative causal effect of family size on children's educational attainment, which are consistent with those of Li, Zhang, and Zhu (2005). They also employ data of the 1990 Census but use the birth of twins to evaluate the exogenous variation in family size. They find negative estimates of -0.03 for school enrollment and -0.04 for the educational level, whereas the estimates in our paper are -0.09 for school enrollment and -0.07 for junior middle school entrance. For school enrollment, the discrepancy in magnitude can be driven by the sample selection. That is, the sample of Li, Zhang, and Zhu (2005) consists of children aged 7 to 17, a large portion of which are still receiving elementary education which is less sensitive to family size. Nevertheless, in our paper, the sample selected consists of older children aged from 14 to 16. The children in this age group should receive secondary education which involves a larger substitution effect because of the higher costs incurred. Therefore, the larger magnitude in our sample is not a surprise.

Although the current work has some limitations[10], our study is among the first to use fertility policy enforcement intensity to instrument the exogenous variation in family size and to identify the causal link between child quantity and child quality in the Chinese Context. While the identification strategies in most existing studies are limited to analysis when the family size increases from two to three, our strategy exploits variation in the distribution of family size in a much broader domain. The current research also sheds light on China's economic development. The study indicates that the birth control policy has a positive effect of enhancing human capital investment by reducing the fertility in China. From the perspective of endogenous economic growth models, the improved quality of the labor force is an impetus for economic growth, and hence in this aspect, China's population control policy is beneficial to its economic development. However, the controversial side effects of the OCP should be considered as well. As shown in the paper, the sex selection for the second child was evidenced from the sample of the 1990 Census. The consequence of the imbalanced sex ratio incurred will manifest itself in the long run, and so more studies are needed to investigate this problem.

Appendix: Sample Selection

Census data are restructured to facilitate analysis in the current work. First, for each household, an individual labeled as "child" is matched to a female head (mother) labeled as "household head" or "spouse of the household head" (households without a female head are dropped from the sample). Moreover, the variables of interests such as children's educational outcome, demographic characteristics, parental characteristics, household characteristics, and

[10] Due to data limitation, we are unable to control for the household registration type in our analysis (household registration information is unavailable in the 1982 Census). The households in urban and rural sectors can have differences in fertility and education preference as well as access to public education resources, which may lead to the different effects of child quantity on quality for the two sectors. Additionally, the study is also limited to the educational outcome of children, which is incomprehensive with respect to children's well being. Therefore, our future work may rely on more comprehensive and traceable household data that provide more information on the household registration status and other aspects of children's well-being.

so on are integrated for each household. Birth order and duplicate births are identified by birth year and birth month.

To serve the purpose of the paper, census data are restricted to a subsample according to the following criteria:

a) The subsample is restricted to households that have at least one child, and the number of children in the household is equal to the number of surviving births of the female head (the number of children in the household can be derived by counting the individuals whose relationship to the household head is "child"), that is, those households with children who have left or are deceased are excluded. This restriction ensures that the first child in the household can be identified and observed validly.

b) Only households with the first child aged between 15 and 17 are included in the analysis. The sample is dropped if information on the first child's educational level and enrollment status is missing.

c) Only Han families which the OCP mainly target are studied in the paper.

d) Households with duplicate births are dropped to identify the first singleton and to control correctly the characteristics of higher-parity children.

e) Samples with mothers who gave birth under age 15 and those with missing father's information are excluded as well from the analysis.

f) The samples from the autonomous regions of Guangxi, Inner Mongolia, Ningxia, Tibet, and Xinjiang where minority groups are mostly located are excluded.

