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Family Size and Children's Education: Evidence from the One-Child Policy in China

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Family Size and Children's Education:
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Abstract. Evidence on a causal link between family size and children's education, as in the trade-off suggested by Gary S. Becker between child quantity and quality, is still inconclusive. Recent empirical studies have focused heavily on China, exploiting for identification the country's One-Child Policy (OCP) as an exogenous source of variation in the number of offspring. This literature, however, suffers from measurement error in the key policy variable (individual OCP coverage) and the use of inadequate measures of child quality outcomes (educational attainment). Using a novel and more accurate taxonomy of provincial OCP regulations and studying exclusively post-compulsory schooling outcomes of children that are subject to parental discretion, we find evidence for a sizeable child quantity-quality trade-off in China. Various robustness checks corroborate this conclusion.

Keywords: Family Size, Education, One-Child Policy, Quantity-Quality Trade-Off.
JEL Classification: J13, J18, I2.

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1 Introduction

The quantity and quality of children is of paramount importance for the operation and performance of economies. Determining the volume and quality of labor supplied on factor markets, population growth and human capital formation are key drivers of economic growth and of pivotal relevance for the financing of public pension systems. The quantity and quality of offspring also affect the inter-generational transmission of wealth, income and education, and mould the functioning of marriage markets. In light of their paramount importance, it is little surprising that social scientists have shown great interest in the determinants of child quantity and quality and the relationship between the two. This long-standing interest has received further stimulus by Gary S. Becker's (1960) quantity-quality model of fertility, which identified a potential trade-off between quantity and quality, arising from a non-linear household budget constraint that causes the marginal cost of child quality to increase in child quantity (and vice versa) (Becker, 1960; Becker and Lewis, 1973).[1]

Testing empirically for the existence and size of a causal link between family size and children's quality is difficult. The reason is that both child quantity (number of children) and child quality (e.g. educational choices) are subject to parental discretion and thus endogenous and possibly also chosen simultaneously. Empirical studies on the link between family size and children's quality have addressed this identification problem by making use of exogenous variation in child quantity provided by twin births (Angrist et al., 2010; Black et al., 2005; Li et al., 2008), the gender of newborns (Lee, 2008), the height of children (Lee, 2012), and birth control policies (Qian, 2009; Liu, 2014; Li and Zhang, 2017). The evidence produced, however, is mixed. Some studies find a negative effect of child quantity on quality, while others find no effect or even a positive effect. In part, this inconclusive evidence may be explained by a focus on developed rather than developing countries. In developed countries, which exhibit more generous welfare systems, any quantity-quality trade-off should be less strong, if not entirely absent (Li et al., 2008). But even for developing countries such as China, which has received growing attention in recent years and arguably provides a more adequate testing ground, the evidence remains mixed. This recent strand of studies for China, however, suffers from a number of methodological shortcomings that cast doubt on the validity and robustness of this literature's findings. Exploiting for identification China's One-Child Policy (OCP), the most influential population policy in world history, as an exogenous source of variation in household size, studies in this recent branch of literature suffer from severe measurement error in their key policy variable (individual OCP coverage) and in part also in their child quality outcome considered (educational attainment).

In this paper, we address these shortcomings in the literature and re-examine the relationship between family size and child quality for China. Using household data from the 2000 Chinese census and exploiting for identification variation across time and regions in individual OCP coverage, we produce new evidence based on instrumental variable (IV) regressions on the effect of child quantity

[1] Becker's quantity-quality model provides a potential explanation for why economies which experienced steady income growth have witnessed both falling fertility rates and rising education levels, a phenomenon at odds with standard Malthusian predictions that growth of production should stimulate population growth (Malthus, 1798).

on the educational attainment of children of post-compulsory schooling age. We restrict the analysis to households with mothers who are Han, i.e. members of the largest ethnic group in China, and who have an agricultural Hukou, as individuals with an agricultural background provide a more adequate testing ground for the same reasons that also justify a focus on developing rather than developed countries. Our results show that exogenous reductions in child quantity induced by the fertility restrictions of the OCP substantially increased the educational attainment of children. Various robustness checks corroborate this finding.

Our paper contributes to the empirical literature on the link between family size and children's quality in several ways. First, by providing new evidence on the link between family size and children's education for China, we add to and complement the growing body of empirical literature that focuses on this country. Second, and of importance from a methodological perspective, we introduce a new and continuous instrumental variable for individual OCP coverage, which measures more accurately than hitherto the case in the literature the actual degree to which women were subjected to OCP fertility restrictions during their years of prime fertility. We construct this instrumental variable from detailed information that we compiled and processed from regional family planning regulations in China's thirty-one provinces and changes in these regulations over time, as well as from information on women's prime fertility age, their ethnicity, and their economic background. This new measure of OCP coverage can in the future be fruitfully employed also in other applications, such as the study of tilted sex ratios at birth and their effects on marriage market outcomes or criminal activity. As data availability may be more limited in other applications, we also gauge in additional explorations, and as a point of reference and service to other researchers, the relative importance of ethnic background information or household Hukou for obtaining a measure of OCP coverage that is highly correlated with the measure of OCP coverage which makes full use of all relevant information. Finally, we use enrollment (current or past) in post-compulsory education as a measure of child quality, an outcome that is more clearly subject to parental discretion than general school enrollment which has been used in parts of the literature.

The paper proceeds as follows. Section 2 provides a detailed account of the OCP in China and reviews the relevant empirical literature on the link between family size and children's quality. Section 3 describes the data and our identification strategy. Section 4 presents the regression results and discusses various robustness checks. Finally, section 5 summarizes our core findings and concludes.

2 Background

2.1 One-Child Policy (OCP)

The One-Child Policy (OCP) was introduced by the Chinese central government as a means to curb rapid population growth, a step deemed necessary to avoid shortages in the supply of food and housing and aid the country in its transition to a modern economy. The OCP did not mark the beginning of centralized family planning and birth control efforts in China. In fact, first steps in this direction date back to the 1950s.[2] The year 1979, however, marks a historic watershed in Chinese family planning policy. In that year, several provinces (but not all) introduced in their territory what came to be known as the One-Child Policy (OCP), among them Beijing, Tianjin, Shanghai and Jiangsu. Prior to that date, public policies had merely advocated the virtues of low fertility and encouraged birth control. Now, governments in these provinces explicitly prescribed low fertility targets for couples and enforced these targets with the help of severe financial fines in case they were breached.[3]

Although formally announced in 1979 and meant to apply for the whole country, the OCP was therefore de facto implemented only piecemeal and at first only in selected Chinese provinces. The OCP was also not uniform in the fertility restrictions it imposed across couples of different ethnic and economic background. Exemptions for minorities, those with an agricultural background (agricultural hukou[4]), and parents with both an agricultural background and a first-born girl were introduced in many provinces in the 1980s and 1990s, albeit at different times.[5] Furthermore, in the 1990s, the first children of families that had already been covered by the OCP became of marriageable and fertile age. Most provinces permitted couples to have a second child if both spouses had been born as a single child to their parents. Further exemptions were introduced in late 2013, and again only in some provinces, that a second child was permissible if at least one spouse had been a single child. In 2016, the OCP was officially terminated by allowing all couples, irrespective of their ethnic, economic and regional background, to henceforth have two children.[6]

The afore-sketched history of the OCP, its implementation and evolution, makes clear that, during the course of its term, the OCP was not homogenous across provinces, couples, and time, but rather a changing complex conglomerate of time-variant and province-specific regulations and exemptions that in practice entailed great diversity both in the degree of the policy's coverage and in its bite. The empirical literature on the quantity-quality trade-off in China (Qian, 2009; Liu, 2014; Li and Zhang, 2017), and studies investigating other outcomes, such as sex ratio imbalances (Bulte et al., 2011; Li et al., 2011), which exploit the OCP for identification, generally fail to take into account this heterogeneity of the OCP. In the next section, we will discuss this shortcoming in

[2]The document "Instructions on Population Control" (guan yu kong zhi ren kou wen ti de zhi shi) from 1955 stated that the Communist Party was supportive of family planning as a means to facilitate population health and economic prosperity. On March 5th, 1978, the National People's Congress adopted Article 53 of the "*Constitution of the People's Republic of China*" which stated that the country advocates and promotes family planning, marking the first incident that family planning was officially enshrined in the fundamental law of the country (Yang, 2004).

[3]See Scharping (2003) and Ebenstein (2010) for information on monetary punishments for such excess fertility as envisaged in provincial family planning regulations.

[4]The hukou system is a household registration system in force since the 1950s. Under this system, everybody is registered and given a hukou certificate. The household booklet (hu kou bu) contains, amongst other things, information on the ethnic and economic background of each family member. See, for example, Cheng and Selden (1994) for further details on the hukou system.

[5]The 7th document, also named "*Report on the Family Planning Work*" (guan yu ji hua sheng yu gong zuo qing kuang de hui bao), was issued in 1984 and explicated that a second birth was only allowed with permission in rural areas and otherwise prohibited, and that appropriate birth control regulations should be implemented among minorities.

[6]On December 27, 2015, the Standing Committee of the National People's Congress passed the amendment of the Population and Family Planning Law that a 2-child policy is to be implemented from January 1, 2016.

detail, review the existing literature on the link between family size and child quality and discuss mismeasurement in OCP regulations and individual OCP coverage in studies that investigate other outcomes than child quality for China.

2.2 Previous Literature

Existing studies on the causal effect of child quantity on quality employ a variety of identification strategies and consider different countries. One source of exogenous variation in child quantity exploited in the literature is the gender of first-borns (Lee, 2008) or the sex composition of siblings (Conley and Glauber, 2006; Angrist et al., 2010). In societies that exhibit a preference for sons, families with a first-born girl tend more towards having a second child; and among parents with a preference for gender heterogeneity among their offspring, those with two children that are of the same sex are more likely to seek a third child. Using the gender of the first child as an instrument for child quantity in 2SLS regressions, Lee (2008) studies parental investment in child education in South Korea. Lee finds evidence for a trade-off between the quantity and quality of children, a trade-off that becomes more pronounced as a family's sibling size increases. Exploiting variation in the sex composition of the first two children, and using 1990 U.S. Census data, Conley and Glauber (2006) find that sibling size has a negative effect on the likelihood of attending a private school and a positive effect on the grade retention for second-born boys. Using the same instrument, but data from the 20% microdata samples from the 1995 and 1983 Israeli censuses, Angrist et al. (2010) in contrast find no evidence for a quantity-quality trade-off in Israel. The use of information on the gender of children for identification in these studies, however, is not unproblematic, as the spread of ultrasound technology in the 1980s has made prenatal identification and selection of the sex of fetuses viable. This potential endogeneity of a child's gender casts doubt on the validity of this IV (Li et al., 2008).

