Published in final edited form as:
Demography. 2020 December ; 57(6): 2085–2111. doi:10.1007/s13524-020-00931-2.

Parental Investment After the Birth of a Sibling: The Effect of Family Size in Low-Fertility China

Shuang Chen[1]

[1]Office of Population Research, 284 Wallace Hall, Princeton University, Princeton, NJ 08540, USA

Abstract

A large body of research has examined the relationship between family size and child well-being in developing countries, but most of this literature has focused on the consequences of high fertility. The impact of family size in a low-fertility developing country context remains unknown, even though more developing countries are expected to reach below-replacement fertility levels. Set in China between 2010 and 2016, this study examines whether an increase in family size reduces parental investment received by the firstborn child. Using data from the China Family Panel Studies (CFPS), this study improves on previous research by using direct measures of parental investment, including monetary and nonmonetary investment, and distinguishing household-level from child-specific resources. It also exploits the longitudinal nature of the CFPS to mediate the bias arising from the joint determination of family size and parental investment. Results show that having a younger sibling significantly reduces the average household expenditure per capita. It also directly reduces parental investment in the firstborn child, with two exceptions: (1) for firstborn boys, having a younger sister does not pose any competition; and (2) for firstborn children whose mothers have completed primary education or more, having a younger brother does not reduce parental educational aspirations for them. Findings from this study provide the first glimpse into how children fare as China transitions to a universal two-child policy regime but have wider implications beyond the Chinese context.

Keywords

Family size; Parental investment; Resource dilution; Gender; China

---

sc37@princeton.edu.

Authors' Contributions Shuang Chen conceptualized, designed, conducted, and wrote the research.

Ethics and Consent The author reports no ethical issues.

Conflict of Interest The author declares no conflicts of interest.

Data Availability The CFPS data analyzed in the current study are available in the Peking University Open Research Data Platform at https://doi.org/10.18170/DVN/45LCSO

Introduction

The relationship between family size and child well-being in developing countries has long been of interest to demographers (Bougma et al. 2015; Desai 1995; Eloundou-Enyegue and Williams 2006; King 1987; Knodel and Wongsith 1991; Knodel et al. 1990; Kugler and Kumar 2017; Li et al. 2008; Marteleto and de Souza 2012; Mueller 1984). Most of this literature has focused on the consequences of high fertility on child welfare. Yet nearly one-half of the world population today lives in countries with fertility levels below 2.1, and low-fertility countries are no longer restricted to the developed world (United Nations Department of Economic and Social Affairs 2017). With more countries in the developing world expected to reach below-replacement fertility levels in the near future (United Nations Department of Economic and Social Affairs 2017), there is a compelling need to renew our understanding of the impact of family size on child well-being in developing countries under the new fertility regime.

In a low-fertility developing country context, it remains an empirical question whether an increase in *sibship size* (i.e., the number of siblings) reduces parental investment received by the existing child. On the one hand, with limited support from the state and parents assuming the main responsibility for providing resources to children, an increase in sibship size is more likely to result in *resource dilution*, reducing the resources available for each child (Desai 1995; Gibbs et al. 2016). On the other hand, parents may have already taken into account the potential impact of increased family size when making fertility decisions. If only those parents who can maintain the level of investment in the existing child decide to have another child, then an increase in sibship size may not affect the exiting child because of self-selection into sibship sizes. Moreover, if parents allocate resources unequally among children—as is often the case in developing settings (Behrman 1997)—increased sibship size may reduce parental investment in some children but not affect, or even increase, parental investment in others.

The current study, set in China between 2010 and 2016, examines parental investment received by the firstborn child as s/he transitions from having no siblings to having a younger sister or brother.[1] Since the early 1990s, China has reached and sustained below-replacement fertility levels (Cai 2010; Feeney and Jianhua 1994; Morgan et al. 2009). The latest estimate of the period total fertility rate (TFR) using the 2015 mini-census was 1.047, which placed China among countries with the lowest fertility rates in the world (Guo et al. 2019). Government reports of the TFR in 2016, ranging from 1.25 to 1.7, were higher but still well below 2.1 (Zhao and Zhang 2018). Fertility ideals in China have also reached well below the two-child norm that characterizes many Western low-fertility countries (Morgan et al. 2009). In the meantime, parents' aspirations for each child, along with investments in children's education, have grown rapidly in both rural and urban areas (Attané 2016; Chi and Qian 2016; Greenhalgh and Winckler 2005:227, 234), and the escalating direct and opportunity costs of education are largely borne by households (Chi and Qian 2016;

[1] I am unable to estimate the effect of higher-parity births in this context because only 5% of the firstborn children had transitioned from having a sibling to two siblings in the survey. Consistent with the survey data, according to the 2015 Chinese census, births of parity three or more account for only a small fraction of the total births in China (Guo et al. 2019).

Heckman and Yi 2012; Khor et al. 2016; Li et al. 2017a; Liu et al. 2009; Zhang et al. 2013). At the high school level, China is estimated to have one of the highest tuition rates in the world, at up to 82% of the net per capita income of a rural household (Liu et al. 2009). At the compulsory level (i.e., primary and middle school levels), even though education is nominally free, the total household educational expenditure has continued to rise in urban areas owing to the increasing out-of-school expenditure on private tutoring and extracurricular activities (Chi and Qian 2016). In rural areas, as the labor shortage has rapidly increased the wages of low-skilled workers, the high opportunity cost of staying in school has become the main reason for dropping out before finishing middle school (Yi et al. 2012). In addition to the below-replacement fertility level coupled with the high private cost of education, China further presents an apposite case for studying resource dilution and allocation in a context of persistent son preference (Ebenstein 2010, 2011; Ebenstein and Leung 2010; Gupta et al. 2003; Poston 2002).

In the United States, Blake (1981:440) argued that sibship size not only constitutes one of the most important background characteristics that influence children’s educational opportunities but also a factor that is more “readily affected by choice” than is family socioeconomic status. For China, investigating the effect of sibship size has an even deeper significance because couples’ family size decisions are shaped more by public policy. Contrary to popular misconception, China’s one-child policy introduced in 1979 encompasses large geographic and demographic variation (Baochang et al. 2007; Zeng and Hesketh 2016). By the end of the 1990s, only slightly more than one-third of the population were estimated to be subject to a strict one-child policy (Baochang et al. 2007). Previously, the effect of the one-child policy on child well-being sparked extensive debate (Zeng and Hesketh 2016). Two more recent studies investigated sibship size and educational outcomes around 1990, right before China reached below-replacement fertility (Li et al. 2008; Qian 2018). The current study is set in a period (2010–2016) during which further exemptions to the one-child policy were introduced. By 2011, all provinces had permitted couples who were both only-children themselves to have two children (Zeng and Hesketh 2016). In November 2013, couples in which at least one of the partners was an only-child were allowed to have two children, making another 11 million couples eligible (Attané 2016). In October 2015, a universal two-child policy was introduced (Zeng and Hesketh 2016). Thus, it provides the first glimpse into how children fare as China transitions to a universal two-child policy regime.

Empirically, this study addresses two major challenges faced by previous research by drawing on data from the China Family Panel Studies (CFPS). First, although resource dilution is often taken to be the explanation for the observed relationship between sibship size and child educational attainment in developing countries (Eloundou-Enyegue and Williams 2006; Knodel and Wongsith 1991; Knodel et al. 1990; Kugler and Kumar 2017; Li et al. 2008; Marteleto and de Souza 2012), there is a surprising lack of direct tests of whether increased sibship size reduces parental investment, the key mechanism linking sibship size to child educational attainment according to the resource dilution hypothesis (Blake 1981, 1989). Without direct tests, it remains unclear whether any of the observed relationships between sibship size and educational attainment in the existing studies can be attributed to resource dilution.

In this study, I use detailed and direct measures of parental investment available from the CFPS, including both monetary and nonmonetary investment, and distinguishing household-level resources from investment received by a specific child. Second, this study exploits the longitudinal nature of the CFPS to mediate the bias arising from the joint determination of family size and educational investment. If parents who invest more in the firstborn child are also less likely to have a second child, simply comparing children with and without a sibling would overestimate the negative effect of sibship size on parental investment (Angrist et al. 2010; Ferrari and Zuanna 2010; Guo and VanWey 1999a; Workman 2017). Persistent son preference and prevalent sex selection at birth (Ebenstein 2010; Huang et al. 2016b) pose additional challenges to identifying the sibship size effect given that unobserved factors may jointly determine the gender of the firstborn, the decision to have a second child, and the gender of the second child, along with resource allocation among children. Following Guo and VanWey (1999a), this study compares outcomes for the same firstborn child before and after having a younger brother or sister, thereby effectively controlling for any time-invariant individual-level heterogeneity that might confound the relationship between sibship size and parental investment.

Theoretical Background

Resource Dilution

The resource dilution hypothesis (Anastasi 1956; Blake 1981, 1989) states that additional children in a family dilute parental inputs by dividing them among more children. Although the resource dilution hypothesis provides a self-evident explanation for a negative relationship between sibship size and child well-being, empirical studies from developing countries have found neutral or even positive relationships (Anh et al. 1998; Buchmann 2000; Chernichovsky 1985; Gomes 1984). More recent studies have advanced the literature by comparing the sibship size effects on child well-being across countries and over time (Bras et al. 2010; Eloundou-Enyegue and Williams 2006; Li et al. 2017b;Lu and Treiman 2008; Maralani 2008; Marteleto and de Souza 2012; Park 2008; Xu 2008).

The varying sibship size effects across contexts have led researchers to shift the focus from whether a large sibship size disadvantages children to the conditions under which it does so. One crucial condition for increased sibship size to result in resource dilution is that parents bear the primary responsibility for providing resources to the child. In contexts where the state, communities, or extended families provide considerable support, an increase in sibship size may not reduce the resources available to a child (Desai 1995; Gibbs et al. 2016; Lu and Treiman 2008; Park 2008; Shavit and Pierce 1991; Xu 2008). Another condition is that the total amount of resources remains fixed with increased sibship size. In contexts where siblings not only consume but also contribute to household resources (Chu et al. 2007; Marteleto and de Souza 2013), children may not be disadvantaged by having many siblings.