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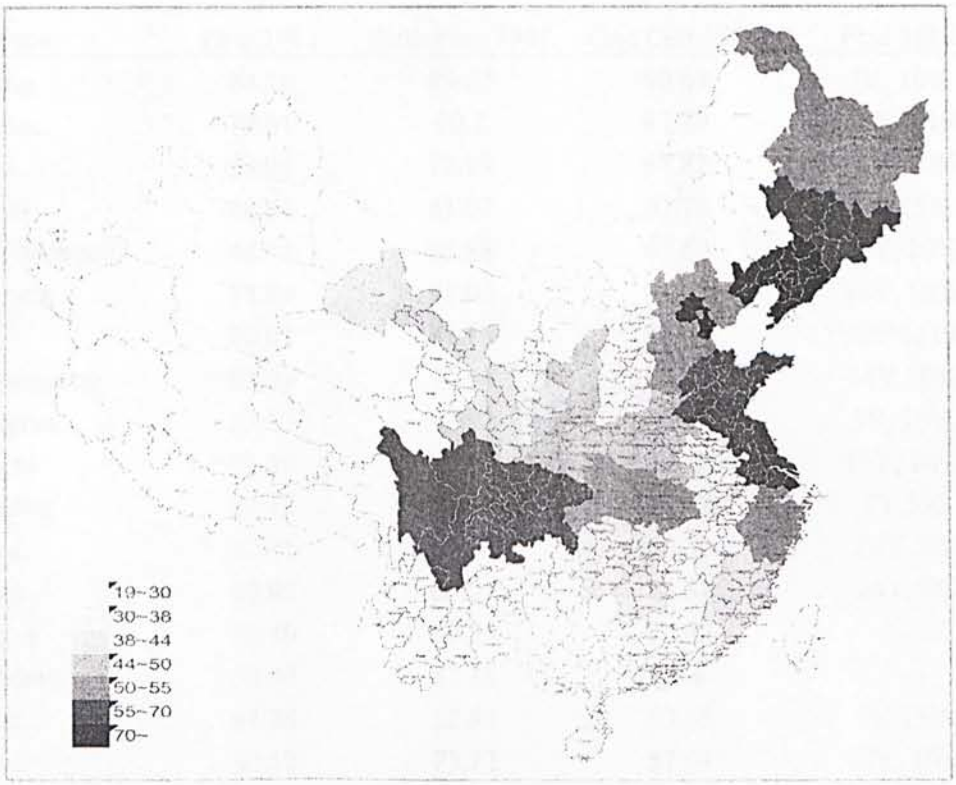
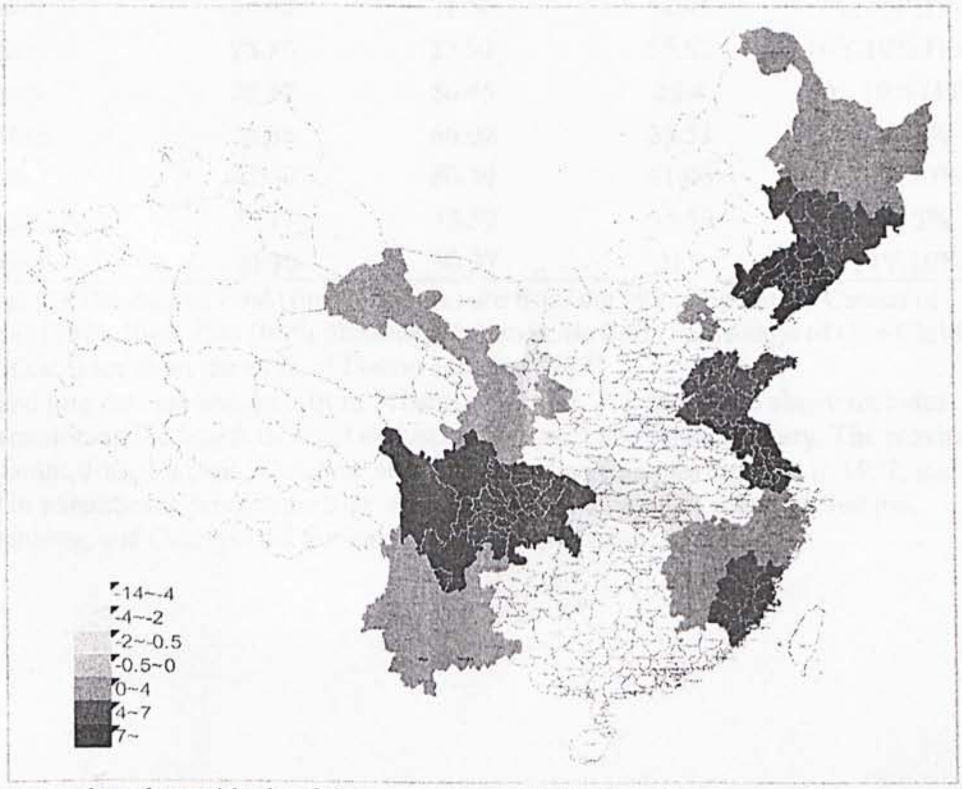
Map I. The Distribution of First Birth Rate



Map II. The Distribution of the Policy Enforcement Intensity



Notes: The map plots the residuals of the regression in Table 2, which are used to measure the fertility policy enforcement.

