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Sibling sex composition, intrahousehold resource allocation, and educational attainment in China

Lei Zheng

Correspondence:
zhenglei@bnu.edu.cn
Faculty of Education and Capital
Institute of Economics of Education,
Beijing Normal University, 19 Xinjiekou
Wai Street, Beijing 100875, China

Abstract

Studies have found that the decline of the fertility rate, which reduces the number of siblings, is an important factor in narrowing the gender gap in education. However, given the number of children, sex composition of siblings also affects individual educational attainment. Few relevant studies on this issue are available in China. This study investigates the effects of sibling sex composition on intrahousehold resource allocation and individual educational attainment in the patriarchal cultural context of China. Under the influence of Chinese traditional culture and economic rationality, parents' preference for sons leads to biased allocation of resources within the family, and the cost difference between raising boys and girls reinforces such a biased distribution. Analysis based on a nationally representative dataset confirms the hypothesis of this study. It finds that having brother(s) is detrimental to educational attainment and that the higher the proportion of girls in sibship, the more schooling one attains. This sibling sex composition effect is gender asymmetric and also heterogenous across birth cohorts.

Keywords: Sibling sex composition; Educational attainment; Intrahousehold resource allocation; Son preference; Gender inequality

Background

More than 60 years after the establishment of the People's Republic of China, along with a gradual increase of education level for all, the educational gender gap continues to narrow (Connelly and Zheng 2007; Hannum et al. 2009a). Many studies have explained the trend of educational gender inequality from the perspective of macroinstitutional structure or public policy (Wu 2012; Ye and Wu 2011). Recent studies have proposed a new perspective, exploring the impact of macro policies and institutions, especially population policies, on micro household decision-making and individual educational attainment (Zheng and Zhang 2013).

Resource dilution theory states that, under the given family resource constraints, an increasing number of siblings induces more intense competition among siblings and the average resources allocated to each child will be reduced, which could adversely affect individual educational attainment (Blake 1981). Due to the traditional preference for boys in China, the competition for resources is particularly detrimental for girls in large families (Wang 2005). China's family planning policy reduced fertility, easing family budget constraints and thereby improving girls' access to education (Lee 2011; Li et al. 2008; Tsui and Rich 2002; Wu 2012; Ye and Wu 2011).

However, resource dilution theory does not examine the impact that children of different genders impose on the intrahousehold resource allocation process. Because parents have different preferences for boys and girls and child-rearing costs also differ, the sex composition of siblings impacts both competition within families and the patterns of intrahousehold distribution. The sibling size effect is a measure of inequality between families, while the sibling sex composition effect indicates inequality within the family (Lu and Treiman 2008). To better understand the impact of sibling configuration on individual socioeconomic outcomes, it is necessary to investigate the effect of sibling sex composition (Chu et al. 2007; Powell and Steelman 1990). Currently, there are competing theories to explain the relationship between sibling sex composition and educational attainment, but the empirical evidence is not consistent and little research has been conducted in Mainland China.

This study used the China General Social Survey from 2008 (CGSS2008) to investigate the association between sibling sex composition and individual educational attainment, enhancing our understanding of within-family factors that lead to educational gender inequality. We found that the presence of brothers in sibship impedes educational attainment and the higher the proportion of girls in sibship, the more schooling one attains. This sibling sex composition effect is gender asymmetric and also heterogenous across birth cohorts. We argue that this effect derives from son preference and different costs in the upbringing of boys and girls, motivated by economic rational choice.

The second section of this article reviews relevant theories and empirical evidence; the third section introduces the relation between sibling sex composition and intrahousehold resource allocation under the cultural background of the Chinese patriarchal family, as well as the research hypotheses; the fourth section describes the data and research methods used; the fifth section reports and discusses regression results; and the sixth section presents conclusions.

Literature review

Research on the effect of sibling sex composition focuses on two issues. First, does sibling sex composition really affect individual educational attainment? Second, what is the mechanism by which sibling sex composition influences educational attainment? There are two different types of theoretical explanations. The first group stresses the budget constraints that parents face in allocating resources and the impact of different parental preferences; the other group stresses that the interactions within families among siblings and between parents and children are influenced by sibling sex composition, which generates heterogeneous education development.

Theory model
Sibling sex composition and intrahousehold resource allocation
Becker and Tomes (1979, 1986) argue that budget-constrained parents must rationally allocate resources within the family in order to maximize their utility. If the parents prefer to maximize the sum of income of their children, then they will prioritize investment in children who have a higher marginal rate of return. Because men participate longer in the labor market (Li and Zhang 2008) and there is prevalent discrimination against women in the labor market in many countries, the return of educational investment for men outweighs that of women (Lu and Treiman 2008). Thus, parents are

more likely to invest in education for boys than girls. If this is the case, then having a brother is a 'threat' to both boys and girls because the boy sucks away educational resources, impeding other children's education investment. Having sisters instead is beneficial. This theory is also called the 'efficiently allocating hypothesis' (Li and Zhang 2008).

However, parents may not aim at maximizing the sum of children's income when allocating resources. Griliches (1979: S61) notes that 'families in fact act as (potential) income equalizers.' Parents tend to allocate more resources to children who are naturally disadvantaged. Based on this notion, Behrman et al. (1982) propose the 'compensating hypothesis.' Assuming that parents dislike income inequality among their children, those less gifted or holding a disadvantaged place in the labor market will be given more resources in order to compensate for their weaknesses and to achieve equality among children in the long run. The compensating hypothesis predicts the exact opposite to the efficiently allocating hypothesis: the presence of brothers is beneficial to individual educational attainment, and the presence of sisters has the opposite effect.

Budget constraint theory states that the cost difference between raising boys and girls leads sibling sex composition to affect family budget constraints and educational attainment (Amin 2009; Bauer and Gang 2001; Butcher and Case 1994; Parish and Willis 1993; Strauss and Thomas 1995: 1983–1985). An important factor that determines child-rearing costs is marriage finances. If the amount of bride price paid for a son differs from that of the dowry paid for a daughter, this results in different costs of raising boys or girls. In some cultures, the dowry payment is the main source of funding for marriage, thus raising a daughter means a higher cost (Strauss and Thomas 1995:1985). Therefore, under budget constraints, preparation for a daughter's marriage in the future crowds out educational investment. In this regard, we can expect a connection between the proportion of girls in siblings and individual educational attainment (Li and Zhang 2008).

Sibling sex composition and intrahousehold interaction

Another group of studies views the interaction among siblings and with their parents as a socialization process. These within-family interactions vary with sibling sex composition (Butcher and Case 1994). Through this process of socialization within the family, parents form different expectations and goals for boys and girls.

The reference group theory proposed by Butcher and Case (1994) states that when there is only one daughter, parents will use the same standards for the girl as for their sons. However, if they give birth to another girl, then the parents will use girls' standards for her. Therefore, girls who are the only daughter among brothers have a higher educational level than those who have at least one sister.

Rosenberg's (1965) sex minority hypothesis states that regardless of gender, the child who is the sex minority in a family will receive special treatment from parents, thus achieving relatively high educational attainment. Conley's 'revised sex minority hypothesis' states the opposite. This theory posits that being the sex minority or having siblings of the opposite sex impedes access to education because 'same sex siblings may stimulate a competitive, achievement-orientated environment among children while opposite sex ones may engender a more sociable, less aggressive environment' (Conley 2000: 445).

return on investment. By contrast, educational investment in girls hardly brings returns once the girls marry and become 'spilled water.'[b]

Sibling sex composition and intrahousehold resource allocation

In Chinese culture, intra-household resource allocation is characterized as a gender-based pattern that includes bidirectional intergenerational transfers and asymmetric intragenerational transfers. Intrahousehold resource allocation is a multistep process. Parents must first decide how to balance expenditures between themselves and their children. The Chinese social culture was formed under the traditional culture of family and kinship ties. In addition, the social welfare system is imperfect. Parents tend to spend a large part of their income on child rearing when they are young, and get support from their children when old. The main expenditure and most important saving motive for Chinese families is related to children (Wei and Zhang 2011). This intergenerational transfer pattern reflects an intertemporal reciprocity for parents and children (Greenhalgh 1985; Feldman et al. 2006).