Both conditions are met in many developing countries today: as the buffering role of the state and the extended family declines, demand for child labor decreases, and the cost and responsibility of childrearing and education fall almost entirely on parents, increased sibship size should result in substantial resource dilution. Empirical evidence from countries as diverse as Thailand, Indonesia, Brazil, Cameroon, and China has pointed to a consistent trend whereby the positive relationship between sibship size and child educational attainment disappears and a negative relationship emerges and grows stronger (Eloundou-Enyegue and Williams 2006; Knodel et al. 1990; Lu and Treiman 2008; Maralani 2008; Marteleto and de Souza 2012).

Resource Reallocation

An increase in family size not only reduces the average amount of resources per capita but may also lead to a reallocation of resources. The latter process, which has been overlooked by the resource dilution hypothesis, could produce a neutral or even positive effect of sibship size on parental investment. For one thing, parents can reduce their own consumption after having another child to keep the level of educational investment intact. Evidence from the United States has suggested that parents rearrange resources to mitigate the negative impact of increased family size on child well-being (Cáceres-Delpiano 2006). More importantly, the resource dilution hypothesis is silent on how finite parental resources are allocated among children within the same household (King 1987; Mueller 1984). If parents invest unequally among children (Becker and Tomes 1976; Behrman 1997), they may be able to maintain or even increase the level of educational investment in a specific child at the expense of the other children in the household (Lafortune and Lee 2014; Montgomery et al. 2000).

Across East Asian societies, research has suggested that the effect of sibship size on parental resources depends on the child’s gender and birth order (Chu et al. 2007, 2008; Greenhalgh 1985; Kang 2010; Parish and Willis 1993; Yu and Su 2006). The debate has centered on what exactly drives and diminishes differential parental investment among children. Using a sample of individuals born in postwar Taiwan between the late-1930s and mid-1960s, Greenhalgh (1985) showed that parents invest strategically in daughters’ education to ultimately advance sons’ education. She argued that for parents rooted in the patriarchal family system in East Asia, the expanded educational and labor market opportunities provide them with new means to reproduce and reinforce gender inequality. Parish and Willis (1993) disagreed that parents simply sacrifice daughters’ education for sons’; rather, they argued that the differential investment in sons’ and daughters’ education is conditional on household resource constraints. Using retrospective data collected on individuals who reached age 12 from the 1940s to the 1970s in Taiwan, they found that early-born daughters marry early to ease the household resource constraint, which benefits both younger brothers and younger sisters; however, in more recent periods and among affluent families, there is less need for one child to sacrifice for another. Yu and Su (2006) agreed that the differential investment in sons’ and daughters’ education is conditional on resource constraint; however, using a longitudinal survey of individuals born between 1935–1876 in Taiwan, they found that male firstborns enjoy privileges that do not extend to female firstborns, suggesting that culturally defined norms regarding gender and birth order also play a role in shaping the intrahousehold resource allocation in Chinese society.

Although the various theoretical propositions broadly suggest a sibling competition under resource constraint that benefits later-born children at the expense of earlier-born girls in the East Asian context, the empirical evidence does not line up neatly. For example, in Taiwan, Parish and Willis (1993) found that women are disadvantaged by having more younger sisters but not younger brothers. Yet, Chu et al. (2007) found women's education to be negatively associated with both the number of younger sisters and the number of younger brothers. A recent study set in mainland China concluded that for both women and men, being the oldest child in the family is associated with significantly more education (Lei et al. 2017). In a separate study set in Japan, Lee (2009) found that girls with college-educated brothers attain more education than those without, contradicting the hypothesis that boys drain resources from their sisters. A common weakness of these empirical studies is that they rely on models comparing children from different families and consequently are subject to omitted variable bias arising from unobserved differences among families and individuals.

Measuring Parental Investment

Despite the large body of research on the effect of sibship size in developing countries, almost all the empirical studies have been limited to examining educational attainment (Bougma et al. 2015; Eloundou-Enyegue and Williams 2006; Knodel and Wongsith 1991; Knodel et al. 1990; Kugler and Kumar 2017; Li et al. 2008; Marteleto and de Souza 2012; Ponczek and Souza 2012; Schmeer 2009). Without direct measures of parental investment, it remains unclear whether any of the observed relationships between sibship size and educational attainment is produced by resource dilution or reallocation given that parental resources are not the only determinant of educational attainment (Strauss and Thomas 1995).

Research set in the United States has directly examined measures of parental investment as intervening variables linking sibship size and child educational attainment. This research has demonstrated the theoretical importance of distinguishing the level of resources (i.e., household-level resources vs. child-specific investment) (Blake 1981, 1989; Downey 1995) and type of resources (i.e., monetary vs. nonmonetary investment) (Downey 1995; Guo and VanWey 1999b; Workman 2017). For example, Blake (1981) argued that the negative effect of sibship size on child-specific investment cannot be compensated by providing a more advantageous home environment shared by all children. Downey (1995) demonstrated that not all types of parental resources are equally susceptible to dilution: monetary resources decline more rapidly with increased sibship size than nonmonetary resources measured by parental educational aspirations, communication with children, and social capital. In the Chinese context, both monetary and nonmonetary investments have been shown to determine children's educational attainment and achievement (Brown and Park 2002; Knight et al. 2009; Liu and Xie 2015; Zhao 2015; Zhao and Glewwe 2010). This study examines the monetary resources measured by both household-level expenditure per capita and child-specific educational expenditure. For nonmonetary resources, following Downey (1995) and Blake (1981, 1989), this study focuses on parental aspirations for their children's academic attainment.

Parental educational aspiration is conceptualized as an important parental attitude and belief that influences children's sense of efficacy, aspirations, and academic achievement through socialization (Bandura et al. 1996, 2001; Murayama et al. 2016; Parsons et al. 1982; Zimmerman et al. 1992, 2016). In sociology, according to the Wisconsin model of status attainment, parental aspiration is a key social-psychological mediator between family socioeconomic background and educational attainment (Davies and Kandel 1981; Sewell and Shah 1968; Sewell et al. 1969). When testing the resource dilution hypothesis in the United States, Downey (1995) and Blake (1981, 1989) showed that parental educational aspiration is a child-specific, interpersonal resource that mediates the relationship between sibship size and educational outcomes. In the Chinese context, research has demonstrated that parental academic aspirations predict children's educational attainment even after controlling for household economic resources, school quality, and children's prior academic performance (Zhao and Glewwe 2010; Zhang et al. 2007). Thus, it is potentially an intervening variable explaining the relationship between sibship size and educational attainment.

Another reason to focus on parental academic aspirations in the Chinese context is that it reflects not only socioeconomic but also cultural differences among households (Kao and Tienda 1998; Okagaki and Frensch 1998). Specifically, in China, the mother's educational aspirations have been shown to correlate with how much future financial help she anticipates from the child, and mother's gender attitudes determine how similar or different her aspirations are for sons and daughters (Zhang et al. 2007). Therefore, parental academic aspiration is a particularly appropriate measure of nonmonetary resources to study not only the effect of sibship size but also how the effect is moderated by gender.

Endogeneity of Sibship Size

A major challenge to identify the effect of sibship size is that sibship size and parental educational investment may be jointly determined. For example, if parents with higher educational aspirations for their children both invest more in their children and have fewer children, a smaller sibship size cannot be said to have increased parental investment. In China, concerns about producing a "high-quality child" have not only led to increasing parental investment in child education but have also contributed to the growing preferences for one-child families (Greenhalgh and Winckler 2005). In this context, simply comparing children of different sibship sizes would overestimate the negative effect of sibship size on parental investment (Angrist et al. 2010; Ferrari and Zuanna 2010; Guo and VanWey 1999a).

Various identification strategies have been used to address the endogeneity of sibship size (Angrist et al. 2010; Black et al. 2005; Conley and Glauber 2006; Ferrari and Zuanna 2010; Jæger 2008; Kugler and Kumar 2017; Lee 2008; Li et al. 2008; Ponczek and Souza 2012; Qian 2018; Rosenzweig and Wolpin 1980). Two of the studies using the 1% sample of the 1990 Chinese Population Census have reached opposite conclusions about the sibship size effect on education: while Li et al. (2008) showed a negative effect of family size on children's educational attainment and school enrollment in rural China, Qian (2018) found that for one-child families in rural China, an additional child significantly increased school enrollment of firstborn children. Li et al. (2008) used twin births to identify the exogenous change in sibship size. However, prior research found that Chinese couples purposely misreport their nontwin children as twins in the census to avoid the punishment for violating the one-child policy (Huang et al. 2016a), suggesting that twin births (recorded in the census) may not be exogenous. Qian (2018) exploited the relaxation of the one-child policy around 1984 permitting second births for eligible couples in rural China to identify the exogenous change in sibship size, using a difference-in-difference-in-difference estimator:

that is, a triple interaction term among whether the individual is born in a county with policy relaxation, whether the individual is a girl, and her birth cohort. However, the county-level variation in the terms and conditions of the policy relaxation is a result of deliberately adapting the higher-level policy to local conditions and accommodating local peasants' son preference and reproductive needs (Greenhalgh 1986; Greenhalgh and Winckler 2005), and thus are most likely endogenous.

Following Guo and VanWey (1999a), this study uses fixed-effect models to account for any heterogeneity (observed or unobserved) across individuals. Instead of comparing children with different sibship sizes, the fixed-effect model compares the outcomes of the same child before and after a sibling is born; thus, it effectively controls for any individual-level unobserved effect that may confound the relationship between sibship size and parental investment. Guo and VanWey (1999a) showed that the negative relationship between sibship size and cognitive development disappears once the fixed-effect model is applied. Critics of the study focused on the restriction of the analytic sample to widely spaced siblings (Downey et al. 1999; Guo and VanWey 1999b) and young mothers (Phillips 1999). However, Guo and VanWey's (1999a) original findings have recently been corroborated by studies addressing these shortcomings (Sandberg and Rafail 2014; Workman 2017).