Table 1. Spatial Variation in Fertility Policy Enforcement

Province	First 1981	Birth Plan 1981	One Cert 1981	Fine 1982
Beijing	84.10	89.02	90.67	7Y, 10%
Tianjin	78.51	90.2	87.89	5Y, 20% (1988)
Hebei	52.24	72.99	67.82	14Y, 10%
Shanxi	47.84	61.07	57.78	7Y, 15%
Inner Mongolia	44.12	63.88	47.59	14Y, 10%
Liaoning	71.64	91.02	91.02	14Y, 10%
Jilin	60.01	81.84	81.84	1Y, 20% (1988)
Heilongjiang	53.89	70.64	85.87	14Y,10%
Shanghai	87.03	92.92	94.8	3Y, 10%
Jiangsu	61.38	78.32	85.5	10Y, 10%
Zhejiang	54.12	70.07	56.77	7Y,5%
Anhui	37.41	63.94	50.58	14Y,5%
Fujian	40.90	65.95	25.31	14Y,5%
Jiangxi	36.19	69.56	23.82	-
Shandong	60.48	82.28	86.6	-
Henan	44.38	62.84	60.85	7Y,15%
Hubei	50.12	73.72	57.91	14Y, 10%
Hunan	43.23	63.54	40.32	5Y, 10%
Guangdong	37.00	68.73	31.6	14Y, 10%
Guangxi	31.21	60.53	19.58	-
Sichuan	56.42	71.56	82.45	7Y, 5% (1984)
Guizhou	23.76	23.91	55.62	14Y,10% (1984)
Yunnan	28.32	56.45	26.4	1Y, 10% (1986)
Shannxi	49.86	66.02	65.53	7Y, 5%
Gansu	43.30	60.39	41.46	10Y,10%
Qinghai	26.77	35.59	35.59	7Y, 5%
Ningxia	30.90	30.37	21.2	14Y,10%

Notes: (1) The data of First (first-birth rate) are from the 1982 Population Census of China (1982); Birth Plan (birth planning rate) and One Cert (Percentage of One-Child Certificate) are from the work of Poston and Gu (1987)

(2) The fine data are obtained from Scharping (2003). The fine listed above includes information on the length of wage deduction and percent of annual salary. The provinces of Tianjin, Jilin, Sichuan, Guizhou, and Shanxi had no fine rate reported in 1982, and the year in parentheses denotes the time when the fine rate was first reported. Jiangxi, Shangdong, and Guangxi did not have fine rate reported in the 1980s.

Table 2. First-birth Rate and Provincial Socio-economic Characteristics

	First-birth rate
Total fertility rate 1973	-0.156***
	(0.034)
% of adults (aged 20–49) with Junior Middle or above	0.015***
	(0.002)
Woman aged 15–24 / woman aged 15–39	-0.039**
	(0.019)

Notes: (1) Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
(2) The total fertility rate in 1973 is from Scharping (2003) . The number of women aged between 15 and 44 is from the China Population Statistics Compilation, 1949–1985 (1988). The % of adults (aged 20–49) with Junior Middle or above is derived from the 1% sample of the China Population Census.

Table 3. Descriptive Statistics of the Restricted Subsample of the 1982 and 1990 Chinese Population Census

	Whole Sample		Strict		Non-strict	
	1982	1990	1982	1990	1982	1990
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Observations of 1st born children	63,191	109,197	33,329	56,316	29,862	52,781
Age	14.98	14.97	14.97	14.96	14.98	14.97
Male %	51.12	51.28	51.26	51.33	50.97	51.24
First Child Education						
Entrance to junior middle %	58.40	56.92	60.23	59.04	56.35	54.66
Enrollment Status %	40.23	64.64	40.43	65.64	40.00	63.57
Number of children in the household	3.49	2.47	3.37	2.29	3.63	2.66
Having two or more children %	97.43	90.86	97.46	88.14	97.41	93.77
Having three or more children %	83.81	41.35	81.45	31.99	86.44	51.33
Mother's age	37.08	38.16	37.05	38.10	37.11	38.22
Father's age	40.30	40.51	40.34	40.42	40.24	40.61
Mother's Education						
Illiterate	48.58	30.74	47.95	28.96	49.28	32.65
Primary school	36.42	48.92	36.56	51.02	36.27	46.69
Junior middle school	10.56	16.75	10.88	16.29	10.19	17.23
Senior middle school or above	4.44	3.59	4.61	3.73	4.26	3.44
Father's Education						
Illiterate	18.39	10.43	18.18	9.73	18.63	11.18
Primary school	46.98	48.42	47.97	50.57	45.87	46.14
Junior middle school	25.29	31.61	23.89	30.37	26.87	32.93
Senior middle school or above	9.33	9.53	9.96	9.33	8.63	9.75

Notes: All statistical data in the table are related to the characteristics of first-born children aged 14-16, and the sample selection follows the criteria described in the paper. The regions are categorized according to the residuals of the regression in Table 2.