A second, also prominent, and early source of exogenous variation in child quantity used in the literature are twin births. Exploiting twin births for identification, Rosenzweig and Wolpin (1980) study the effect of family size (number of offspring) on the educational attainment of children in India. Consistent with the quantity-quality trade-off, the authors find a larger family size to adversely affect the average educational attainment of children. Li et al. (2008) also find a negative effect of family size, identified by a twin birth, on the educational attainment of children in China. The same holds true for Glick et al. (2007), who, using data from the Romania Integrated Household Survey, show that unplanned fertility (through a twin birth) has a negative impact on children's nutrition and schooling. Similarly, Rosenzweig and Zhang (2009), using data from the Chinese Child Twins Survey, find a negative effect of an increase in family size trough a twin birth at child parity one or two on the school performance and self-assessed health of children. Using data for Norway and employing standard OLS regression analysis, Black et al. (2005) also find an additional child to reduce the average educational attainment of children in a household. However, they produce evidence which shows that this effect becomes significantly smaller, once family background characteristics are controlled for, and that it disappears altogether when birth order is accounted for in the analysis. Furthermore, using twin births as an IV in 2SLS regressions, Black et al. (2005) find family size to have only negligible effects on the quality of children. For several reasons, however, the use of twin births as an instrument (like the afore-discussed gender of a child) is not unproblematic. First, as noted in Black et al. (2005), their use tends to bias 2SLS towards producing evidence in support of a trade-off between quantity and quality of offspring. Since the spacing between twin births is zero, parents may shift more resources towards non-twin children which causes bias in estimates of the quantity-quality trade-off (Rosenzweig and Zhang, 2009). Second, the birth weight of twins is lower than that of non-twins, which can also directly affect the outcome of children. Finally, with the onset and spread of assisted reproductive technology that carries the risk of elevated twinning rates, a twin birth no longer needs to constitute an exogenous event beyond the control of parents, but becomes potentially subject to endogenous parental choices and hence self-selection of parents.

A third, and more recent source of exogenous variation in child quantity exploited in the literature is public policy, in particular the One-Child Policy (OCP) in China which limited (albeit at different times in different regions and for different groups) the maximum number of children that households could have to one. Focusing only on rural China and using a 1% sample of the Chinese 1990 census and county-level data from the 1989 *China Health and Nutrition Survey (CHNS)*, Qian (2009) exploits as an instrument for family size the regional variation in the exemption of parents from the OCP when they have a first-born girl to study the effect of sibling numbers on the school enrollment of first-born children. Qian finds no evidence for a negative effect of child quantity on quality. The study, however, uses county-level OCP exemption information only from 1989, and ignores possible other exemptions, both concurrent and prior to 1989, that could impact the fertility behavior of women over the course of their fertile age. Moreover, a number of children considered in the analysis of Qian (2009) are still in compulsory education and of compulsory schooling age, where parental discretion in schooling choices is limited, if not completely lacking. Liu (2014), in turn, mainly uses data from the 1993 *CHNS* and exploits exemptions from the OCP as well as regional variations in the level of fines imposed for unsanctioned births as an IV. The findings of this study suggest a significant negative effect of number of siblings on child quality, as measured by a height-for-age z-score. However, OCP exemption status and fines are sampled only for three years, 1989, 1991 and 1993, again ignoring earlier potential exemptions (or restrictions) affecting female fertility over the course of women's fertile age. Finally, Li and Zhang (2017), exploiting regional differences in OCP enforcement intensity as an instrument for family size and using data from the Chinese censuses of 1982 and 1990, find a negative effect of family size on the educational attainment of first-born Han children. Their variable of policy enforcement intensity, measured by an excess fertility rate, is defined as the percentage of all Han mothers aged 25-44 with at least one surviving child who gave a higher order birth (2nd or higher) in 1981. This definition of Li and Zhang (2017), and hence their underlying identification strategy, is therefore not based on actual policy regulations, their measurement and quantification, but on the factual realization of births, which is highly problematic, as realized births are subject also to parental discretion and hence the influence of parental preferences.

Apart from the afore-mentioned studies by Qian (2009), Liu (2014), Li and Zhang (2017), the OCP has been used also as an exogenous source of variation in studies investigating outcomes other than the quantity-quality trade-off. Bulte et al. (2011), for instance, examine the role of the OCP for the extremely male-biased gender ratio in China, a country with strong son preferences. In their analysis, they use only the birth year of a child to identify children born to parents covered by OCP regulations. The exclusive distinction between children born before/in or after 1979 is a very rough measure of parental exposure to OCP regulations that ignores entirely the variation across provinces in the introduction of the OCP. Since they only assume that ethnic minorities are exempt from the OCP throughout all provinces in China after 1979, the various exemptions granted to specific ethnic and economic groups across provinces and across time are also ignored (we discuss provincial family planning regulations in detail in Section 3.1). A quite similar dichotomous measure, but also far from perfect, is used by Li et al. (2011) in their difference-in-differences based analysis of the effect that the OCP had on the sex ratio at birth in China. They define a child to be born under OCP regulations if the child is of Han ethnicity and born after 1979. As discussed above, ethnic minorities, however, were not always exempted from the OCP, nor were Han always restricted by the OCP. Furthermore, only few provinces actually implemented the OCP already in 1979. Overly simplistic classifications, as the ones employed in these studies, entail sizeable measurement error in the actual OCP coverage of individuals which can significantly bias estimates.

3 Data and Empirical Strategy

In the empirical analyses, we make use of two types of data. The first is self-compiled and summarizes in detail and for the first time the introduction and evolution of the OCP and its various exemptions across provinces and time. The second contains household information from the 5th Chinese Census in 2000. We use information from both data sources to construct our key policy variable, i.e. the extent of exposure of women during their fertile years to OCP fertility restrictions. From the second data source, we also obtain information on the number of siblings in a household (our child quantity measure) and the educational attainment of children (the basis of our child quality measure), in addition to more general household background information.

In the following, we first describe in detail both data sources and the construction of our key variables (Sections 3.1 and 3.2). After that, in Section 3.3, we document the importance of various household background information for constructing a variable that fully captures the complex time-variant and province-specific body of OCP regulations and exemptions that potentially restrict the fertility choices of a household. The objective of this exercise is to identify factors that are of prime importance for correctly quantifying the intensity of OCP treatment of households, and thereby provide a point of reference and service to other researchers who may have less than the full universe of information at their disposal (depending on the specific application and data accessibility) that is necessary to construct an encompassing policy variable for the OCP coverage of households. In

Section 3.3 we furthermore provide summary statistics for our final estimation sample. Finally, in Section 3.4, we present and discuss our empirical strategy.

3.1 OCP Regulations and Exemptions

A concise single-document summary of the OCP with all of its regulations and exemptions does not exist. We therefore had to construct such a detailed summary ourselves drawing on numerous publications and directives that describe the different family planning regulations enforced over time in China's provinces.[7] The result of this comprehensive policy review is tabulated in Table 1 below. From its earliest inception in 1979 and through to the year 2000, Table 1 provides information for each province (column 1) on the year the OCP has been first implemented (column 2) and any periods of years in which certain types of households have been exempted from the obligation to bear at most one child (columns (3)-(6)). These households fall into four types. First, households in which both spouses have an ethnic minority background (column 3). Second, households in which at least one spouse has an ethnic minority background (column 4). Third, households in which both spouses have an agricultural Hukou[8] (column 5). And finally, households in which both spouses have an agricultural Hukou and also a first-born girl (column 6).[9] The last exemption is sometimes referred to as the 1.5-child policy (Ebenstein, 2010; Yang, 2012). Altogether, we consider thirty-one provinces.[10]

As can be seen from Table 1, there is great variation across provinces and across time within provinces in OCP exemptions granted to specific types of households. There is also great heterogeneity across provinces in the year they first implemented OCP fertility restrictions. The OCP did not start in 1979 in all of China, as assumed in parts of the literature and used therein as a cut off date to define OCP treatment in the empirical analysis (see discussion below). In fact, only a minority of provinces implemented the OCP already in 1979. Moreover, after 1979, some provinces were newly formed, or dissolved and integrated into other provinces, so residents of these provinces were covered by different OCP regulations before and after such administrative territorial

[7]The different sources we used for this purpose are listed in Table A-1 in the appendix.

[8]Hukou provides information on household type. There were two types of Hukou until 2000, an agricultural Hukou for people who have an agricultural background, and a non-agricultural Hukou for people who don't have an agricultural background.

[9]Note that in Table 1 we disregard two exemptions that are immaterial for our analysis. The first is the exemption of spouses from OCP coverage who have parents that had already been subject to OCP regulations. The second is the exemption of parents who have a first-born child with a non-genetic disease. Note also that we recorded Tibet in Table 1 as a province with no OCP regulations in the period under investigation. The reason is that the OCP in Tibet covered only Han cadres who account for a very small fraction of the total population in Tibet.

[10]Hong Kong and Macau, both returned to China in the 1990s, have never implemented the OCP. The same holds true for Taiwan, which China still considers an integral part of the People's Republic of China.

