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Are Grandparents a Good Substitute for Parents as the Primary Caregiver? The Impact of Grandparents on Children's Academic Performance

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Are Grandparents a Good Substitute for Parents as the Primary Caregiver? The Impact of Grandparents on Children's Academic Performance

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Abstract

This study examines the impacts of caregiving by grandparents on children's academic performance in China, using data from the China Family Panel Studies (CFPS 2010 and 2014). Applying pooled OLS, instrumental variables and fixed-effects models with panel data estimation techniques, we find evidence that grandparents appear to have an adverse effect on the test scores of their school-age grandchildren. We further examine the mechanisms of this negative effect. Our results suggest that the education of grandparents plays an important role on the success of grandchildren and that increased schooling of grandparents can mitigate the negative effects of non-parental caregivers; thus, there are potential positive intergenerational impacts as grandparents become more educated themselves. When examining additional channels depressing test scores, we find evidence of grandparents' tendency to overindulge single-child grandchildren and grandsons. Lastly, it also appears that the common parenting practices of grandparents are detrimental to childhood development.

Keywords: children; grandparents; instrument variable; academic performance; China

JEL classification: I25; J13; O53

1. Introduction

Grandparent caregiving, where grandparents act as the primary caregiver for their grandchildren, has become increasingly common all over the world. In the US, at least 40% of grandparents reported providing some type of childcare and 15% of them reported providing extensive caregiving to their grandchildren (Fuller-Thomson and Minkler, 2001). Thus, grandparent-provided childcare is of first-order importance in the US (Rupert and Zanella, 2018). In Europe, it is even more extensive with almost 60% of grandparents providing care to a grandchild aged 15 or under (Hank and Buber, 2009). In Taiwan, parents rely heavily on grandparents once their children are in primary school. Almost three quarters of grandchildren have grandparents as their primary caregivers during their elementary school years (Lin 2009). In China, childcare provided by grandparents is also highly prevalent and is the focus of this study (Goh, 2006; Logan and Bian, 1999).

It has been documented that grandparents providing informal care to grandchildren is a pragmatic solution in China, in face of the high rate of female labor force participation rate even after child birth, limited day care for children, and mistrust towards domestic helpers (Chen, 1985; Goh, 2006; Goh and Kuczynski, 2014; Logan and Bian, 1999) And this kind of informal care is more feasible in China than in other countries, as China has a tradition of multiple generations living under the same roof (Bian et al. 1998; Chu and Yu 2010; Chu et al. 2011). In our sample, over 20% of children aged 10-15 are mainly cared by grandparents.

In this study, we assess the impact of the care provided by grandparents on the test scores of grandchildren by applying pooled OLS, instrumental variables and fixed-effects models with panel data techniques on a nationally representative sample from the China Family Panel Studies (CFPS 2010 and 2014). We find evidence that grandparents who take the role of the main caregiver have an adverse effect on the standardized test scores of their grandchildren. We also find that relatively low educational attainment of grandparents may be impeding the academic performance of grandchildren; meanwhile, increased education of grandparents can mitigate the negative effect of caregiving by grandparents. When we further explore the mechanisms of this impact, we find results that point towards an overindulgence of grandchildren -- the negative effect of grandparenting on children's academic performance is more pronounced for boys than

for girls, and it is more pronounced for only children than for children with siblings. Lastly, we find that grandparents have on average different parenting practices, and these differential attributes may partially explain the negative effect of grandparents on children's academic performance relative to parents. For example, grandparents spend less time checking homework and creating a home environment conducive to studying. Taken together, our results suggest that, on net, grandparents may not be providing similar guidance and assistance to their grandchildren as parents in terms of cognitive ability development.

We contribute to the literature by providing new evidence on the impact of grandparents on children's educational outcomes. First, although there is no consensus on this issue, most studies in the literature found a non-negative effect (Ciang and Park, 2015; Bol and Kalmijn, 2016; Liu, 2016; Kroeger and Thompson, 2016; Song, 2016; Song and Mare, 2019; Tanskanen and Nanielsbacka, 2018; Harvey, 2020). Our finding of a negative impact on children's academic performance paints a not so rosy picture of grandparents being the primary caregiver of school-age children. Second, many of existing studies on intergenerational effects either focus on the intergenerational educational mobility (education of one generation on the education of another) or investigate the effect of grandparental coresidence. These latter studies aim to capture complementarities and divisions of labor within a household when multiple generations provide care. Here, we study the effect of grandparents from another aspect: their role as the primary caregiver on test scores. Though there is high correlation between coresidence and taking care of grandchildren, grandparents being the primary caregiver likely exerts a more direct effect on children's outcomes. In addition, being the primary caregiver captures directly grandparents' substitution for parents, the implication of which deserves academic attention. Third, we believe we are the first to thoroughly examining the channels with which having grandparents as the primary caregiver affects grandchildren's academic performance.

The remainder of this paper is organized as follows. Section 2 discusses the related literature on the impact of grandparents on the human capital of grandchildren. Section 3 introduces the empirical strategy and our hypotheses. Section 4 presents the data and descriptive results. Section 5 discusses the empirical results. Section 6 concludes.

1. Literature Review

Research suggests that grandparents may have numerous impacts on their grandchildren ranging from educational attainment, academic performance, and health outcomes.

The impact of grandparents on children: education

Earlier studies mostly find either positive or no significant effect of grandparents on the educational outcomes of grandchildren. In the US, Kroeger & Thompson (2016) investigate intergenerational transmissibility of education by examining a three-generation sample of 20th century women. They find that the education of the grandmother strongly positively impacts the educational attainment of granddaughters. In another study of grandparents in the US, Song (2016) finds the impact on education depends on whether the grandchild lives in a single parent or two-parent families and on the race of the families. They find the strongest results of the positive impact of grandparents for grandchildren when both parents are living at home and the weakest effects for grandchildren living in single unmarried parent families. Grandchildren of divorced parents were in the middle in terms of the size of the beneficial grandparent effects. These findings suggest that grandparents may be able to *complement* parents when both parents are together and available to help the children with their studies, but grandparents may not be *substitutes* when there are absentee parents. Thus, it appears that when grandparents can be part of a bigger family, they are more likely to have positive impacts on intergenerational mobility. In a more recent study of the US, however, Harvey (2020) finds that co-residency with grandparents in childhood has no significant effect on later young adult outcomes, including education.

In other countries, there is less evidence of an impact of grandparents on the educational outcomes of grandchildren. While Tanskanen and Danielsbacka (2018) find grandparental investment in the UK as measured by parent-grandparent contact frequency and grandparental financial support is associated with improved grandchild's cognitive outcomes; however, the positive association disappears with individual fixed effects. In the Netherlands, Bol and Kalmijn (2016) find that grandparents' resources, measured by education, occupational status, and cultural resources, have no effect on grandchildren's schooling.

We have found only a handful of studies directly examining grandparents' impact on schooling in China and none of them focuses solely on the substitutability of grandparents for other caregivers. An early paper on China by Falbo (1991) finds that co-residing grandparents do not negatively affect the academic performance of their school-age grandchildren. Instead, more contact with better-educated grandparents is found to be positively associated with academic performance measured by language and math test scores. More recently, Deng et al. (2019) examine co-residency and family structure jointly and find that children in multigenerational families have higher test scores. Boys, in particular, benefit the most from multigenerational families. The paper most closely related to our paper is that by Zeng and Xie (2014) who look at the link between grandparents' care and the education of grandchildren in rural China; similar to many of the studies discussed above, grandparents' impacts depend on the living environment. Coresidency of grandparents produces a positive impact on the educational attainment of grandchildren similar to coresident parents, while non-coresidency has no effect on educational attainment of grandchildren. This positive connection may be due to enhanced attachment by coresidency with grandparents and complementarities. Thus, it does not appear that there is conclusive evidence regarding the substitutability (rather than complementarity) of grandparents for parents in China and our paper aims to fill that gap.

The impact of grandparents on children: health

Another aspect of human capital is health-related outcomes. Several studies look at the health costs and benefits of having grandparents as caregivers of their grandchildren. While the impact on schooling was mostly found to be null or positive, the majority of studies of grandparents' impact on child health suggest negative impacts and indicate some overindulgent behavior of grandparents. He, Li and Wang (2018) found that there was excessive weight gain for children in the presence of coresiding grandparents. This occurred due to decreased physical activity in rural areas and changes in diet in urban areas. The overall effect was found to be more pronounced in rural areas than in urban areas, and stronger for boys than for girls. In another study of Chinese grandchildren, by Li, Adab and Cheng (2015) find that the weight gain and obesity from grandparent caregiving is due to increased intake of sugary drinks and unhealthy snacks. A more recent study by Sun and Yang (2021) also finds negative impact of grandparenting on children's health in China, especially in the rural regions. They find that children who are taken care of by

grandparents are associated with lower height-for-age z-score and a higher frequency of illness. Evidence from other countries shows similar results. In Japan, Morita et al. (2019) find that despite lower BMIs when there are Japanese grandparents coresiding with the family, the grandchildren receive irregular snack food intake. Lastly, in sub-saharan Africa, grandmothers' coresidency is associated with greater stuntedness if the grandmother is relatively young or old (Schrijner and Smits, 2018).

Parenting Styles

Different parenting styles between grandparents and parents have also been posited as a contributor to differential impacts by grandparent's care. These parenting styles suggest that some grandparents may lack the inclination or ability to discipline or to help their grandchildren academically. Yue et al (2019) find that in rural Shaanxi the grandmother's parenting is less effective than the mother's as she does not engage with children in a way that encourages early development. For example, she rarely tells stories, sings, or uses toys to play with children. Li et al (2019) find in Jintan, Jiangsu, grandparenting styles, especially grandparental care, were prone to overprotection which could lead to a child's emotional and behavioral problems. Goh (2006) finds that grandparents are too lenient and indulgent towards the grandchildren, and parents play the role of disciplinarian mostly. Grandparents often pamper children in China where they may not be able to perform age appropriate tasks and they participate in less housework (Goh, 2006; Goh and Kuczynski, 2013).

