

The Effects of Grandparents on Children's Schooling:

Evidence from Rural China

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ABSTRACT

Past studies of intergenerational mobility in the U.S. have found that the influence of grandparents on their grandchildren's socioeconomic outcomes is completely mediated through the middle generation. Drawing on data from the 2002 Chinese Household Income Project (CHIP) survey, we investigate the direct effects of grandparents on grandchildren's educational attainment in rural China. The results show that the U.S. pattern does not apply to China, primarily due to the high prevalence of multigenerational coresidence in China. We find that the educational level of coresident grandparents directly affects the educational attainment of their grandchildren, with an effect size equivalent to that of parental education. In contrast, the education of non-coresident and deceased grandparents does not have any effect. These findings lead to the conclusion that coresidence is a critical condition for grandparents' influences on grandchildren. Thus, the finding of no direct effect of grandparents in the prior literature may be attributable to a low rate of multigenerational coresidence in the U.S.

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Introduction

In his presidential address at the 2010 Annual Meeting of the Population Association of America, Mare (Mare 2011) urged demographers to pay more attention to multigenerational processes and influences. He pointed out that research on intergenerational mobility has hitherto been limited mostly to studies of two generations—parents and their offspring—to the neglect of the effects of grandparents and other extended family members. Mare argued that while the nuclear-family based approach may be appropriate for some specific social contexts (e.g., 20th-century American society), it overlooks the importance of family in generating and maintaining social inequality in general. A potential fruitful context for studying multigenerational effects is Asia, where the role of the extended family is more prominent and extensive than in the West. If there are multigenerational influences—for example, grandparents' effects on children's educational outcomes—anywhere, we should find them in Asian societies.

Previous research has found that grandparents do not exert significant and direct influences on grandchildren's outcomes, as their influences are completely mediated through the middle generation {e.g., Warren and Hauser 1997; Erola and Moisiu 2006}. We revisit this research topic by examining the effects of grandparent education on children's educational attainment in rural China. Our study departs from prior research in taking the living arrangement of grandparents into account. China is a suitable site for a study with this approach because the prevalence of multigenerational coresidence is high there. In the

Chinese tradition, the ideal family structure is a patrilineal, extended household with multiple generations living under the same roof {Bian, Logan, and Bian 1998; Chu and Yu 2009; Chu, Xie, and Yu 2010; Greenhalgh 1985; Lavelly and Ren 1992; Thornton and Lin 1994; Whyte 2004; Whyte and Xu 2003}. We base this paper on the premise that coresident and non-coresident grandparents are categorically different in their influences on grandchildren. Because coresident grandparents are involved in day-to-day childrearing, they play a prominent, parent-like role in their grandchildren's lives. Conversely, non-coresident grandparents see their grandchildren only occasionally and can thus exert only limited influence on them. We develop three testable hypotheses from this premise. To test these hypotheses, we analyze a nationally representative sample of rural children from the 2002 Chinese Household Income Project (CHIP). We find that the effect of coresident grandparents' education on grandchildren's educational attainment is as large as that of parental education, while the education of non-coresident grandparents has no effect. On average, living with grandparents reduces the likelihood of school dropout, but that effect varies substantially with the education of coresident grandparents.

These results suggest that the finding of a null grandparent effect in advanced countries such as the U.S. may be attributed to the low prevalence of multigenerational coresidence. If our finding that *only* coresident grandparents directly affect grandchildren holds true in general, then the average grandparent effect must be weak in the U.S. where only 9% of the children live with grandparents.

Theoretical Issues

Do Grandparents Matter?