Table 1: Introductions of OCP and Exemptions across Provinces and Time

Province:	**OCP**	**Exemptions if:**			
	from:	**both spouses minority**	**one spouse minority**	**both spouses agricultural**	**both spouses agricultural with a girl**
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Beijing	1979				
Tianjin	1979				
Hebei	1982	1984–1994 1995[a] –			1989–
Shanxi	1982	1982–			1990–
Inner Mongolia	1982		1982–1995 1996[a] –		1988–
Liaoning	1980	1982-1984 1985[b] –		1985[c] –	1985–
Jilin	1984	1994[a] –	1985–1993		
Heilongjiang	1979	1981–1993 1994[a] –			1990–
Shanghai	1979				
Jiangsu	1979				
Zhejiang	1982	1990[d] –	1982–1989		
Anhui	1981	1981–			1988–
Fujian	1982	1984–1991[d] 1992[e] –			
Jiangxi	1981	1990–			1985–
Shandong	1980	1984–			1986–
Henan	1981	1990[f] –			1990–
Hubei	1981				1988–
Hunan	1982	1990[g] –		1990[h] –	1987–
Guangdong	1980	1980–1997 1998[f] –		1986–1997	1998–
Guangxi	1982	1989[a] –	1985-1988[a]		1989–
Hainan	1980	1980–1989	1990[d] –	1986–	
Chongqing	1980				
Sichuan	1980				
Guizhou	1982	1982–1998		1982-1987 1988[h] –	1998–
Yunnan	1979			1979–	
Tibet					
Shaanxi	1981	1981–			1986–
Gansu	1982	1982–1989 1990[f] –			1990–
Qinghai	1982	1986[f] –	1986[i] –		
Ningxia	1982		1982–	1982–	
Xinjiang	1992		1992–	1992–	

Notes: The table documents province-level OCP introduction years and exemptions. For each province (column (1)), column (2) shows the year when the OCP was first introduced. Columns (3) - (6) indicate any periods of exemptions from the OCP granted to four different types of households. Some exemptions at province level were furthermore restricted to special groups or governed by particular regulations: (a) only minorities with a total population less than 10 million (Manchu and Zhuang have populations exceeding 10 millions); (b) female spouse must be agricultural; (c) one spouse must belong to a minority, whose total population is less than 10 million; (d) does not apply to the minority Zhuang; (e) both spouses must be agricultural and not belong to the minority Zhuang; (f) both spouses must be agricultural; (g) one spouse must be agricultural; (h) one spouse must belong to a minority; (i) both spouses must be non-agricultural. The regulations used to construct this table are listed in Table A-1 in the appendix.

restructuring.[11]

The complexity, time-varying nature, and great regional diversity of OCP regulations documented in Table 1 have been largely ignored in existing empirical work, or taken into account only partially. For instance, Bulte et al. (2011) and Li et al. (2011) assume that the OCP took force in 1979 throughout all of China and that it applied undifferentiated and with universal coverage to all Han population. Clearly, neither was the case. They wrongly assume that exemptions from the OCP existed in all provinces, i.e. throughout China, for all minorities in all years after 1979. Moreover, it disregards other exemptions from OCP fertility restrictions that have been granted in different provinces to different groups at different times. Qian (2009), who focuses only on first-born children from rural areas in four out of the 30 provinces in China in 1990 (Liaoning, Jiangsu, Shandong and Henan), also considers but a single type of exemption from OCP regulations, the exemption for agricultural households with a first-born girl. Focusing on but one exemption again fails to do justice to the restrictions households actually faced in their fertility behavior during their fertile years. Liaoning province, for instance, had a very large minority population at the time, parts of which were exempted from OCP regulations even when both spouses were not agricultural or households did not have a first-born girl.[12] Furthermore, in the study by Qian (2009), exemptions for agricultural households with a first-born girl are recorded only in a single year immediately prior to 1990, i.e. in the year 1989. Liu (2014), in turn, who also studies only a subset of Chinese provinces, considers different types of exemptions, as well as fines for violations of OCP regulations, to construct instrumental variables for the number of siblings in a household in 1993. In the study, household fertility is assumed to be fully unrestricted by OCP regulations if the household could enjoy an exemption in at least one year in 1989, 1991 or 1993. However, this narrow definition ignores that households may have been subject to quite different OCP regulations before 1989, governing part or most of their fertile years and hence reproductive behavior. Finally, the study by Li and Zhang (2017) considers an excess fertility rate, which it defines as the share of Han mothers of primary childbearing age who gave a higher-order birth in 1981. The assumption that all higher-order births to Han mothers in 1981 were not permitted under the OCP, however, is wrong. In Hunan province, for example, OCP regulations were implemented only in 1982, a year after the stock-taking year chosen to define the excess fertility rate. As a consequence, all births in Hunan in 1981 that are defined as "excess births" in the analysis are effectively misclassified. Furthermore, taking reference to but a single calendar year (1981) ignores the time-varying nature and great regional diversity of OCP regulations and exemptions that in practice governed household fertility (over its fertile life time) in China.

[11] Hainan province, for example, was created only in 1988 out of parts of Guangdong province. Residents of these parts were hence subject to Guangdong family planning regulations before 1988, and to Hainan family planning regulations thereafter. Chongqing, in turn, became again a province in 1997 after having been an integral part of Sichuan province for more than forty years (1954-1996). Before 1997, but not thereafter, residents of Chongqing were hence to observe Sichuan OCP regulations. Table 1 takes these changes into account by combining regulations for residents in Hainan and Chongqing with the respective regulations that existed in Guangdong and Sichuan in earlier years.

[12] In the 1990 Chinese Census, about 20% of the population in Liaoning province had minority status, a much higher fraction than the national average at the time in China.

Heterogeneity in the introduction and modification of OCP regulations at provincial level and variation across households (in calendar time) in the female fertile life span imply that women covered at some point by OCP regulations may exhibit great differences in the degree to which their life-time fertility was de facto subjected to OCP fertility restrictions. OCP treatment, in short, is far from dichotomous in nature (complete vs. no coverage) but may assume different intensities. Modeling such different intensities of treatment requires a continuous measure of individualized OCP coverage or treatment. The share of female fertile lifetime subjected to OCP regulations provides such a measure. Ranging from zero (not restricted at all) to one (complete life-time fertility span restricted), such a life-time-based treatment definition is also more in line with Becker's original formulation of the quantity-quality model, where children are considered a durable consumption and production good, and households are to make life-time decisions (or life-time plans) on reproduction, child quality investments, and own consumption (Becker, 1960). In the literature, however, dichotomous measures of OCP coverage have been generally used, based, for example, on whether or not OCP regulations were in force at the particular point in time a woman gave birth (see discussion above). Such dichotomous measures are clearly inadequate to capture the actual degree to which female reproductive capacity was constrained by OCP family planning policies.

A potential concern regarding identification is that households may systematically observe OCP fertility restrictions in the breach, depending on household income. In particular, if richer households care more about the quantity of children, but less about their quality, and self-select, based on their income, into having a second child in which they invest less, then any association in the data between OCP induced changes in quantity of offspring is not fully exogenous, and responses in educational outcomes to such changes will not capture the true causal effect of variations in the quantity of children on their quality. There are several reasons, however, why such a scenario is unlikely to be a major concern in the setting we investigate. First, financial fines for breaches of the OCP were very substantial, if not prohibitive. Ebenstein (2010), for instance, cites a table of monetary punishments for excess fertility in China from 1979 to 2000 from Scharping (2003), showing that monetary punishment ranges up to 500% percent of annual salary. Second, households violating OCP fertility restrictions were routinely subjected to various forms of discrimination by public authorities. For instance, 1996 population and family planning regulations in Shandong decreed that employees with unsanctioned births do not get paid during maternity leave, forego the chance to be promoted or rewarded for five years, and even could face demotion or dismissal. Last but not least, and using data from the Chinese Health and Nutrition Survey (CHNS) for the year 2000, we regressed the total number of children a woman has on annual household wage and other type of income[13], controlling also for province and mother age fixed effects. The results of this regression test show no significant positive effect of household income on child quantity. The same finding emerges if we consider urban and rural area separately, or restrict the sample to households with women born in 1958-1979, i.e. to women who could fully be subjected to OCP regulations during

[13] Non-wage income includes, amongst others, asset rental income, welfare income, and transfers from parents.

their prime fertility years.[14] Furthermore, in our later analysis, we will consider only households with an agricultural Hukou. Income differences across this more homogenous group of households are more limited in magnitude.

3.2 Household Census Data

The second type of data we use is a 0.95‰ random sample of households surveyed in the 5th Chinese Census in the year 2000, provided by the National Bureau of Statistics of China. Several features of the 2000 census are advantageous, if not vital, for an analysis of the quantity-quality trade-off in China. First, the census contains information on an individual's schooling level, from which we can extract information on the post-compulsory educational choices of children. Second, the census contains information on households from 31 provinces in China, rather than only a subset of (possibly selective) regions, as considered in parts of the literature (Qian, 2009; Liu, 2014). This allows us to consider the whole of China in the analysis and to exploit more fully the great heterogeneity and variation in OCP regulations across time, provinces, nationalities, and household types. Third, the census provides information on the total number of children a woman has born and raised irrespective of whether these children still reside at the parental home on the census day (i.e. a measure of total child quantity, rather than an undercount that is possibly selective). Finally, the census records the nationality of each person (not only whether a person is Han or not), which permits us to consider specific exemptions from the OCP that apply only to particular minorities in the construction of our key policy variable, the intensity of exposure of a woman during her fertile years to the fertility restrictions of the OCP. We use both the census data and the data we compiled on OCP regulations and exemptions to construct this policy variable. The dependent variable and all explanatory variables in our analysis are also constructed from the census data. In the following, we consider each of these in turn. We begin with our three key variables, the quality of children, the quantity of children, and our IV, i.e. our key policy variable.

Quality of children (dependent variable): We measure child quality by a dichotomous variable that takes value one if a child has completed (or is currently enrolled in) post-compulsory education on the census day, and zero otherwise. Compulsory schooling in China includes primary school and junior secondary school education, which together amount to nine years of schooling. As children attend primary school from age six, children complete compulsory schooling at age 15.[15] After compulsory education, children may continue with senior secondary school education or other forms of post-compulsory schooling. Post-compulsory schooling choices are subject only to parental discretion, that is, a parental choice variable unfettered by public schooling laws. As such, they are better suited to proxy parental child quality investment than coarser measures, such as total years of schooling or school enrollment, which consists mostly of compulsory schooling, that have been used in parts of the literature on China (Qian, 2009). Given our child quality measure,

[14] Estimation results are available from the author upon request.

[15] The 1986 Compulsory Education Law of China decreed that children under 15 who had dropped out of school must go back to school and continue with their education until they are aged 15 (Fang et al., 2012). Children born after 1971 are covered by this law.

the child population of interest consists of children who are aged 15 or older. We hence restrict our estimation sample to households in which there is at least one child that is aged 15 or older when surveyed in the 2000 census.

Quantity of children (key explanatory variable): We measure child quantity by the number of siblings a child has. The number of siblings equals the total number of children a child's mother has born and raised less one. There are hence zero siblings in a single-child household, and a single sibling in a two-children household.