Data and Methods

Data

This study uses four waves of data (2010, 2012, 2014, and 2016) from the China Family Panel Study (CFPS). Covering 25 provinces, the CFPS is the largest near-nationwide, longitudinal survey in China (Xie and Lu 2015). The survey followed members in 14,960 households and any children born to these households over the six years. The extensive information collected from the household, adult, and child questionnaires makes it possible to construct a sample of firstborn children who are linked to their mother's fertility histories and other family-level information collected prospectively. Furthermore, for every child aged under 16 at the time of the survey, a questionnaire is administered to their parents, which contains rich, comparable, and repeated measures of household resources and educational investment. This unique design enables the identification of the sibship size effect using within-person fixed-effect models.

Measurement

Three outcome variables are examined. *Household-level resources* are measured by household expenditure per capita, which is the monthly household expenditure divided by the size of the household. *Household expenditure* includes several components, including food and nonfood consumption, taxes and transfers, insurance premiums, and mortgages. *Child-specific investment* is measured by two variables: parental educational aspirations and educational expenditure. *Parental educational aspirations* refer to the years of education the parent hopes the firstborn child to attain. Years of education are converted from the level of education reported by the parent.[2] *Educational expenditures* are defined as the total amount the household has spent on the firstborn child's education in the past year, including tuition, miscellaneous school fees, tutoring, extracurricular activities, books and supplies, and other education-related expenses. For children under primary school age, educational expenditures includes tuition and miscellaneous fees charged by daycare and kindergarten as well as expenses on various early childhood education activities outside daycare and kindergarten. Importantly, educational expenditures include only the amount paid by the household, excluding any government subsidies or support from extended families.

Time-varying control variables include the year of the survey (2010, 2012, 2014, or 2016), age of the child at the time of the survey (modeled by a series of dummy variables for each year of age), and urban/rural residence at the time of the survey. For the analysis of effect heterogeneity, several time-invariant variables are used, including the gender of the child, the spacing between the child and his/her next younger sibling (less than two years, two to four years, or more than four years), whether the child has a nonagricultural *hukou*,[3] whether the child is of ethnic minority or Han majority, and mother's educational attainment (less than primary, primary, middle school, high school and above).

Sample Restrictions

For the analysis of household expenditures per capita and parental educational aspirations, the samples are extracted from a total of 18,415 person-years of observations on firstborn children aged under 16 at the time of each wave of the survey. For child-specific educational expenditures, because educational expenditure data are collected only for children older than 1, the analytic sample is extracted from 17,143 person-years of observations aged 1 to 15.

Because the focus is on the transition from having no siblings to one sibling, I exclude all observations with two or more siblings. From the remaining person-years with complete data on the outcome variable and covariates, I discard children who had already had a younger sibling when they were first observed. Including the *already treated*—that is, children who already had a younger sibling at the beginning of the study—may bias the estimation of the treatment effect (Sobel 2012:526). I further exclude children with fewer than two waves of observations. As a final step, I exclude a small number of children whose younger siblings are twins. Details of the sample restrictions are presented in Table A1 in the online appendix. In the sensitivity analysis, I test whether the results are robust to sample selection and attrition.

The final analytic samples contain 3,553 children (10,096 person-years) for the analysis of household expenditure per capita; 3,010 children (7,733 person-years) for the analysis of parental educational aspirations; and 3,330 children (9,549 person-years) for the analysis of child-specific educational expenditure. Descriptive statistics of the three analytic samples are presented in Table 1.

[2]0 = no need to go to school, 6 = primary school, 9 = middle school, 12 = high school, 15 = vocational/technical college, 16 = four-year college, 18 = master's degree or PhD.

[3]The nonagricultural *hukou* (*feinong hukou*) status grants various privileges and social benefits, and the conversion to nonagricultural *hukou* status is considered a key path of upward social mobility (Chan and Buckingham 2008; Chen and Fan 2016). Although *hukou* status could change over time, very few cases of change have been reported among the sample of children used in this study, some of which might be due to misreporting. Therefore, the variable is treated as time-invariant in the analysis, and the value reported in the latest wave of the survey is used.

Analytic Strategy

Let y_{it} denote the parental investment received by child i at time t. I use fixed-effects methods (Wooldridge 2001:265) to estimate the following basic model:

$$y_{it} = \mathbf{x}_{it}\boldsymbol{\beta} + c_i + u_{it}, \quad t = 1, 2, 3, 4 \tag{1}$$

The treatment variable of interest is $\mathbf{x}_{it}$, which indicates whether child i had a younger brother or sister before year t. c_i is the unobserved effect (or individual heterogeneity), and u_{it} represents the idiosyncratic errors.

A major advantage of the fixed-effects method is that it allows individual heterogeneity, c_i, to be arbitrarily correlated with $\mathbf{x}_{it}$. In other words, even though sibship size and parental investment outcomes may be jointly determined by the individual- and household-level attributes, such as the child's gender, innate ability, household socioeconomic status, and parents' motivations, the fixed-effects estimator is consistent as long as these attributes are time-invariant. Thus, in this case, fixed-effects models are more robust than pooled ordinary least squares (OLS) models or random-effects models, which are not consistent if sibship size is correlated with any unobserved individual heterogeneity.

Although the fixed-effect model relaxes the assumption that sibship size is orthogonal to any time-invariant unobserved effect, it still requires the strict exogeneity assumption of the explanatory variables conditional on the unobserved effect (Wooldridge 2001:252), which implies that sibship size in each period is uncorrelated with the idiosyncratic error in each period. Thus, several observable time-varying control variables are added to the basic model shown in Eq. (1): year of the survey, age of the child, and urban/rural residence at the time of the survey. Later in the article, I present sensitivity analyses showing that the estimates are robust to the inclusion of other potential time-varying confounders.

Another limitation of the fixed-effects models is that the result can be generalized only to those firstborn children who had a sibling born during the study period. In other words, the fixed-effects model estimates an average treatment effect on the treated (ATT) (Brüderl and Ludwig 2015). It does not tell us what would have happened to those who remained an only child during the study period if they had had a sibling. Given the gradual relaxations of China's one-child policy, those who experience an increase in sibship size may be changing over time. Thus, the question remains whether the results generated from this study will continue to hold. To address this question, in the following section, I first describe the selection into having a younger sibling using observable time-invariant characteristics. After estimating the average effect of having a younger sibling, I present tests of whether the sibship size effect varies by these observable characteristics. I further present exploratory evidence on how policy relaxations may be changing the selection into having a younger sibling and discuss its implications.

Results

Descriptive Statistics

Figure 1 illustrates the composition of the analytic sample used for household expenditure per capita, grouped by treatment status: (1) never had a younger sibling versus had a younger sibling; and (2) among those who had a younger sibling, had a younger brother versus had a younger sister. The composition of the analytic samples for the other two outcomes are similar.

Among the 3,553 firstborn children, 933 (26%) had a younger sibling during the study period. Compared with those who never had any young siblings, firstborn children who had a younger sibling are more likely to be girls, without a nonagricultural *hukou*, and have mothers with less than high school education. Among the 933 firstborn children who had a younger sibling, 508 (54%) had a younger brother, and 425 (46%) had a younger sister. Compared with those who had a younger sister, a greater proportion of those who had a younger brother are girls, ethnic minorities, and spaced less than two years apart from their younger sibling.

There is clear evidence of a skewed sex ratio: 54% of the total firstborn children in the analytic sample for household expenditure per capita are boys; about the same percentage of firstborn children who had a younger sibling during the study period had a younger brother. Firstborn girls are not only more likely to have a younger sibling, but among those who had a younger sibling, 57% had a younger brother. In comparison, firstborn boys who had a younger sibling are equally likely to have a younger brother and a younger sister. Prevalent son preference in the Chinese context brings additional challenges to identifying the sibship size effect. Given that firstborn girls are more likely to have a younger sibling than firstborn boys, the gender of the firstborn child determines both the sibship size and parental investment outcomes. However, as discussed earlier, the fixed-effects estimator used in this study effectively controls for any time-invariant confounding factors, including the gender of the firstborn child and any unobserved factors that determine the gender of the firstborn child, such as parents' gender values and son preferences. Moreover, given the prevalence of sex selection at second parity (Ebenstein 2010; Huang et al. 2016b), simply comparing children with younger brothers with those with younger sisters would have led to biased estimates of the effect of sibling gender on parental investment in the first child. The fixed-effect model specified in Eq. (1) is not subject to this bias because the effect of having a younger brother is estimated only from the subsample of firstborns who had a younger brother, and the effect of having a younger sister is estimated separately from the subsample of firstborns who had a younger sister.

Average Effect

Figure 2 presents the average effects of having a younger brother and having a younger sister, respectively, on the three measures of parental investment. The full estimates are detailed in Table A2 in the online appendix. Having a younger brother or younger sister reduces the household expenditure per capita by 18% and 11%, respectively, and both reductions are statistically significant at the 95% level. Having a younger brother also significantly reduces both measures of child-specific parental investment: it lowers parental educational aspirations for the firstborn child by 0.3 years and reduces the educational expenditure on the firstborn child by 29%. In comparison, having a younger sister does not significantly lower the parental educational aspirations for the firstborn child. It reduces the educational expenditure on the firstborn child by 24%, and the reduction is statistically significant at the 90% level.

Effect Heterogeneity

Table 2 presents models testing whether the younger brother/sister effect varies significantly by observable characteristics of the firstborn child and household. For household expenditure per capita, the negative effect of having a younger sibling (brother or sister) does not vary significantly by the firstborn child's gender, *hukou* status, spacing with the younger sibling, mother's educational attainment, or ethnicity.