Table 4. Means of the Number of Children, Entrance to Junior Middle and School Enrollment by Cohort and Policy Enforcement Intensity

Panel A: First-born children aged between 14 and 16

	Number of Children			Entrance to Junior Middle		
	Intensity of the Fertility Control			Intensity of the Fertility Control		
	Strict (1)	Non-strict (2)	Diff (3)	Strict (1)	Non-strict (2)	Diff (3)
1990	2.293	2.658	-0.365	0.590	0.547	0.044
	(0.0035)	(0.0041)	(0.0053)	(0.0021)	(0.0022)	(0.0030)
1982	3.369	3.634	-0.264	0.602	0.564	0.039
	(0.0057)	(0.0065)	(0.0086)	(0.0027)	(0.0029)	(0.0039)
Diff	-1.076	-0.975	-0.101	-0.012	-0.017	0.005
	(0.0063)	(0.0073)	(0.0102)	(0.0034)	(0.0036)	(0.0049)
				Wald Estimator=-0.050		

Panel B: First-born children aged between 15 and 16

	Number of Children			School Enrollment		
	Intensity of the Fertility Control			Intensity of the Fertility Control		
	Strict (1)	Non-strict (2)	Diff (3)	Strict (1)	Non-strict (2)	Diff (3)
1990	2.357	2.716	-0.360	0.656	0.636	0.021
	(0.0043)	(0.0051)	(0.0066)	(0.0025)	(0.0026)	(0.0036)
1982	3.468	3.732	-0.264	0.404	0.400	0.004
	(0.0073)	(0.0082)	(0.0109)	(0.0034)	(0.0035)	(0.0049)
Diff	-1.112	-1.015	-0.096	0.252	0.236	0.016
	(0.0079)	(0.0092)	(0.0128)	(0.0042)	(0.0044)	(0.0061)
				Wald Estimator=-0.171		

Notes: The regions are categorized according to the residuals of the regression in Table 2. Standard errors are in parentheses.

Table 5. Effect of policy enforcement intensity on family size

	Panel A: First-born children aged 14-16			Panel B: First-born children aged 15-16		
	(1)	(2)	(3)	(4)	(5)	(6)
F*T	-0.0229***	-0.0229***	-0.0233***	-0.0228***	-0.0228***	-0.0242***
	(0.0007)	(0.0007)	(0.0012)	(0.0009)	(0.0009)	(0.0013)
F*T*$d_{i,1}$			-0.0008			
			(0.0017)			
F*T*$d_{i,2}$			0.0018			0.0026
			(0.0017)			(0.0018)
F*$d_{i,1}$		0.0014*	0.0019			
		(0.0008)	(0.0014)			
F*$d_{i,2}$		0.0027***	0.0016		0.0013	-0.0004
		(0.0008)	(0.0014)		(0.0008)	(0.0015)
Girl	0.2961***	0.2961***	0.2961***	0.2936***	0.2936***	0.2936***
	(0.0040)	(0.0040)	(0.0040)	(0.0051)	(0.0051)	(0.0051)
Mother's Education Level						
Primary School	-0.1858***	-0.1858***	-0.1858***	-0.1861***	-0.1861***	-0.1861***
	(0.0050)	(0.0050)	(0.0050)	(0.0062)	(0.0062)	(0.0062)
Junior Middle School	-0.4526***	-0.4525***	-0.4524***	-0.4383***	-0.4383***	-0.4382***
	(0.0067)	(0.0067)	(0.0067)	(0.0085)	(0.0085)	(0.0085)
Senior Middle School	-0.5760***	-0.5758***	-0.5758***	-0.5806***	-0.5804***	-0.5805***
	(0.0120)	(0.0120)	(0.0120)	(0.0158)	(0.0158)	(0.0158)
Junior College	-0.5828***	-0.5824***	-0.5822***	-0.5182***	-0.5181***	-0.5179***
	(0.0240)	(0.0240)	(0.0240)	(0.0311)	(0.0311)	(0.0310)
University or above	-0.5505***	-0.5499***	-0.5499***	-0.4997***	-0.4996***	-0.4995***
	(0.0257)	(0.0257)	(0.0257)	(0.0348)	(0.0348)	(0.0348)
Father's Education Level						
Primary School	0.0390***	0.0390***	0.0389***	0.0423***	0.0423***	0.0422***
	(0.0069)	(0.0069)	(0.0069)	(0.0086)	(0.0086)	(0.0086)
Junior Middle School	0.0432***	0.0431***	0.0431***	0.0491***	0.0491***	0.0490***
	(0.0074)	(0.0074)	(0.0074)	(0.0092)	(0.0092)	(0.0092)
Senior Middle School	-0.0269***	-0.0272***	-0.0273***	-0.0289**	-0.0290**	-0.0291**
	(0.0103)	(0.0103)	(0.0103)	(0.0132)	(0.0132)	(0.0132)
Junior College	-0.3232***	-0.3233***	-0.3233***	-0.2990***	-0.2990***	-0.2990***
	(0.0162)	(0.0162)	(0.0162)	(0.0206)	(0.0206)	(0.0206)
University or above	-0.3410***	-0.3411***	-0.3412***	-0.3496***	-0.3496***	-0.3496***
	(0.0166)	(0.0166)	(0.0166)	(0.0214)	(0.0214)	(0.0214)
Observations	172,288	172,288	172,288	110,714	110,714	110,714
R-squared	0.4155	0.4155	0.4155	0.4133	0.4133	0.4133