Grandparents' tendency to indulge grandchildren appears universal and is insensitive to grandparents' cultural background and educational attainment. Studies find that grandparents enjoy pampering grandchildren and their different parenting styles are deliberately used to differentiate their identity and relationship from parents (Eli et al, 2016; Pankhurst et al, 2019; Roberts and Pettigrew, 2010).

Son preference

Evidence shows that son preference is still prevalent in China, especially among older generations and among these who are less educated (Bo, 2018; Kubo & Chaudhuri, 2017; Lin et al, 2021; Wu, et al. 2021). It has been found that son preference can be manifested in neglecting

and reduced investing on girls, though abortion of female fetuses and female infanticide have been prohibited by law since the 1990s when legislative efforts have been made to increase women's and children's rights (Kubo and Chaudhuri, 2017; Lin et al, 2021; Tafuro, 2020). Son preference is more likely to occur in traditional societies where people have little access to modern information, such as education and media (Robitaille, 2020). Therefore, increasing parents' and grandparents' access to modern information can potentially help to alleviate the discrimination against girls.

In the next section, we review our empirical strategy and explain the hypotheses we test based on the current state of the literature and predictions based on a conceptual framework of substitutability on caregiving.

2. Empirical Strategy: Conceptual Framework and Testable Hypotheses

The overall impact of grandparents on the educational outcomes of grandchildren is uncertain as there are numerous ways that grandparents can interact with their grandchildren. In theory, grandparents can *substitute* for parents who are absent or can *complement* parents who are available. The former relationship is more likely to be negative if grandparents are ill equipped to help with schoolwork; meanwhile the latter being potentially positive if parents and grandparents specialize in the aspects of caregiving in which they are better suited. We focus our analysis on the impact of grandparents as the primary caregiver and are testing whether *grandparents are a good substitute* for parents. In this case, we suggest the following hypotheses:

Hypothesis 1. Grandparents are not a good substitute for parents in taking care of children in terms of their academic needs.

According to the previous literature, grandparent's parenting styles and feeding practices are different from parents' and are likely to be ineffective in helping the childhood development of

grandchildren. If caregiving by grandparents creates human capital gaps at a young age, these differentials in educational attainment can contribute to a lifetime income inequality.

For the potential channels, we test the following four hypotheses.

Hypothesis 2. The lower education of grandparents relative to parents is one of the causes of the negative effect of grandparents as primary caregiver on children's academic performance.

The intuition is that there will be a negative effect of grandparents on test scores due to their lack of means of helping grandchildren academically.

Hypothesis 3. Grandparents' tendency to overindulge grandchildren is one of the causes of the negative effect on children's academic performance.

According to the previous literature, it is common for grandparents to want to overindulge and overprotect their grandchildren and this may be particularly true if this is an only child and if the child is a boy in a country with son preferences. In this case, they do not discipline their grandchildren adequately.

Hypothesis 4. Grandparents have less effective parenting practices.

We will formally test whether grandparents have less effective parenting practice, which will harm their grandchildren academically. This includes not actively engaging with students outside of school or not showing interest in schoolwork.

Hypothesis 5. Grandparents negatively affect children' health, and therefore, have a negative effect on children's academic performance.

According to the previous literature, grandparents may be unaware of the importance of healthy diet and physical exercise; as a result, grandparents as the primary caregiver may have a negative effect on their grandchildren's health status, which will negatively affect their academic performance.

To test Hypothesis 1, we examine the impact of caregiving by grandparents in the following linear model for test scores:

$$Y_{ict} = \alpha + \beta Grandparent_{ict} + \gamma X_{ict} + \eta M_{ct} + \theta_c + \delta_t + \varepsilon_{ict} \quad (1)$$

where Y_{ict} is the child's academic performance, standardized test score of Chinese word and math tests combined, for person i from county c in time t . The variable *Grandparent* is an indicator for whether a grandparent is reported as the primary caregiver of the child, instead of parents, and β is our main coefficient of interest.

We include a number of controls in X_{ict} which is a row vector of explanatory variables including age, gender, ethnicity, hukou category, parents' years of education, left-behind child status, number of siblings, log of household per capita income, and father's occupation categories. M_{ct} denotes some time-variant community characteristics, including kindergarten accessibility in the

community. θ_c denotes county fixed effects, δ_t are time fixed effects and ε_{ict} is a disturbance term. We cluster all standard errors at the household level.

To test Hypothesis 2, we further add the difference in education of parents and caregiving grandparents and the average years of schooling of grandparents, to explore whether the lower educational attainment of caregiving grandparents is a cause of the unsuitability of grandparents replacing parents as the primary caregiver. The difference in education of parents and caregiving grandparent's variable is equivalent to an interaction term of the grandparents' caregiving status and the difference in education of parents and the grandparents. The estimation equation becomes:

$$Y_{ict} = \alpha + \beta Grandparent_{ict} + \mu Diff_{ict} + \varphi Gedu_{ict} + \gamma X_{ict} + \eta M_{ct} + \theta_c + \delta_t + \varepsilon_{ict} \quad (2)$$

where $Diff_{ict}$ is the difference in education of parents and caregiving grandparents and $Gedu_{ict}$ is the average years of schooling of grandparents. Given the difference is positive because the parents are typically more educated than their parents, we expect μ to be negative as this differential widens. And if grandparents' education is an effective channel, we would expect β to be less negative.

To test Hypothesis 3, we will look into the heterogeneity in terms of gender and family size. And to test Hypotheses 4 and 5, we will change the dependent variable into the corresponding variables, such as different parenting style variables and child's self-rated health status, and estimate the equations by linear probability model (LPM). We prefer LPM here, because our model includes county fixed effects, which impose a significant computational burden on estimating a logit or probit model. In addition, Angrist et al. (2010) suggest that the LPM estimators are consistent.

Identification

A concern of the estimation strategy in equation (1) is that caregiving may not be exogenous. For example, having a grandparent as the primary caregiver may relate to family resources and

ability which may also have implications for the test scores of children. Furthermore, the decision to migrate by a parent and parents' fertility decision may be tied to economic need and ability of the parents which may also be correlated with children's test scores. To address these possible endogeneity problems caused by omitted variable bias, we estimate Instrumental Variables (IV) regressions.

For identification, we first assume only the primary caregiver variable is endogenous. Following the literature, we use parents' numbers of sisters and brothers, separately, as the instrument variables for primary caregiver.¹ The idea is that parents' siblings may have their own children, who will compete for the care provided by grandparents. For the exclusion restriction, we believe that parents' numbers of sisters and brothers is pre-determined and should not have a direct effect on the child's academic performance. Next, we assume both primary caregiver and the left-behind child status are endogenous. The instrumental variables for left-behind child status we used were the number of other migrants in the household excluding parents and its squared term. Based on the social network theory, if there are other household members who have migrated, they can provide information regarding the migration destination; this network connection can lower the migration costs for the sample child's parents. But this relationship may not be linear. In the extreme case, if all other able adult household members migrated, then the parents may have to stay to take care of the children and possibly the elderly as well.² On the other hand, other migrants should not affect the sample child's academic outcomes directly. Lastly, we assume primary caregiver, the left-behind child status and the number of siblings are all endogenous. The additional instrumental variables for the number of siblings are the gender of the first-born child and the average number of children per household in the local community. The former one is fair to be assumed random and is commonly used for countries or regions with

¹ The number of instruments used in the literature varies widely and we also tried a wide variation. For example, Reinkowski (2013) uses the gender of the first-born child as an instrument for the presence of grandparents when looking at the impact of grandchildren on the health of grandparents. Rupert and Zanella (2017) use the probability of being a grandparent as an IV for having grandchildren affecting their labor supply. For a similar analysis, Wang and Marcotte (2007) use (1) the number of dependent grandchildren and (2) the number of adult children (separately) as IVs for caring for grandchildren. When looking for IVs for grandparent care – most similar to our study -- He, Li and Wang (2018) look at the numbers of parents' brothers and sisters.

² In our empirical analysis, we found that the turning point is three. Before the turning point, the likelihood of parental migration increases in the number of other migrants in the household. But, if there are more than three migrants in the household, the likelihood of parental migration is smaller.

son preference in the literature, the latter one further capture the local fertility customs and the strictness of family planning policy.

3. Data and Variables

We use data from the 2010 and 2014 waves of the China Family Panel Studies (CFPS) dataset. This dataset is collected and compiled by the Institute of Social Science of Peking University and covers 25 provinces in China representing 95 percent of the Chinese population. The nationally representative survey collects individual-, family-, and community-level longitudinal data in contemporary China, with a wealth of information on demographics, economic activities, education outcomes, migration, and health. In particular, the CFPS has collected information on the primary caregiver for children under 16 years old and standardized math and Chinese word test scores for individual aged 10 and above which allows us to examine the effects of caregiving on academic outcomes for grandchildren aged between 10 and 15. In the pooled sample, we delete the repeated observations over the two years by keeping these in 2010 only, and delete the observations with missing key variables. In our main sample, we have 3,789 observations of children between 10 and 15.

a. Key Variables

The dependent variable is the standardized equally-weighted average score of Chinese word and math tests. The raw scores ranged between 0 and 24 for the math test, and between 0 and 34 for the word test. We first normalize the total test score to 100 for word and math tests, respectively. Then we take the average of the two normalized test scores; in this way, word and math tests will have equal weight. Lastly, we standardize the average test score by age to its z-score by age, which has mean of zero and standard deviation of one. We also do a robustness test for calculating the test scores this way, by using the standardized total scores of word and math tests, in section 5.9.; in this way, we simply sum the math and word scores so that the word test has more weight than math test because there were more points on the word exam. Our key variable of interest is a dummy variable indicating whether grandparent is the primary caregiver instead of parents.

b. Other covariates

We include many independent variables as controls to limit problems with omitted variable bias and focus on the role of grandparents as primary caregivers in our multivariate analysis, including age, gender, ethnicity, hukou category, the average years of schooling of parents, left-behind child status, number of siblings, log of household per capita income, father's occupation categories and kindergarten accessibility in local community, as well as county and year fixed effects. Left-behind child is a dummy variable which takes value of 1 if either or both of the parents migrated for work for at least 6 months, and value of 0 otherwise. Father's occupation is divided into five categories: leading cadre & self-employed, professionals & technical, worker, farmer, and unemployed.