Sociologists and demographers have long been interested in the question of social mobility: “To what extent is a person’s socioeconomic standing determined by his or her family of origin?” As Mare (Mare 2011) has pointed out, this research field is mostly dominated by a two-generation paradigm, which views family influence as a Markovian process—the idea that the future generation is independent of its past generations conditionally on the present generation (i.e. depends *only* on the present generation). In other words, grandparents’ and grandchildren’s social classes are associated only because grandparents influence parents and parents in turn influence grandchildren. If the intergenerational influence is indeed a Markovian process, then the complicated process of multigenerational family influences can be simplified to the single association between parents and their children, as the effect of an ancestor from X generations ago can be expressed as the association between two consecutive generations raised to the X^{th} power (Bartholomew 1982).

The available research on intergenerational continuity across three generations, based primarily on the mid-twentieth century American experience, does generally support this Markovian view of grandparent effects. For example, Cherlin and Furstenberg (Cherlin and Furstenberg 1986) explored the intergenerational transmission of values and found that grandparents’ influence over their grandchildren’s views is mediated through the middle generation. In other words, grandparents pass on a legacy to their grandchildren if and only if they are successful in transmitting their values to their children. Warren and Hauser (Warren and Hauser 1997) examined the association of grandparents and grandchildren’s social status, using structural equation models to account for measurement errors. They also found that grandparents did not exert a direct influence. After controlling for parents’ characteristics, the

educational level or the occupational status of grandparents had few significant effects on their grandchildren's educational level or occupational status. A recent study by Erola and Moision {^Erola and Moision 2006}, utilizing Finnish Data and the mobility table approach, arrived at the same conclusion: taking more than two consecutive generations into account adds very little additional explanatory power to the analysis of intergenerational mobility. Is the empirical evidence convincing enough that we should now accept Markovian-type models as adequate descriptions of multigenerational family influences in general?

Not yet. In our view, prior analyses have so far failed to find grandparent effects because they have not adequately conceptualized theoretical reasons as to why grandparents may matter. As a result, not enough research effort has been expended on exploring the social context where multigenerational influences are mostly likely to exist. To see why grandparents may matter, we borrow from the extensive literature on why parents matter for children. In the literature on parental effects, three groups of factors have emerged as causal pathways: biological, economic, and socio-emotional {Ermisch 2003; Furstenberg 2011; Heckman 2006, 2011; McLanahan and Percheski 2008; McLanahan and Sandefur 1994; Teachman 1987}. The plausibility of the biological explanation is self-evident. Scientists have known for many years that talents and tendencies are encoded in genes and partially heritable. Numerous behavioral genetic studies have attempted to estimate the heritability of intelligence and personality traits. However, we still do not yet know the true extent to which human development is shaped by nature (i.e., genetics) versus nurture (i.e., environment).

Both the economic and the socio-emotional explanations are concerned with "nurture." The economic explanation is rooted in the idea that parents purposely invest, in terms of financial resources, in their children (Becker 1993; Mincer 1974). From this perspective, parents of higher socioeconomic standing have more resources to devote to their

children's upbringing and education, and it is those advantages that money can buy--better nutrition, health care, private lessons, etc.--that are responsible for differences in children's outcomes.

In contrast to the economic explanation, the socio-emotional explanation emphasizes routine social interactions between parents and children and how parents' non-financial investments in children such as cognitive stimulation, affection, and discipline affect their capabilities, behaviors, and socioeconomic outcomes later {Ermisch 2003; Furstenberg 2011; Hauser, Tsai, and Sewell 1983; Lareau 2003; McLanahan and Percheski. 2008; McLanahan and Sandefur 1994; Sewell, Haller and Portes 1969; Waldfogel and Washbrook 2011}. An extensive literature has established that children from different family backgrounds face "diverging destinies" {McLanahan 2004}. Highly-educated parents have more stable marriages, more resources, and fewer children than less-educated parents. While they work longer hours, highly-educated parents devote more time to child rearing, especially in child enrichment activities {Bianchi, Robinson, and Milkie 2006}. In recent years, more and more researchers have come to see parenting inputs as the primary determinant of children's outcome and financial resources as a subordinate factor whose effects are mediated through the quality of parenting {Costello, Compton, Keeler et al. 2003; Rutter 2006; Cunha and Heckman 2009; Heckman 2011}.