Notes: (1) Robust standard errors in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$
(2) The control group consists of the individuals from the 1982 Census; all specifications include the region of birth dummies, the year of birth dummies, and the mother's age at birth dummies.

Table 6. Effect of policy enforcement intensity on entrance to junior middle school and school enrollment

	Panel A: Entrance to junior middle			Panel B: School enrollment		
	(1)	(2)	(3)	(4)	(5)	(6)
F*T	0.0018***	0.0018***	0.0018***	0.0021***	0.0021***	0.0014**
	(0.0004)	(0.0004)	(0.0006)	(0.0004)	(0.0004)	(0.0007)
F*T*di,1			0.0005			
			(0.0009)			
F*T*di,2			-0.0005			0.0014
			(0.0009)			(0.0009)
F*di,1		-0.0008*	-0.0012			
		(0.0004)	(0.0007)			
F*di,2		-0.0019***	-0.0016**		0.0009**	-0.0000
		(0.0004)	(0.0007)		(0.0004)	(0.0007)
Girl	-0.0919***	-0.0919***	-0.0919***	-0.1446***	-0.1446***	-0.1446***
	(0.0021)	(0.0021)	(0.0021)	(0.0027)	(0.0027)	(0.0027)
Mother's Education Level						
Primary School	0.1292***	0.1291***	0.1291***	0.0793***	0.0793***	0.0793***
	(0.0027)	(0.0027)	(0.0027)	(0.0033)	(0.0033)	(0.0033)
Junior Middle School	0.2923***	0.2922***	0.2921***	0.1852***	0.1853***	0.1853***
	(0.0034)	(0.0034)	(0.0034)	(0.0045)	(0.0045)	(0.0045)
Senior Middle School	0.2977***	0.2976***	0.2976***	0.2437***	0.2438***	0.2437***
	(0.0052)	(0.0052)	(0.0052)	(0.0076)	(0.0076)	(0.0076)
Junior College	0.3312***	0.3309***	0.3308***	0.1656***	0.1658***	0.1658***
	(0.0093)	(0.0093)	(0.0093)	(0.0166)	(0.0166)	(0.0166)
University or above	0.2428***	0.2424***	0.2424***	0.2353***	0.2353***	0.2354***
	(0.0078)	(0.0078)	(0.0078)	(0.0153)	(0.0153)	(0.0153)
Father's Education Level						
Primary School	0.0586***	0.0586***	0.0586***	0.0343***	0.0343***	0.0342***
	(0.0036)	(0.0036)	(0.0036)	(0.0043)	(0.0043)	(0.0043)
Junior Middle School	0.1732***	0.1733***	0.1733***	0.1234***	0.1234***	0.1233***
	(0.0038)	(0.0038)	(0.0038)	(0.0047)	(0.0047)	(0.0047)
Senior Middle School	0.2224***	0.2226***	0.2227***	0.1915***	0.1914***	0.1914***
	(0.0050)	(0.0050)	(0.0050)	(0.0065)	(0.0065)	(0.0065)
Junior College	0.3296***	0.3296***	0.3297***	0.1977***	0.1977***	0.1977***
	(0.0070)	(0.0069)	(0.0069)	(0.0108)	(0.0108)	(0.0108)
University or above	0.2759***	0.2760***	0.2760***	0.2869***	0.2869***	0.2869***
	(0.0061)	(0.0061)	(0.0061)	(0.0098)	(0.0098)	(0.0098)
Observations	172,288	172,288	172,288	110,714	110,714	110,714
R-squared	0.1885	0.1886	0.1886	0.1890	0.1890	0.1891