c. Descriptive statistics

Table 1 presents summary statistics for the main variables used in the analysis which we split by the type of main caregiver. Among the sample, 68.1% are mainly taken care of by their mother, 22% are mainly taken care of by grandparents, and less than 10% are mainly taken care of by fathers. The standardized test scores have mean of zero by design. Children who are mainly taken care of by grandparents instead of parents do not have significantly lower mean test scores, on average, though this unconditional difference in mean has no causal interpretation. Left-behind children make up 11.5% of the sample and they are more likely to be mainly taken care of by grandparents. The average age is 12.1 years, and those mainly taken care of by grandparents are 0.368 years younger than others. Over half (about 52%) of the sample is male, and 10.7% is reported to be ethnic minority. Over three-fourths of the sample has rural hukou and 60.2% lives in rural areas where children are more likely to be mainly taken care of by grandparents. The sample children have 1.037 siblings on average, and 29.4% of them are the only children in the family. Those who are mainly taken care of by grandparents are more likely to be only children and thus have fewer siblings than others. The average per capita household income is 7,589 yuan. The average years of education for parents are 6.476, and for grandparents are 3.256, which indicates grandparents have substantial fewer years of schooling comparing to parents and the difference between their educational attainments will be positive in our regression analysis. On average, children who are mainly taken care of by grandparents instead

of parents have more educated parents. About half of children in our sample live in a community with kindergarten accessibility, and children living in the community with kindergarten accessibility are less likely to have grandparents as the primary caregiver. Children whose fathers are leading cadre in the work units, self-employed and workers are more likely to have grandparents as the primary caregiver, while children whose fathers are farmers are less likely to have grandparents as the primary caregiver.

The bottom part of Table 1 shows the descriptive statistics of our instrumental variables. On average, the parents of children mainly taken care of by grandparents have fewer siblings than the parents of children mainly taken care of by parents, as we expected. On average, there are 0.451 other household members who are migrants in the households of sample children, and the number is significantly higher for children mainly taken care of by grandparents than others. Again, this is to be expected as grandparents can step in when parents have migrated. Lastly, children in household with first-born girl are less likely to have grandparents as the primary caregiver. And the average number of children in local community is 1.896.

Table 1 here

4. Results

We present results of the effect of grandparents as primary caregiver on children's standardized mean test scores for all children pooled across both years, and then explore the channels by testing Hypotheses 2 – 5. We also consider possible endogeneity of caregiving status and possible endogeneity of left-behind children status and number of siblings. We conclude this section with robustness and sensitivity analysis.

Hypothesis 1. Grandparents are not a good substitute for parents in taking care of children in terms of their academic needs.

5.1. The effect of the grandparent as primary caregiver on children's test scores

Table 2 reports the OLS and 2SLS estimates of equation (1) for all children in our sample pooled across both years, and the detailed first-stage results of the 2SLS estimates are reported in Table A1 in the Appendix. Columns 1, 2 and 3 are the OLS estimates. In column 1, we control for the demographics of the child, including age, gender, ethnic minority, hukou status, number of siblings, log of household per capita income, and parents' education and migration status, as well as county fixed effects and a year fixed effect. Column 2 adds community characteristics, and Column 3 adds additional family characteristics including father's occupation categories, with farmer as the default category. The robust standard errors are clustered at the household level and are reported in the parentheses. Next, we show the IV estimation results in Columns 4, 5 and 6. In Column 4, we only treat the primary caregiver variable as endogenous; in Column 5, we treat both primary caregiver and left-behind children status as endogenous; and in Column 6, we treat primary caregiver, left-behind children status and number of siblings all as endogenous.

Table 2 here

The results in Columns 1, 2 and 3 in Table 2 consistently show that having a grandparent as the primary caregiver, instead of parents, has a negative effect on children's standardized mean test scores. The marginal effect is about 0.1; that is, all else held equal, having grandparent, rather than parents, as the primary caregiver decreases the child's mean test score by about 0.1 standard deviations. In addition, being a boy, being an ethnic minority, having rural hukou, and having more siblings are associated with lower mean test scores, and parents' education levels, household per capita income and kindergarten accessibility in local community are associated with higher mean test scores. These associations line up with findings in the literature that girls test better, more educated family members have spillover effects and more financial means (income) per child translates into more investment in education.

The 2SLS estimation results in Columns 4, 5 and 6 in Table 2 also indicate significant negative effect of grandparents as the primary caregiver on children's academic performance. The first-stage results of the 2SLS estimations show that the instrumental variables have strong correlation with the potentially endogenous variables, with robust Kleibergen-Paap Wald rk F-statistics of 37.170, 14.845 and 10.815, respectively. Also, the instrumental variables pass the over-identification test, with Hansen J statistics p-value of 0.931, 0.597 and 0.772 for different specifications. To further test the validity of our instrumental variables, we also estimate a reduced-form model including the instrumental variables as covariates. The estimation results are reported in Table A2 in the Appendix. For easy comparison, Column 1 is the same pooled OLS result as in Column 3 in Table 2, and Columns 2 – 4 are the estimation results for the reduced form model with the instrumental variables as covariates. It appears that including the instrumental variables as covariates barely affects the regression coefficients of our key variable of interest, and the marginal effect of grandparent being the primary caregiver is still about 0.1. In addition, the F-test statistics do not reject the null hypothesis that all the coefficients of the instrumental variables jointly equal to zero. Therefore, we conclude that our instrumental variables do not have an effect on children's standardized mean test scores other than through their effects on the potentially endogenous variables.

The p-values for the endogeneity test are 0.227, 0.572 and 0.480 which implies that we can treat grandparent's primary caregiver status, left-behind children status and number of siblings as exogenous. It seems that our covariates, such as parents' education and occupations and family per capita income, proxy for family resources and ability well, and therefore, the explanatory variables are uncorrelated with the residual any more. Since the OLS estimation is more efficient than the 2SLS estimation which only estimates the local average treatment effect, and in our case, both are consistent according to the endogeneity test statistics, we prefer the OLS estimates and only report the OLS estimates for the rest of our analysis (Hayashi, 2000; Stock and Yogo, 2005).

In sum, both the OLS estimates and the 2SLS estimates indicate that grandparents being the primary caregiver have a negative effect on children's academic performance. This provide direct evidence for our hypothesis 1 which states that grandparents are not good substitute for parents in taking care of children in terms of their academic needs.

5.2. Are grandparents substituting parents in providing academic assistance?

To further examine whether grandparents are a good substitute for parents in terms of meeting children's academic needs, we look into the tutoring information provided in the survey which is summarized in Table 3. It seems that the overall likelihood of being tutored by anyone (including family members, professional tutors or other nonfamily members) is not significantly different between children who are mainly taken care of by grandparents and children who are mainly taken care of by parents, but the likelihood of being tutored by parents is significantly lower for children who are mainly taken care of by grandparents. And this decrease in the likelihood of being tutored by parents is larger in size than the increase in the likelihood of being tutored by grandparents; therefore, the total likelihood of being tutored by parents or grandparents for children who are mainly taken care of by grandparents is still lower than that for children who are mainly taken care of by parents. The summary statistics in Table 3 show some evidence that grandparents' caregiving partially crowds out the academic assistance provided by parents, and the assistance grandparents provided cannot compensate enough for the withdrawal of that of the parents' in terms of intra-household allocation of resources. However, these results are merely suggestive evidence of a causal relationship and we further investigate the impact of caregiving on tutoring in regression analysis.

Table 3 here

Table 4 here

Table 4 shows the estimation result of a model similar to equation (1) with dependent variables now switched to the tutoring variables presented in Table 3. The results from different specifications are very similar, so we only show the results for the specification that is the same as in Column 3 in Table 2. The dependent variable in Column 1 in Table 4 is a dummy variable indicating the child was tutored last semester, in Column 2 is a dummy variable indicating the

child was tutored by parents or grandparents last semester, and in Column 3 is a dummy variable indicating the child was tutored by parents last semester. The estimation results show that the likelihood of being tutored is decreased in all three cases if grandparents are the primary caregiver, all else held equal. And the decrease in tutoring cannot be explained by the less academic needs of children who are mainly taken care of by grandparents, because there is no significant difference in the test scores between the two groups of children, as shown in Table 1. Judging on the academic needs, children who were mainly taken care of by grandparents probably have more need for tutoring service, given that they scored slightly lower than children who were mainly taken care of by parents. The largest decrease comes from the likelihood of being tutored by parents, followed by from the likelihood of being tutored by parents or grandparents, which again demonstrates that grandparents are acting as substitutes for parents in providing academic assistance when they are the primary caregiver, but the amount of the assistance they provide cannot compensate enough for the withdrawal of that of the parents', let alone the quality of the academic assistance.

Hypothesis 2. The lower education of grandparents relative to parents is one of the causes of the negative effect of grandparents as primary caregiver on children's academic performance.

5.3. Impact of Grandparents by Educational Attainment

5.3.1 Education Channel

To formally test hypothesis 2 and the education channel, we extend the baseline model in equation (1) by adding the difference in education of parents and caregiving grandparents and the average years of schooling of grandparents, as shown in equation (2).

If hypothesis 2 is true, μ in equation (2) should be negative, and β should be less negative. The estimation results are shown in Table 5. Adding the grandparents' education terms makes the effect of grandparent being the primary caregiver much smaller and become not significant. The coefficient of the difference in education of parents and caregiving grandparents is negative and

significant at 10% in most cases, which indicates that one year difference (lower) of caregiving grandparents' education comparing to that of parents' will decrease the mean test score of children who are mainly taken care of by grandparents by 0.018 standard deviation.