Having a younger brother reduces parental aspirations for both firstborn girls and firstborn boys, and the negative effect does not differ significantly by firstborn gender. In comparison, the neutral average effect of having a younger sister on parental educational aspirations (shown in Fig. 2) is due to its opposite effects on firstborn girls and boys, as illustrated in Fig. 3: having a younger sister reduces parental aspirations for firstborn girls by more than 0.33 years but increases parental aspirations for firstborn boys by 0.27 years. Consistently, the negative effect of younger sister on educational expenditure is also mainly driven by firstborn girls, even though the estimated coefficient on the interaction term is not statistically significant. Taken together, the findings suggest that a younger sister does not pose competition to firstborn boys; in fact, parents may concentrate more resources on the firstborn boys after his younger sister is born, as implied by the positive effect of having a younger sister on educational aspirations.

The negative average effect of having a younger brother on parental educational aspirations is mainly driven by children with uneducated mothers. As demonstrated in Fig. 4, for children whose mothers have less than primary education, having a younger brother reduces parents' educational aspirations by 1.23 years. In comparison, for children whose mothers have at least primary education, having a younger brother does not significantly reduce parental educational aspirations. A similar pattern is found for the education expenditure on the firstborn, as presented in Table 2: for firstborn children with uneducated mothers, having a younger brother reduces the educational expenditure they receive by as much as 58%—a greater reduction than for those with educated mothers.

Sensitivity Analysis

The Strict Exogeneity Assumption

Even though the fixed-effect model effectively controls for any unobserved effect that is time-invariant, it still requires that sibship size in each time period is uncorrelated with the idiosyncratic error in every period. The models presented so far control for time-varying covariates including the year of the survey, urban/rural residence, and age of the child. But the estimates may still be biased by other time-varying covariates. Here, I examine whether the estimates are robust to the inclusion of two potential time-varying variables that might confound the relationship between sibship size and parental investment.

First, the health condition of the firstborn child might affect parents' fertility decisions as well as their level of educational investment at a given time. The top panel of Table A3 (online appendix) presents the estimates from fixed-effect models with and without controlling for whether the child has been ill in the month preceding the survey. There is little change in either the size or the significance level of the estimates after controlling for the time-varying health status.

Second, although the fixed-effects model controls for any time-invariant "ability" differences among children, time-varying ability of the firstborn child may still confound the relationship between sibship size and parental investment at each period. The bottom panel of Table A3 (online appendix) presents estimates with and without controlling for a proxy of time-varying ability: the academic performance in Chinese and mathematics classes in the semester preceding the time of the survey. Because this measure of time-varying ability is available only for children older than 6, all the models presented in the bottom panel of Table A3 are estimated on a subsample of person-years when the firstborn child is older than 6. For this subsample of observations, adding the ability variable incurs little change to the size and significant levels of the estimated effects of younger brother and younger sister.

In addition, the changing eligibility to have a second child over time, due to the phased relaxations of the one-child policy, might be correlated with unobservable time-varying covariates that confound the relationship between sibship size and parental investment. To check whether the strict exogeneity assumption may be violated by the changing eligibility, I conduct a falsification test by repeating the same analysis on a subsample of firstborn girls without nonagricultural *hukou*. Rural parents whose first child is a girl has been eligible to have a second child since as early as 1984 (Baochang et al. 2007). If the result observed on the full sample were biased by the changing eligibility during the study period, one would expect to see different results among the subsample of girls without nonagricultural *hukou* who are not subject to the same bias. Table A4 in the online appendix compares the estimates using the subsample with estimates using the full sample of firstborn girls. There is no statistically significant difference in the coefficients, suggesting that the effects estimated on the full sample of girls are not driven by unobservable factors correlated with the changing policy.

Discretionary Versus Nondiscretionary Educational Expenditures

The measure of educational expenditure used earlier includes both discretionary expenditures and nondiscretionary expenditures, including tuitions and other school-incurred expenses (such as miscellaneous fees, rooms and board, and transportation costs). If the change in total educational expenditure is a result of changing parental investment and resource reallocation, as posited by the theoretical framework, one should expect the change to be driven by changes in discretionary expenditures (such as expenses on books and supplies, educational software, extracurricular activities, and tutoring) rather than nondiscretionary expenditures. Table 3 summarizes the estimated effects of having a younger sibling on the total, discretionary, and nondiscretionary educational expenditures, respectively. As expected, having a younger brother or sister does not significantly change the nondiscretionary educational expenditures but has a strong negative effect on discretionary educational expenditures. Having a younger brother reduces the discretionary educational expenditures by 36%, and having a younger sister reduces the discretionary educational expenditures by 43%.

Sample Selection and Attrition

All the fixed-effects models presented earlier are estimated on unbalanced panels. Several factors contribute to attrition and sample selection. First, by design, the CFPS survey collects measures of parental aspirations and educational expenditures for slightly different subsamples of children across the four waves. For example, parental aspirations were collected for only those children of even years of age in the 2010 survey to reduce the response burden. Second, individuals may be entering and exiting the panel. Finally, the outcome variables and covariates used in the preceding analysis might be missing for some survey waves even when people do not leave the survey. The fixed effects on the unbalanced panel might be inconsistent if sample selection is correlated with the idiosyncratic error in each period, violating the strict exogeneity assumption of the explanatory variables conditional on the unobserved effect (Wooldridge 2001:579).

Table A5 in the online appendix presents two tests for sample selection bias. The top panel presents estimates using a subset of the unbalanced panel containing children who have complete observations for the baseline as well as all the subsequent waves of the survey. The estimates on the subset do not change the general conclusions about the average effects of younger brother and sister. The bottom panel presents a test for sample selection bias suggested by Nijman and Verbeek (1992) (see also Wooldridge 2001:581), which adds to the fixed-effects model an indicator of whether the individual is present in the previous survey wave and conducts a *t* test for the lagged selection indicator. None of the lagged selection indicators is statistically significant at the 95% level, failing to reject the null hypothesis that the idiosyncratic error at a given period is uncorrelated with selection for any period.

Discussion

Resource Dilution, Resource Reallocation, and Self-selection

My findings provide strong evidence of resource dilution: having a younger sibling reduces the average household expenditure per capita across the board. Previous research has argued that if children not only consume but also contribute to household resources, parental investment received by a child may not be reduced by increased sibship size because the total amount of household resources does not stay fixed (Chu et al. 2007; Marteleto and de Souza 2013; Ponczek and Souza 2012). In the current study, however, the total amount of household-level economic resources does not seem to rise as fast as the family size. Indeed, the sample of firstborn children used in this study is younger than 16. Because few children and adolescences in China engage in paid work (Tang et al. 2018), it is unlikely that they contribute substantially to the total household economic resources after a younger sibling is born.

It was hypothesized that parents may reallocate resources in a way that keeps the child-specific investment intact, but this does not seem to be the case in most instances: having a younger sibling directly reduces the parental investment in the firstborn child as measured by parental educational aspirations and educational expenditures. One exception is that if the firstborn child is a boy, having a younger sister does not significantly reduce either the parental aspirations or the educational expenditure he receives; in fact, there is suggestive evidence that it may increase the parental aspirations for his education. This finding is broadly in line with previous research set in East Asia suggesting that firstborn girls, compared with firstborn boys, are disproportionately disadvantaged by having younger siblings (Chu et al. 2007; Parish and Willis 1993; Yu and Su 2006). More specifically, the current study shows that although firstborn girls face competition posed from both younger brothers and younger sisters, firstborn boys are negatively impacted only by having a younger brother; they do not face competition from younger sisters.

Another exception is that for children whose mothers have attained primary education or above, having a younger brother does not significantly reduce the parental educational aspirations. The negative effect of having a younger brother on child-specific parental investment is predominantly driven by children whose mothers have less than primary education. Two possible explanations for the variation in sibship size effect by mother's education may be at play. On one hand, uneducated mothers might be faced with more household resource constraints and therefore, compared with educated mothers, may find it more difficult to maintain the educational aspirations for the firstborn child after having a son. On the other hand, educated and uneducated mothers' fertility decisions may be driven by distinct concerns, and thus the varying sibship size effect is due to the different selection mechanisms into a second child. Research has demonstrated that women of lower social status are more likely to value children, especially sons, as protection against marital disruption, securers of their own status within the family, or as a form of risk insurance or old-age support (Oppenheim Mason 1987). It is likely that only educated mothers have considered the potential negative impact on child "quality" when making second-child decisions, whereas uneducated mothers' decisions are driven by other concerns.

An alternative explanation for why parental investment in the firstborn child is not reduced by the birth of a sibling is that the resource dilution effect may have been offset by economies of scale whereby the average cost of childrearing diminishes with increased family size (Qian 2018; Shen et al. 2017). If this were the case, supposing that economies of scale are larger when children are of the same sex or closely spaced (e.g., they can more easily share clothes and books), one would expect the effect of having a sibling to be less negative on the firstborn child when the firstborn child and the sibling are of the same sex or closely spaced. However, the results presented earlier in Table 2 indicate the opposite: the effect of a younger brother is more negative on the parental investment in the firstborn boy than the firstborn girl, and the effect of having a sister is more negative on the parental investment in the firstborn girl than the firstborn boy. There is also no evidence that the effect of a younger sibling varies significantly by spacing. Therefore, I rule out economies of scale as an explanation.

Implications Under the Universal Two-Child Policy

As mentioned earlier, the results estimated from the fixed-effects models can be generalized only to children who had a younger sibling between 2010 and 2016. The question arises as to whether the results hold any implications for China under the universal two-child policy, which was introduced at the end of 2015. The answer depends on whether the selection into having a younger sibling changes as more couples become eligible to have a second child as well as whether the sibship size effect varies among the subpopulations.

The period of the current study is unique in that exemptions have been gradually introduced to the one-child policy, allowing the empirical exploration of how changes in the eligibility to have a second child may have affected the selection process and the extent to which results from the current study may hold at least in the near future. For example, in the analytic sample of household expenditure per capita, of the 933 younger siblings born over the study period, 53% were born before November 2013; 31% were born between November 2013 and October 2015, when couples in which at least of the partners was an only-child were allowed to have two children; and the remaining 16% were born after the universal two-child policy was introduced. Figure 5 compares the characteristics of children who had no siblings versus those who had a sibling, and separates the latter group of children according to the policy period during which their sibling was born.