For families with many children, parents need to further decide how to allocate resources among the children. As mentioned earlier, increasing investment in boys is an efficient allocation of resources (Strauss and Thomas 1995). The traditional son preference leads parents to favor boys over girls in intergenerational transfer (Chu et al. 2007; Greenhalgh 1985; Feldman et al. 2006; Hannum et al. 2009b). In order to maximize the limited resources to invest in boys, parents also adopt an asymmetric lateral transfer to meet the needs of sons at the expense of daughters (Chu et al. 2007; Greenhalgh 1985; Parish and Willis 1993). Parents either reduce investment in education for girls or urge girls to work or marry early to ease the financial burden for the family and provide for younger siblings' education (Chu et al. 2007; Parish and Willis 1993). Because parents prioritize boys in both intragenerational and intergenerational transfers, the presence of male siblings is detrimental to educational attainment. This boy-biased distribution pattern can be summarized as 'take more from daughters to give more to sons and thus get more for themselves' (Greenhalgh 1985:276).

The third step is the allocation of resources among children's different expenditures. In Chinese society, children's education and marriage are the two most important motives for household savings (Wei and Zhang 2011). These two items constitute the major cost of raising children. Preference for son leads to increased spending on education for boys; therefore, the educational cost of raising boys is higher. Marriage costs can also be higher for boys. Many research works show that grooms' families pay a bride price that surpasses the value of a dowry (Brown et al. 2011; Wei and Zhang 2011; Zhang 2000). The motive to save is stronger for a son's marriage than for a daughter's. Grooms' families have a higher saving rate a few years before and after the wedding than brides' families. The groom's family pays for the majority of the wedding expenses (Wei and Zhang 2011). In rural areas, there is a type of expense specifically for social occasions. Through funerals, weddings, and everyday gift giving, families increase spending to raise their social status in the community. For poor families, such status-seeking expenditure on weddings is particularly common (Brown et al. 2011). In addition, living in the husband's house after marriage is a widespread tradition in China (Feldman et al. 2006). From the 1960s on, married couples were less likely to live in old houses, and the proportion living in newly built houses gradually increased. Especially from the early 1990s, preparing a new house for the newlyweds became a basic

necessity (Zhang 2000), and this is mainly the responsibility of the groom's family (Wei and Zhang 2011). The gradually rising cost of building houses in rural areas and purchasing apartments in urban areas undoubtedly pushed up the marriage costs of rearing a boy.

In summary, raising boys has relatively higher costs. Given the strong preference for sons, this does not reduce the allocation of resources to boys, but instead leads to boys occupying more intrahousehold resources. Differences in the child-raising costs intensify the role of boys as 'absorbers' in the family. Therefore, a high proportion of girls among siblings eases parents' burden to save for their children, especially the pressure to pay for marriages. Accordingly, each child's education spending will increase. Our consideration of gender difference in child-raising costs on the basis of son preference is an important addition to current study on the gender-based intrahousehold resource allocation model in Chinese families.[c]

Hypothesis

The above analysis shows that the efficiently allocating hypothesis and budget constraints theory may be more relevant in explaining the impact of sibling sex composition on educational attainment. We propose the following four hypotheses:

Hypothesis 1: Sibling sex composition affects individual educational attainment, and this effect is gender asymmetric.

In terms of individual educational attainment, the presence of brothers is disadvantageous but the presence of sisters or a higher proportion of girls is favorable. Therefore, we expect that the dummy variable representing 'having brothers' has a negative correlation with individual educational attainment, while the proportion of girls and the dummy variable representing 'having sisters' has a positive correlation with individual educational attainment. In addition, since parents try to prioritize boys' investment needs due to the son preference, boys' educational attainment is less influenced by sibling sex composition.

Hypothesis 2: Sibling sex composition has heterogeneous effects among individuals of different socioeconomic status and household registry.

Having higher socioeconomic status or holding urban household registration status (*hukou*) may lower parental son preference. As such, families also have a greater chance to provide for the aged through social security or by the aged themselves. Thus, the motivation to raise a son for old-age support is weaker. The sibling sex composition effect is expected to be weaker for people with higher socioeconomic status or urban *hukou*.

Hypothesis 3: The sibling sex composition effect decreases as the mother's status rises in the family.

Because mothers prefer to increase their children's human capital investment or prefer to increase spending on daughters (Alderman and King 1998), the person who makes family decisions will affect their children's educational opportunities. As a traditional patriarchal society, in China, the husband occupies an unshakable position in the home. The unitary model is applicable to study the Chinese family in which the husband is

the sole decision maker (Chau et al. 2007). However, with the improvement of the educational level and social status of women, wives have more and more opportunities to share the decision-making power with the husband, which may ameliorate gender inequality in intrahousehold resource allocation. We expect that the effect of sibling sex composition decreases as the mother's status at home increases.

Hypothesis 4: The effect of sibling sex composition is heterogenous across cohorts, depending on the policy direction in that specific historical period.

The educational attainment of the Chinese is influenced by the ideologies and the socioeconomic and educational policies in different historical periods (Hao 2007; Li 2003; Deng and Treiman 1997; Zhou et al. 1998). When educational policy is oriented toward radical destratification, the connection between individual educational attainment and family background weakens. But, when such policy is no longer dominant, the dependency of educational attainment on family background resumes its existing path (Li 2003; Deng and Treiman 1997).

Different from class inequality, educational gender inequality based on intrahousehold distribution is more complex. For example, the impact of efficiency-oriented economic development policies on educational gender inequality is not consistent. Modernization theory states that with economic growth and modernization, gender differences in education will decrease. The 'women in development' theory, however, states that the initial stages of economic development will expand gender difference because men benefit relatively more from an improved economic environment and development opportunities in the economy. The narrowing educational gender gap is only possible when the economy develops further (Hannum 2005).

Therefore, we expect that the effect of sibling sex composition depends on the historical period in which the individual receives education. When the country adopts equality-oriented policies, the impact of sibling sex composition on educational attainment diminishes. This is particularly evident for those receiving education during the Cultural Revolution. In contrast, when the country adopts an efficiency-oriented policy, it may intensify the relationship between sibling sex composition and educational attainment. However, with the further development of the economy, the effect of sibling sex composition diminishes.

Methods
Data

The data for this study was drawn from the 2008 Chinese General Social Survey (CGSS2008). The survey uses four-stage stratified (district/county, township/street, neighborhood/village, households) unequal probability sampling methods. Samples include nationwide areas except for Ningxia, Qinghai, and Tibet provinces (or autonomous regions), for a total of 6,000 urban and rural residents over the age of 18.[d] We limited the sample to participants who completed their highest level of education, have at least one sibling, and provided family background information on parental education and career information. The actual effective sample size is thus 5,271 people.

Variables

We used years of completed schooling to measure individual educational attainment.