Table 5 here

5.3.2 Placebo tests

If grandparents as primary caregiver exert a negative effect on children's test scores due to their lack of education, then grandparents with higher levels of education should have smaller negative effect or no negative effect. To test this, we did placebo tests where we only keep primary caregiving grandparents who are relatively more educated. Because the average years of schooling of parents of children who are mainly taken care of by grandparents is 6.966 as shown in Table 1, we delete the observations in which the caregiving grandparents have fewer than 4.5 years of schooling. In this way, the average years of schooling of the remaining caregiving grandparents becomes 6.968. We re-estimate equation (1) for this subsample of relatively educated grandparents as the first placebo test. But notice that as the average years of schooling of the caregiving grandparents increases, the average years of schooling of the corresponding parents also increases. For the subsample in the first placebo test, the average years of schooling of the corresponding parents become 8.416, which is still 1.5 years more than that of the caregiving grandparents. Therefore, we have the second placebo test, where we delete the observations in which the caregiving grandparents have fewer than 6 years of schooling, equivalent to primary education. In this way, the average years of schooling of the remaining caregiving grandparents becomes 7.816, and that of the corresponding parents becomes 8.651 which is much closer and makes the grandparents more substitutable for parents in terms of their educational attainment.

Table 6 here

The estimation results for the placebo tests are shown in Table 6. Columns 1 – 3 are results for the first placebo test and Columns 4 – 6 are results for the second placebo test. In all cases, grandparents being the primary caregiver no longer exert significant negative effect. And the coefficients of the grandparents being the primary caregiver variable becomes much smaller comparing to the results in Table 2. Therefore, results in Table 6 provide further evidence to support our Hypothesis 2 that the education of the grandparents is of first order importance.

Hypothesis 3. Grandparents' tendency to overindulge grandchildren is one of the causes of the negative effect on children's academic performance.

5.4. Impact of Grandparents by gender of child

Table 7 here

Table 7 shows the effect of grandparents as primary caregiver on children's mean test scores by gender of child. Panel A is the results from estimating equation (1), and Panel B is the results from estimating equation (2). Grandparents as primary caregiver consistently have a significant negative effect on children's mean test scores for boys, but the negative effect on girls is smaller and not significant at 10% level of significance. Compared to boys with parents as their primary caregiver, boys with grandparents as their primary caregiver scored 0.106 standard deviations lower, all else held equal. Panel B in Table 7 shows that grandparents' education is an important channel in explaining the negative effect of grandparents as primary caregiver for girls, but it does not help to explain the negative effect for boys.

There are two potential explanations for the negative effect of grandparenting on boys. One possibility is that grandparents invest less in boys academically. The other one is that grandparents' overindulgence harm boys unintentionally. Given son preference in China, the negative effect of grandparenting is unlikely to be the result of underinvestment in boys as grandparents would not desire to intentionally set back their grandsons in school; instead, it seems that grandparents are less effective in disciplining boys, which is detrimental to their academic performance. Meanwhile, the negative, though not significant, effect of grandparenting on girls which can be alleviated by increasing education of grandparents provides support for our assumption that there is son preference in China. We interpret the lack of negative effect for girls, holding all else constant, in that grandparents do not overindulge their granddaughters to the same extent as grandsons.

5.5. Impact of Grandparents by number of siblings

Table 8 here

If grandparents are more likely to overindulge grandchildren, then the only child in household should be more likely to be cherished and overindulged. Table 8 shows the effect of grandparents as primary caregiver on children's mean test scores by the only child status. Panel A is the results from estimating equation (1), and Panel B is the results from estimating equation (2).

Grandparents as primary caregiver have significant negative effects on both only children and children with siblings, with bigger effect on the former one. Comparing to only children with parents as their primary caregiver, only children with grandparents as their primary caregiver scored 0.138 standard deviations lower, all else held equal. And comparing to children with siblings who have parents as their primary caregiver, children with siblings who have grandparents as their primary caregiver scored 0.098 standard deviations lower, all else held equal.

Panel B in Table 8 shows that grandparents' education is an important channel in explaining the negative effect of grandparents as primary caregiver on children with siblings, but it does not help to explain the negative effect on only children. Thus, we believe the results in Table 8 provide further evidence for Hypothesis 3, and grandparents overindulging only-child and male grandchildren is another channel at work which is not a function of grandparents' education.

As a caveat, the findings in Table 7 and Table 8 overlap to some degree, as boys are more likely to be the only children in families, and girls are more likely to have siblings. The findings are consistent in both tables and both support our Hypothesis 3.

5.6. Internal locus of control and overindulgence

We compare grandparents' and parents' locus of control (LOC), and examine whether there is a connection between their difference in LOC and the lack of substitutability of grandparents for parents as the primary caregiver through the overindulgence channel. LOC refers to individuals' beliefs about the extent of control that they have over things that happen to them, and there are internal and external LOCs (Rotter, 1966). For example, an individual with a greater internal LOC tends to attribute his/her success to his/her own ability and action; to the contrary, an individual with a greater external LOC tends to attribute his/her success to random chance, environmental factors, or the actions of others. Research has found that parents with less internal LOC are more likely to overindulge their children (Clarke and Bredehoft, 2001).

In our sample, grandparents are less likely to believe "hard working is important for success", "education is important for success", and "hard working pays off", comparing to parents, as shown in Table A3 in the Appendix. And therefore, grandparents appear to have less internal LOC, comparing to parents of our sample children. This is consistent with our findings that grandparents as the primary caregiver are more likely to overindulge the children.

Hypothesis 4. Grandparents have less effective parenting practice.

5.7. Parenting

We measure parenting practice by two sets of questions. One is answered by adults regarding how frequently he/she discuss school life with the child, how frequently he/she ask the child to finish homework, how frequently he/she check the child's homework, and how frequently he/she restrict the child from watching TV. We generate dummy variables for each of these variables, which equals to one if the adult's answer is "often" or "usually", and equals to zero otherwise. The other set of questions is answered by the interviewers regarding their observations of whether the home environment indicates caregivers caring about the child's education and whether the caregivers take the initiative to actively communicate with the child. We generate dummy variables for each of these variables, which equals to one if the interviewer agrees or extremely agrees, and equals to zero otherwise.

The descriptive statistics of these variables are shown in Table A4 in the Appendix. It appears that, comparing to children with parents as their primary caregiver, children with grandparents as their primary caregiver are less likely to have a caregiver who frequently discuss school life with them, less likely to have caregiver who frequently ask them to finish homework, less likely to have caregiver who frequently check their homework, and less likely to have caregiver who frequently restrict their TV time. In addition, children with grandparents as their primary caregiver are less likely to have a home environment where education is a priority and less likely to have caregivers who take the initiative to actively communicate with them.

Table 9 here

These unconditional differences in mean have no causal interpretation; therefore we re-estimate equation (1) using these parenting variables as the dependent variables. The results from different specifications are very similar, so we only show the results for the specification that is the same as in Column 3 in Table 2. After controlling for child's individual and household characteristics, community characteristics, and county and year fixed effects, grandparent as primary caregiver is negatively associated with the frequency of caregiver discussing school life with the child, the frequency of caregiver asking the child to finish homework, the frequency of

caregiver checking homework, and the frequency of caregiver restricting the child's TV time. Grandparent as primary caregiver is also negatively associated with an education-promoting home environment and negatively associated with caregiver's actively communicating with the child, holding child's individual and household characteristics, community characteristics, year and interviewer constant. Overall, we find that grandparents as primary caregiver is associated with parenting practices which are less effective in promoting child's education.

Hypothesis 5. Grandparents negatively affect children's health, and therefore, have a negative effect on children's academic performance.

5.8. Health channel

In this subsection, we test whether children's health can be a channel which explains the negative effect of grandparents as primary caregiver on children's academic performance, by testing whether grandparents as the primary caregiver have a negative effect on children's self-rated health status. We define a dummy variable which equals to one if the child reports he/she being healthy or very healthy, equals to zero otherwise, and we estimate equation (1) using this health dummy variable as the dependent variable. The result is shown in Table 10.

Table 10 here

We do not find evidence supporting grandparents as primary caregiver negatively affect children's health; on the contrary, we find that grandparents as primary caregiver has a significant positive effect on children's self-rated health status. Comparing to children with parents as primary caregiver, children with grandparents as primary caregiver are 1.4% more likely to be healthy, all else held equal. Therefore, children's health is not a valid channel through which grandparents as primary caregiver negatively affect children's academic performance. These results stand in

contrast to other studies largely conducted in other countries and are an important area for future research.

5.9. Robustness checks

In this section, we perform two kinds of robustness checks.³ First, we use the standardized total scores of word and math tests, instead of the standardized mean scores of word and math tests. In the former one, word test score has more weight than math test score, while in the latter one, word test score and math test score have equal weight. We re-estimate equation (1) using both OLS and 2SLS, and the results are reported in Table 11.

Table 11 here

The results in Table 11 are consistent with and very similar to the results in Table 2. The OLS estimates in Columns 1 – 3 show that grandparent being the primary caregiver, instead of parents, decreases the child's total test scores by about 0.1 standard deviation. The 2SLS estimates in Columns 4, 5 and 6 in Table 11 also indicate significant negative effect of grandparent being the primary caregiver on children's academic performance. The first-stage results of the 2SLS estimations shows that the instrumental variables have strong correlation with the potentially endogenous variables, with robust Kleibergen-Paap Wald rk F-statistics of 37.191, 14.849 and 10.814, respectively. Also, the instrumental variables pass the over-identification test, with Hansen J statistics p-value of 0.902, 0.637 and 0.792 for different specifications. Moreover, the p-values for the endogeneity test are 0.226, 0.453 and 0.439 which implies that we can treat grandparent's primary caregiver status, left-behind children status and number of siblings as exogenous. To sum up, both the OLS estimates and the 2SLS estimates indicate that grandparents being the primary caregiver have a negative effect on children's academic performance.

³ Because we have a small sample of left-behind children, we also estimate the effect of grandparenting on children's standardized test scores for children from non-migrant households. And the results are consistent with our main findings. The results are available upon request.

In the second sensitivity analysis, we estimate a fixed-effects model by keeping the repeated observations over year 2010 and 2014. The estimation results are reported in Table 12. In column 1, we control for the demographics of the child, including number of siblings, log of household per capita income, and parents' migration status, as well as individual fixed effects. Column 2 adds region fixed effect and community characteristics, and Column 3 adds additional family characteristics including father's occupation categories, with farmer as the default category. The results show that grandparents being the primary caregiver, instead of parents, worsen the child's academic performance, which is consistent with our main findings.