OCP coverage (instrumental variable): The policy variable we use to quantify the intensity by which female reproductive capacity is restricted by OCP regulations is defined as the share of prime fertility years of a woman that are subject to OCP regulations. Ranging from zero (no coverage) to one (complete coverage), this measure of OCP coverage is a function of several factors: female age in different calendar years, the nationality and household Hukou type of a woman, and the province a female resides in. Province information is vital, because province of residence determines when a female was in fact first subjected to OCP regulations, and which kind of exemptions she could potentially enjoy at certain times throughout the course of the OCP and her fertile life span. In our baseline specification, we consider the prime fertility age of women to lie between 21 to 35 years of age. This choice is inspired by several factors. First, women in China must be at least 20 years old to be able to marry. Second, descriptive explorations for women aged 49 to 50 in the census year of 2000 (i.e. women born in 1950 or 1951 who have completed their fertility by the time of the census), reveal that 86.4% of their children were born when these mothers were aged 21 to 35, and 95.05% were born when they were aged between 21 and 40. The overwhelming majority of births hence occured when mothers were aged 21 to 35, respectively 21 to 40 (we will consider the latter and broader age span of mothers in one of our robustness checks). Note that for defining our OCP coverage variable, we make exclusive use of information on females but not males (their husbands). This restriction is inspired by the possibility that marriages may be selectively formed to enjoy certain exemptions from OCP regulations by marrying a man that is eligible for exemptions, e.g. because of his minority status. We also disregard information on the gender of a first-born child when we model the 1.5-child policy (i.e. a household is exempt from the OCP if both spouses have an agricultural Hukou and their first child is a girl). The reason for doing so is again potential endogeneity, now in fertility choices, and possibly also in the determination of the gender of first-borns (Dyson and Moore, 1983; Banister, 2004; Feldman et al., 2007; Li and Zheng, 2009).[16]

Other covariates (potentially affecting fertility and child education): In addition to our key explanatory variable, the quantity of siblings of a child, we will in part of our analysis control also for other potential determinants of child quantity and quality. These are: (1) province

[16]Sex-selective abortions, assisted through new technology for pre-natal sex determination in the 1980s, carry the risk that gender of offspring is not exogenous (Li and Zheng, 2009). In fact, the prima facie reason for introducing the 1.5-child policy in China has been to help the family with a first-born girl to get more and sufficient labor for farm work (Yang, 2009). The 1.5-child policy also reduces the incentive of parents with a preference for sons to abort first pregnancies of mothers who carry a female child to term.

fixed effects to account for time-invariant differences across regions in average fertility levels and educational attainment; (2) sets of indicators for mother and child age to control for aggregate cohort effects across provinces on parental schooling investment, parental reproductive behavior and child school attainment; and (3) mothers' and fathers' educational attainment (measured again respectively by indicator variables for post-compulsory school attendance) to control for potential endowment and preference effects of parental background on parental child quantity and quality choices.

3.3 Determinants of OCP Coverage and Summary Statistics

This subsection provides information on the frequency distribution of households in our 2000 census data that have been more, respectively less, subjected to OCP fertility restrictions during the prime fertility years of mothers. It also considers correlations between different incomplete measurements of OCP household coverage and a complete encompassing measure of such coverage to gauge the respective importance of different household characteristics for obtaining a high-quality measure of actual OCP coverage. Finally, we provide summary statistics for our final estimation sample.

Table 2 tabulates, for all households in the census year 2000 in which mothers are aged 35 to 50, the respective fractions of households (in percent) that have been subjected to OCP restrictions zero to fifteen years during mothers' prime fertility years.[17]

In the literature, two pieces of household information and corresponding exemption clauses are often used to construct a household policy variable for OCP coverage, household ethnicity (or nationality) and household Hukou type (or agricultural background) (Qian, 2009; Li et al., 2011; Liu, 2014). Table 2 considers first each of these dimensions in isolation for defining a measure of the OCP coverage of households (in columns (2) and (3)) and then compares the two resulting distributions of OCP coverage intensity across households to the distribution that results when information on both of these household characteristics and respective OCP exemtptions are considered (column (4)). In this way, one can gauge the respective importance of each of these two dimensions for obtaining a suitable measure of the actual OCP coverage of households in empirical applications. Two major findings emerge from Table 2. First, the distribution in column (3), which is based only on information on household agricultural Hukou type and exemption regulations for such type of households, is very close to the coverage distribution in column (4) that results when one uses "full" household and policy exemption information. The distribution that results when only information on household ethnicity and corresponding exemptions regulations are considered (column 2), in contrast, differs quite markedly from the one in column (4). These findings may come at little surprise, given that 80% of the Chinese population has an agricultural background, but only 10% is from a minority. Information on the agricultural Hukou status of households, but not information on their ethnicity, is hence indispensable for constructing a measure of household OCP coverage that does justice to the actual OCP restrictions faced by the overwhelming majority

[17]Households in which a child was born before 1965 are dropped to exclude potential adoptees and stepchildren and avoid other forms of measurement error in the number of children.

Table 2: Sources of OCP Coverage and Exemptions at Household Level (in %)

Fertile years:	**Source of exemption: mother minority**	**mother agricultural**	**complete**
(1)	(2)	(3)	(4)
0	2.76	6.58	7.85
1	0.37	2.00	2.18
2	0.79	3.05	3.53
3	0.29	3.39	3.44
4	1.52	6.33	6.25
5	2.38	10.18	9.78
6	3.85	12.14	11.82
7	4.70	10.90	10.61
8	5.34	4.88	4.78
9	5.51	5.42	5.32
10	5.64	3.17	3.12
11	6.00	3.29	3.21
12	5.94	2.75	2.71
13	5.41	2.60	2.56
14	5.14	2.62	2.57
15	44.34	20.70	20.29
	100.00	100.00	100.00

Notes: The table shows the respective fractions of households (in percent) that have been subjected to OCP restrictions zero to fifteen years (column 1) during mothers' prime fertility years for all households in the census year 2000 in which mothers are aged 35 to 50 and no child is older than 35. Columns (2) and (3) construct measures of OCP coverage of households using only ethnicity information, respectively agricultural Hukou information. Column (4) provides an encompassing measure of OCP coverage that uses information on both ethnicity and agricultural Hukou.

of the Chinese population. Second, about 44% of households are classified as being covered by OCP restrictions throughout the entire fifteen years of female prime fertility, when only information on household ethnicity and corresponding OCP exemptions are considered (see last-but-one entry in column (2)). This figure is more than twice as large as the corresponding figure for the complete measure of OCP coverage (column (4)). Taken together, both findings illustrate that severe mis-measurement or mis-classifications may result when household agricultural Hukou information is disregarded. In fact, and as shown in Table 3, information on agricultural background and associated exemptions suffices to produce a measure of household OCP coverage that is very highly correlated with an encompassing measure that makes full use of both ethnicity and agricultural Hukou information.

China has a huge population that is economically and ethnically diverse. As individuals of different Hukou types and nationalities may behave quite differently, we restrict the estimation sample to the more homogenous group of Han Chinese (mothers) which have an agricultural Hukou. This group, which still accounts for the majority of the Chinese population, mainly lives in less developed areas, where the quantity-quality trade-off (if anything) should be more pronounced.

Table 3: Correlations between Different OCP Measures at Household Level

	mother minority	**mother agricultural**	**complete**
mother minority	1.0000		
mother agricultural	0.3026	1.0000	
complete	0.3833	0.9701	1.0000

Notes: The table shows correlation coefficients between three measures of OCP coverage, one that uses only ethnicity information, one that uses only agricultural Hukou information, and one that uses information on both ethnicity and agricultural Hukou.

Our final estimation sample consists of 67,953 children from 46,814 households. Table 4 provides summary statistics for this estimation sample.

Table 4: Summary Statistics for Estimation Sample

	Mean	Std. Dev.	Min	Max
number of siblings	1.6494	0.9945	0	9
enrollment in post-compulsory education	0.1524	0.3594	0	1
OCP	0.4661	0.2238	0	1
mother education (enroll. in post-comp. edu.)	0.0374	0.1897	0	1
father education (enroll. in post-comp. edu.)	0.1181	0.3227	0	1
child age:				
15-19	0.6347	0.4815	0	1
20-23	0.2555	0.4362	0	1
24-27	0.0918	0.2888	0	1
28-31	0.0171	0.1298	0	1
32-35	0.0008	0.0284	0	1
mother age:				
35-40	0.2355	0.4243	0	1
41-45	0.3848	0.4866	0	1
46-50	0.3797	0.4853	0	1
Total observations	67,953			

Notes: The table shows summary statistics for the final estimation sample, which consists of 67,953 children (observations) for 46,814 households (mothers). The data are from a 0.95‰ random sample of household census data from the 5th Chinese census in the year 2000, provided by the National Bureau of Statistics of China. Child quantity is measured by *number of siblings*, defined as the total number of children a mother has minus 1, and child quantity is measured by *enrollment in post-compulsory education*, a dummy variable that equals 1 if the child is enrolled or has finished post-compulsory education, and 0 otherwise. *OCP*, our policy variable of interest, is defined as the share of years of female prime fertility that are restricted by OCP regulations. Mother and father education are measured by indicators for (current or past) enrollment in post-compulsory education. Children are classified into five age groups (15-19, 20-23, 24-27, 28-31, 32-35), and mothers into three age groups (35-40, 41-45, 46-50).

3.4 Empirical Strategy

To identify the effects that exogenous variations in child quantity induced by OCP fertility restrictions had on child quality (as measured by post-compulsory schooling attendance), we estimate

2SLS regressions of the following type:

$$
\begin{aligned}
Q_i &= \delta_0 + \delta_1 N_i + \delta_2 X_i + \varepsilon_{i2} && \text{(2nd stage)} \\
N_i &= \theta_0 + \theta_1 \mathrm{OCP}_i + \theta_2 X_i + \varepsilon_{i1} && \text{(1st stage)}
\end{aligned}
$$

where Q_i is the quality of child i, a dichotomous dependent variable for post-compulsory schooling attendance, N_i is the number of siblings of child i, and X_i is a vector of characteristics of child i, its parents, and its household. X_i includes a set of dummies for child i's age, its mother's age, and the household's province, as well as two indicators for parental education, one for post-compulsory school attendance of the mother, and one for post-compulsory school attendance of the father. OCP_i, our first-stage instrumental variable, measures the degree of OCP coverage of child i's household and ranges from zero (no coverage) to one (complete coverage of mother's prime fertility years). Finally, ε_{i1} and ε_{i2} are error terms. In our baseline specification, we cluster standard errors at the level of households since more than one child could be from the same household. In a robustness check, however, we cluster standard errors also at the level of provinces where family planning regulations are made. As our dependent variable is dichotomous, we furthermore run IV probit regressions. As these produce qualitatively identical results, we do not report them in the main text.[18]

We expect a household that is longer subjected to OCP fertility restrictions during the prime fertility years of the mother to have fewer children. In other words, we expect θ_1 in the first-stage regression to be negative. Furthermore, if a child quantity-quality trade-off indeed exists, then exogenous reductions in child quantity, induced by OCP household coverage, should lead to an increase in child quality, that is, the likelihood of a child to obtain some post-compulsory schooling should rise. If so, δ_1 in the second-stage regression should be negative.