Notes: (1) Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

(2) The control group consists of the individuals from the 1982 Census; all specifications include the region of birth dummies, the year of birth dummies, and the mother's age at birth dummies.

Table 7. Effect of family size on educational attainment

	OLS	OLS	2SLS	2SLS	2SLS
	(1)	(2)	(3)	(4)	(5)
instrument	N.A	N.A	F*T	F*T	F*T, F*T*di,1 and F*T*di,2
Panel A: Entrance to Junior middle (first-born children 14-16)					
# Children	-0.0675***	-0.0675***	-0.0769***	-0.0767***	-0.0774***
	(0.0013)	(0.0013)	(0.0159)	(0.0159)	(0.0159)
F*di,1		-0.0007*		-0.0007*	-0.0007*
		(0.0004)		(0.0004)	(0.0004)
F*di,2		-0.0017***		-0.0017***	-0.0017***
		(0.0004)		(0.0004)	(0.0004)
Observations	172,288	172,288	172,288	172,288	172,288
R-squared	0.2015	0.2015	0.2012	0.2013	0.2012
Panel B: School Enrollment (first-born children 15-16)					
# Children	-0.0533***	-0.0533***	-0.0904***	-0.0915***	-0.0894***
	(0.0016)	(0.0016)	(0.0196)	(0.0197)	(0.0196)
F*di,2		0.0009**		0.0010**	0.0010**
		(0.0004)		(0.0004)	(0.0004)
Observations	110,714	110,714	110,714	110,714	110,714
R-squared	0.1972	0.1972	0.1932	0.1929	0.1934

Notes: (1)Robust standard errors in parentheses;*** p<0.01, ** p<0.05, * p<0.1
(2) All specifications include the region of birth dummies, year of birth dummies, gender of the first child dummy, mother's age at first-birth dummies, mother's educational level, and father's education level.

Table 8. Effect of policy enforcement intensity on sex Selection at higher birth parity

Panel A: Fraction of males at 2nd birth% by census year (first-born children aged 14-16)

	1982	1990
	(1)	(2)
Observations of 2nd born child	61570	99130
Fraction of males at 2nd birth%	51.38	51.93
95% confidence interval	(50.99, 51.78)	(51.48, 51.97)

Panel B: Fraction of males at 2nd birth by census year and policy enforcement intensity

	1982	1990	Diff
	(1)	(2)	(3)
Strict	0.517	0.522	-0.006
	(0.0022)	(0.0022)	(0.0032)
Non-strict	0.512	0.515	-0.003
	(0.0028)	(0.0029)	(0.0040)
Diff	0.004	0.007	-0.003
	(0.0036)	(0.0037)	(0.0051)

Panel C: Effect of intensity of policy enforcement on the sex selection

Dependent variable	Boy at second birth	Fraction of younger brothers
F*T	0.0000	0.0001
	(0.0004)	(0.0003)
Observations	160700	160700
R-squared	0.0014	0.0121

Notes: Robust standard errors are in parentheses.

(1)The regions are categorized according to the residuals of the regression in Table 2.

(2)The regression controls for region of birth dummies, year of birth dummies, gender of the first child dummy, mother's age at first-birth dummies, mother's educational level and father's educational level

Table 9. Student-teacher ratio of regular secondary school by Region

	1981	1990	Diff
	(1)	(2)	(3)
Non-Strict	17.13	16.15	0.98
	(0.812)	(0.796)	(0.425)
Strict	17.56	16.60	0.96
	(0.613)	(0.629)	(0.44)
Diff	-0.42	-0.45	0.028
	(1.049)	(1.042)	(0.615)

Notes: (1) The regions are categorized according to the residuals of the regression in Table 2. Robust standard errors are in parentheses.
(2) The data on the number of full time-teachers and student enrolled in regular secondary school are from the China Data Center, University of Michigan and China Statistics Yearbook 1981 & 1990.