The most drastic change illustrated in Fig. 5 is that children who had a younger sibling are increasingly composed of those with highly educated mothers: of the total firstborn children who had a sibling, the percentage having a mother with high school education or more increased from 14% to 37%, whereas the proportion having a mother with less than primary level of education declined from 15% to only 2%. Because the negative effect of a younger brother on child-specific investment is mainly driven by children of uneducated mothers, the negative effect of a younger brother on child-specific investment is expected to decrease as increasingly more highly educated mothers take up the policy allowing a second child. Meanwhile, although Fig. 5 shows a slight increase in the proportion of firstborn boys having a younger sibling over time, the direction of selection remains largely unchanged: firstborn girls are still much more likely to have a younger sibling. As firstborn girls drive the negative effect of younger sisters on child-specific parental investment, these effects are expected to continue to hold.

In addition, Fig. 5 suggests that with recent policy relaxation, more children with nonagricultural *hukou* are selecting into having a younger sibling. However, the analysis presented earlier found no evidence that the effect of a younger sibling on any of the three parental investment measures varies significantly by the *hukou* status. As more children with nonagricultural *hukou* select into having a younger sibling, future research may also obtain a more precise estimate of how sibship size may differ by *hukou* status. Similarly, even though a smaller proportion of children over time are younger than 2 years old when their younger sibling is born, and a larger proportion of them are spaced more than four years apart from their younger siblings, the study found no evidence that the sibship size effect varies significantly by the spacing between the firstborn and his/her younger sibling. Alternative specifications using continuous measures of spacing (in years) and both linear and quadratic terms led to similar, nonsignificant results.

Conclusions

Does increased sibship size reduce parental investment on the firstborn child in a low-fertility, developing context? Using the case of China, this study generates several key findings. First, there is strong evidence of resource dilution: having a younger sibling significantly reduces the average household expenditure per capita. I hypothesized that if parents reallocate the household resources after having another child or factor in the negative effect of a second child on the firstborn when making fertility decisions, then a sibship size effect on parental investment in the firstborn child may not be observed. Nonetheless, in most instances, I found that having a younger sibling directly reduces parental investment in the firstborn child, as measured by educational aspirations and educational expenditures. One exception is that for firstborn boys, having a younger sister does not pose any competition and may even increase parental aspirations for him. Another exception is that for children whose mothers have at least primary education, having a younger brother does not reduce parental educational aspirations for them, and the negative effect of having a younger brother is predominantly driven by children whose mothers have less than primary education. As increasingly more highly educated mothers are expected to take up the policy allowing a second child, the negative effect of a younger brother on child-specific investment is expected to diminish over time.

It is important to note that the sibship size effects on parental investment examined in this study are limited to the short term. Parents may revise their educational aspirations and reallocate economic resources among children as they age and progress through school; therefore, one should be cautious with extrapolating the short-term effect to the long term.

Can findings from the Chinese case be applied to a broader context? Although China’s unique government policy may have jump-started and accelerated its fertility decline, socioeconomic development has been the key driving force of its transition to below-replacement fertility, not unlike other developed and developing societies (Cai 2010; Morgan et al. 2009; Zeng and Hesketh 2016; Zhao and Zhang 2018). It is therefore not surprising to find that similar mechanisms driving the sibship size effect on child welfare in contemporary China are also at work in other contexts. For example, resource dilution is the main driver of the negative effect of sibship size on child educational attainment in a variety of developing countries where resource-constrained parents with high aspirations for their children bear almost all the cost and responsibility for educating their children (Eloundou-Enyegue and Williams 2006; Knodel et al. 1990; Lu and Treiman 2008; Maralani 2008; Marteleto and de Souza 2012). The effect of sibship size has been shown to depend on gender in not only East Asian but also European societies (Kalmijn and van de Werfhorst 2016; Li et al. 2017b). A recent study of adult children in 18 European countries found that number of brothers reduces women’s odds of completing college more than the number of sisters, and the negative association between the number of brothers and women’s college completion is stronger in more gender-unequal societies measured by the Gender Inequality Index of the United Nations (Kalmijn and van de Werfhorst 2016). Therefore, findings generated from this study have wider implications beyond the Chinese context.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

The research reported in this publication was supported by the Eunice Kennedy Shriver National Institute of Child Health & Human Development of the National Institutes of Health under Award Number P2CHD047879 and Award Number T32HD007163. The content is solely the responsibility of the author and does not necessarily represent the official views of the National Institutes of Health.

References

Anastasi A (1956). Intelligence and family size. Psychological Bulletin, 53,187–209. [PubMed: 13323165]

Angrist J, Lavy V, & Schlosser A (2010). Multiple experiments for the causal link between the quantity and quality of children. Journal of Labor Economics, 28, 773–824.

Anh TS, Knodel J, Lam D, & Friedman J (1998). Family size and children's education in Vietnam. Demography, 35, 57–70. [PubMed: 9512910]

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

Bandura A, Barbaranelli C, Caprara GV, & Pastorelli C (1996). Multifaceted impact of self-efficacy beliefs on academic functioning. Child Development, 67, 1206–1222. [PubMed: 8706518]

Bandura A, Barbaranelli C, Caprara GV, & Pastorelli C (2001). Self-efficacy beliefs as shapers of children's aspirations and career trajectories. Child Development, 72, 187–206. [PubMed: 11280478]

Baochang G, Feng W, Zhigang G, & Erli Z (2007). China's local and national fertility policies at the end of the twentieth century. Population and Development Review, 33, 129–147.

Becker GS, & Tomes N (1976). Child endowments and the quantity and quality of children. Journal of Political Economy, 84(4), S143–S162.

Behrman JR (1997). Chapter 4: Intrahousehold distribution and the family In Rosenzweig MR & Stark O (Eds.), Handbook of population and family economics (Vol. 1, pp. 125–187). Amsterdam, Netherlands: Elsevier.

Black SE, Devereux PJ, & Salvanes KG (2005). The more the merrier? The effect of family size and birth order on children's education. Quarterly Journal of Economics, 120, 669–700.

Blake J (1981). Family size and the quality of children. Demography, 18, 421–442. [PubMed: 7308532]

Blake J (1989). Family size and achievement. Berkeley: University of California Press.

Bougma M, LeGrand TK, & Kobiané J-F (2015). Fertility decline and child schooling in urban settings of Burkina Faso. Demography, 52, 281–313. [PubMed: 25520263]

Bras H, Kok J, & Mandemakers K (2010). Sibship size and status attainment across contexts: Evidence from the Netherlands, 1840–1925. Demographic Research, 23, 73–104. 10.4054/DemRes.2010.23.4

Brown PH, & Park A (2002). Education and poverty in rural China. Economics of Education Review, 21, 523–541.

Brüderl J, & Ludwig V (2015). Fixed-effects panel regression In Best H & Wolf C (Eds.), The SAGE handbook of regression analysis and causal inference (pp. 327–358). London, UK: SAGE.

Buchmann C (2000). Family structure, parental perceptions, and child labor in Kenya: What factors determine who is enrolled in school? Social Forces, 78, 1349–1378.

Cáceres-Delpiano J (2006). The impacts of family size on investment in child quality. Journal of Human Resources, 41, 738–754.

Cai Y (2010). China's below-replacement fertility: Government policy or socioeconomic development? Population and Development Review, 36, 419–440. [PubMed: 20882701]

Chan KW, & Buckingham W (2008). Is China abolishing the hukou system? China Quarterly, 195, 582–606.

Chen C, & Fan CC (2016). China's hukou puzzle: Why don't rural migrants want urban hukou? China Review, 16, 9–39.

Chernichovsky D (1985). Socioeconomic and demographic aspects of school enrollment and attendance in rural Botswana. Economic Development and Cultural Change, 33, 319–332.

Chi W, & Qian X (2016). Human capital investment in children: An empirical study of household child education expenditure in China, 2007 and 2011. China Economic Review, 37, 52–65.

Chu CYC, Tsay RS, & Yu R (2008). Intergenerational transmission of sex-specific differential treatments: The allocation of education resources among siblings. Social Science Research, 37, 386–399.

Chu CYC, Xie Y, & Yu R (2007). Effects of sibship structure revisited: Evidence from intrafamily resource transfer in Taiwan. Sociology of Education, 80, 91–113.

Conley D, & Glauber R (2006). Parental educational investment and children's academic risk estimates of the impact of sibship size and birth order from exogenous variation in fertility. Journal of Human Resources, 41, 722–737.

Davies M, & Kandel DB (1981). Parental and peer influences on adolescents' educational plans: Some further evidence. American Journal of Sociology, 87, 363–387.

Desai S (1995). When are children from large families disadvantaged? Evidence from cross-national analyses. Population Studies, 49, 195–210.

Downey DB (1995). When bigger is not better: Family size, parental resources, and children's educational performance. American Sociological Review, 60, 746–761.

Downey DB, Powell B, Steelman LC, & Pribesh S (1999). Much ado about siblings: Change models, sibship size, and intellectual development: Comment on Guo and VanWey. American Sociological Review, 64, 193–198.

Ebenstein A (2010). The "missing girls" of China and the unintended consequences of the one child policy. Journal of Human Resources, 45, 87–115.

Ebenstein A (2011). Estimating a dynamic model of sex selection in China. Demography, 48, 783–811. [PubMed: 21594735]

Ebenstein A, & Leung S (2010). Son preference and access to social insurance: Evidence from China's rural pension program. Population and Development Review, 36, 47–70.

Eloundou-Enyegue PM, & Williams LB (2006). Family size and schooling in sub-Saharan African settings: A reexamination. Demography, 43, 25–52. [PubMed: 16579207]

Feeney G, & Jianhua Y (1994). Below replacement fertility in China? A close look at recent evidence. Population Studies, 48, 381–394.