Identification in our 2SLS setting requires that our instrumental variable OCP_i is uncorrelated with the error term ε_{i2} in the second-stage outcome equation (instrument exogeneity) but correlated with the potentially endogenous child quantity measure N_i (instrument relevance). The former requirement, while not testable, is likely to be satisfied, given the exogeneity (for individual households) of provincial OCP regulations and exemptions and the fact that we do control for potential confounders, such as province of residence, mother and child age, as well as parental education. The second requirement is testable and can be shown to hold. As we will see, when discussing our regression results in Section 4, OCP_i and N_i are indeed highly correlated in our data. Systematic household migration across provinces can pose a potential threat to identification if such migration seeks to avoid unfavorable provincial restrictions on household fertility. The actual scale of cross-province migration in our estimation sample, however, is very low. Using province information on an individual's place of current residence (in 2000) and birth shows that 96.49% of mothers in our estimation sample (accounting for 96.41% of all children under study in our analysis) still resided in their province of birth in the year 2000. As we will show in a robustness

[18]Results of IV probit regressions for our baseline specification are provided in the appendix.

check, dropping households that ever migrated from our estimation sample proves immaterial for our findings.

4 Results

4.1 Main Results

As we focus in our analysis on households of mothers who are Han with an agricultural Hukou, variation in the extent of individual OCP coverage in our estimation sample comes from three sources only, the age of a mother (determining her fertile life span in calendar time), the calendar year that OCP regulations at province level were first introduced, and the timing and degree of exemptions from OCP regulations granted at province level to individuals with an agricultural Hukou. Our main OLS and 2SLS results for different variants of the regression specification described in Section 3.4 are shown in Table 5. Throughout, standard errors are clustered at a household level

Columns (1) and (2) in Table 5 report results from simple OLS and 2SLS regressions of child quantity on child quality, where we consider as additional regressors only the age of a mother and a set of dummy variables for the different Chinese provinces. Age of mother controls for cohort effects, such as differences in preferences and in average economic conditions and the differential exposure of different female cohorts to OCP regulations. Province dummies, in turn, control for time-invariant differences in child quantity and quality between provinces. The results of this simple 2SLS regression show that the longer a mother's prime fertility years are subject to OCP fertility restrictions, the fewer children she tends to have (first stage) and that this exogenous reduction in child quantity, in turn, is associated with a statistically significant increase in child quality (second stage), i.e. the likelihood of a child of post-compulsory schooling age to have post-compulsory education (see column (2) of Table 5). The instrument is strong (large F-statistic) and its negative coefficient is large: mothers covered by the OCP for their entire fertile years tend to have an average 0.29 children less than they would have got if they had not been subject to any fertility restrictions, a sizable exogenous reduction in child quantity. Furthermore, the impact of this policy-induced reduction in family size on child quality is also large. An additional sibling is predicted to reduce the likelihood of a child to have post-compulsory education by 0.26. Children of mothers covered by the OCP for their entire fertile years therefore have an average $-0.29 \times (-0.26) = 0.075$ higher likelihood to have post-compulsory schooling than children of mothers who were never constrained in their fertility by OCP regulations. This is a sizable increase in child quality given that the (unconditional) average likelihood of children in our estimation sample to have post-compulsory education is only 0.15. The OLS results reported in column (1) also show a negative and statistically significant coefficient estimate of sibling size, albeit one that is much smaller in absolute magnitude. Based on this estimate, the same decrease in the number of siblings (by 0.29) is predicted to increase the probability of being enrolled in post-compulsory education by only $-0.29 \times (-0.04) = 0.012$, which suggests that OLS tends to severely underestimate the true effect of child quantity on quality.

We next add two indicator variables to our set of regressors that take value one if the mother,

Table 5: OLS and 2SLS Estimates of the Effect of Number of Siblings on Child Quality

	OLS	2SLS		OLS	2SLS		OLS	2SLS	
		1. stage	2. stage		1. stage	2. stage		1. stage	2. stage
	(1)	(2)		(3)	(4)		(5)	(6)	
number of siblings	-0.04***		-0.26***	-0.04***		-0.23***	-0.04***		-0.17***
	(0.00)		(0.05)	(0.00)		(0.05)	(0.00)		(0.04)
mother education				0.14***	-0.26***	0.09***	0.14***	-0.28***	0.10***
				(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
father education				0.12***	-0.01	0.12***	0.12***	-0.02	0.12***
				(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)
OCP		-0.29***			-0.28***			-0.33***	
		(0.04)			(0.04)			(0.04)	
mother age	Yes	Yes		Yes	Yes		Yes	Yes	
province dummy	Yes	Yes		Yes	Yes		Yes	Yes	
child age	No	No		No	No		Yes	Yes	
F-statistic		55.29			50.75			68.10	
observations	67,953	67,953		67,953	67,953		67,953	67,953	

Notes: The dependent variable in the OLS and second stage 2SLS regressions is a binary indicator for the enrollment of a child in post-compulsory education. The dependent variable in the first stage of the 2SLS regression is the number of siblings of a child. All regressions control for child age in five groups (15-19, 20-23, 24-27, 28-31, 32-35) and mother age in three groups (35-40, 41-45, 46-50). *, **, *** denote statistical significance at 10%, 5% and 1% level. Standard errors are clustered at the household level and reported in parentheses.

respectively father, has post-compulsory schooling (columns (3) and (4) in Table 5). These binaries control for parental education and account also for potential differences among parents in preferences and capabilities that are related to own education and of potential importance for parental quantity and quality choices, such as the importance parents attach to child education and fertility and their ability to provide personal support to their children in school. As shown in column (4) of Table 5, our 2SLS second-stage coefficient estimate for the number of siblings remains negative, statistically significant, and sizable, although its absolute magnitude (the scale of the trade-off between quantity and quality) is now marginally smaller. Furthermore, our estimated first-stage effect of OCP coverage on child quantity is virtually unchanged. Consistent with expectations, more educated parents tend to have fewer (only mothers) but more educated children (both mothers and fathers).

Finally, we further augment our specification by adding controls for the age of children. Adding a set of dummies for different age cohorts controls for potential birth cohort effects in family size and educational attainment. As shown in column (6) of Table 5, however, controlling for the age of children does not materially affect our 2SLS estimates. The second stage coefficient estimate for the number of siblings remains negative and significant (albeit now somewhat further reduced in magnitude), and our instrument stays strong and of sizable influence for family size.

Summarizing the above, our results suggest that a sizable quantity-quality trade-off existed in China during the period under investigation, a finding that proves robust to various changes in model specification. We tried IV probit instead of a linear probability model specification, which produces qualitatively identical results (see Table A-2 in the appendix).[19] Our findings also prove

[19] As this also holds true for all other 2SLS regressions we estimated and report in the following, we will not tabulate the results of these IV probit regressions. For the interested reader, they are available from the author upon request.

robust to the use of alternative ways of clustering standard errors (see Table A-3 in the appendix). First, we clustered standard errors at the level of provinces at which family planning regulations were made. With only 31 provinces, the number of clusters is small, which could bias standard errors and lead to over-rejection (Cameron et al., 2008; Cameron and Miller, 2015). We therefore use a wild bootstrap test after 2SLS estimation when clustering at province level. The effect of child quantity in the second stage remains significant, albeit at a lower level (10%), while the significance of our instrument (OCP) in the first stage remains unchanged. Second, we clustered standard errors at the level of 91 groups with differential exposure to OCP restrictions, defined by combinations of mother age (3 age groups) and province of residence (31 provinces).[20] For children whose mothers reside in the same province and are of the same age and Hukou (agricultural) live in households that are subjected to the same OCP regulations. Reassuringly, clustering standard errors at this group level also proves immaterial for the statistical significance of our (first-stage) instrument and (second-stage) measure of child quantity.

4.2 Robustness Checks

We carried out checks on the robustness of our findings to various changes in the estimation sample. These changes include (i) the restriction of the estimation sample to households with mothers who still live in their province of birth, (ii) the omission of mothers who are never or completely constrained by OCP regulations during their prime fertility years, (iii) the restriction of the analysis to the oldest child living in a family, and (iv) the extension of the estimation sample to children of mothers who were forty years or older at the time of the 2000 census survey. We also checked the robustness of our results to (v) the use of an alternative dichotomous child quantity measure that captures only whether a child does have any other siblings at all. In the following, we discuss each of the tests in turn.

4.2.1 Excluding Mothers Who No Longer Live in Province of Birth

As discussed in Section 3.4, preference-driven selective endogenous migration of mothers to provinces less stringent in OCP regulations poses a potential threat to identification in our regression setup. However, as noted before, only about 3.6% of children in our estimation sample are from a household with a mother who at the time of the census in the year 2000 resides in a province that differs from her province of birth. The scale of any preference-driven selective cross-province migration in our data, if indeed present at all, is hence quite limited at best. Nevertheless, as a robustness check, we re-estimated our baseline model of column (6) in Table 5, excluding from the estimation sample those children with mothers who no longer live in their respective province of birth. Compared to our baseline results, however, the estimated coefficient of the number of siblings remains negative, statistically significant, and of similar magnitude (see column (2) in Table 6). This finding suggests

[20]In Tibet, we only have children in our estimation sample whose mothers are in the age group 35-40. Therefore, we have only 91 groups instead of $(31 \times 3 =)$ 93 groups.

that our results do not suffer from potential bias caused by preference-driven selective endogenous migration of mothers to provinces that are less stringent in their OCP regulations.

TABLE 6: 2SLS Estimates of the Effect of Number of Siblings on Child Quality in Households with Mothers who still Reside in Province of Birth

	Baseline	**No Change in Province of Residence**
	(1)	(2)
2nd stage		
number of siblings	-0.17***	-0.18***
	(0.04)	(0.04)
1st stage		
OCP	-0.33***	-0.32***
	(0.04)	(0.04)
mother age	Yes	Yes
province dummy	Yes	Yes
mother education	Yes	Yes
father education	Yes	Yes
child age	Yes	Yes
F-statistic	68.10	64.84
observations	67,953	65,513

Notes: Column (1) reproduces our baseline results from column (6) in Table 5. Column (2) reports results from re-estimating our baseline model of column (6) in Table 5 on a restricted sample of children whose mothers still live in their respective province of birth. The dependent variable in the second stage of the 2SLS regressions is a binary indicator for the enrollment of a child in post-compulsory education. The dependent variable in the first stage of the 2SLS regressions is the number of siblings of a child. All regressions control for child age in five groups (15-19, 20-23, 24-27, 28-31, 32-35) and mother age in three groups (35-40, 41-45, 46-50). *, **, *** denote statistical significance at 10%, 5% and 1% level. Standard errors are clustered at the household level and reported in parentheses.