In searching for potential causal effects of grandparents on grandchildren, we may base our expectations on the current literature on parental effects that emphasizes the importance of the socio-emotional pathway. If grandparents exert a significant influence on grandchildren after controlling for parents' characteristics, the causal mechanism cannot be biological because genetic influences are entirely mediated by the middle generation. The main mechanism is unlikely to be economic either, as research on parental effects suggests

that parenting is far more important than money and financial resources are a very crude proxy of the real determinants of child outcomes {Cunba and Heckman 2009}. This leaves the socio-emotional pathway as the most plausible direct link between grandparents and grandchildren. But unlike genetic influences and the provision of financial resources, socio-emotional mechanisms of influences require direct interactions between grandparents and grandchildren. That is, grandparents must be *involved* in their grandchildren's day-to-day lives in order to exert significant influences on their well-being.

From the perspective of grandchildren, there are three types of grandparents: coresident, non-coresident, and deceased. We expect coresident grandparents to exert a direct influence on their grandchildren because they are involved in childrearing. We expect non-coresident grandparents to exert a weaker influence on their grandchildren due to their limited interactions with grandchildren. Deceased grandparents should not have any causal effects on their grandparents because they have no direct contact with grandchildren. The overall grandparent effect is an average effect across the three types of grandparents, weighted by their shares. Based on our data from rural China, coresident, non-coresident, and deceased grandparents account for 6%, 59%, and 35% of all grandparents for children aged 7 to 18, respectively. Thus, if as we argued above, only coresident grandparents exert significant influences on their grandchildren, the "average" grandparent effect must be quite weak. The breakdown of grandparents by survival status and living arrangement for U.S. children is not available, but we can expect the "average" effect to be even weaker due to the much lower rate of multigenerational coresidence in the U.S. From this perspective, the average grandparent effect without distinguishing grandparents' survival status and living arrangement is not a meaningful quantity; it is but a severely watered-down version of the real effect of interest--the effect of coresident grandparents.

Coresidence in China

In China, multigenerational coresidence is not only a traditional cultural ideal {Chu, Xie, and Yu 2011}, but also a practice strengthened by state policies and economic conditions {Zhang 2004}. For example, restrictions on migration through the Hukou system helped maintain close ties among extended family members {Davis-Friedman 1991}. The chronic urban housing shortage has reinforced the living arrangement of multigenerational coresidence {Logan, Bian, and Bian 1998}. Importantly, women's relatively high labor force participation rate and the elderly's reliance on family for financial support and care make multigenerational coresidence a convenient living arrangement for the exchange of services between generations.¹ As previous research has shown, coresidence in China is responsive to the practical needs of the elderly parents, their adult children, and their grandchildren {Chu, Xie, and Yu 2011; Logan and Bian 1999}. It first serves the younger generation's need for childcare, and later the older generation's need for old-age care {Chen 2004, 2005; Chu, Xie, and Yu 2011; Zhang 2004}.

Although the tendency towards multigenerational coresidence has declined in recent years, the rate remains high, in part due to a rapid fertility decline in China's recent past {Zeng 2004}. The percentage of households that are multigenerational is five times as high in China as that in the United States, 19% vs. 4% {Zeng 2004}. Based on our own calculation of the 2005 China Inter-Census Survey data, two thirds of persons aged 65 and over live with adult children and 26% of persons aged 18 and under live with grandparents, compared to 18% and 9% in the U.S., respectively {U.S. Census Bureau 2008}. The proportion of

¹ Women's labor force participation has been high in China, despite a declining trend since the late 1980s. Among women age 31 to 40 in urban China, for example, 87% participated in the labor force in 2006 {Han and Zhang 2010}, compared to 75% in the U.S. {Bureau of Labor Statistic 2002}.

elderlies living with adult children is much higher than the proportion of children living with grandparents because there are more young people than older people in both populations.