Ferrari G, & Zuanna GD (2010). Siblings and human capital: A comparison between Italy and France. Demographic Research, 23, 587–614. 10.4054/DemRes.2010.23.21

Gibbs BG, Workman J, & Downey DB (2016). The (conditional) resource dilution model: State- and community-level modifications. Demography, 53, 723–748. [PubMed: 27173795]

Gomes M (1984). Family size and educational attainment in Kenya. Population and Development Review, 10, 647–660.

Greenhalgh S (1985). Sexual stratification: The other side of "growth with equity" in east Asia. Population and Development Review, 11, 265–314.

Greenhalgh S (1986). Shifts in China's population policy, 1984–86: Views from the central, provincial, and local levels. Population and Development Review, 12, 491–515.

Greenhalgh S, & Winckler EA (2005). Governing China's population: From Leninist to neoliberal biopolitics. Stanford, CA: Stanford University Press.

Guo G, & VanWey LK (1999a). Sibship size and intellectual development: Is the relationship causal? American Sociological Review, 64, 169–187.

Guo G, & VanWey LK (1999b). The effects of closely spaced and widely spaced sibship size on intellectual development: Reply to Phillips and to Downey et al. American Sociological Review, 64, 199–206.

Guo Z, Gietel-Basten S, & Gu B (2019). The lowest fertility rates in the world? Evidence from the 2015 Chinese 1% sample census. China Population and Development Studies, 2, 245–258.

Gupta MD, Zhenghua J, Bohua L, Zhenming X, Chung W, & Hwa-Ok B (2003). Why is son preference so persistent in east and south Asia? A cross-country study of China, India and the Republic of Korea. Journal of Development Studies, 40, 153–187.

Heckman JJ, & Yi J (2012). Human capital, economic growth, and inequality in China (NBER Working Paper No. 18100). Cambridge, MA: National Bureau of Economic Research.

Huang W, Lei X, & Zhao Y (2016a). One-child policy and the rise of man-made twins. Review of Economics and Statistics, 98, 467–476.

Huang Y, Tang W, Mu Y, Li X, Liu Z, Wang Y, … Zhu J (2016b). The sex ratio at birth for 5,338,853 deliveries in China from 2012 to 2015: A facility-based study. PLOS ONE, 11(12), e0167575 10.1371/journal.pone.0167575 [PubMed: 27941978]

Jæger MM (2008). Do large sibships really lead to lower educational attainment? Acta Sociologica, 51, 217–235.

Kalmijn M, & van de Werfhorst HG (2016). Sibship size and gendered resource dilution in different societal contexts. PLOS ONE, 11(8), e0160953 10.1371/journal.pone.0160953 [PubMed: 27560371]

Kang C (2010). Family size and educational investments in children: Evidence from private tutoring expenditures in South Korea. Oxford Bulletin of Economics and Statistics, 73, 59–78.

Kao G, & Tienda M (1998). Educational aspirations of minority youth. American Journal of Education, 106, 349–384.

Khor N, Pang L, Liu C, Chang F, Mo D, Loyalka P, & Rozelle S (2016). China’s looming human capital crisis: Upper secondary educational attainment rates and the middle-income trap. China Quarterly, 228, 905–926.

King EM (1987). The effect of family size and family welfare: What do we know? In Johnson DG & Lee RD (Eds.), Social demography. Population growth and economic development: Issues and evidence (pp. 373–411). Madison: University of Wisconsin Press.

Knight J, Li S, & Deng Q (2009). Education and the poverty trap in rural China: Setting the trap. Oxford Development Studies, 37, 311–332.

Knodel J, Havanon N, & Sittitrai W (1990). Family size and the education of children in the context of rapid fertility decline. Population and Development Review, 16, 31–62.

Knodel J, & Wongsith M (1991). Family size and children’s education in Thailand: Evidence from a national sample. Demography, 28, 119–131. [PubMed: 2015939]

Kugler AD, & Kumar S (2017). Preference for boys, family size, and educational attainment in India. Demography, 54, 835–859. [PubMed: 28484996]

Lafortune J, & Lee S (2014). All for one? Family size and children’s educational distribution under credit constraints. American Economic Review, 104, 365–369.

Lee J (2008). Sibling size and investment in children’s education: An Asian instrument. Journal of Population Economics, 21, 855–875.

Lee KS (2009). Competition for resources: A reexamination of sibship composition models of parental investment. Journal of Marriage and Family, 71, 263–277.

Lei X, Shen Y, Smith JP, & Zhou G (2017). Sibling gender composition’s effect on education: Evidence from China. Journal of Population Economics, 30, 569–590. [PubMed: 28479674]

Li H, Loyalka P, Rozelle S, & Wu B (2017a). Human capital and China’s future growth. Journal of Economic Perspectives, 31(1), 25–48.

Li H, Zhang J, & Zhu Y (2008). The quantity-quality trade-off of children in a developing country: Identification using Chinese twins. Demography, 45, 223–243. [PubMed: 18390301]

Li J, Dow WH, & Rosero-Bixby L (2017b). Education gains attributable to fertility decline: Patterns by gender, period, and country in Latin America and Asia. Demography, 54, 1353–1373. [PubMed: 28681167]

Liu A, & Xie Y (2015). Influences of monetary and non-monetary family resources on children’s development in verbal ability in China. Research in Social Stratification and Mobility, 40, 59–70.

Liu C, Zhang L, Luo R, Rozelle S, Sharbono B, & Shi Y (2009). Development challenges, tuition barriers, and high school education in China. Asia Pacific Journal of Education, 29, 503–520.

Lu Y, & Treiman DJ (2008). The effect of sibship size on educational attainment in China: Period variations. American Sociological Review, 73, 813–834.

Maralani V (2008). The changing relationship between family size and educational attainment over the course of socioeconomic development: Evidence from Indonesia. Demography, 45, 693–717. [PubMed: 18939668]

Marteleto LJ, & de Souza LR (2012). The changing impact of family size on adolescents' schooling: Assessing the exogenous variation in fertility using twins in Brazil. Demography, 49, 1453–1477. [PubMed: 22810834]

Marteleto LJ, & de Souza LR (2013). The implications of family size for adolescents' education and work in Brazil: Gender and birth order differences. Social Forces, 92, 275–302.

Montgomery MR, Arends-Kuenning M, & Mete C (2000). The quantity-quality transition in Asia. Population and Development Review, 26, 223–256.

Morgan SP, Zhigang G, & Hayford SR (2009). China's below-replacement fertility: Recent trends and future prospects. Population and Development Review, 35, 605–629. [PubMed: 20376285]

Mueller E (1984). Income, aspirations, and fertility in rural areas of less developed countries In Schutjer WA & Stokes CS (Eds.), Rural development and human fertility (pp. 121–150). New York, NY: Macmillan.

Murayama K, Pekrun R, Suzuki M, Marsh HW, & Lichtenfeld S (2016). Don't aim too high for your kids: Parental overaspiration undermines students' learning in mathematics. Journal of Personality and Social Psychology, 111, 766–779. [PubMed: 26595715]

Nijman T, & Verbeek M (1992). Nonresponse in panel data: The impact on estimates of a life cycle consumption function. Journal of Applied Econometrics, 7, 243–257.

Okagaki L, & Frensch PA (1998). Parenting and children's school achievement: A multiethnic perspective. American Educational Research Journal, 35, 123–144.

Oppenheim Mason K (1987). The impact of women's social position on fertility in developing countries. Sociological Forum, 2, 718–745.

Parish WL, & Willis RJ (1993). Daughters, education, and family budgets Taiwan experiences. Journal of Human Resources, 28, 863–898.

Park H (2008). Public policy and the effect of sibship size on educational achievement: A comparative study of 20 countries. Social Science Research, 37, 874–887.

Parsons JE, Adler TF, & Kaczala CM (1982). Socialization of achievement attitudes and beliefs: Parental influences. Child Development, 53, 310–321.

Phillips M (1999). Sibship size and academic achievement: What we now know and what we still need to know: Comment on Guo and VanWey. American Sociological Review, 64, 188–192.

Ponczek V, & Souza AP (2012). New evidence of the causal effect of family size on child quality in a developing country. Journal of Human Resources, 47, 64–106.

Poston DL Jr. (2002). Son preference and fertility in China. Journal of Biosocial Science, 34, 333–347. [PubMed: 12117213]

Qian N (2018). The effect of China's one child policy on sex selection, family size, and the school enrolment of daughters In Anderson S, Beaman LA & Platteau J-P (Eds.), Towards gender equity in development (pp. 296–318). Oxford, UK: Oxford University Press.

Rosenzweig MR, & Wolpin KI (1980). Testing the quantity-quality fertility model: The use of twins as a natural experiment. Econometrica, 48, 227–240. [PubMed: 12261749]

Sandberg J, & Rafail P (2014). Family size, cognitive outcomes, and familial interaction in stable, two-parent families: United States, 1997–2002. Demography, 51, 1895–1931. [PubMed: 25260413]

Schmeer KK (2009). Changing sibship size and educational progress during childhood: Evidence from the Philippines. Journal of Marriage and Family, 71, 787–801. [PubMed: 26251553]

Sewell WH, Haller AO, & Portes A (1969). The educational and early occupational attainment process. American Sociological Review, 34, 82–92.

Sewell WH, & Shah VP (1968). Parents' education and children's educational aspirations and achievements. American Sociological Review, 33, 191–209. [PubMed: 5665863]

Shavit Y, & Pierce JL (1991). Sibship size and educational attainment in nuclear and extended families: Arabs and Jews in Israel. American Sociological Review, 56, 321–330.

Shen G, Zou J, & Liu X (2017). Economies of scale, resource dilution and education choice in developing countries: Evidence from Chinese households. China Economic Review, 44, 138–153.

Sobel ME (2012). Does marriage boost men's wages? Identification of treatment effects in fixed effects regression models for panel data. Journal of the American Statistical Association, 107, 521–529.