4.2.2 Excluding Never And/Or Fully OCP-Constrained Mothers

Mothers who are never or fully covered by OCP fertility restrictions during their fertile years may be different from mothers who are subjected at least partially to such restrictions. In the estimation sample, about 4.08% of households (accounting for 4.14% of all children) are never covered by the OCP, while 7.21% of households (housing 5.76% of all children) are fully covered by OCP fertility restrictions. Our baseline estimation sample, however, includes all mothers, irrespective of the degree of their exposure to the (treatment of the) OCP. As a consequence, the second-stage coefficient estimate of child quantity (number of siblings) captures an average effect across all women that exploits variations in OCP coverage both at the extensive and at the intensive margin. Mothers who are never or fully covered by OCP fertility restrictions during their fertile years are not exposed to any variation in policy when fertile. Treatment (full coverage) and no treatment (no coverage at all) for these mothers are hence exclusively determined by a combination of province of residence and age, a combination that may have a direct effect on child education, invalidating our instrument.

To gauge the relevance of such concerns, we re-estimated our baseline 2SLS specification of column (6) in Table 5 using three different restricted estimation samples. The first excludes mothers who were never covered by the OCP during their fertile years, the second excludes mothers who were completely covered by OCP restrictions during their fertile years, and the third excludes mothers who were either never or fully covered.[21] Table 7 reports estimates from these regressions of our two key coefficients, the first-stage coefficient on our IV and the second-stage coefficient on our child quantity measure. As is evident, both are still negatively signed and highly statistically significant. The first-stage coefficient estimate of our IV turns out even somewhat larger in absolute magnitude when we drop households that are fully covered by the OCP during mothers' prime fertility years.

Table 7: 2SLS Estimates of the Effect of Number of Siblings on Child Quality in Households Where Mothers Are Not Never And/Or Fully Constrained by the OCP

	Baseline	**OCP∈(0,1]**	**OCP∈[0,1)**	**OCP∈(0,1)**
	(1)	(2)	(3)	(4)
2nd stage				
number of siblings	-0.17***	-0.18***	-0.18***	-0.21***
	(0.04)	(0.04)	(0.04)	(0.04)
1st stage				
OCP	-0.33***	-0.34***	-0.43***	-0.45***
	(0.04)	(0.04)	(0.05)	(0.05)
mother age	Yes	Yes	Yes	Yes
province dummy	Yes	Yes	Yes	Yes
mother education	Yes	Yes	Yes	Yes
father education	Yes	Yes	Yes	Yes
child age	Yes	Yes	Yes	Yes
F-statistic	68.10	73.29	67.26	69.15
observations	67,953	65,139	64,036	61,222

Notes: Column (1) reproduces our baseline results from column (6) in Table 5. Columns (2) to (4) report results from re-estimating our baseline model of column (6) in Table 5 for different restricted estimation samples. Column (2) excludes mothers (and their children) from the estimation sample that are never restricted by the OCP during their prime fertility years, column (3) excludes mothers that are throughout (fully) restricted during their years of prime fertility, and column (4) excludes mothers that are either never or fully restricted by OCP fertility regulations. The dependent variable in the second stage of the 2SLS regressions is a binary indicator for the enrollment of a child in post-compulsory education. The dependent variable in the first stage of the 2SLS regressions is the number of siblings of a child. All regressions control for child age in five groups (15-19, 20-23, 24-27, 28-31, 32-35) and mother age in three groups (35-40, 41-45, 46-50). *, **, *** denote statistical significance at 10%, 5% and 1% level. Standard errors are clustered at the household level and reported in parentheses.

4.2.3 The Oldest Child

Our estimation sample considers all children aged 15 or older, irrespective of whether these children are first-born children or children of higher birth parity. First-born children, however, are

[21] The first of these restricted samples of mothers only considers variation in the intensity of OCP coverage across mothers who are ever covered by the OCP.

conceptually different from children born at higher parities. The reason is that parents were never constrained by the OCP in their decision to have a first child, i.e. in their decision to have children at all. Conditional on having children, OCP regulations only restricted how many children parents may have. Parents may also treat children of different parity systematically different.

To see whether the undifferentiated use of children of different birth parities matters for our results, we restricted the estimation sample to the oldest child who is still residing in a household. Note that this child need not be the first-born child if some child has already moved out. Since we don't have any information on children who have moved out by the census year, we cannot identify the first-born child. Nevertheless, we can use two types of subsamples to explore the importance of first-born status and, more generally, birth parity for our results. First, we restricted the estimation sample to those oldest children who live in households where the total number of children born to a woman is identical to the number of children who still live at home. The drawback of this approach is that we lose a large number of observations and that mothers in such households are disproportionately young and hence more likely to be subjected to OCP regulations during their prime fertility years, reducing the variation in child quantity that is caused by OCP coverage. Second, since older children are more likely to have moved out of the parental household, we restricted in a second robustness check the estimation sample further by dropping in addition the oldest 10% of children. These 10% of children were born before 1976. The oldest children remaining in this restricted estimation sample are now more likely to be the first-born children. For each of these two restricted estimation samples, we estimateed the effect that siblings have on the quality of the oldest child using again our 2SLS baseline specification of column (6) in Table 5.[22] Table 8 contains the relevant regression output. The estimated first-stage coefficients of the policy variable are still negative and significant, but smaller in absolute magnitude than for our baseline estimation sample. Furthermore, if we compare specifications (1) and (2), the policy effect is slightly smaller in the second specification, which can be explained by the fact that the likelihood of households with younger children to be fully covered by the OCP is higher. This is consistent with the findings in Section 4.2.2. The estimated second-stage coefficient on child quality is again negative and significant in both specifications.

4.2.4 Prime Fertility Age 21-40 And Mothers Aged 40^{+}

In our baseline specification, the estimation sample covered children of post-compulsory schooling age (fifteen years or older) of mothers who are aged at least 35 at the time of the 2000 census and we assumed that women are of prime fertility age between the ages of 21 and 35. In further robustness checks, we tested whether our findings are sensitive to variation in the minimum age of mothers considered in the analysis as well as variation in the upper age limit used for defining the prime fertile age span of women. Both dimensions are of importance for the level of the cutoff age for completed fertility of women considered in the analysis.

[22] If there are any twins or triplets among these oldest children, we keep only one of them in the sample (we keep the child that has the smallest household member number).

Table 8: 2SLS Estimates of the Effect of Number of Siblings on Child Quality for the Oldest Child in a Household

	Baseline	**Restr. Sample I**	**Restr. Sample II**
	(1)	(2)	(3)
2nd stage			
number of siblings	-0.17***	-0.24***	-0.24***
	(0.04)	(0.06)	(0.08)
1st stage			
OCP	-0.33***	-0.24***	-0.21***
	(0.04)	(0.03)	(0.04)
mother age	Yes	Yes	Yes
province dummy	Yes	Yes	Yes
mother education	Yes	Yes	Yes
father education	Yes	Yes	Yes
child age	Yes	Yes	Yes
F-statistic	68.10	55.36	33.86
observations	67,953	46,814	42,145

Notes: Column (1) reproduces our baseline results from column (6) in Table 5. Columns (2) and (3) report results from re-estimating our baseline model of column (6) in Table 5 for different restricted estimation samples. Column (2) restricts the estimation sample to the oldest child in a household, and column (3) drops from this restricted estimation sample the oldest 10% of children. The dependent variable in the second stage of the 2SLS regressions is a binary indicator for the enrollment of a child in post-compulsory education. The dependent variable in the first stage of the 2SLS regressions is the number of siblings of a child. All regressions control for child age in five groups (15-19, 20-23, 24-27, 28-31, 32-35) and mother age in three groups (35-40, 41-45, 46-50). *, **, *** denote statistical significance at 10%, 5% and 1% level. Standard errors are clustered at the household level and reported in parentheses.

First, and before changing the definition of prime fertility age, we restricted only the focus to children of mothers who are aged 40 or older (rather than 35 or older as in our baseline setting), keeping the 15-year fertility age span as well as our measure of mothers' OCP coverage intensity from our baseline specification unchanged. As a result of this sample restriction to older mothers, total sample size declines from $67,953$ to $55,304$. Re-estimating our model on this smaller restricted sample produces an estimated effect of OCP coverage on the number of siblings that is still negative but much larger in absolute magnitude than that in our baseline results reported in column (6) of Table 5 (see column (2) in Table 9). A potential explanation for this sizable increase is that women in the restricted estimation sample (now mothers aged 40^{+}) are less covered by the OCP because of their average older age so that they could realize a second birth when desiring multiple children. The second-stage result still indicates a sizeable trade-off between number of siblings and the likelihood of a child to be enrolled in (or have completed) post-compulsory education. The likelihood of having post-compulsory education increases by $-0.71 \times (-0.10) = 0.071$ percentage points if OCP coverage intensity of a mother changes from 0 (no coverage) to 1 (complete coverage). The share of children in the estimation sample that are enrolled in (or have completed) post-compulsory education is only 0.162.

Second, and in addition to considering only women aged at least 40 at the time of the 2000 census (as in column (2) of Table 9), we also expanded from 15 to 20 years the maximum number of years we consider for defining the prime fertile age span of mothers, adjusting in line with this change also our measure of mothers' OCP coverage intensity. This measure remains bounded between zero and one, but its value for a particular woman may now be different, as we expanded the number of years in which women are considered fertile. Re-estimating our baseline 2SLS specification of column (6) in Table 5 using both the older sub-group of mothers and the longer fertile life span definition produces results that are qualitatively identical to our baseline results (see column (3) in Table 9). The estimated first-stage coefficient on our IV and the estimated second-stage coefficient on our child quantity measure are both still negatively signed and highly statistically significant. As in column (2) of Table 9, the first-stage coefficient estimate of our IV turns out considerably larger in absolute magnitude than in our baseline specification. The estimated second-stage coefficient of number of siblings, however, is again very close in value to our baseline estimate.