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Table 1. Descriptive statistics by caregiver

	Full sample			grandparent as caregiver		parent as caregiver		Difference value
	Obs	mean	st.d.	mean	st.d.	mean	st.d.	
<i>Key variables</i>								
standardized mean test score	3789	0.004	0.987	-0.039	0.983	0.017	0.988	-0.056
mother as caregiver	3789	0.681	0.466					
grandparent as caregiver	3789	0.220	0.414					
father as caregiver	3789	0.099	0.298					
<i>Covariates</i>								
left-behind children	3789	0.115	0.319	0.288	0.453	0.066	0.248	0.222***
age	3789	12.102	1.673	11.801	1.612	12.187	1.680	-0.386***
male	3789	0.519	0.500	0.517	0.500	0.519	0.500	-0.002
ethnic minority	3789	0.107	0.309	0.097	0.296	0.110	0.312	-0.013
rural area	3788	0.602	0.489	0.641	0.480	0.591	0.492	0.050***
rural hukou	3789	0.780	0.414	0.781	0.414	0.780	0.415	0.001
number of siblings	3789	1.037	0.974	0.912	0.912	1.072	0.988	-0.160***
only child	3789	0.294	0.456	0.354	0.478	0.277	0.448	0.077***
per capita income	3789	7589	9422	7701	8974	7557	9546	144
parents' mean years of education	3789	6.476	3.901	6.966	3.625	6.338	3.965	0.628***
grandparent's mean education	3623	3.256	2.924	3.308	2.905	3.243	2.929	0.065
caring grandparent's education				3.136	3.331			
difference in education of caring grandparents and parents				3.657	3.596			
community has kindergarten	3656	0.504	0.500	0.475	0.500	0.512	0.500	-0.037*
father's occupation: leading cadre & self employed	3789	0.090	0.286	0.126	0.332	0.080	0.271	0.046***
father's occupation: professionals & technical	3789	0.031	0.172	0.023	0.149	0.033	0.178	-0.010
father's occupation: worker	3789	0.404	0.491	0.495	0.500	0.379	0.485	0.116***
father's occupation: farmer	3789	0.278	0.448	0.207	0.406	0.298	0.457	-0.091***

father's occupation: unemployed	3789	0.233	0.422	0.249	0.433	0.228	0.419	0.021
<i>Instruments</i>								
number of mother's sisters	3541	1.179	1.273	0.784	1.100	1.271	1.293	-0.487***
number of mother's brothers	3541	1.306	1.170	0.801	1.019	1.424	1.171	-0.623***
number of father's sisters	3560	1.155	1.274	0.842	1.169	1.231	1.287	-0.389***
number of father's brothers	3560	1.060	1.228	0.546	0.916	1.186	1.262	-0.640***
number of other migrant household members	3789	0.451	0.792	0.663	1.048	0.391	0.691	0.272***
first-born child is a girl	3662	0.561	0.496	0.499	0.500	0.576	0.494	-0.077***
local mean number of children per household	3758	1.896	0.610	1.882	0.584	1.899	0.617	-0.017

* p<0.10, ** p<0.05, *** p<0.01

Table 2. Effect of grandparent as caregiver on children's mean test scores

	OLS				2SLS	
	1	2	3	iv1	iv2	iv3
grandparenting	-0.102** (0.039)	-0.096** (0.040)	-0.105*** (0.040)	-0.333* (0.184)	-0.322** (0.160)	-0.345** (0.156)
left-behind child	0.011 (0.050)	0.008 (0.051)	-0.039 (0.054)	-0.052 (0.082)	0.046 (0.294)	0.112 (0.301)
age	0.003 (0.009)	0.003 (0.009)	0.003 (0.009)	-0.003 (0.010)	-0.003 (0.010)	-0.058 (0.068)
male	-0.113*** (0.029)	-0.111*** (0.029)	-0.105*** (0.029)	-0.106*** (0.030)	-0.105*** (0.030)	-0.004 (0.010)
minority	-0.175** (0.071)	-0.139* (0.071)	-0.152** (0.072)	-0.109 (0.072)	-0.106 (0.072)	-0.095*** (0.034)
rural hukou	-0.172*** (0.048)	-0.166*** (0.051)	-0.158*** (0.051)	-0.135*** (0.050)	-0.143*** (0.052)	-0.124* (0.073)
parents' mean years of education	0.050*** (0.006)	0.050*** (0.006)	0.046*** (0.006)	0.048*** (0.006)	0.048*** (0.006)	-0.157*** (0.059)
sibling	-0.099*** (0.025)	-0.091*** (0.025)	-0.090*** (0.025)	-0.104*** (0.026)	-0.103*** (0.026)	0.049*** (0.007)
lnincome	0.041** (0.017)	0.042** (0.017)	0.036** (0.017)	0.030* (0.018)	0.029 (0.018)	0.030 (0.018)
community has kindergarten		0.076* (0.040)	0.071* (0.040)	0.053 (0.041)	0.053 (0.041)	0.053 (0.041)
father's occupation: leading cadre & self employed			0.210*** (0.060)	0.259*** (0.063)	0.237*** (0.081)	0.232*** (0.081)
father's occupation: professionals & technical			0.141 (0.098)	0.158 (0.097)	0.148 (0.102)	0.139 (0.102)
father's occupation: worker			0.116*** (0.041)	0.153*** (0.043)	0.135** (0.063)	0.131** (0.063)
father's occupation: unemployed			0.006 (0.045)	0.044 (0.048)	0.030 (0.061)	0.024 (0.062)
R-Square/Adjusted R-Square	0.296	0.296	0.300	0.015	0.015	0.010
Observations	3789	3656	3656	3372	3372	3366
Hansen J p-value				0.931	0.597	0.772

Overid p-value	0.923	0.639	0.792
Underid p-value	0.000	0.000	0.000
F-stat for weakid	37.170	14.845	10.815
Endog test p-value	0.227	0.572	0.480

Standard errors clustered at the household level are reported in parentheses. All regressions control for year fixed effect and county fixed effect.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3. Descriptive statistics of tutoring

	Full sample			grandparent as caregiver		parent as caregiver		Difference value
	Obs	mean	st.d.	mean	st.d.	mean	st.d.	
tutored	3789	0.472	0.499	0.451	0.498	0.477	0.500	-0.026
tutored by parents or grandparents	3789	0.397	0.489	0.337	0.473	0.414	0.493	-0.077***
tutored by parents	3789	0.386	0.487	0.299	0.458	0.411	0.492	-0.112***
tutored by grandparents	3789	0.022	0.148	0.059	0.235	0.012	0.110	0.047***

* p<0.10, ** p<0.05, *** p<0.01

Table 4. tutoring

	tutored	tutored by parents or grandparents	tutored by parents
	1	2	3
grandparenting	-0.040** (0.019)	-0.100*** (0.019)	-0.133*** (0.019)
left-behind child	-0.104*** (0.026)	-0.176*** (0.025)	-0.191*** (0.024)
age	-0.074*** (0.004)	-0.066*** (0.004)	-0.064*** (0.004)
male	0.061*** (0.014)	0.029** (0.014)	0.027** (0.014)
minority	-0.048 (0.038)	-0.032 (0.037)	-0.031 (0.037)
rural hukou	-0.018 (0.027)	-0.014 (0.027)	-0.019 (0.027)
parents' mean years of education	0.031*** (0.003)	0.032*** (0.003)	0.033*** (0.003)
sibling	0.012 (0.010)	-0.028*** (0.010)	-0.033*** (0.010)
lnincome	0.005 (0.009)	0.003 (0.008)	0.004 (0.008)
community has kindergarten	0.018 (0.020)	-0.006 (0.019)	-0.010 (0.019)
father's occupation: leading cadre & self employed	-0.013 (0.031)	-0.022 (0.030)	-0.025 (0.029)
father's occupation: professionals & technical	0.028 (0.049)	-0.003 (0.047)	-0.005 (0.047)
father's occupation: worker	0.006 (0.021)	-0.012 (0.020)	-0.015 (0.020)
father's occupation: unemployed	0.001 (0.022)	-0.035* (0.021)	-0.031 (0.021)

R-Square	0.241	0.259	0.268
Observations	4016	4016	4016

Standard errors clustered at the household level are reported in parentheses. All regressions control for year fixed effect and county fixed effect.

* p<0.10, ** p<0.05, *** p<0.01

Table 5. with interaction term

	1	2	3
grandparenting	-0.049 (0.058)	-0.041 (0.060)	-0.056 (0.060)
difference in education of caring grandparents and parents	-0.018* (0.011)	-0.018* (0.011)	-0.017 (0.011)
grandparents' mean years of education	-0.003 (0.007)	-0.004 (0.007)	-0.004 (0.007)
left-behind child	0.000 (0.056)	0.001 (0.057)	-0.052 (0.059)
age	0.001 (0.009)	0.002 (0.009)	0.001 (0.009)
male	-0.111*** (0.029)	-0.110*** (0.030)	-0.105*** (0.030)
minority	-0.151** (0.073)	-0.112 (0.072)	-0.125* (0.073)
rural hukou	-0.175*** (0.049)	-0.175*** (0.052)	-0.164*** (0.052)
parents' mean years of education	0.054*** (0.006)	0.053*** (0.006)	0.050*** (0.007)
sibling	-0.098*** (0.026)	-0.090*** (0.026)	-0.090*** (0.025)
lnincome	0.038** (0.017)	0.039** (0.018)	0.032* (0.018)
community has kindergarten		0.067* (0.041)	0.060 (0.041)
father's occupation: leading cadre & self employed			0.237*** (0.061)
father's occupation: professionals & technical			0.123 (0.099)
father's occupation: worker			0.135*** (0.041)
father's occupation: unemployed			0.021 (0.046)
R-Square	0.303	0.302	0.307
Observations	3623	3497	3497