Strauss J, & Thomas D (1995). Chapter 34, Human resources: Empirical modeling of household and family decisions. Handbook of Development Economics, 3, 1883–2023.

Tang C, Zhao L, & Zhao Z (2018). Child labor in China. China Economic Review, 51, 149–166.

United Nations Department of Economic and Social Affairs. (2017). World population prospects: The 2017 revision, key findings and advance tables (Working Paper No. ESA/P/WP/248). New York, NY: United Nations Population Division.

Wooldridge JM (2001). Econometric analysis of cross section and panel data (1st ed.). Cambridge, MA: MIT Press.

Workman J (2017). Sibling additions, resource dilution, and cognitive development during early childhood. Journal of Marriage and Family, 79, 462–474.

Xie Y, & Lu P (2015). The sampling design of the China Family Panel Studies (CFPS). Chinese Journal of Sociology, 1, 471–484. [PubMed: 29854418]

Xu J (2008). Sibship size and educational achievement: The role of welfare regimes cross-nationally. Comparative Education Review, 52, 413–436.

Yi H, Zhang L, Luo R, Shi Y, Mo D, Chen X, … Rozelle S (2012). Dropping out: Why are students leaving junior high in China's poor rural areas? International Journal of Educational Development, 32, 555–563.

Yu W, & Su K (2006). Gender, sibship structure, and educational inequality in Taiwan: Son preference revisited. Journal of Marriage and Family, 68, 1057–1068.

Zeng Y, & Hesketh T (2016). The effects of China's universal two-child policy. Lancet, 388, 1930–1938. [PubMed: 27751400]

Zhang L, Yi H, Luo R, Liu C, & Rozelle S (2013). The human capital roots of the middle income trap: The case of China. Agricultural Economics, 44(s1), 151–162.

Zhang Y, Kao G, & Hannum E (2007). Do mothers in rural China practice gender equality in educational aspirations for their children? Comparative Education Review, 51, 131–157.

Zhao G (2015). Can money "buy" schooling achievement? Evidence from 19 Chinese cities. China Economic Review, 35, 83–104.

Zhao M, & Glewwe P (2010). What determines basic school attainment in developing countries? Evidence from rural China. Economics of Education Review, 29, 451–460.

Zhao Z, & Zhang G (2018). Socioeconomic factors have been the major driving force of China's fertility changes since the mid-1990s. Demography, 55, 733–742. [PubMed: 29623608]

Zimmerman BJ, Bandura A, & Martinez-Pons M (1992). Self-motivation for academic attainment: The role of self-efficacy beliefs and personal goal setting. American Educational Research Journal, 29, 663–676.

Zimmerman BJ, Bandura A, & Martinez-Pons M (2016). Self-motivation for academic attainment: The role of self-efficacy beliefs and personal goal setting. American Educational Research Journal. 10.3102/00028312029003663

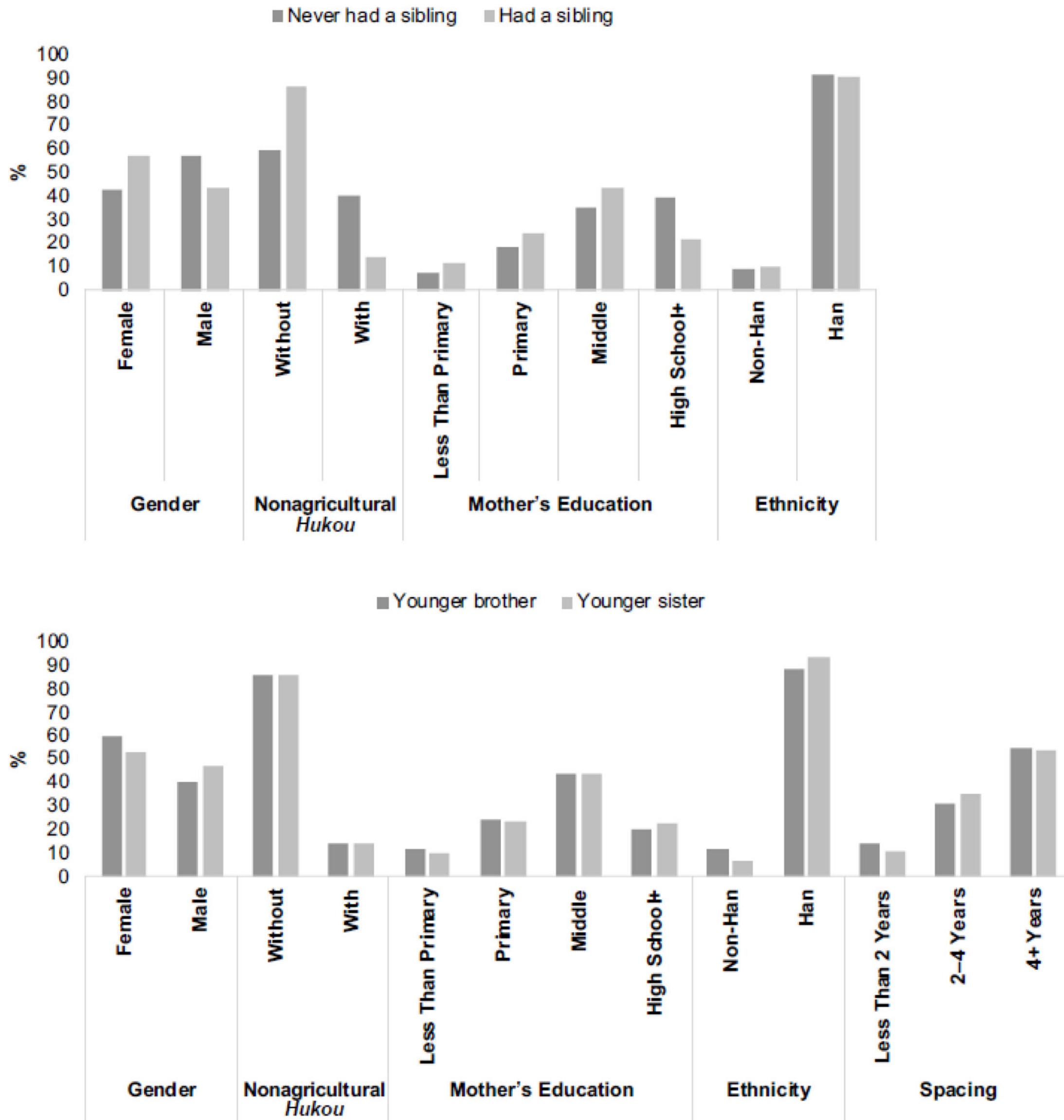

Fig. 1.

Composition of analytic sample for household expenditure per capita, by treatment status (never had a sibling vs. had a sibling; had a younger brother vs. had a younger sister).

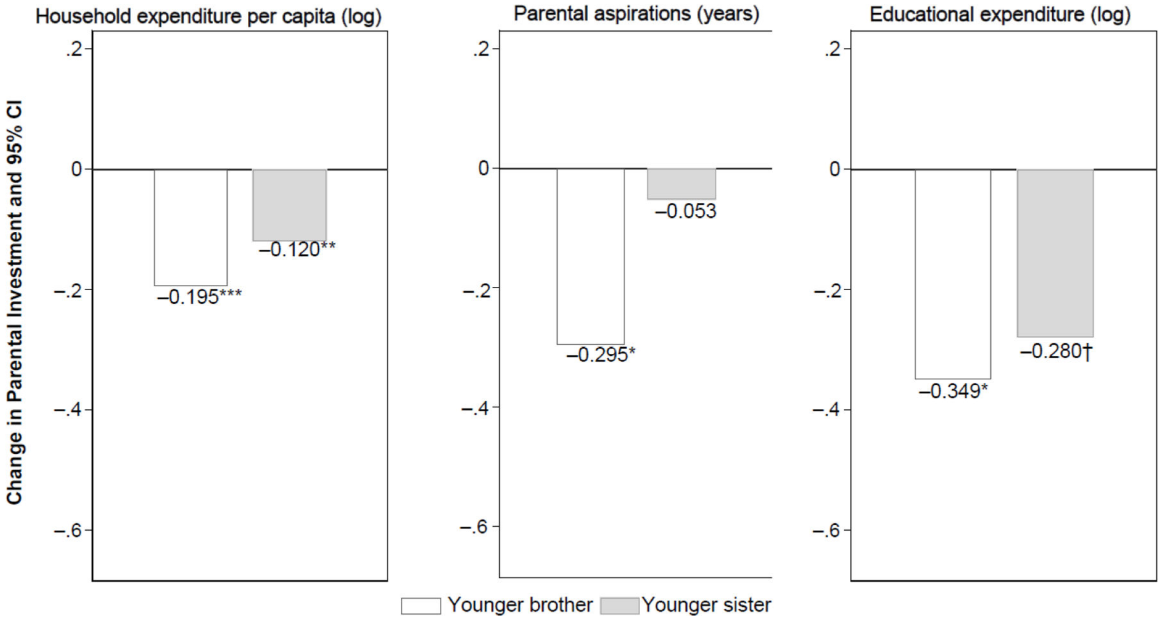

Fig. 2.

Estimated average effects of having a younger brother/sister with 95% confidence intervals (CI). *Source:* Table A2 in the online appendix. †$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$

Fig. 3.