Referring to previous research (Butcher and Case 1994; Hauser and Kuo 1998; Kaestner 1997) and in particular compared to Li and Zhang (2008) study, we introduced measurements for sibling sex composition in a series of regression models: a dummy variable indicating whether respondents have brothers (have brothers = 1), a dummy variable indicating whether respondents have sisters (have sisters = 1), and the ratio of girls among siblings (including the participant).

We also controlled the number of siblings that participants have and the participant's ranking among siblings. The range for number of siblings was 0 to 12. Since only 0.52% of the respondents had over eight siblings, in order to avoid the impact of the few extreme values on estimation results, we used Xiaoyu Wu's (2012) method and assigned eight to those who had over eight siblings.[e] The ranking value ranges between 1 and 12, but 99.03% of the respondents rank lower than seventh among siblings; thus, we assigned seven for those who ranked higher than seventh.[f]

Gender, ethnicity, household registration status (*hukou*), and political and socioeconomic status of parents are also important determinants for individual educational attainment in China (Hannum 2002; Hannum and Xie 1994; Lu and Treiman 2008; Wu and Treiman 2004). Therefore, we controlled respondent's age, gender (female = 1), ethnicity (ethnic Han = 1), *hukou* status when going to school, and parents' education level (the higher years of schooling between parents), father's international socio-economic index of occupational status (ISEI) when respondents were fourteen years old, whether the father was a member of Chinese Communist Party (CCP member = 1), and other variables. Since CGSS2008 did not ask respondents for their family income at age 14, we used parental education level and father's occupation on ISEI when the respondents were 14 years old as the proxy variables to indicate the family's socioeconomic status.

The structure of household registration status and father's occupation on ISEI needs more explanation. Due to the fact that many people begin elementary school at age 7 or later (Lu and Treiman 2008) and the initial stage of the household registration status directly affects the quality of future opportunities at a series of educational stages, we adopted Ye and Wu's (2011) approach and used a dummy variable indicating whether the respondents had urban *hukou* at age 7 or younger (have urban *hukou* = 1).

CGSS2008 used the 1988 International Standard Classification of Occupations to code father's occupation when respondents were 14 years old. We converted it to an index figure on ISEI according to Ganzeboom et al.'s (1992) method.

Since many of the respondents did not report their father's occupational status when the respondents were age 14 and the average level of education for this group of the respondents was rather low (76.07% of missing values received no more than 9 years of education), we filled in information for missing values. Specifically, we first substituted mother's ISEI index score when the respondent was age 14 (Wu 2012). If the mother's information was also missing, we then categorized the sample into four groups according to whether the respondents had urban *hukou* at age 7 or younger and whether the respondent's father was a member of Chinese Communist Party, and substituted the missing value using the mean ISEI score of the fathers in the four population categories. We then used Lu and Treiman's (2008) method to set up a dummy variable representing that the father's ISEI score is missing (father's ISEI information is missing = 1).

Descriptive statistics are shown in Table 1.

Table 1 Descriptive statistics for major variables

Variable	Mean	SD
Years of completed schooling	7.270	4.098
Have urban *hukou* at age 7 or younger	21.12%	0.408
Han ethnic groups	91.62%	0.277
Age	44.165	13.116
Female	51.64%	0.500
Parental years of schooling	4.491	4.309
Father's ISEI	45.477	9.852
Father's ISEI is missing	72.89%	0.445
Father was a member of CCP when respondent was 14	9.87%	0.298
Sibling number	3.349	1.769
Ranking among siblings at birth	2.681	1.536
Have brother(s)	87.06%	0.336
Have sister(s)	81.24%	0.390
Ratio of female among siblings	48.35%	0.241
N	5,271	

Data are weighted according to the sampling probabilities.

Method

We used ordinary least squares method (OLS) to estimate the impact of sibling sex composition on educational attainment, and the data are weighted according to the sampling probability. Since the data we used in each primary sampling unit (PSU, district/county) sampled 60 respondents from 60 households, the presence of clusters in the district/county level can bias the standard errors of the estimated coefficients from OLS. Thus, we report the robust standard errors adjusted for district/county clustering.

Results and Discussion

Descriptive results of sibling sex composition and educational attainment

As shown in Table 2, with an increasing number of siblings, the average years of schooling tends to decline. This is in line with the children quantity-quality trade-off rule (Wu 2012; Ye and Wu 2011). In addition, Table 2 reveals an interesting phenomenon: even controlling for the number of siblings, individual educational attainment systematically correlates with sibling sex composition. In each sibling size, if the individual has brother(s), the number of years of schooling is less than for those who do not. In contrast, individuals who have sisters have higher number of years of schooling than those who do not. However, the advantage of having sisters disappeared or even reversed after sibling size increases to six. One explanation may be that since the respondents who have a number of siblings exceeding six and do not have sisters are rare, the measurement error resulted in a group with extremely high levels of education. Overall, the results in Table 2 indicate that having brothers impedes individual educational attainment and having sisters benefits individual education attainment and the negative effect of brothers is more consistent and significant than the positive effect of sisters.

Table 2 Mean years of schooling, by sibling size and sex composition

Number of siblings	Total	No Brothers	Have Brothers	No Sisters	Have Sisters
0	9.80 (390)	9.80 (390)	-	9.80 (390)	-
1	9.09 (862)	9.38 (358)	8.89 (504)	8.89 (504)	9.38 (358)
2	8.12 (1,193)	8.58 (188)	8.03 (1,005)	7.64 (316)	8.29 (877)
3	6.90 (1,080)	8.38 (104)	6.74 (976)	5.98 (127)	7.02 (954)
4	6.53 (937)	8.28 (40)	6.45 (897)	6.03 (43)	6.55 (894)
5	6.38 (695)	7.02 (13)	6.37 (682)	6.18 (27)	6.39 (669)
6	6.00 (388)	8.88 (3)	5.98 (385)	9.24 (5)	5.96 (383)
7	6.04 (190)		6.04 (190)	11.00 (0)	6.04 (190)
8+	6.00 (113)		6.00 (113)	0 (1)	6.06 (112)
Mean	7.44 (5,849)	9.23 (1,096)	7.02 (4,753)	8.46 (1,413)	7.11 (4,436)

Data are weighted according to the sampling probabilities. Weighted frequency in parentheses.

Expectation of old-age support and educational attainment

Parents favor boys in resource allocation because they mainly rely on sons for future old-age support. The limitation of the data does not provide information on parents' expectations before making educational investment decisions, so we cannot verify this directly. However, we make an indirect test using the information on living arrangements provided in the data.

In China's family culture, adult children living with their elderly parents often bear the main responsibility for old-age support (Xie and Zhu 2009). We calculated the average education levels of males and females, respectively, according to whether the adult child lived with the father (or mother).[g] We expected that those children who are married and live with their father (or mother) are the main source of old-age support of parents and thus received special attention and preferences during their education; their educational level should thus be higher, particularly for women.

We found that for women who live with parents, the average years of schooling is 1.04 years higher than those who do not ($p = 0.0007$). For men, the former is 0.29 years higher than the latter ($p = 0.0981$) (see Table 3). Thus adult children living with parents have a higher average educational level, and this is particularly evident for women. One possible explanation is that regardless of whether male adult children live with their parents or not, they are assumed to generally bear responsibility for old-age support. But, in the 'married daughter is like spilled water' culture, women bear the responsibility of old-age support only when they live with their parents. Thus, parents exceptionally favored investment in education for the daughter they would live with, and the expected return strongly motivates the decision on education investment.