Not only is multigenerational coresidence far more prevalent in China than in the U.S., it is also less selective on parental resources. In the U.S., children living with grandparents come disproportionately from a minority background² and disrupted families. In 2004, for example, 57% of the children not living with either parent and 14% of those in single-parent families lived with grandparents, compared to 4% of those in two-parent families. In China, the likelihood of living with grandparents does not vary substantially by parental presence. In 2005, the percentage of children living with grandparents was 28%, 24%, and 44% among those living with two parents, those living with single parents, and those not living with either parent, respectively.³ Hence, grandparents tend to *supplement* parental presence in China, but *substitute* for parents in the U.S.

While American children living with grandparents are more likely to live in poverty than are children living in households with no grandparents present {U.S. Census Bureau 2008}, multigenerational coresidence in China is not highly selective with respect to socioeconomic background {Chu, Xie, and Yu 2011; Logan and Bian 1999; Zhang 2004}. Reflecting the patriarchal values of the Chinese society, coresidence with the husband's parents is far more common than coresidence with the wife's parents {Chen 2005; Chu, Xie, and Yu 2011}. Recent research has indicated that couples who co-reside with the wife's parents have a higher joint income, and couples who co-reside with the husband's parents have a slightly lower joint income, than those who do not co-reside with parents on either

² In 2004, 14% of black children, 12% of Hispanic children, and 13% of Asian children lived with grandparents, while only 6% of white non-Hispanic children did so (U.S. Census Bureau 2008).

³ Authors' own calculations using the same sources as given in footnote 3.

side (Chu, Xie, and Yu 2011). Overall, however, there are no substantial socioeconomic differences between adult children who co-reside with their parents and those who do not.

The Effects of Coresident Grandparents on Children

Because in the U.S. multigenerational coresidence is associated with socioeconomic disadvantages of children, such as being raised by single mothers, the effect of living with grandparents has largely been studied within the context of single parenthood {Szinovacz 1998}. Many studies have reported that children from single-mother families do better in school and exhibit fewer behavioral problems when they live with extended families {Aquilino 1996; DeLeire and Kalil 2002; Entwisle and Alexander 1996; Leadbeater and Bishop 1994; Thompson, Entwisle, and Alexander 1992}. For example, DeLeire and Kalil {^DeLeire and Kalil 2002} found that teenagers of never-married mothers and divorced mothers who live in multigenerational households are just as likely to graduate from high school or to attend college as children in married families. In a cross-national comparative study, Park {^Park 2007} reported small-to-no effects of single parenthood on children’s cognitive abilities in Asia and attributes this finding to a more involved role of grandparents in raising such children in Asia. Hence, the literature suggests that the presence of grandparents can effectively compensate for the disadvantages of single parenthood.

Our literature search did not yield any studies on the effects of coresident grandparents on children’s educational attainment in mainland China. However, we did find two studies on Taiwan. Both studies reported that students living with grandparents have higher standardized test scores than those not living with grandparents {Kuan and Yang 2004; Pong and Chen 2009}. What is particularly significant about these studies—something that U.S.-based studies cannot shed light on—is that the positive effect of living with

grandparents exists for children from two-parent families as well as from single-parent families.

How do children benefit from the presence of grandparents? As we discussed earlier, parents and grandparents can potentially affect children through three groups of causal mechanisms: biological, economic, and socio-emotional. Obviously, biological mechanisms do not require coresidence. Although economic mechanisms can potentially operate without coresidence, an argument can be made that for most grandparents who are not well-off enough to make substantial cash transfers, coresidence can bring economic resources to children through direct sharing and economies of scale. However, our main theoretical position is that the most important way in which grandparents affect children is socio-emotional, requiring coresidence or at least frequent interaction.