Estimated heterogeneous effects of having a younger brother/sister on parental educational aspirations with 95% confidence intervals (CI), by firstborn gender. *Source:* Table 2. $^{\dagger}p < .10$; $^{*}p < .05$

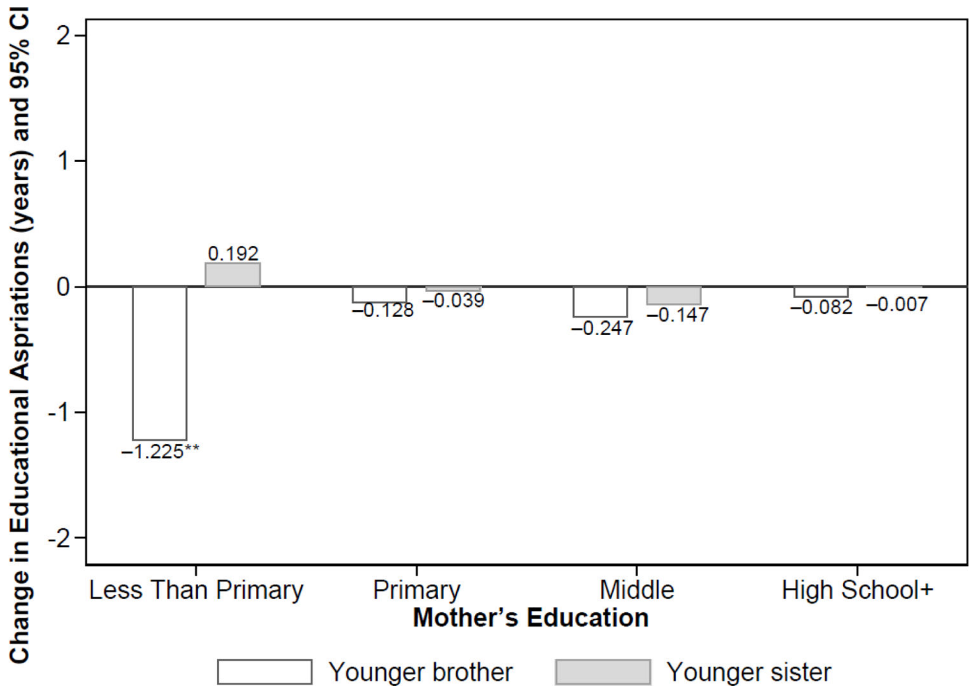

Fig. 4.

Estimated heterogeneous effects of having a younger brother/sister on parental educational aspirations with 95% confidence intervals (CI), by mother's education. *Source:* Table 2. ***p* < .01

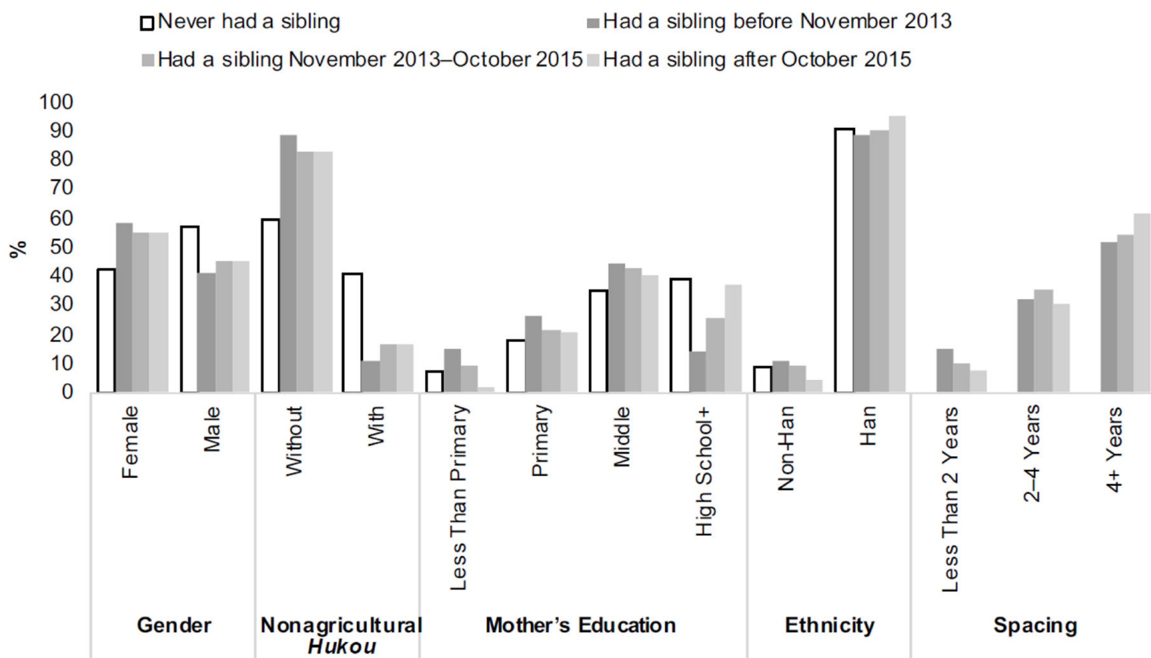

Fig. 5.

Composition of analytic sample for household expenditure per capita, by treatment status (never had a sibling vs. had a sibling) and timing of the treatment. In November 2013, couples in which at least one of the partners was an only-child were allowed to have two children. In October 2015, a universal two-child policy was introduced. *Source:* Author's calculation using CFPS (2010, 2012, 2014, 2016).

Table 1

Descriptive statistics of the analytic sample for each outcome variable

	Household Expenditure per Capita (log)	Educational Aspirations (years)	Educational Expenditure (log)
Time-Varying Covariates			
N (person-years)	10,096	7,733	9,549
Outcome variable	6.51	15.97	5.60
	(0.95)	(1.78)	(3.61)
Age	5.99	5.90	6.63
	(4.13)	(3.93)	(3.84)
Have a younger brother (%)	8.64	10.00	8.18
Have a younger sister (%)	6.91	8.16	6.80
Urban residence (%)	50.96	50.47	50.38
Survey year (%)			
2010	20.01	14.46	22.98
2012	24.43	18.32	29.13
2014	30.60	35.01	28.04
2016	24.97	32.21	19.85
Time-Invariant Covariates			
N (individuals)	3,553	3,010	3,330
Male (%)	53.56	53.55	53.72
Nonagricultural *hukou* (%)	33.55	32.13	33.84
Han ethnicity (%)	90.94	90.90	90.99
Spacing (%)			
Less than 2 years	12.65	12.46	12.33
2–4 years	33.23	33.76	33.49
4 or more years	54.13	53.78	54.19
Mother’s education (%)			
Less than primary	8.47	8.17	9.70
Primary	19.48	19.37	20.30
Middle school	37.55	38.27	37.81
High school and above	34.51	34.19	32.19

Note: Standard deviations are shown in parentheses.

Source: CFPS (2010, 2012, 2014, 2016).

Table 2

Estimates of heterogeneous effects of having a younger brother/sister from individual fixed-effects models

	Household Expenditure per Capita (log)		**Educational Aspirations (years)**		**Educational Expenditure (log)**	
	Brother	**Sister**	**Brother**	**Sister**	**Brother**	**Sister**
Firstborn gender (ref. = female)						
Brother/sister	−0.196*** (0.0490)	−0.082 (0.057)	−0.227 (0.148)	−0.326† (0.188)	−0.320 (0.203)	−0.433* (0.209)
Male × brother/sister	0.000731 (0.0852)	−0.078 (0.080)	−0.170 (0.221)	0.592* (0.252)	−0.070 (0.303)	0.325 (0.286)
Spacing (ref. = less than 2 years)						
Brother/sister	−0.127 (0.102)	−0.230 (0.153)	−0.138 (0.284)	0.049 (0.365)	−0.688* (0.346)	−0.683 (0.504)
2–4 years × brother/ sister	−0.00896 (0.120)	0.095 (0.169)	−0.011 (0.339)	−0.435 (0.442)	0.139 (0.444)	0.411 (0.558)
4 years+ × brother/ sister	−0.112 (0.116)	0.135 (0.162)	−0.260 (0.325)	0.086 (0.400)	0.521 (0.398)	0.458 (0.536)
Nonagricultural *hukou* (ref. = without)						
Brother/sister	−0.184*** (0.0463)	−0.126** (0.046)	−0.290* (0.132)	−0.118 (0.150)	−0.391* (0.175)	−0.206 (0.161)
With × brother/sister	−0.0732 (0.110)	0.0415 (0.106)	−0.039 (0.229)	0.441 (0.309)	0.372 (0.389)	−0.663 (0.507)
Mother’s education (ref. = less than primary)						
Brother/sister	−0.182† (0.104)	−0.170 (0.125)	−1.225** (0.440)	0.192 (0.643)	−0.859* (0.432)	−0.652† (0.372)
Primary × brother/ sister	0.0166 (0.123)	0.069 (0.148)	1.097* (0.483)	−0.231 (0.697)	0.936† (0.499)	0.442 (0.460)
Middle × brother/sister	−0.050 (0.121)	−0.027 (0.138)	0.979* (0.468)	−0.339 (0.671)	0.481 (0.477)	0.537 (0.422)
High school+ × brother/sister	0.018 (0.141)	0.203 (0.153)	1.144* (0.476)	−0.199 (0.655)	0.384 (0.618)	0.141 (0.551)
Ethnicity (ref. = non-Han)						
Brother/sister	−0.276† (0.144)	−0.045 (0.178)	−0.301 (0.387)	1.245 (0.861)	−0.195 (0.469)	−0.559 (0.433)
Han × brother/sister	0.091 (0.149)	−0.081 (0.182)	0.006 (0.400)	−1.399 (0.867)	−0.177 (0.490)	0.311 (0.455)

Notes: All models control for survey year, age, and rural/urban residence. Standard errors, shown in parentheses, are clustered at the individual level.

Source: CFPS (2010, 2012, 2014, 2016).

† $p < .10$;

* $p < .05$;

** $p < .01$;

*** $p < .001$

Table 3

Estimates of average effects of having a younger brother/sister on total, discretionary and nondiscretionary educational expenditures (log)

	Total	Discretionary	Nondiscretionary
Younger Brother	−0.349 * (0.163)	−0.440 ** (0.159)	−0.167 (0.160)
Younger Sister	−0.280 † (0.155)	−0.566 *** (0.154)	−0.0122 (0.167)
N	9,549	9,459	9,549

Note: All individual fixed-effects models control for survey year, age, and rural/urban residence. Standard errors, shown in parentheses, are clustered at the individual level.

Source: CFPS (2010, 2012, 2014, 2016).

† $p < .10$;

* $p < .05$;

** $p < .01$;

*** $p < .001$