TABLE 9: 2SLS Estimates of the Effect of Number of Siblings on Child Quality for Mothers Aged 40^{+} and Prime Fertility Age 21-40

	Baseline	**Mothers Aged 40^{+}**	**Mothers Aged 40^{+} / Fertile Age 21-40**
	(1)	(2)	(3)
2nd stage			
number of siblings	-0.17***	-0.10***	-0.16***
	(0.04)	(0.03)	(0.04)
1st stage			
OCP	-0.33***	-0.71***	-0.72***
	(0.04)	(0.07)	(0.09)
mother age	Yes	Yes	Yes
province dummy	Yes	Yes	Yes
mother education	Yes	Yes	Yes
father education	Yes	Yes	Yes
child age	Yes	Yes	Yes
F-statistic	68.10	116.13	67.17
observations	67,953	55,304	55,304

Notes: Column (1) reproduces our baseline results from column (6) in Table 5. Columns (2) and (3) report results from re-estimating our baseline model of column (6) in Table 5 for different groups of mothers and different definitions of the prime fertile age span of mothers. Column (2) considers children of mothers who are aged 40 or older (rather than 35 or older as in our baseline setting), keeping the 15-year fertility age span as well as our measure of mothers' OCP coverage intensity from our baseline specification unchanged. Column (3), in addition, expands from 15 to 20 years the maximum number of years we consider for defining the prime fertile age span of mothers, adjusting in line with this change also our measure of mothers' OCP coverage intensity. The dependent variable in the second stage of the 2SLS regressions is a binary indicator for the enrollment of a child in post-compulsory education. The dependent variable in the first stage of the 2SLS regressions is the number of siblings of a child. All regressions control for child age in five groups (15-19, 20-23, 24-27, 28-31, 32-35) and mother age in three groups (35-40, 41-45, 46-50). *, **, *** denote statistical significance at 10%, 5% and 1% level. Standard errors are clustered at the household level and reported in parentheses.

4.2.5 Binary Siblings Indicator

In a final test, we checked the robustness of our results to the use of an alternative and dichotomous child quantity measure that captures only whether a given child does have any siblings at all. This binary child quantity variable takes value 1 if a child has any siblings at all, and 0 otherwise. This alternative definition is more in line with the critical threshold set by the OCP between one and two children. The second-stage coefficient on this endogenous binary regressor hence measures the marginal effect of having any siblings, rather than the marginal effect of having one more sibling as in our baseline model.

The results of this robustness test are shown in Table 10. As can be seen, OCP coverage exerts a statistically significant negative effect on the probability of a child to have any siblings at all: mothers covered by the OCP for their entire fertile years have a 0.12 lower likelihood of having multiple children than they would have got if they had not been subject to any fertility restrictions. Moreover, this policy-induced reduction in the likelihood of a second birth tends to increase average child quality: having siblings is predicted to reduce the likelihood of a child to have post-compulsory education by 0.47. Children of mothers covered by the OCP for their entire fertile years therefore have an average $-0.12 \times (-0.47) = 0.0564$ higher likelihood to have post-compulsory schooling than children of mothers who are never constrained in their fertility by OCP regulations. Given that the (unconditional) average likelihood of children in our estimation sample to have post-compulsory education is only 0.15, this is a sizable increase in child quality.[23]

TABLE 10: 2SLS Estimates of the Effect of Having Any Siblings on Child Quality

	Baseline	**Binary Siblings Indicator**
	(1)	(2)
2nd stage		
siblings (number or binary)	-0.17***	-0.47***
	(0.04)	(0.10)
1st stage		
OCP	-0.33***	-0.12***
	(0.04)	(0.01)
mother age	Yes	Yes
province dummy	Yes	Yes
mother education	Yes	Yes
father education	Yes	Yes
child age	Yes	Yes
F-statistic	68.10	139.27
observations	67,953	67,953

Notes: Column (1) reproduces our baseline results from column (6) in Table 5. Column (2) uses a dichotomous child quantity measure (instead of the number of siblings) that takes value 1 if a child has any siblings at all, and 0 otherwise. The dependent variable in the second stage of the 2SLS regressions is a binary indicator for the enrollment of a child in post-compulsory education. The dependent variable in the first stage of the 2SLS regressions is the number of siblings of a child (column (1)), respectively a binary indicator that takes value 1 if a child has any siblings at all, and 0 otherwise (column (2)). All regressions control for child age in five groups (15-19, 20-23, 24-27, 28-31, 32-35) and mother age in three groups (35-40, 41-45, 46-50). *, **, *** denote statistical significance at 10%, 5% and 1% level. Standard errors are clustered at the household level and reported in parentheses.

[23]Considering only mothers aged at least 40 at the time of the 2000 census and assuming women are fertile until this age, as done in Section 4.2.4, produces qualitatively identical results.

5 Conclusion

In this paper, we investigated empirically for China the potential trade-off between child quantity and quality, a trade-off first suggested in 1960 by later Nobel Laureate Gary S. Becker. For identification, we exploited China's One-Child Policy (OCP) as an exogenous source of variation in the number of offspring to a woman. Our results show strong evidence for a sizable child quantity-quality trade-off among children of Han mothers with an agricultural background, a population which accounts for about three quarters of all children born in China. This finding proves robust to various changes in the estimation sample, the use of an alternative and dichotomous child quantity measure, and the level at which we cluster standard errors.

In our analysis, we have used a novel and more accurate measure of individual OCP coverage than hitherto the case in the literature. This measure draws on and combines for the first time detailed regional information on actual OCP implementation, regulations, and exemptions in 31 Chinese provinces, which we collected from provincial family planning regulations, with information on the actual childbearing age of women at particular points in time and their ethnic and agricultural background. Not dichotomous as in existing studies, this continuous measure captures more accurately the intensity of treatment individual women have been exposed to by OCP regulations that restricted their childbearing decisions over the course of their lifetime span of fertility. Other than in parts of the literature for China, we also restricted the analysis to educational outcomes of children of post-compulsory schooling age only, i.e. to educational outcomes which are indeed subject to parental discretion.

The new measure of individual OCP coverage developed in this paper and used in our analyses can be fruitfully employed in other applications in future research, e.g. for studying tilted sex ratios at birth, marriage market dynamics and patterns, or criminal activity in China. As data availability may be more limited in other applications, we gauged in additional explorations, as a point of reference and service to other researchers, the relative importance of ethnic background information or household Hukou for obtaining a measure of OCP coverage that is highly correlated with the measure of OCP coverage which makes full use of all relevant information.

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Appendix

TABLE A-1: Regulations and Exemptions of One-Child Policy

Province	Regulation	Date of Release	Date of Implementation
Beijing	Interim Provisions of Beijing on Population and Family Planning	10/12/1979	11/01/1979
	Regulations of Beijing on Population and Family Planning	01/15/1991	06/01/1991
	Regulations of Beijing on Population and Family Planning (revision)	05/14/1999	05/14/1999
Tianjin	Document (1979) 6	- -/- -/1979	- -/- -/1979
	Document (1979) 85	- -/- -/1979	- -/- -/1979
	Decision on Encouraging late childbearing and Controlling the Second Birth	04/17/1981	04/17/1981
	Regulations of Tianjin on Population and Family Planning	11/02/1988	01/01/1989
	Regulations of Tianjin on Population and Family Planning (revision)	03/09/1993	03/09/1993
	Regulations of Tianjin on Population and Family Planning (revision)	04/15/1994	07/01/1994
	Regulations of Tianjin on Population and Family Planning (revision)	07/30/1997	07/30/1997
Hebei	Document (1979) 122	07/- - /1979	07/- - /1979
	Interim Provisions of Hebei on Family Planning	04/05/1982	05/01/1982
	Report of Conference on Family Planning in Heibei	08/04/1984	08/04/1984
	Regulations of Hebei on Population and Family Planning	03/20/1989	03/20/1989
	Regulations of Hebei on Population and Family Planning (1st revision)	09/02/1994	09/02/1994
	Regulations of Hebei on Population and Family Planning (2nd revision)	09/03/1997	09/03/1997
Shanxi	Interim Provisions of Shanxi on Family Planning	09/07/1979	10/01/1979
	Provisions of Shanxi on Family Planning	06/29/1982	12/01/1982
	Notice on the Implementation of "Provisions of Shanxi on Family Planning"	11/28/1986	01/01/1987
	Regulations of Shanxi on Population and Family Planning	09/22/1989	01/01/1990
	Regulations of Shanxi on Population and Family Planning (revision)	04/06/1999	10/01/1999
Inner Mongolia	Regulations of Inner Mongolia on Population and Family Planning	10/15/1990	10/15/1990
	Regulations of Inner Mongolia on Population and Family Planning (1st revision)	11/17/1995	11/17/1995
	Regulations of Inner Mongolia on Population and Family Planning (2nd revision)	11/29/1999	11/29/1999
Liaoning	Document (1979) 131	06/16/1979	06/16/1979
	Supplementary Provisions on Issues of Family Planning	06/24/1982	06/24/1982
	Regulations of Liaoning on Population and Family Planning	05/28/1988	05/28/1988
	Regulations of Liaoning on Population and Family Planning (1st revision)	09/25/1992	09/25/1992
	Regulations of Liaoning on Population and Family Planning (2nd revision)	09/27/1997	09/27/1997
Jilin	Document (1979) 299	09/26/1979	09/26/1979
	Document (1984) 111	08/18/1984	08/18/1984
	Interim Provisions on Family Planning	04/20/1985	05/01/1985
	Regulations of Jilin on Population and Family Planning	07/21/1988	07/21/1988
	Regulations of Jilin on Population and Family Planning	09/11/1993	10/01/1993
	Regulations of Jilin on Population and Family Planning (revision)	11/14/1997	11/14/1997
Heilongjiang	Document (1979) 263	- -/- -/1979	- -/- -/1979
	Document (1983) 10	- -/- -/1983	- -/- -/1983
	Regulations of Heilongjiang on Population and Family Planning	12/13/1989	02/01/1990
	Regulations of Heilongjiang on Population and Family Planning	05/21/1994	07/01/1994
	Regulations of Heilongjiang on Population and Family Planning	12/18/1999	02/01/2000

Table A-1: Regulations and Exemptions of One-Child Policy (Cont'd)