Socio-emotionally, children benefit from the presence of grandparents in many ways. Coresident grandparents are directly involved in childrearing {Minkler and Roe 1993}. They may read to their grandchildren, help them with homework, provide discipline and supervision, and serve as role models {Bengtson 1975; King and Elder 1997}. Coresident grandparents carry out many household chores, including cooking, laundry, cleaning, grocery shopping, etc. This not only allows parents more time to be involved with their children's education, but may also directly release older grandchildren from chores so that they can focus on schoolwork. Coresident grandparents play a role in the socialization of children by promoting traditional values such as respect, the importance of education, and work ethics. Good values and behaviors can, in turn, improve children's academic performance {Jackson 1968; Stevenson and Stigler 1992}. In addition, coresident grandparents can contribute to children's well-being by improving household dynamics and creating a closer network of relatives. Children in multigenerational households face more diverse adult-child

relationships and have a larger circle of trusted adults. These relationships can provide psychological support and social capital, which contribute to children's achievement and development.

In western societies with an emphasis on individualism, the responsibilities of childrearing lie entirely with parents or parent-like legal guardians. When both parents live with their children, the influences of grandparents on children may be limited. This is not true in Chinese societies or other Asian societies with similar cultural traditions. To explain this, let us provide a broad sketch of the Chinese family system and its implications for intergenerational relationships.

At the risk of over-simplification, the Chinese family can be characterized as patriarchal, patrimonial, patrilineal, and patrilocal.⁴ Involving multiple generations and marital unions along the male lineage, an extended Chinese family is a complicated social system, with the eldest male at the top of the social hierarchy. The core value of the Chinese family system is filial piety, the idea that children should respect their elderly parents (Knapp 2005; Whyte 2004). In this traditional system, a child is not just a child of his/her parents, but a child of a whole extended family, subject to both the authority and the care of the head of the family--usually the grandfather. Hence, within the Chinese family cultural tradition, grandparents not only live with grandchildren but also have both the authority and the obligation to exert influences on them. Of course, contemporary China has been significantly transformed by several revolutions in the past century, and as a result the Chinese family is no longer as patriarchal as before (Whyte 2004, 2010; Xie and Zhu 2009). However, cultural traditions never die out completely but are transformed into new practices as potential tool kits (Swidler 1986). We believe that the traditional Chinese family system is still relevant in

⁴ We base this characterization on Greenhalgh (1985), Knapp (2005), Thornton and Lin (1994), and Whyte (2004).

contemporary China and provides the social context where grandparents are allowed or even expected to be intimately involved in raising grandchildren.

Hypotheses

From the preceding discussion of theoretical issues pertaining to grandparent effects on children, we propose three testable hypotheses below. While the family structure literature tends to focus on the presence of grandparents and the social mobility literature on the education of grandparents, we combine those separate lines of investigation and argue that the resources that grandparents provide to their grandchildren vary by both education and coresidence status.

Hypothesis 1 (coresidence effect): Children living with grandparents have higher educational attainment than children not living with grandparents.

As discussed earlier, coresidence facilitates grandparents' provision of supplementary financial and parenting resources to their grandchildren. In addition, coresident grandparents are more likely to invest in the well-being of their grandchildren than grandparents who live apart from them because coresidence helps build a closer emotional bond between grandparents and their grandchildren through daily interactions.

Hypothesis 2 (education effect): The education of grandparents has a positive influence on the educational attainment of their grandchildren.

Children benefit from the education of grandparents because better-educated grandparents have more resources to offer than less-educated grandparents. While past research has suggested that the effect of grandparent education is completely mediated by the socioeconomic status of parents in the U.S., this may not be the case in China. Due to the greater importance of extended family and the core Chinese family value of filial piety, we

conjecture that controlling for parental socioeconomic status will not completely eliminate the positive influence of overall grandparent education in China.

Hypothesis 3 (interaction effects): The education of coresident grandparents exerts a far greater effect on grandchildren's educational attainment than the education of non-coresident grandparents and deceased grandparents.