Of course, an alternative explanation is that children with higher levels of education are more capable of bearing the expenses of old-age support and thus live with their parents (Xie and Zhu 2009). However, we further found that, regardless of whether they live with parents, the average years of schooling gap between women and men in general is 1.41 years ($p = 0.0000$). Among those individuals who do not live with their parents, this educational gender gap is 1.44 years ($p = 0.0000$); among those individuals living with their parents, this gap is only 0.69 years ($p = 0.0172$) (also see Table 3). Thus, living with parents (i.e., bearing the main responsibility for old-age support) significantly reduces gender differences in education. This may be because parents invest

Table 3 Mean years of schooling by living arrangement and gender

	Not living with father (mother)	Living with father (mother)	Difference
Male	8.71	8.99	−0.29*
Female	7.27	8.31	−1.04***
Difference	1.44***	0.69**	

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

more in education for those daughters that they expect will provide support during their old age. We thus speculate the following: parents' expectations of old-age support affect their decision on educational investment for children, and mainly relying on sons caused the inequality in allocation of resources within the family. In other words, lower parental investment in education for girls than boys is due mainly to the fact that boys are assumed to take greater responsibility for old-age support. If girls were expected to take care of their elderly parents, then parental investment in education for girls might not necessarily be less than that for boys. To some extent, this proves that economic motives are often more intense than the impact of cultural practices in the decision-making process. Of course, this is only a preliminary verification. Taking into account the fact that parents' expectations and educational investment decisions are often decided simultaneously, this should not be interpreted as causality.

The overall impact of sibling sex composition and the heterogeneity of the impact between the genders

We next examined the impact of sibling sex composition on educational attainment. Overall, we found a significant effect of sibling sex composition. Full sample regression results found that having brothers significantly reduces years of education by 0.4 years ($p = 0.050$). Every increase of 10% in the proportion of girls among siblings leads to an increase in individual years of schooling by 0.1 years ($p = 0.002$). The positive effect on educational attainment from having sisters is not significant.[h]

Models (1) to (3) in Table 4 further investigate whether, as previous studies have shown, sibling sex composition impacts only women (Chu et al. 2007) or have a greater impact on women (Li and Zhang 2008). From the regression results, having brothers (disadvantageous sibling sex composition) has no effect on men, but has a significant negative effect for women—having brothers significantly decreases years of schooling of women by 1.023 years (=0.020–1.043, $p = 0.002$), and this effect has a significant gender difference. Results also show that the reference group theory presented by Butcher and Case (1994) was not confirmed; we did not find having brothers to be beneficial for women's educational attainment. The impact of having sisters (favorable sibling sex composition) is not significant for men or women. A higher proportion of girls among siblings (favorable sibling sex composition) has a significant positive effect for men and women, but this effect does not have a significant gender difference.

The above results indicate that favorable sibling sex composition is equally beneficial for men and women, but disadvantageous sibling sex composition only adversely affects women and does not affect men. Therefore, the effects of sibling sex composition are not simply a greater impact on women's education, but also have complex gender heterogeneity, a result that differs from Chu and his colleagues' observations (Chu et al.

Table 4 Heterogeneous effects of sibling sex composition on years of schooling, by gender

Independent variables	Model (1)	Model (2)	Model(3)
Have urban *hukou*	2.136*** (0.230)	2.155*** (0.235)	2.139*** (0.229)
Han ethnic group	0.917*** (.313)	0.929*** (0.312)	0.934*** (0.312)
Age	−0.059*** (.006)	−0.059*** (0.008)	−0.058*** (0.009)
Female	−0.654* (0.333)	−1.006*** (0.255)	−1.908*** (0.332)
Parental educational level	0.236*** (0.024)	0.237*** (0.025)	0.237*** (0.024)
Father's ISEI	0.009 (.006)	0.010 (0.006)	0.009 (0.006)
Father's ISEI missing	−0.975*** (0.171)	−0.981*** (0.168)	−0.979*** (0.171)
Father was a member of CCP	0.489** (0.214)	0.466** (0.216)	0.497** (0.215)
Sibling number	−0.180*** (0.043)	−0.205*** (0.049)	−0.217*** (0.044)
Ranking among siblings at birth	0.154*** (0.040)	0.153*** (0.040)	0.157*** (0.040)
Have brother(s)	0.020 (0.201)		
Have brother(s) × female	−1.043*** (0.334)		
Have sister(s)		0.441 (.268)	
Have sister(s) × female		−0.717** (0.318)	
Ratio of female siblings			0.972** (0.436)
Ratio of female siblings × Female			0.143 (0.656)
Constant	8.777*** (.560)	8.487*** (0.696)	8.509*** (0.660)
R^2	0.357	0.355	0.357
N	5,271	5,271	5,271

Data are weighted according to the sampling probabilities. Standard error for clustering robustness in parentheses.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

2007). However, this again precisely proves that sibling sex composition matters because of the strong son preference and budget constraints faced by Chinese families. When the household is more budget-constrained because of disadvantageous sibling sex composition, parents start by reducing the investment in education for girls, thus leading to an asymmetric impact of sibling sex composition between genders.

We also referred to Li and Zhang's (2008) method, incorporating gender minority as a variable to verify whether parents prefer the minority gender in children. It was found that a minority position does not have a significant effect on education attainment.[i]

From the above results, we can argue that hypothesis 1 was confirmed: sibling sex composition affects individual educational attainment, and the efficiently allocating hypothesis and the budget constraint theory best fit the findings here. The effects of sibling sex composition have a complex asymmetry between men and women.

Effects of sibling sex composition by socioeconomic status and household registration

According to our expectations, if the sex composition effect weakens as family socioeconomic status rises, then the main effects and interactions should have the opposite effect coefficient. As shown in Table 5, the results of models (1) to (6) are consistent with this expectation: the net effects of sibling sex composition displayed a tendency toward zero, but the results were not robust.

The results of models (1) to (3) in Table 5 show that the advantage of having sisters decreases as parents' education level increases. Specifically, at the mean value of

Table 5 Effects of sibling sex composition by socioeconomic status, household registration status, and relative status of the mother