Standard errors clustered at the household level are reported in parentheses. All regressions control for year fixed effect and county fixed effect.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6. Placebo tests

	education of caregiving grandparents ≥ 4.5			education of caregiving grandparents ≥ 6		
	1	2	3	1	2	3
grandparenting	-0.067 (0.052)	-0.070 (0.054)	-0.078 (0.054)	-0.046 (0.057)	-0.049 (0.059)	-0.060 (0.060)
left-behind child	0.007 (0.057)	0.010 (0.059)	-0.035 (0.062)	0.044 (0.058)	0.049 (0.060)	-0.000 (0.063)
age	0.003 (0.010)	0.002 (0.010)	0.002 (0.010)	0.003 (0.010)	0.002 (0.010)	0.002 (0.010)
male	-0.131*** (0.030)	-0.134*** (0.031)	-0.127*** (0.031)	-0.119*** (0.031)	-0.121*** (0.031)	-0.115*** (0.031)
minority	-0.207*** (0.073)	-0.181** (0.073)	-0.195*** (0.074)	-0.202*** (0.073)	-0.175** (0.073)	-0.190*** (0.073)
rural hukou	-0.164*** (0.050)	-0.164*** (0.053)	-0.157*** (0.053)	-0.156*** (0.051)	-0.156*** (0.054)	-0.149*** (0.054)
parents' mean years of education	0.053*** (0.006)	0.053*** (0.006)	0.049*** (0.006)	0.053*** (0.006)	0.052*** (0.006)	0.048*** (0.006)
sibling	-0.099*** (0.028)	-0.091*** (0.028)	-0.088*** (0.028)	-0.101*** (0.028)	-0.092*** (0.028)	-0.089*** (0.028)
lnincome	0.025 (0.017)	0.026 (0.018)	0.020 (0.018)	0.027 (0.018)	0.028 (0.018)	0.022 (0.018)
community has kindergarten		0.055 (0.042)	0.051 (0.042)		0.056 (0.042)	0.050 (0.042)
father's occupation: leading cadre & self employed			0.233*** (0.062)			0.237*** (0.062)
father's occupation: professionals & technical			0.150 (0.099)			0.152 (0.099)
father's occupation: worker			0.109** (0.044)			0.112** (0.045)
father's occupation: unemployed			0.011 (0.048)			0.025 (0.049)

R-Square	0.314	0.313	0.317	0.317	0.317	0.321
Observations	3332	3208	3208	3257	3136	3136

Standard errors clustered at the household level are reported in parentheses. All regressions control for year fixed effect and county fixed effect.

* p<0.10, ** p<0.05, *** p<0.01

Table 7. girls vs. boys
Panel A

	girls			boys		
	1	2	3	1	2	3
grandparenting	-0.078 (0.055)	-0.080 (0.056)	-0.091 (0.056)	-0.113** (0.056)	-0.099* (0.057)	-0.106* (0.057)
left-behind child	0.089 (0.071)	0.098 (0.074)	0.055 (0.079)	-0.048 (0.075)	-0.070 (0.076)	-0.127 (0.079)
age	0.013 (0.013)	0.011 (0.013)	0.011 (0.013)	-0.009 (0.013)	-0.009 (0.014)	-0.009 (0.013)
minority	-0.190* (0.098)	-0.147 (0.098)	-0.156 (0.098)	-0.177* (0.101)	-0.149 (0.103)	-0.161 (0.104)
rural hukou	-0.195*** (0.066)	-0.183*** (0.070)	-0.179** (0.070)	-0.153** (0.067)	-0.153** (0.071)	-0.147** (0.071)
parents' mean years of education	0.053*** (0.007)	0.052*** (0.007)	0.050*** (0.008)	0.052*** (0.008)	0.051*** (0.009)	0.046*** (0.009)
sibling	-0.094*** (0.034)	-0.087** (0.034)	-0.088*** (0.034)	-0.103*** (0.035)	-0.093*** (0.036)	-0.089** (0.036)
lnincome	0.017 (0.023)	0.020 (0.024)	0.015 (0.024)	0.050** (0.024)	0.052** (0.024)	0.045* (0.024)
community has kindergarten		0.057 (0.053)	0.051 (0.054)		0.070 (0.060)	0.064 (0.060)
father's occupation: leading cadre & self employed			0.162* (0.086)			0.259*** (0.089)
father's occupation: professionals & technical			0.009 (0.126)			0.247 (0.153)

father's occupation: worker			0.099*			0.138**
			(0.057)			(0.060)
father's occupation: unemployed			0.011			0.027
			(0.066)			(0.065)
R-Square	0.371	0.372	0.374	0.297	0.298	0.303
Observations	1824	1770	1770	1965	1886	1886

Standard errors clustered at the household level are reported in parentheses. All regressions control for year fixed effect and county fixed effect.

* p<0.10, ** p<0.05, *** p<0.01

Panel B

	girls			boys		
	1	2	3	1	2	3
grandparenting	0.037 (0.078)	0.034 (0.079)	0.025 (0.079)	-0.133 (0.083)	-0.114 (0.085)	-0.131 (0.086)
difference in education of caring grandparents and parents	-0.034** (0.014)	-0.035** (0.014)	-0.036** (0.014)	-0.000 (0.015)	0.001 (0.015)	0.003 (0.015)
grandparents' mean years of education	0.001 (0.009)	-0.002 (0.009)	-0.002 (0.009)	-0.005 (0.009)	-0.004 (0.009)	-0.005 (0.009)
left-behind child	0.090 (0.081)	0.102 (0.084)	0.049 (0.089)	-0.085 (0.080)	-0.099 (0.081)	-0.161* (0.084)
age	0.012 (0.013)	0.011 (0.014)	0.010 (0.014)	-0.014 (0.014)	-0.015 (0.014)	-0.014 (0.014)
minority	-0.141 (0.099)	-0.099 (0.099)	-0.113 (0.099)	-0.162 (0.103)	-0.131 (0.104)	-0.139 (0.105)
rural hukou	-0.192*** (0.069)	-0.194*** (0.073)	-0.188*** (0.072)	-0.167** (0.067)	-0.169** (0.071)	-0.160** (0.072)
parents' mean years of education	0.058*** (0.008)	0.057*** (0.008)	0.056*** (0.008)	0.053*** (0.009)	0.052*** (0.010)	0.047*** (0.010)
sibling	-0.091** (0.035)	-0.086** (0.035)	-0.086** (0.035)	-0.095*** (0.036)	-0.085** (0.037)	-0.082** (0.036)
lnincome	0.008 (0.024)	0.010 (0.025)	0.004 (0.025)	0.055** (0.025)	0.058** (0.026)	0.051** (0.025)
community has kindergarten		0.046	0.035		0.065	0.058

		(0.055)	(0.055)		(0.060)	(0.060)
father's occupation: leading cadre & self employed			0.193**			0.296***
father's occupation: professionals & technical			(0.089)			(0.091)
father's occupation: worker			0.028			0.175
			(0.131)			(0.151)
father's occupation: unemployed			0.126**			0.149**
			(0.058)			(0.062)
			0.048			0.021
			(0.068)			(0.067)
R-Square	0.384	0.384	0.387	0.306	0.306	0.312
Observations	1742	1692	1692	1881	1805	1805

Standard errors clustered at the household level are reported in parentheses. All regressions control for year fixed effect and county fixed effect.

* p<0.10, ** p<0.05, *** p<0.01

Table 8. only child vs. child with siblings
Panel A

	only child			child with siblings		
	1	2	3	1	2	3
grandparenting	-0.129*	-0.141*	-0.138*	-0.086*	-0.078	-0.098*
	(0.070)	(0.072)	(0.072)	(0.051)	(0.051)	(0.051)
left-behind child	0.054	0.054	0.056	0.020	0.013	-0.046
	(0.095)	(0.097)	(0.109)	(0.063)	(0.064)	(0.067)
age	-0.006	-0.008	-0.009	0.003	0.003	0.004
	(0.017)	(0.017)	(0.017)	(0.011)	(0.011)	(0.011)
male	-0.096*	-0.099*	-0.098*	-0.107***	-0.103***	-0.095***
	(0.052)	(0.053)	(0.053)	(0.036)	(0.036)	(0.037)
minority	-0.111	-0.103	-0.105	-0.181**	-0.148	-0.163*
	(0.121)	(0.126)	(0.128)	(0.090)	(0.091)	(0.091)
rural hukou	-0.151**	-0.159**	-0.160**	-0.251***	-0.221***	-0.211***
	(0.069)	(0.077)	(0.078)	(0.071)	(0.076)	(0.076)
parents' mean years of education	0.051***	0.051***	0.051***	0.049***	0.047***	0.042***

	(0.009)	(0.009)	(0.010)	(0.007)	(0.007)	(0.007)
sibling				-0.113***	-0.098***	-0.096***
				(0.032)	(0.032)	(0.032)
lnincome	0.041	0.035	0.032	0.047**	0.048**	0.042**
	(0.029)	(0.030)	(0.030)	(0.020)	(0.020)	(0.020)
community has kindergarten		-0.014	-0.014		0.118**	0.111**
		(0.070)	(0.070)		(0.051)	(0.051)
father's occupation: leading cadre & self employed			0.017			0.280***
			(0.126)			(0.073)
father's occupation: professionals & technical			0.021			0.202
			(0.149)			(0.143)
father's occupation: worker			0.022			0.128***
			(0.092)			(0.047)
father's occupation: unemployed			-0.037			0.003
			(0.096)			(0.055)
R-Square	0.322	0.327	0.328	0.270	0.264	0.270
Observations	1113	1057	1057	2676	2599	2599

Standard errors clustered at the household level are reported in parentheses. All regressions control for year fixed effect and county fixed effect.