As mentioned earlier, better-educated grandparents have more resources to offer than less-educated grandparents, and coresident grandparents are more willing, and have greater opportunities, to invest in their grandchildren. We view grandparents' education as a proxy for the stock of their financial, human, and network resources, and coresidence status as a condition for grandparents' effects on grandchildren. From this perspective, grandparents' education and coresidence status should have an interactive effect (as opposed to additive effects) on grandchildren's well-being. This interaction effect can be stated alternatively: the benefit of multigenerational coresidence for children increases with the education of grandparents.

We suspect that the effect of coresident grandparents' education is strong, perhaps as strong as that of parental education. This is because coresident grandparents in China are often the primary caregivers of young children so that both parents can work full time or even migrate to distant locations while leaving children behind. Grandchildren in such a living arrangement spend as much time with the coresident grandparents as with their parents, if not more. Thus, if family influence depends on the amount of contact, coresident grandparents can exert as much influence as parents.

The amount of contact between non-coresident grandparents and their grandchildren varies substantially. Ideally, we would like to test if the influence of non-coresident

grandparents increases with residential proximity and the frequency of visits between extended families. Unfortunately, our dataset does not have such measures.

Deceased grandparents have no direct contact with grandchildren, and thus their education should have no effect on grandchildren's educational attainment. An "effect" of deceased grandparents may nonetheless be observed if parental characteristics are inadequately controlled for.⁵ That is, unobserved parental characteristics which are correlated with both grandparents' and grandchildren's statuses might be mistaken for a grandparent effect. Thus, estimating the "effect" of deceased grandparents' education has the benefit of uncovering a potential problem of poor measurement.

Data and Methods

The Chinese Household Income Project (CHIP) is a repeated cross-sectional nationally representative survey conducted by China's National Bureau of Statistics in 1988, 1995, 2002, and 2007. Our study draws on the 2002 CHIP to capitalize on a unique feature of the study: it collected education data on the full set of grandparents regardless of their survival and residence statuses.⁶ This information allows us to address our main question: do the effects of grandparents' education on children's educational attainment vary by living arrangement?

⁵ Another reason we might observe a deceased grandparent effect is that there may be a lagged effect of past influence. Perhaps the deceased grandparents formerly lived with the grandchild and died only recently. This situation is rare and thus unlikely to cause a significant bias.

⁶ The survey collected education data on both sets of parents for the household head and the spouse. We assume that the parents of the head and the spouse are the grandparents of the children in the household because divorce is extremely rare in this sample. For example, among those who had ever been married, 94.6% were currently married, 0.4% were divorced, and 5.1% were widowed.

Chinese society is deeply segmented into rural China and urban China by household registration status, or called *hukou*, with the former much disadvantaged relative to the latter (Wu and Treiman 2004). The 2002 CHIP drew separate samples of rural households, urban households, and migrant households. The first two samples covered households living in their places of household registration, while the migrant sample captured households that are registered in rural areas but have left to live in urban areas. We limit analysis to the rural sample because there is little variation in our dependent variable, school dropout before age 18, in the urban sample, and because there are very few coresident grandparents in the migrant sample.

The rural sample includes 8,840 children ages 7 to 18. We limit analysis to those who lived with both parents in their parents' homes because complete education data on all grandparents and parents was collected for this group only. Over 90% of the children lived in such an arrangement. The rest of the children mostly lived in their grandparents' homes or in their parents' homes with single parents.

Because the education of deceased and non-coresident grandparents was reported by proxy respondents, a substantial proportion of the sampled households have missing data on these variables. We dropped approximately 10% of the children that have missing data on all four grandparents, but retained cases with missing data for 1 to 3 grandparents (about 20% of the sample) and imputed the missing values. A total of five data sets were imputed from other known covariates using the multiple imputation method, and the regression results were

aggregated.⁷ The final sample used in analysis contains 7,244 children living in 4,533 households.