Independent variables	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)	Model (9)	Model (10)	Model (11)	Model (12)
Have urban residential registration	2.145*** (0.231)	2.137*** (0.233)	2.142*** (0.230)	2.134*** (0.230)	2.146*** (0.233)	2.126*** (0.227)	1.806*** (0.306)	2.074*** (0.254)	1.556*** (0.233)	2.130*** (0.231)	2.151*** (0.234)	2.132*** (0.230)
Han ethnic group	0.930*** (0.313)	0.941*** (0.318)	0.928*** (0.310)	0.934*** (0.313)	0.935*** (0.314)	0.936*** (0.312)	0.925*** (0.314)	0.639* (0.344)	0.641* (0.342)	0.928*** (0.313)	0.936*** (0.314)	0.934*** (0.311)
Age	−0.060*** (0.009)	−0.058*** (0.009)	−0.059*** (0.009)	−0.059*** (0.009)	−0.060*** (0.009)	−0.058*** (0.009)	−0.059*** (0.009)	−0.064*** (0.007)	−0.064*** (0.007)	−0.059*** (0.009)	−0.060*** (0.009)	−0.058*** (0.009)
Female	−1.571*** (0.125)	−1.593*** (0.126)	1.838*** (0.165)	−1.568*** (0.124)	1.591*** (0.125)	1.841*** (0.165)	1.566*** (0.124)	1.354*** (0.107)	−1.535*** (0.126)	1.566*** (0.124)	1.591*** (0.125)	1.836*** (0.165)
Parental education	0.190*** (0.040)	0.316*** (0.040)	0.168*** (0.036)	0.237*** (0.024)	0.238*** (0.025)	0.237*** (0.024)	0.236*** (0.024)	0.238*** (0.017)	0.238*** (0.017)	0.235*** (0.024)	0.238*** (0.025)	0.234*** (0.024)
Father's ISEI	0.010 (0.006)	0.010* (0.006)	0.009 (0.006)	−0.013 (0.011)	0.019* (0.010)	0.022* (0.012)	0.009 (0.006)	0.008* (0.004)	0.009* (0.004)	0.010 (0.006)	0.010 (0.006)	0.010 (0.006)
Father's ISEI missing	−0.982*** (0.170)	−0.970*** (0.167)	−0.978*** (0.171)	−0.996*** (0.167)	−0.982*** (0.169)	1.000*** (0.167)	0.984*** (0.168)	−0.921*** (0.132)	−0.910*** (0.134)	−0.977*** (0.170)	−0.977*** (0.170)	−0.969*** (0.170)
Father was a member of CCP	0.473** (0.216)	0.433** (0.216)	0.541** (0.216)	0.463** (0.216)	0.460** (0.215)	0.485** (0.216)	0.482** (0.215)	0.573*** (0.154)	0.591*** (0.153)	0.478** (0.216)	0.462** (0.214)	0.491** (0.215)
Sibling number	−0.175*** (0.043)	−0.217*** (0.050)	−0.216*** (0.043)	−0.180*** (0.043)	−0.206*** (0.048)	−0.218*** (0.043)	−0.179*** (0.043)	−0.211*** (0.046)	−0.228*** (0.044)	−0.179*** (0.043)	−0.207*** (0.048)	0.217*** (0.043)
Ranking among siblings at birth	0.155*** (0.040)	0.158*** (0.040)	0.156*** (0.039)	0.157*** (0.040)	0.154*** (0.040)	0.156*** (.040)	0.156*** (0.040)	0.139*** (0.033)	0.141*** (0.033)	0.155*** (0.040)	0.154*** (0.040)	0.157*** (0.040)
Sibling sex composition	−0.721*** (0.260)	0.559** (0.244)	0.332 (0.384)	−1.632*** (0.539)	0.537 (0.566)	2.296** (0.900)	−0.508* (0.260)	−0.057 (0.174)	0.382 (0.273)	−0.417** (0.203)	0.049 (0.167)	0.995*** (0.331)
Sibling sex composition × parental education level	0.054 (0.037)	−0.096*** (0.031)	0.141*** (0.054)									
Sibling sex composition × father's ISEI				0.027** (0.012)	−0.011 (0.013)	−0.028 (0.020)						
Sibling sex composition × urban household registration							0.393 (0.356)	−0.106 (0.233)	0.888** (0.364)			

Table 5 Effects of sibling sex composition by socioeconomic status, household registration status, and relative status of the mother (Continued)

Sibling sex composition × relative status of mother										0.143 (0.156)	−0.042 (0.207)	0.399 (0.306)
Constant	9.410*** (0.589)	8.328*** (0.696)	8.861*** (0.643)	10.138*** (0.716)	8.422*** (0.703)	7.898*** (0.703)	9.203*** (0.567)	9.834*** (0.554)	9.707*** (0.569)	9.100*** (0.572)	8.816*** (0.640)	8.464*** (0.637)
R^2	0.356	0.356	0.358	0.357	0.354	0.357	0.355	0.366	0.368	0.355	0.354	0.357
N	5,271	5,271	5,271	5,271	5,271	5,271	5,271	5,271	5,271	5,271	5,271	5,271

The variables of sibling sex composition for models (1), (4), (7), and (10) are "have brother(s)", for model (2), (5), (8), and (11) are "have sister(s)", and for model (3), (6), (9), and (12) are 'proportion of female siblings,' respectively. Data are weighted according to the sampling probabilities. Standard error for clustering robustness in the parentheses. $*p < 0.1$; $**p < 0.05$; $***p < 0.01$.

parental education level (4.491 years), the presence of sisters leads to a significant increase in years of schooling, 0.128 years (=0.559−0.096 × 4.491). With the improvement of parents' education level, this advantage gradually disappears. However, the impact of having brothers on educational attainment does not change with an increase in parental education level, but the influence of proportion of female siblings increases.

Models (4) to (6) in Table 5 reflect the heterogenous effects of sibling sex composition varying with father's ISEI score. We found that the main effects and interaction effects of the three sex composition variables are all of opposite signs, but only the effects of having brothers are significant. When taking the mean value of father's ISEI score (45.477), having brothers leads to a decrease of educational attainment by 0.404 years of schooling (=−1.632 + 0.027 × 45.477). However, as father's ISEI score steadily improves, this disadvantageous effect gradually disappears.

Does the effect of sibling sex composition differentiate with different household registration status? Having brothers and 'the proportion of female siblings' have a significant negative and a significant positive coefficient, respectively, for the subsample with rural *hukou*, but these two variables have no significant effects for the subsample with urban *hukou*.[j] However, based on the results of models (7) to (9) in Table 5, the interaction terms revealed that such effects do not significantly differ by *hukou* status.

Based on these results, hypothesis 2 is only partially confirmed: the effects of sibling sex composition weaken as socioeconomic status increases, but the results are not robust. Meanwhile, the effects of sibling sex composition between urban and rural household registration holders reveal no consistent variation. Possible explanations may include the following: first, in a model with explanatory variables and interaction terms, limited sample size can lead to an increase in the standard error of estimated coefficients; second, the effects of sibling sex composition are the result of rational choice in the face of budget constraints. Although we speculate that having a higher level of education, occupational status, or urban *hukou* of the family should lead to greater awareness of gender equality, none of these variables is a direct measure of the family's economic status or the degree of the budget constraints faced. Because of data limitations, we were unable to directly verify the use of household income when respondents were attending school.

Mother's status in the family and effects of sibling sex composition

We use whether the mother has a relatively higher level of education or higher ISEI score than that of the father as a proxy indicator of relative status at home. This variable is a dummy variable. If the mother's level of education or ISEI score is higher than that of the father's corresponding index, the variable value is 1 and 0 otherwise. We divided the sample into two subgroups according to whether the mother has a higher status. The subsample regression results[k] showed that first, only in the subsample in which mother has a lower status did sibling sex composition significantly affect educational attainment as expected. In the subsample with mothers with higher status, sibling sex composition did not impact educational attainment. Second, the levels of education of men and women were significantly different only in the lower-status subsample; there was no significant difference in the higher-status subsample. This

indicates that the relative increase of the status of the mother may improve the welfare of girls.[1]

In order to test whether increasing relative status of the mother can lead to significant change in the effects of sibling sex composition, we added an interaction term to models (10) to (12) in Table 5 to directly test it. The results show that though the main effects and interactions have opposite signs (except for 'proportion of female siblings'), the interaction term was not significant. In other words, the effects of sibling sex composition do not change significantly as the relative status of the mother improves, and therefore, hypothesis 3 is not confirmed. The possible reasons for this include first, the higher-status subsample size is much smaller than the lower-status subsample size, leading to a larger standard error of the estimate coefficients. Second, due to the limitation of data, the variables used in this article may not accurately reflect the bargaining power of the mother in the home. Future studies can use whether the mother is the head of household, the mother's income relative to the father's, the bride-price relative to the amount of dowry, and even whether the mother's first child is a boy, as more appropriate metrics to test this hypothesis (Wu and Li 2011).

The effects of sibling sex composition on different birth cohorts

More than 60 years after new China was founded, although the 'two-line struggle' existed in the first half of 'Mao era', the overall dominant national policies were based on the ideology of destratification. Especially during the Cultural Revolution period, the country took a radical approach, aiming at eliminating class, gender, and urban and rural differences in education policy (Tsang 2000). A number of policy products such as 'Iron Girl' (*tie guniang*)[m] aimed at eliminating gender differences (Jin 2006). After Mao's death, economic reforms and opening up motivated national policy to be more oriented toward the pursuit of efficiency. Deng Xiaoping's southern tour in 1992 marked a further deepening of economic reform.