* p<0.10, ** p<0.05, *** p<0.01

Panel B

	only child			child with siblings		
	1	2	3	1	2	3
grandparenting	-0.238**	-0.234**	-0.231**	0.018	0.024	-0.002
	(0.108)	(0.113)	(0.112)	(0.070)	(0.071)	(0.072)
difference in education of caring grandparents and parents	0.013	0.010	0.010	-0.033**	-0.033**	-0.031**
	(0.016)	(0.017)	(0.017)	(0.014)	(0.014)	(0.014)
grandparents' mean years of education	0.002	0.004	0.004	-0.001	-0.005	-0.006
	(0.010)	(0.010)	(0.010)	(0.009)	(0.009)	(0.009)
left-behind child	0.176*	0.179*	0.165	-0.006	-0.009	-0.074
	(0.104)	(0.108)	(0.122)	(0.067)	(0.069)	(0.071)
age	-0.013	-0.013	-0.013	0.002	0.001	0.002
	(0.018)	(0.018)	(0.018)	(0.011)	(0.012)	(0.012)

male	-0.112** (0.053)	-0.105* (0.055)	-0.104* (0.055)	-0.097*** (0.036)	-0.095** (0.037)	-0.089** (0.037)
minority	-0.112 (0.128)	-0.098 (0.131)	-0.102 (0.132)	-0.157* (0.091)	-0.122 (0.092)	-0.134 (0.093)
rural hukou	-0.170** (0.070)	-0.179** (0.079)	-0.174** (0.081)	-0.241*** (0.075)	-0.226*** (0.079)	-0.213*** (0.079)
parents' mean years of education	0.047*** (0.010)	0.047*** (0.011)	0.045*** (0.011)	0.055*** (0.008)	0.053*** (0.008)	0.049*** (0.008)
sibling				-0.113*** (0.033)	-0.099*** (0.033)	-0.097*** (0.032)
lnincome	0.042 (0.030)	0.039 (0.030)	0.034 (0.031)	0.046** (0.020)	0.047** (0.021)	0.040* (0.021)
community has kindergarten		-0.008 (0.074)	-0.008 (0.074)		0.095* (0.051)	0.086* (0.051)
father's occupation: leading cadre & self employed			0.050 (0.135)			0.309*** (0.074)
father's occupation: professionals & technical			0.062 (0.153)			0.157 (0.144)
father's occupation: worker			0.060 (0.099)			0.144*** (0.047)
father's occupation: unemployed			-0.002 (0.105)			0.015 (0.055)
R-Square	0.348	0.350	0.351	0.276	0.270	0.277
Observations	1024	973	973	2599	2524	2524

Standard errors clustered at the household level are reported in parentheses. All regressions control for year fixed effect and county fixed effect.

* p<0.10, ** p<0.05, *** p<0.01

Table 9. parenting

	Adult's answer			Interviewer's answer		
	Discuss school life	ask to finish homework	check homework	restrict watching TV	Caregiver cares about child's	Caregiver communicates

					education	with child
grandparenting	-0.078***	-0.033**	-0.075***	-0.035*	-0.055***	-0.086***
	(0.021)	(0.016)	(0.021)	(0.021)	(0.021)	(0.022)
left-behind child	-0.039	-0.020	-0.043	-0.010	-0.086***	-0.082***
	(0.029)	(0.023)	(0.029)	(0.028)	(0.028)	(0.029)
age	-0.003	-0.015***	-0.057***	-0.012***	0.000	-0.005
	(0.005)	(0.003)	(0.005)	(0.005)	(0.004)	(0.004)
male	-0.008	0.020*	0.035**	-0.011	-0.012	-0.007
	(0.016)	(0.012)	(0.015)	(0.016)	(0.015)	(0.015)
minority	0.048	-0.033	-0.018	-0.004	-0.111***	0.003
	(0.041)	(0.029)	(0.042)	(0.039)	(0.039)	(0.041)
rural hukou	-0.032	-0.013	0.012	0.039	-0.040	-0.023
	(0.030)	(0.020)	(0.029)	(0.028)	(0.033)	(0.030)
parents' mean years of education	0.020***	0.006***	0.023***	0.001	0.020***	0.014***
	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
sibling	-0.021*	-0.011	-0.016	-0.005	-0.013	-0.016
	(0.011)	(0.011)	(0.011)	(0.013)	(0.012)	(0.012)
lnincome	-0.006	0.005	-0.005	0.002	0.028***	0.034***
	(0.009)	(0.006)	(0.009)	(0.009)	(0.009)	(0.009)
community has kindergarten	0.024	-0.007	0.011	0.017	-0.017	-0.002
	(0.022)	(0.015)	(0.021)	(0.021)	(0.026)	(0.025)
father's occupation: leading cadre & self employed	0.024	0.021	-0.009	-0.034	0.040	0.083**
	(0.035)	(0.026)	(0.034)	(0.034)	(0.032)	(0.033)
father's occupation: professionals & technical	0.026	-0.075*	0.010	-0.083	0.155***	0.135**
	(0.051)	(0.041)	(0.050)	(0.052)	(0.052)	(0.054)
father's occupation: worker	-0.010	0.013	0.003	0.007	0.058***	0.062***
	(0.023)	(0.016)	(0.022)	(0.022)	(0.022)	(0.023)
father's occupation: unemployed	-0.022	0.025	0.014	-0.011	0.034	0.044*
	(0.024)	(0.017)	(0.023)	(0.023)	(0.025)	(0.025)
R-Square	0.123	0.123	0.172	0.113	0.441	0.431
Observations	3870	3870	3870	3867	3973	3973

Standard errors clustered at the household level are reported in parentheses. All regressions control for year fixed effect and county fixed effect.

* p<0.10, ** p<0.05, *** p<0.01

Table 10. Health channel

	1	2	3
grandparenting	0.013*	0.013*	0.014*
	(0.007)	(0.008)	(0.008)
left-behind child	-0.011	-0.011	-0.008
	(0.012)	(0.012)	(0.013)
age	0.002	0.001	0.001
	(0.002)	(0.002)	(0.002)
male	-0.002	-0.001	-0.001
	(0.006)	(0.006)	(0.006)
minority	-0.004	0.003	0.003
	(0.018)	(0.018)	(0.018)
rural hukou	-0.006	-0.007	-0.007
	(0.009)	(0.009)	(0.009)
parents' mean years of education	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)
sibling	0.001	-0.000	-0.000
	(0.004)	(0.004)	(0.004)
lnincome	-0.002	-0.002	-0.002
	(0.003)	(0.003)	(0.003)
community has kindergarten		0.001	0.002
		(0.008)	(0.008)
father's occupation: leading cadre & self employed			-0.016
			(0.012)
father's occupation: professionals & technical			0.003
			(0.017)
father's occupation: worker			-0.004
			(0.008)
father's occupation: unemployed			-0.000
			(0.008)
R-Square	0.088	0.081	0.082
Observations	3847	3714	3714

Standard errors clustered at the household level are reported in parentheses.

All regressions control for year fixed effect and county fixed effect.

* p<0.10, ** p<0.05, *** p<0.01

Table 11. Robustness Check: total test scores

	1	2	3	iv1	iv2	iv3
grandparenting	-0.100** (0.039)	-0.093** (0.040)	-0.103** (0.040)	-0.330* (0.184)	-0.342** (0.160)	-0.362** (0.156)
left-behind child	0.001 (0.050)	-0.003 (0.051)	-0.048 (0.054)	-0.063 (0.081)	0.075 (0.293)	0.126 (0.298)
age	0.003 (0.009)	0.002 (0.009)	0.002 (0.009)	-0.004 (0.010)	-0.005 (0.010)	-0.062 (0.067)
male	-0.127*** (0.029)	-0.126*** (0.029)	-0.120*** (0.029)	-0.121*** (0.030)	-0.120*** (0.030)	-0.005 (0.010)
minority	-0.196*** (0.072)	-0.159** (0.072)	-0.171** (0.072)	-0.129* (0.072)	-0.125* (0.072)	-0.112*** (0.034)
rural hukou	-0.165*** (0.048)	-0.159*** (0.051)	-0.152*** (0.051)	-0.129** (0.051)	-0.137*** (0.052)	-0.142* (0.073)
parents' mean years of education	0.050*** (0.006)	0.050*** (0.006)	0.046*** (0.006)	0.048*** (0.006)	0.048*** (0.006)	-0.147** (0.059)
sibling	-0.095*** (0.025)	-0.086*** (0.025)	-0.085*** (0.024)	-0.099*** (0.026)	-0.099*** (0.026)	0.049*** (0.006)
lnincome	0.041** (0.016)	0.043** (0.017)	0.036** (0.017)	0.031* (0.018)	0.029 (0.018)	0.030* (0.018)
community has kindergarten		0.066* (0.040)	0.062 (0.040)	0.044 (0.041)	0.043 (0.041)	0.043 (0.041)
father's occupation: leading cadre & self employed			0.201*** (0.059)	0.248*** (0.063)	0.221*** (0.081)	0.218*** (0.081)
father's occupation: professionals & technical			0.131 (0.098)	0.148 (0.097)	0.133 (0.102)	0.124 (0.102)
father's occupation: worker			0.114*** (0.041)	0.151*** (0.043)	0.128** (0.063)	0.126** (0.063)
father's occupation: unemployed			0.001 (0.045)	0.042 (0.048)	0.023 (0.061)	0.018 (0.062)
R-Square/Adjusted R-Square	0.296	0.297	0.300	0.014	0.012	0.008
Observations	3788	3655	3655	3371	3371	3365
Hansen J p-value				0.902	0.637	0.792

Overid p-value	0.891	0.674	0.810
Underid p-value	0.000	0.000	0.000
F-stat for weakid	37.191	14.849	10.814
Endog test p-value	0.226	0.453	0.439

Standard errors clustered at the household level are reported in parentheses. All regressions control for year fixed effect and county fixed effect.

* p<0.10, ** p<0.05, *** p<0.01

Table 12. Robustness Check: FE model with panel data

	1	2	3
grandparenting	-0.230*	-0.272*	-0.271*
	(0.136)	(0.149)	(0.153)
left-behind child	0.017	0.047	0.104
	(0.165)	(0.176)	(0.175)
sibling	-0.536	-0.847	-0.832
	(0.460)	(0.547)	(0.538)
lnincome	-0.024	0.005	0.019
	(0.063)	(0.064)	(0.067)
urban		-0.517*	-0.458
		(0.297)	(0.291)
community has kindergarten		0.357**	0.361**
		(0.153)	(0.155)
father's occupation: leading cadre & self employed			-0.101
			(0.279)
father's occupation: professionals & technical			-0.069
			(0.432)
father's occupation: worker			-0.183
			(0.154)
father's occupation: unemployed			-0.028
			(0.129)
Adjusted R-Square	0.057	0.095	0.100
Observations	2752	2609	2609
# of groups	2489	2379	2379

Standard errors clustered at the household level are reported in parentheses.