Our primary goal is to estimate the effects of grandparents' education on children's educational attainment by living arrangement. Because the sample consists of children ages 8 to 17, many of whom have not completed schooling yet, OLS regression with completed years of schooling as the dependent variable is not appropriate for these data. Instead, we use a Cox proportional hazard model to analyze how long children persist in the educational system.⁸ This way we can treat children still in school as right-censored cases in survival analysis.

Each child has four grandparents, whether or not they are observed or even known to the child. The independent variables of interest are the characteristics of the grandparents. Based on their survival and coresidence statuses, we classify all grandparents into three mutually-exclusive groups: deceased grandparents (DG), non-coresident grandparents (NCG), and coresident grandparents (CG). Note that non-coresident and coresident grandparents are distinguished not by their own living arrangement but by their co-residential relationship to the focus children in our CHIP sample. As we discussed earlier, coresidence is still a common living arrangement for the elderly in China. Non-coresident grandparents for

⁷ The missing value of years of schooling was imputed for 228 paternal grandfathers, 655 paternal grandmothers, 313 maternal grandfathers, and 786 maternal grandmothers. We used the predictive mean matching method with household income, grandparents' characteristics (year of birth, survival status, and party membership), as well as parental characteristics (education and occupation) as inputs. We used the MI package in Stata 12.

⁸ We also used enrollment status as the outcome variable in an earlier analysis with the logit model. The substantive results are similar and thus not reported here. We prefer survival analysis because while the logistic model only considers current enrollment status at the time of the survey, survival analysis makes use of information as to when children dropped out of school if they were no longer enrolled.

the focus children in our CHIP sample may live with other grandchildren (i.e., cousins of the sampled child).⁹

Our key independent variable is grandparents' education, measured as years of schooling in the CHIP survey. The average years of schooling for grandparents varies significantly by sex and birth cohort.¹⁰ To construct a measure comparable across cohorts, we converted the original measure to a percentile score such that it measures a grandparent's education relative to his or her same-sex contemporaries born in the same decade. For example, a grandfather born in the 1940s with 6 years of schooling receives a score of 61. As we will show later, the three types of grandparents—DG, NCG, and NG—differ in birth cohort and sex composition. We prefer the percentile-score measure because it standardizes those differences and renders the comparison of grandparents' education effects by survival status and living arrangement more valid, but we also report the results of a sensitivity analysis using alternative measures of education.

Let variable t (for time) denote the grade level that a child attends. The outcome of our statistical analysis is the hazard at t , i.e., the probability that the child drops out of school at t given that he/she has stayed in school prior to t . To estimate the main effect of living with grandparents on the likelihood of dropout, we start with the following Cox model:

$$h(t) = h_0(t) * \exp(b_1 * D_{NCG>0} + \mathbf{b}_2 * \mathbf{C}), \quad (1)$$

where $h_0(t)$ is the baseline hazard of school dropout, specified as a nonparametric function in the Cox model. We estimate the parameters of the covariates, which are specified to have

⁹ In the CHIP data, over 80% of the people ages 65 and over lived with children and grandchildren.

¹⁰ For example, the mean years of schooling was about 3 for grandparents and 1.5 for grandmothers. A man with 6 years of education born before 1920 is over the 90th percentile among his contemporaries; had he been born in the 1940s, he would be only at the 61st percentile.

multiplicative effects on the hazard of leaving school at any given time t . The variable of interest here is the dummy variable $D_{NCG>0}$, which indicates whether the child lives with any grandparents. \mathbf{C} represents a vector of control variables which include the child's birth year (centered at 1990), sex, parental education, and parental occupations.