We referred to Hao's (2007) method and divided the sample into five groups according to the birth cohort of the sample. Cohort 1 (born before 1946), as previously calculated, primary school begins at seven years old[n]; this group would take the university entrance exam no later than 1965 so they were not affected by the Cultural Revolution. Cohort 2 (born 1947 to 1957), part of this group experienced the Great Leap Forward policy of expanding basic education between 1958 and 1960 while in primary school or middle school (Tsang 2000). Additionally, this group experienced the university entrance exam during the Cultural Revolution, so they were most impacted by the Great Leap Forward and Cultural Revolution and their educational attainment was largely independent of family background. Cohort 3 (born 1958 to 1965), part of this group entered middle school during the Cultural Revolution but they entered university basically after 1977 when university entrance exams were resumed, and they were therefore less influenced by the Cultural Revolution. In addition, part of this crowd was influenced by universal basic education policy during primary and secondary education in rural areas in the 1970s (Li and Qi 2011), so relatively speaking, the relation between educational attainment and economic status of the family was also weak. Cohort 4 (born 1966 to 1972), this group entered middle school after the Cultural Revolution and their postprimary education choice was at the beginning of the reform and opening era that emphasized efficiency. Cohort 5 (born after 1973), this group began primary school in 1980 at

the earliest and entered middle school in 1986. This was a time influenced by the Compulsory Education Law that promoted universal education policy, and their university education was at a deepening stage of reform and opening (1992).

Because cohort 1 lived at a time of extreme economic deficiency and educational underdevelopment, the economic value of education was very low so the resource dilution effect was not obvious (Lu and Treiman 2008). We expect that the effects of sibling sex composition do not have a significant impact on their educational attainment. The educational experience of cohort 2 and cohort 3 occurred during the destratification age of the Cultural Revolution. We thus expect they were the least influenced by the effects of sibling sex composition, especially cohort 2 whose educational choices were made in the earlier years of the Cultural Revolution. The educational experience of cohort 4 and cohort 5 occurred mainly in the period of reform and opening up when the policy was oriented toward economic efficiency, and therefore largely impacted by the effects of sibling sex composition. However, cohort 5 received university education in the later stages of reform and opening up and was affected by the Compulsory Education Law, so we expect the impact of the effects of sibling sex composition to be more obvious for cohort 4 than cohort 5.

The results are reported in Table 6. In line with the hypothesis, for cohort 2, the group most influenced by the Cultural Revolution, sibling sex composition did not significantly affect educational attainment. For cohort 4, whose educational experience was completely free from the Cultural Revolution's influence but lacked the intervention of universal education policy and were at the beginning of the reform and opening up era, the coefficients of 'have brothers' and proportion of female siblings are in line with expected significance and sign. With the further development of the reform and the introduction of the Compulsory Education Law, there is no negative effect from having brothers for cohort 5, but the positive effect of the proportion of female siblings has become more apparent. One possible explanation is that for cohort 5, in which the sociodemographic structure further increased the cost of boys' upbringing, the increasing proportion of girls is more pronounced in helping education attainment. Cohort 5 was born precisely at the stage when China's sex ratio at birth rose (Zeng 2006). This led to a surplus of males and thus a disadvantage in the marriage market. In order to increase the son's advantage, families began to increase household savings for future marriage, to the extent that it became almost essential to prepare a house for the son's marriage (Wei and Zhang 2011). Therefore, in this stage, the relative cost of raising a boy became higher, and the positive effect of proportion of girls at home becomes more pronounced.

Rigorous statistical tests further show that there are significant differences in effects of sibling sex composition between birth cohorts, e.g., the difference in have brothers between cohort 2 and cohort 4 ($p = 0.0664$), the difference in proportion of female siblings between cohort 2 and cohort 4 ($p = 0.0240$), and between cohort 2 and cohort 5 ($p = 0.0005$). For the above results, hypothesis 4 is confirmed.

Conclusion

Decreasing sibling size due to the decline of the fertility rate is considered to be an important factor in bridging gender differences in educational attainment. However,

Table 6 The effects of sibling sex composition on different birth cohorts

Independent variable	Model (1)	Model (2)	Model (3)
Have urban residential registration	2.143*** (0.234)	2.151*** (0.238)	2.155*** (0.234)
Han ethnic group	0.893*** (0.306)	0.885*** (0.301)	0.889*** (0.308)
Cohort 2	−0.403 (0.641)	0.157 (0.637)	0.425 (0.546)
Cohort 3	1.378* (0.791)	1.330 (0.824)	0.887 (0.648)
Cohort 4	1.570** (0.641)	1.457** (0.608)	0.911** (0.507)
Cohort 5	2.018*** (0.602)	2.741*** (0.603)	1.461** (0.646)
Female	−1.555*** (0.125)	−1.587*** (0.124)	−1.825*** (0.160)
Parental education level	0.237*** (0.024)	0.238*** (0.024)	0.237*** (0.023)
Father's ISEI	0.009 (0.006)	0.009 (0.006)	0.008 (0.006)
Father's ISEI missing	−0.983*** (0.166)	−0.975*** (0.167)	−0.998*** (0.168)
Father was a member of CCP	0.499** (0.214)	0.482** (0.209)	0.538** (0.215)
Sibling number	−0.170*** (0.044)	−0.206*** (0.050)	−0.208*** (0.044)
Ranking among siblings at birth	0.140*** (0.041)	0.143*** (0.041)	0.136*** (0.039)
Sibling sex composition × cohort 1	−0.342 (0.596)	0.605 (0.593)	0.749 (0.806)
Sibling sex composition × cohort 2	−0.034 (0.328)	0.261 (0.298)	−0.413 (0.472)
Sibling sex composition × cohort 3	−0.593 (0.492)	0.356 (0.630)	1.264* (0.745)
Sibling sex composition × cohort 4	−0.925** (0.367)	0.095 (0.270)	0.998** (0.485)
Sibling sex composition × cohort 5	−0.321 (0.322)	−0.303 (0.190)	1.814*** (0.540)
Constant	5.532*** (0.670)	4.841*** (0.677)	5.193*** (0.615)
R^2	0.361	0.360	0.364
N	5,271	5,271	5,271

The variables of sibling sex composition for models (1) to (3) are 'have brothers,' 'have sisters,' and 'proportion of female siblings,' respectively. Data are weighted according to the sampling probabilities. Standard error for clustering robustness in parentheses. *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

sibling size studies consider 'inequality between families' and may be confounded by the effects of sibling sex composition, birth order, and birth spacing. Therefore, further study of the effects of sibling sex composition can expand the concept of sibling size (Chu et al. 2007; Powell and Steelman 1990). Economics, sociology, and psychology have presented several competing hypotheses to explain the impact of sibling sex composition on individual educational attainment, but the evidence is mixed and few studies are from China.

Based on the national survey data from China, we found that sibling sex composition has a significant impact on educational attainment and the efficiently allocating hypothesis and budget constraints theory can explain intrahousehold distribution within Chinese families. Specifically, having brothers is disadvantageous for individual educational attainment, and the higher the proportion of female siblings, the more education one can attain. The effects of sibling sex composition have complex asymmetry between genders: favorable sibling sex composition affects both men and women, but disadvantageous sibling sex composition affects only women. In addition, we found that there are significant different effects of sibling sex composition for different birth cohorts. However, the effects of sibling sex composition among individuals of different socioeconomic status and household registration status showed no consistent variation or robustness. The impact of improvement of relative status position of the mother in the family on intrahousehold distribution is also insignificant.