All regressions control for year fixed effect and county fixed effect.

* p<0.10, ** p<0.05, *** p<0.01

Table A1. IV estimation

	iv1	1st-stage: grandpa -renting	iv2	1st-stage: grandpa -renting	1st-stage: LBC	iv3	1st-stage: grandpa -renting	1st-stage: LBC	1st-stage: sibling
grandparenting	-0.333*		-0.322**			-0.345**			
	(0.184)		(0.160)			(0.156)			
left-behind child	-0.052	0.205***	0.046			0.112			
	(0.082)	(0.035)	(0.294)			(0.301)			
age	-0.003	-0.012***	-0.003	-0.011***	0.002	-0.004	-0.012***	0.002	0.025***
	(0.010)	(0.004)	(0.010)	(0.004)	(0.003)	(0.010)	(0.004)	(0.003)	(0.007)
male	-0.106***	0.004	-0.105***	0.002	-0.002	-0.095***	-0.023*	-0.002	-0.039
	(0.030)	(0.013)	(0.030)	(0.013)	(0.009)	(0.034)	(0.014)	(0.011)	(0.029)
minority	-0.109	0.011	-0.106	0.009	-0.028	-0.124*	0.001	-0.030	0.117*
	(0.072)	(0.029)	(0.072)	(0.029)	(0.023)	(0.073)	(0.029)	(0.024)	(0.060)
rural hukou	-0.135***	0.048**	-0.143***	0.052**	0.079***	-0.157***	0.051**	0.077***	0.187***
	(0.050)	(0.023)	(0.052)	(0.023)	(0.015)	(0.059)	(0.023)	(0.015)	(0.049)
parents' mean years of education	0.048***	0.006**	0.048***	0.005**	-0.003	0.049***	0.005**	-0.003	-0.018***
	(0.006)	(0.003)	(0.006)	(0.002)	(0.002)	(0.007)	(0.002)	(0.002)	(0.006)
sibling	-0.104***	-0.015	-0.103***	-0.025*	0.001	-0.058			
	(0.026)	(0.014)	(0.026)	(0.014)	(0.008)	(0.068)			
lnincome	0.030*	-0.010	0.029	-0.012	0.019***	0.030	-0.012	0.019***	-0.050***
	(0.018)	(0.008)	(0.018)	(0.008)	(0.005)	(0.018)	(0.008)	(0.005)	(0.018)
community has kindergarten	0.053	-0.022	0.053	-0.017	0.009	0.053	-0.016	0.010	-0.047
	(0.041)	(0.018)	(0.041)	(0.018)	(0.012)	(0.041)	(0.018)	(0.012)	(0.037)
father's occupation: leading	0.259***	0.054*	0.237***	0.087***	0.178***	0.232***	0.090***	0.178***	-0.040
	(0.063)	(0.030)	(0.081)	(0.030)	(0.024)	(0.081)	(0.030)	(0.024)	(0.056)
father's occupation: professionals & technical	0.158	-0.046	0.148	-0.018	0.090***	0.139	-0.016	0.091***	-0.079
	(0.097)	(0.038)	(0.102)	(0.038)	(0.022)	(0.102)	(0.038)	(0.022)	(0.069)
father's occupation: worker	0.153***	0.032	0.135**	0.059***	0.161***	0.131**	0.063***	0.161***	-0.046
	(0.043)	(0.020)	(0.063)	(0.020)	(0.015)	(0.063)	(0.020)	(0.015)	(0.041)
father's occupation: unemployed	0.044	0.015	0.030	0.044**	0.138***	0.024	0.045**	0.139***	-0.038
	(0.048)	(0.021)	(0.061)	(0.021)	(0.016)	(0.062)	(0.021)	(0.017)	(0.038)

# mother's brothers	-0.046*** (0.006)		-0.047*** (0.006)	-0.022*** (0.004)		-0.046*** (0.006)	-0.022*** (0.004)	0.003 (0.013)
# mother's sisters	-0.025*** (0.005)		-0.027*** (0.005)	-0.014*** (0.004)		-0.027*** (0.005)	-0.014*** (0.004)	0.034*** (0.013)
# father's brothers	-0.041*** (0.005)		-0.042*** (0.005)	-0.019*** (0.004)		-0.041*** (0.005)	-0.019*** (0.004)	0.012 (0.016)
# father's sisters	-0.012** (0.006)		-0.013** (0.006)	-0.021*** (0.003)		-0.013** (0.006)	-0.021*** (0.003)	0.013 (0.013)
# other migrant household members			0.034* (0.019)	-0.084*** (0.016)		0.032* (0.019)	-0.084*** (0.017)	0.122*** (0.046)
# other migrant household members squared term			0.013** (0.006)	0.014** (0.006)		0.013** (0.005)	0.014** (0.006)	-0.006 (0.016)
first-born child is a girl						-0.061*** (0.016)	0.001 (0.012)	0.391*** (0.035)
local mean # children per household						-0.017 (0.024)	0.012 (0.019)	0.604*** (0.088)
Adjusted R-Square	0.015		0.015			0.010		
Observations	3372	3372	3372	3372	3372	3366	3366	3366
Hansen J p-value	0.931		0.597			0.772		
Overid p-value	0.923		0.639			0.792		
Underid p-value	0.000		0.000			0.000		
F-stat for weakid	37.170		14.845			10.815		
Endog test p-value	0.227		0.572			0.480		

Standard errors clustered at the household level are reported in parentheses. All regressions control for year fixed effect and county fixed effect.

* p<0.10, ** p<0.05, *** p<0.01

**Table A2. Reduced-form with IVs
as covariates**

	1	2	3	4
grandparenting	-0.105*** (0.040)	-0.104** (0.045)	-0.101** (0.045)	-0.100** (0.045)
left-behind child	-0.039 (0.054)	-0.100 (0.069)	-0.113 (0.069)	-0.113 (0.069)
age	0.003 (0.009)	-0.000 (0.010)	-0.000 (0.010)	0.000 (0.010)
male	-0.105*** (0.029)	-0.107*** (0.031)	-0.108*** (0.031)	-0.090** (0.038)
minority	-0.152** (0.072)	-0.112 (0.073)	-0.114 (0.073)	-0.125* (0.074)
rural hukou	-0.158*** (0.051)	-0.145*** (0.051)	-0.138*** (0.052)	-0.136** (0.053)
parents' mean years of education	0.046*** (0.006)	0.046*** (0.006)	0.046*** (0.006)	0.046*** (0.006)
sibling	-0.090*** (0.025)	-0.101*** (0.026)	-0.099*** (0.026)	-0.105*** (0.028)
lnincome	0.036** (0.017)	0.032* (0.018)	0.036* (0.019)	0.036* (0.019)
community has kindergarten	0.071* (0.040)	0.058 (0.041)	0.058 (0.041)	0.056 (0.041)
father's occupation: leading cadre & self employed	0.210*** (0.060)	0.245*** (0.063)	0.249*** (0.063)	0.250*** (0.063)
father's occupation: professionals & technical	0.141 (0.098)	0.170* (0.100)	0.167* (0.100)	0.160 (0.101)
father's occupation: worker	0.116*** (0.041)	0.144*** (0.044)	0.147*** (0.044)	0.149*** (0.044)
father's occupation: unemployed	0.006 (0.045)	0.042 (0.049)	0.043 (0.049)	0.041 (0.049)
# mother's brothers		0.009 (0.014)	0.009 (0.014)	0.008 (0.014)
# mother's sisters		0.013 (0.013)	0.013 (0.013)	0.013 (0.013)
# father's brothers		0.008 (0.013)	0.007 (0.014)	0.007 (0.014)
# father's sisters		-0.002 (0.014)	-0.003 (0.014)	-0.003 (0.014)
# other migrant household members			-0.061 (0.039)	-0.059 (0.039)
# other migrant household members squared term			0.016 (0.010)	0.015 (0.010)
first-born child is a girl				0.039 (0.042)
local mean # children per household				0.015 (0.058)

R-Square	0.300	0.308	0.309	0.307
Observations	3656	3372	3372	3366
F-test stat for coefficients for IVs jointly equal to 0		0.460	0.700	0.670

Standard errors clustered at the household level are reported in parentheses. All regressions control for year fixed effect and county fixed effect.

* p<0.10, ** p<0.05, *** p<0.01

Table A3. Descriptive statistics of adults' beliefs

	grandparent			parent		Difference
	Obs	mean	st.d.	mean	st.d.	value
"reward for hard work"	702	0.745	0.404	0.822	0.314	-0.077***
"education is important for success"	702	0.722	0.409	0.843	0.292	-0.121***
"hardworking is important for success"	702	0.735	0.412	0.876	0.273	-0.141***

* p<0.10, ** p<0.05, *** p<0.01

Table A4. Descriptive statistics of adults' parenting style

	Full sample			grandparent as caregiver		parent as caregiver		Difference value
	Obs	mean	st.d.	mean	st.d.	mean	st.d.	
Parents discussed school with child	3759	0.472	0.499	0.408	0.492	0.489	0.5	-0.081***
Parents asked child to finish homework	3759	0.834	0.372	0.813	0.39	0.84	0.367	-0.027*
Parent checked child's homework	3758	0.455	0.498	0.42	0.494	0.465	0.499	-0.045**
Parent restricted child from watching TV	3754	0.639	0.48	0.603	0.49	0.65	0.477	-0.047**
Parents care about child' education	3789	0.498	0.5	0.45	0.498	0.511	0.5	-0.061***
Parents communicate with child	3789	0.597	0.491	0.513	0.5	0.62	0.485	-0.107***

* p<0.10, ** p<0.05, *** p<0.01