Province	Regulation	Date of Release	Date of Implementation
Shanghai	Provisions on Family Planning	09/01/1979	09/01/1979
	Regulations of Shanghai on Population and Family Planning	10/11/1990	10/11/1990
	Regulations of Shanghai on Population and Family Planning (revision)	08/02/1993	09/01/1993
	Regulations of Shanghai on Population and Family Planning (revision)	10/30/1996	10/30/1996
Jiangsu	Interim Provisions on Family Planning	07/31/1979	07/31/1979
	Regulations of Jiangsu on Population and Family Planning	10/28/1990	10/28/1990
	Regulations of Jiangsu on Population and Family Planning (revision)	06/16/1995	06/16/1995
	Regulations of Jiangsu on Population and Family Planning (revision)	07/31/1997	07/31/1997
Zhejiang	Document (1979) 108	- -/- -/1979	- -/- -/1979
	Interim Regulations of Zhejiang on Population and Family Planning	03/04/1982	03/04/1982
	Regulations of Zhejiang on Population and Family Planning	02/04/1985	02/04/1985
	Regulations of Zhejiang on Population and Family Planning	01/03/1990	01/03/1990
	Regulations of Zhejiang on Minority Population and Family Planning	09/11/1990	09/15/1990
	Regulations of Zhejiang on Population and Family Planning (revision)	09/28/1995	09/28/1995
Anhui	Document (1979) 38	04/09/1979	04/09/1979
	Interim Provisions of Anhui on Implementing Family Planning	05/09/1981	05/09/1981
	Regulations of Anhui on Population and Family Planning	08/17/1984	12/01/1984
	Regulations of Anhui on Population and Family Planning (revision)	10/31/1988	12/01/1988
	Regulations of Anhui on Population and Family Planning (revision)	08/30/1992	08/30/1992
Fujian	Document (1979) 32	06/01/1979	06/01/1979
	Notice on Family Planning Work	03/08/1982	03/08/1982
	Interim Provisions of Fujian on Minority Family Planning	07/14/1984	07/14/1984
	Regulations of Fujian on Population and Family Planning	04/29/1988	07/01/1988
	Regulations of Fujian on Population and Family Planning (revision)	06/28/1991	07/10/1991
Jiangxi	Several Provisions of Jiangxi on Family Planning (trial)	04/24/1981	04/24/1981
	Interim Provisions of Jiangxi on Problems of Family Planning Work	01/18/1983	01/18/1983
	Regulations of Jiang on Population and Family Planning	06/16/1990	09/01/1990
	Regulations of Jiang on Population and Family Planning (revision)	06/30/1995	09/01/1995
	Regulations of Jiang on Population and Family Planning (revision)	06/20/2007	20/06/2007
Shandong	Interim Provisions of Shandong on Family Planning	03/31/1980	03/31/1980
	Interim Provisions of Shandong on the Second Birth	05/10/1984	05/10/1984
	Regulations of Shandong on Population and Family Planning	07/20/1988	07/23/1988
	Regulations of Shandong on Population and Family Planning (revision)	10/14/1996	10/14/1996
Henan	Interim Provisions of Henan on Family Planning	07/- -/1981	07/- -/1981
	Regulations of Henan on Population and Family Planning	04/12/1990	07/01/1990
Hubei	Document (1979) 140	09/- -/1979	09/- -/1979
	Document (1981) 82	06/13/1981	06/13/1981
	Document (1984) 33	07/26/1984	07/26/1984
	Regulations of Hubei on Population and Family Planning	12/19/1987	03/01/1988
	Regulations of Hubei on Population and Family Planning (revision)	12/01/1991	12/01/1991
	Regulations of Hubei on Population and Family Planning (revision)	03/28/1997	03/28/1997
Hunan	Document (1979) 58	05/26/1979	05/26/1979
	Provisions of Hunan on Family Planning	05/10/1982	05/10/1982
	Regulations of Hunan on Population and Family Planning	12/03/1989	01/01/1990
	Regulations of Hunan on Population and Family Planning (revision)	08/03/1999	08/03/1999

Table A-1: Regulations and Exemptions of One-Child Policy (Cont'd)

Province	Regulation	Date of Release	Date of Implementation
Guangdong	Regulations of Guangdong on Population and Family Planning	02/02/1980	02/02/1980
	Regulations of Guangdong on Population and Family Planning (revision)	05/17/1986	06/01/1986
	Regulations of Guangdong on Population and Family Planning (revision)	12/24/1992	12/24/1992
	Regulations of Guangdong on Population and Family Planning (revision)	09/18/1998	09/18/1998
Guangxi	Provisions of Guangxi on Problems of Family Planning Work	11/06/1979	11/06/1979
	Interim Provisions of Guangxi on Family Planning	11/25/1982	11/25/1982
	Regulations of Guangxi on Population and Family Planning	09/17/1988	01/01/1989
	Regulations of Guangxi on Population and Family Planning (revision)	11/26/1994	11/26/1994
Hainan	Regulations of Hainan on Population and Family Planning	03/11/1989	10/09/1989
	Regulations of Hainan on Population and Family Planning (revision)	11/25/1995	11/25/1995
Chongqing	Regulations of Chongqing on Population and Family Planning	09/13/1997	01/01/1998
Sichuan	Document (1980) 177	08/04/1980	08/04/1980
	Document (1984) 64	07/01/1984	07/01/1984
	Regulations of Sichuan on Population and Family Planning	07/02/1987	07/02/1987
	Regulations of Sichuan on Population and Family Planning (revision)	12/15/1993	12/15/1993
	Regulations of Sichuan on Population and Family Planning (revision)	10/17/1997	10/17/1997
Guizhou	Interim Provisions of Guizhou on Family Planning	06/16/1979	06/16/1979
	Interim Provisions of Guizhou on Family Planning	07/16/1987	01/01/1988
	Regulations of Guizhou on Population and Family Planning	07/24/1998	07/24/1998
Yunnan	Document (1979) 157	- -/- -/1979	- -/- -/1979
	Regulations of Yunnan on Population and Family Planing	12/22/1990	04/01/1991
Tibet	Interim Provisions of Tibet on Family Planning	05/08/1992	05/08/1992
Shaanxi	Document (1979) 101	07/01/1979	07/01/1979
	Interim Provisions of Shaanxi on Family Planning	04/30/1981	05/01/1981
	Regulations of Shaanxi on Population and Family Planing	07/25/1986	07/31/1986
	Regulations of Shaanxi on Population and Family Planing (revision)	03/03/1991	03/03/1991
	Regulations of Shaanxi on Population and Family Planing (revision)	08/02/1997	08/02/1997
Gansu	Document (1979) 152	07/14/1979	07/14/1979
	Document (1982) 105	03/16/1982	03/16/1982
	Interim Provisions of Gansu on Minority Family Planning	02/05/1985	02/05/1985
	Regulations of Gansu on Population and Family Planning	11/28/1989	01/01/1990
	Regulations of Gansu on Population and Family Planning (revision)	09/29/1997	09/29/1997
Qinghai	Interim Provisions of Qinghai on Family Planning	05/31/1982	05/31/1982
	Regulations of Qinghai on Population and Family Planning	04/17/1986	04/17/1986
	Regulations of Qinghai on Population and Family Planning (revision)	02/28/1992	04/01/1992
Ningxia	Interim Provisions of Ningxia on Family Planning	08/28/1986	08/28/1986
	Regulations of Ningxia on Population and Family Planning	12/28/1990	01/15/1991
Xinjiang	Interim Provisions of Xinjiang on Minority Family Planning	04/23/1988	07/01/1988
	Regulations of Xinjiang on Population and Family Planning	08/15/1991	07/01/1992

Notes: The date of release and the date of implementation are written in the way of month/day/year. For the study irrelevant regulations are not listed.

TABLE A-2: IV Probit Estimates of the Effect of Number of Siblings on Child Quality

	1		2		3	
	coefficient	marg. effect	coefficient	marg. effect	coefficient	marg. effect
2nd stage						
number of siblings	-0.90***	-0.28***	-0.87***	-0.27***	-0.76***	-0.25***
	(0.08)	(0.02)	(0.09)	(0.02)	(0.10)	(0.02)
mother education			0.15**	0.05*	0.21***	0.07***
			(0.07)	(0.03)	(0.07)	(0.03)
father education			0.35***	0.12***	0.38***	0.13***
			(0.04)	(0.02)	(0.04)	(0.02)
1st stage						
OCP	-0.29***		-0.28***		-0.33***	
	(0.04)		(0.04)		(0.04)	
mother education			-0.26***		-0.28***	
			(0.02)		(0.02)	
father education			-0.01		-0.02	
			(0.02)		(0.02)	
mother age	Yes		Yes		Yes	
province dummy	Yes		Yes		Yes	
child age	No		No		Yes	
observations	67,951		67,951		67,951	

Notes: The dependent variable in the second stage of the IV Probit regressions is a binary indicator for the enrollment of a child in post-compulsory education. The dependent variable in the first stage of the IV Probit regressions is the number of siblings of a child. All regressions control for child age in five groups (15-19, 20-23, 24-27, 28-31, 32-35) and mother age in three groups (35-40, 41-45, 46-50). *, **, *** denote statistical significance at 10%, 5% and 1% level. Standard errors are clustered at the household level and reported in parentheses.

Table A-3: 2SLS & IV Probit Estimates of the Effect of Number of Siblings on Child Quality When Clustering Standard Errors at Province or Group Level

	Province Level			**Group Level**	
	2SLS		**IVprobit**	**2SLS**	**IVprobit**
2nd stage					
number of siblings	-0.17**	$\star$	-0.25***	-0.17***	-0.25***
	(0.08)		(0.05)	(0.07)	(0.05)
1st stage					
OCP	-0.33***	$\star\star\star$		-0.33***	
	(0.06)			(0.07)	
mother age	Yes	Yes	Yes	Yes	Yes
province dummy	Yes	Yes	Yes	Yes	Yes
mother education	Yes	Yes	Yes	Yes	Yes
father education	Yes	Yes	Yes	Yes	Yes
child age	Yes	Yes	Yes	Yes	Yes
(quasi-)F-statistic	26.08	26.08		20.11	
observations	67,953	67,953	67,951	67,953	67,951

Notes: The dependent variable in the second stage of the 2SLS and IV Probit regressions is a binary indicator for the enrollment of a child in post-compulsory education. The dependent variable in the first stage of the 2SLS and IV Probit regressions is the number of siblings of a child. All regressions control for child age in five groups (15-19, 20-23, 24-27, 28-31, 32-35) and mother age in three groups (35-40, 41-45, 46-50). Standard errors are clustered at province or group level and reported in parentheses. *, **, *** denote statistical significance at 10%, 5% and 1% level. $\star$, $\star\star$, $\star\star\star$ show statistical significance at 10%, 5% and 1% level in a wild bootstrap test after 2SLS estimation when standard errors are clustered at province level.

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