The research and perspectives of this article are similar to Parrish and Willis's work (1993) and Li and Zhang's (2008) study, but the former applied data from the mid-1980s using a sample from Taiwan and the latter used a sample from urban areas in China between 1988 and 2001. This study used data from the 2008 national sample survey, which enables the research to cover a longer timespan and on a larger scale to investigate the issue. In addition, on the basis of existing studies, this study further investigates the interaction between micro family behavior and macro policy and their impacts on the effects of sibling sex composition. This expands the scope of existing literature and furthers our understanding of intrahousehold resource allocation and gender inequality in education.

The results of this study lead to another question worth exploring: is the sibling configuration related to the intrahousehold distribution pattern affected more by gender culture or by the family's economic status? China's 'boy preference' in intrahousehold distribution has long been attributed to traditional cultural gender stereotypes or even gender discrimination, but we argue that this distribution is essentially a rational choice made by budget-constrained parents. For example, we found that parents' expectation of old-age support is related to children's educational attainment. If a daughter can also provide support for the elderly, the parents do not necessarily invest less in girls. Of course, this cannot be interpreted as causality. Future studies could further utilize the social pension insurance coverage as a natural experiment to study this issue.

We did not find consistent differences in intrahousehold distribution patterns related to sibling configuration between groups with different socioeconomic status or *hukou* status. This leads us to further investigate intrahousehold distribution patterns in Chinese families. The *Naotidaogua* (脑体倒挂)[o] phenomenon in educational outcomes and destratification policies have led to the fact that economic conditions are not as divergent as educational level and occupational status between families. Consequently, although sex preferences were considerably different between families with different educational levels and/or residence locations (Xie 1989), the budget constraints were similar across families and intrahousehold allocation was still dominated by economic conditions but not sex preference. In fact, economic rationality in family decision-making is more intense than we expected. Even during a radical era like the Cultural Revolution, parents' economic rationality was still reflected in choosing one adult child to 'go to the countryside' (*shangshan xiaxiang*, 上山下乡). Parents tended to send a weak child to receive 're-education' and kept the more capable child by their side for future old-age support (Li et al. 2010).

Based on the findings of this paper, we argue that the effects of sibling sex composition is the result of a budget constraint environment (Chu et al. 2007), which provides space for public policies to reduce educational gender inequality. For example, policies to ease budget constraints such as an increase in public spending on education or providing good social security could effectively reduce gender inequality within the family. Because our findings are not completely consistent with several existing studies, further studies should continue to investigate this line of research.

Endnotes

[a]Laws in China prohibit the employment of children under the age of 16 in production activities. During compulsory education, the opportunity cost of schooling is higher for girls than for boys. Because in our sample, the individual's average years of schooling are less than 7.3, we argue that the assumption that the opportunity cost of schooling for girls is higher than that of boys is acceptable.

[b]Endnote by translator: This is a Chinese idiom coming from the phrase 'A married daughter is like splashed water,' meaning that when daughters marry they are no longer part of their natal families and cannot be retrieved.

[c]Li and Zhang (2008) referred to this issue but did not discuss it in depth.

[d]Detailed information on this survey is available at: http://www.chinagss.org/index.php.

[e]In some research on the effect of sibling size, researchers use dummy variables to indicate the number of siblings to perform a robustness test. We tried this method and discovered that it did not influence the regression results significantly. Since this study does not focus on the effect of sibling size but rather on the effect of sibling sex composition controlling for the number of siblings, using dummy variables would increase variable numbers while sacrificing the degree of freedom. We thus treat it as a continuous variable in the following analysis.

[f]We truncated the variables of sibling size and ranking at other value, and the regression results did not change significantly.

[g]We consider only those who have at least one sibling and are not single. In this way, we can exclude those who have to live with parents because they are the only child or because they are unmarried and have no other place to live.

[h]The full sample regression results are similar to those shown in Table 4; thus, we did not report the results in the main text.

[i]If the number of boys outweighs the number of girls at home and the respondent is female or the number of girls outweighs the number of boys at home and the respondent is male, then the respondent is a 'gender minority' and assigned value 1, otherwise 0. For brevity, the results are not reported in the main text.

[j]The results are not reported in the main text for the sake of brevity.

[k]The results are not reported in the main text for the sake of brevity.

[l]In fact, a study in Ghana discovered that a female whose mother has a relatively higher level of education than the father is more influential on the human capital investment of their daughters (Thomas 1994). We also discovered that the mother's and father's levels of education have significantly different influence. Specifically, parental education level affects girls' educational attainment more. For girls, the mother's education level is significantly more influential than the father's (detailed regression results are omitted).

[m]Note by translator: this phrase uses the naturally hard and strong adjective 'iron' to describe women. It was extremely popular during the 1960s and 1970s, when Chinese women were glorified by masculine or gender-neutral traits.

[n]In our sample, most of the respondents started their schooling at age 7 (39.24%) or at age 8 (29.17%).

[o]This phrase refers to the phenomenon in which with the same working hours, mental labor earns less or equal to manual labor. The presence of *Naotidaogua* in China is due to the planned economy that aims at diminishing differences between mental and physical labor in the pursuit of formal equality, namely, equality of results, while ignoring substantive equality.

References

Alderman, H, and EM King. 1998. Gender differences in parental investment in education. Structural Change and Economic Dynamics 9(4):453–468.

Amin, V. 2009. Sibling sex composition and educational outcomes: a review of theory and evidence for the UK. Labour 23(1):67–96.

Bauer, T, and IN Gang. 2001. Sibling rivalry in educational attainment: the German case. Labour 15(2):237–255.

Becker, GS, and N Tomes. 1979. An equilibrium theory of the distribution of income and intergenerational mobility. Journal of Political Economy 87:1153–1189.

Becker, GS, and N Tomes. 1986. Human capital and the rise and fall of families. Journal of Labor Economics 4:S1–S39.

Behrman, JR, RA Pollak, and P Taubman. 1982. Parental preferences and provision for progeny. Journal of Political Economy 90(1):52–73.

Blake, J. 1981. Family size and the quality of children. Demography 18(4):421–442.

Brown, PH, E Bulte, and Xiaobo Zhang. 2011. Positional spending and status seeking in rural China. Journal of Development Economics 96(1):139–149.

Butcher, KF, and A Case. 1994. The effect of sibling sex composition on women's education and earnings. Quarterly Journal of Economics 109(3):531–563.

Chau, TW, Li Hongbin, PW Liu, and Jusen Zhang. 2007. Testing the collective model of household labor supply: evidence from China. China Economic Review 18(4):389–402.

Chu, CY Cyrus, Yu Xie, and Yu Ruoh-rong. 2007. Effects of sibship structure revisited: evidence from intrafamily resource transfer in Taiwan. Sociology of Education 80(2):91–113.

Conley, D. 2000. Sibship sex composition: effects on educational attainment. Social Science Research 29(3):441–457.

Connelly, R, and Zhenzhen Zheng. 2007. Enrollment and graduation patterns as China's reforms deepen, 1990–2000. In Education and reform in China, ed. E Hannum and A Park, 81–92. New York: Routledge.

Dayioğlu, M, MG Kirdar, and A Tansel. 2009. Impact of sibship size, birth order and sex composition on school enrolment in urban Turkey. Oxford Bulletin of Economics and Statistics 71(3):399–426.

Deng, Z, and DJ Treiman. 1997. The impact of the cultural revolution on trends in educational attainment in the People's Republic of China. American Journal of Sociology 103(2):391–428.

Feldman, M, S Tuljapurkar, Shuzhuo Li, Xiaoyi Jin, and Nan Li. 2006. Son preference, marriage, and intergenerational transfer in rural China. In Allocating public and private resources across generations, ed. AH Gauthier, CY Cyrus Chu, and Shripad Tuljapurkar, 139–162. Netherlands: Springer.

Ganzeboom, HBG, PM De Graaf, and DJ Treiman. 1992. A standard international socio-economic index of occupational status. Social Science Research 21(1):1–56.

Greenhalgh, S. 1985. Sexual stratification: the other side of 'growth with equity' in East Asia. Population and Development Review 11(2):265–314.

Griliches, Z. 1979. Sibling models and data in economics: beginnings of a survey. Journal of Political Economy 87(5):S37–S64.

Hannum, E. 2002. Educational stratification by ethnicity in China: enrollment and attainment in the early reform years. Demography 39(1):95–117.

Hannum, E. 2005. Market transition, educational disparities, and family strategies in rural China: new evidence on gender stratification and development. Demography 42(2):275–299.

Hannum, E, and Yu Xie. 1994. Trends in educational gender inequality in China: 1949–1985. Research in Social Stratification and Social Mobility 13:73–98.

Hannum, E, J Behrman, M Wang, and J Liu. 2009a. Education in the reform era (in Chinese). In China's great economic transformation, ed. L Brandt, T Rawski, Fang Ying, and Zhao Yang, 182–211. Shanghai: Gezhi Press, Shanghai People's Publishing House.

Hannum, E, P Kong, and Yuping Zhang. 2009b. Family sources of educational gender inequality in rural China: a critical assessment. International Journal of Educational Development 29(5):474–486.

Hao, Dahai. 2007. Studies of stratification of education in China urban areas (1949–2003) (in Chinese). Social Sciences in China 6:94–107.

Hauser, RM, and H-HD Kuo. 1998. Does the gender composition of sibship affect women's educational attainment? Journal of Human Resources 33(3):644–657.

Jacob, M. 2011. Do brothers affect their sister's chances to graduate: an analysis of sibling sex composition effects on graduation from a university or a *Fachhochschule* in Germany. Higher Education 61(3):277–291.

Jin, Yihong. 2006. Rethinking iron-ladies: social gender and labor in China cultural revolution (in Chinese). Sociological Studies 1:169–194.

Kaestner, R. 1997. Are brothers really better? Sibling sex composition and educational attainment revisited. Journal of Human Resources 32(2):250–284.

Kuo, H-HD, and RM Hauser. 1997. How does size of sibship matter: family configuration and family effects on educational attainment. Social Science Research 26(2):69–94.

Lee, Ming-Hsuan. 2011. The one-child policy and gender equality in education in China: evidence from household data. Journal of Family Economic Issues 32(1):41–52.

Li, Chunling. 2003. Transformation of society and politics and inequality of opportunities of education: influence from family background and systemic factors on educational attainment (in Chinese). Social Sciences in China 3:86–98.

Li, Yunsen, and Hao Qi. 2011. Intergenerational causality of education in China rural areas: studies based on basic education policy in 1970s (in Chinese). World Economic Papers 4:72–88.

Li, Hongbin, and Junsen Zhang. 2008. Gender composition's influence on education level (in Chinese). In Human capital investment and return in China, ed. Li Hongbin and Zhang Junsen, 51–74. Beijing: Peking University Press.

Li, Hongbin, Jusen Zhang, and Yi Zhu. 2008. The quantity-quality trade-off of children in a developing country: identification using Chinese twins. Demography 45(1):223–243.

Li, Hongbin, M Rosenzweig, and Jusen Zhang. 2010. Altruism, favoritism, and guilt in the allocation of family resources: Sophie's choice in Mao's mass send-down movement. Journal of Political Economy 118(1):1–38.

Lu, Y, and DJ Treiman. 2008. The effect of sibship size on educational attainment in China: period variations. American Sociological Review 73(5):813–834.

Morduch, J. 2000. Sibling rivalry in Africa. American Economic Review 90(2):405–409.

Ota, M, and PG Moffatt. 2007. The within-household schooling decision: a study of children in rural Andhra Pradesh. Journal of Population Economics 20(1):223–239.

Parish, WL, and RJ Willis. 1993. Daughters, education, and family budgets Taiwan experiences. Journal of Human Resources 28(4):863–898.

Powell, B, and LC Steelman. 1989. The liability of having brothers: paying for college and the sex composition of the family. Sociology of Education 62(2):134–147.

Powell, B, and LC Steelman. 1990. Beyond sibship size: sibling density, sex composition, and educational outcomes. Social Forces 69(1):181–206.

Rosenberg, M. 1965. Society and the adolescent self image. Princeton, NJ: Princeton University Press.

Strauss, J, and D Thomas. 1995. Human resources: empirical modeling of household and family decisions. In Handbook of development economics Vol. IIIA, ed. J Behrman and TN Srinivasan, 1883–2023. North Holland, Amsterdam: Elsevier Science.

Thomas, D. 1994. Like father, like son; like mother, like daughter: parental resources and child height. Journal of Human Resources 29(4):950–988.

Tsang, MC. 2000. Education and national development in China since 1949: oscillating policies and enduring dilemmas. China Review: 579-618.

Tsui, M, and L Rich. 2002. The only child and educational opportunity for girls in urban China. Gender and Society 16(1):74–92.

Wang, W. 2005. Son preference and educational opportunities of children in China - I wish you were a boy! Gender Issues 22(2):3–30.

Wei, Shang-jin, and Xiaobo Zhang. 2011. The competitive saving motive: evidence from rising sex ratios and savings rates in China. Journal of Political Economy 119(3):511–564.

Wu, Yuxiao. 2012. Gender difference of education attainment in China (in Chinese). Chinese Journal of Sociology 4:112–137.

Wu, Xiaoyu, and Lixing Li. 2011. Gender preference and family status of female (in Chinese). Economic Quarterly 3:869–886.

Wu, Xiaogang, and DJ Treiman. 2004. The household registration system and social stratification in China: 1955–1996. Demography 41(2):363–384.

Xie, Yu. 1989. Measuring regional variation in sex preference in China: a cautionary note. Social Science Research 18(3):291–305.

Xie, Yu, and Haiyan Zhu. 2009. Do sons or daughters give more money to parents in urban China? Journal of Marriage and Family 71(1):174–186.

Ye, Hua, and Xiaogang Wu. 2011. Fertility decline and trend of education equality between genders (in Chinese). Sociological Studies 5:153–177.

Zeng, Yi. 2006. The necessity and feasibility of soft landing of late birth of second child policy (in Chinese). Social Sciences in China 2:93–109.

Zeng, W, EA Undurrage, DTA Eisenberg, K Rubio-Jovel, V Reyes-García, R Godoy, and TAPS Bolivia Study Team. 2012. Sibling composition and child educational attainment: evidence from native Amazonians in Bolivia. Economics of Education Review 31(6):1017–1027.

Zhang, Weiguo. 2000. Dynamics of marriage change in Chinese rural society in transition: a study of a northern Chinese village. Population Studies 54(1):57–69.

Zheng, Lei, and Dingquan Zhang. 2013. Review of economic studies of gender difference of education in China (in Chinese). Collection of Women's Studies 2:112–119.

Zhou, X, P Moen, and NB Tuma. 1998. Educational stratification in urban China: 1949–94. Sociology of Education 71(3):199–222.