If a grandparent does not live with a child, he/she may live apart from the child, or may be already deceased. In estimating the effect of living with grandparents, equation (1) does not distinguish between non-coresident and deceased grandparents. The next model allows the child's schooling outcome to vary by the number of grandparents in each of the three categories, deceased grandparents (DG), non-coresident grandparents (NCG), and coresident grandparents (CG):

$$h(t) = h_0(t) * \exp(b_1 * N_{CG} + b_2 * N_{NCG} + \mathbf{b}_3 * \mathbf{C}), \quad (2)$$

where N_{CG} and N_{NCG} are the numbers of coresident and non-coresident grandparents, respectively. Equation (2) does not include the number of DG because N_{DG} is determined by N_{CG} and N_{NCG} ($N_{CG} + N_{NCG} + N_{DG} = 4$). b_1 captures the difference between having a coresident grandparent vs. a deceased grandparent and b_2 captures the difference between having a non-coresident grandparent vs. a deceased grandparent, holding constant the statuses of the other three grandparents and the control variables.

To estimate the main effect of grandparents' overall education on the hazard of dropout, we further specify a model in equation (3):

$$h(t) = h_0(t) * \exp(b_1 * N_{CG} + b_2 * N_{NCG} + b_3 * E_G + \mathbf{b}_4 * \mathbf{C}), \quad (3)$$

where E_G is the sum of the education percentile scores of all four grandparents. Because observations with missing grandparent education are either dropped or imputed, E_G consists of four parts for each child. For the sake of parsimony, we do not distinguish between

grandfathers and grandmothers, or between paternal and maternal grandparents, but use the aggregate measure E_G for a one-parameter test of the overall grandparent education effect.

This is tantamount to including the education of four grandparents (each measured in percentiles by sex and cohort) separately and constraining their coefficients to be equal.

To test *Hypothesis 3*, which states that the education of coresident grandparents has a greater effect on children's educational attainment than that of non-coresident grandparents and deceased grandparents, we add interactions between grandparents' status and education as follows:

$$h(t) = h_0(t) * \exp(b_1 * N_{CG} + b_2 * N_{NCG} + b_3 * E_{CG} + b_4 * E_{NCG} + b_5 * E_{DG} + \mathbf{b}_6 * \mathbf{C}), \quad (4)$$

where E_{CG} , E_{NCG} and E_{DG} are the education of CG, NCG, and DG, respectively. As with E_G , the three education component variables are each measured as the sum of education percentile scores of grandparents in the corresponding category. For example, if a child lives with two grandparents, E_{CG} equals the sum of their percentile scores. If a child lives with one grandparent, E_{CG} equals that coresident grandparent's percentile score. Children not living with any grandparents receive 0 on E_{CG} .

Equation (3) contains a grandparent-status component ($b_1 * N_{CG} + b_2 * N_{NCG}$) and a grandparent-education component ($b_3 * E_{CG} + b_4 * E_{NCG} + b_5 * E_{DG}$). With *Hypothesis 3*, our interest lies in the second component, which specifies the education effect as a weighted sum of the education effects across CG, NCG, and DG. The weights b_3 , b_4 , and b_5 , are interpreted as the effects of E_{CG} , E_{NCG} , and E_{DG} on the hazard of dropout, respectively. Not all children have grandparents of all three types. This, however, does not affect the comparison of b_3 , b_4 , and b_5 , because each child receives the input of all four grandparents' education on the right hand side of the equation.

The introduction of interactions between grandparents' status and education in equation (4) changes the interpretation of b_1 and b_2 . With the presence of the interaction effects with grandparents' education, b_1 now represents the effect of living with a grandparent with an education percentile score of 0 as opposed to having a deceased grandparent with the same level of education; b_2 is the effect of having a non-coresident grandparent as opposed to having a deceased grandparent, also holding the grandparent's education at the lowest level. If we were to plot the education effects separately for CG, NCG, and DG in a figure with grandparents' education on the X -axis and the risk of dropout on the Y -axis, b_3 , b_4 , and b_5 give the slopes of the lines and b_1 and b_2 give the intercept differences of the three lines.

Results

Descriptive Statistics

Our final sample consists of 5,954 children living in 3,704 two-generation families and 1,290 children living in 829 three-generation households. As {Table descriptives} shows, the mean age of children is 13.6 for those living in two-generation households and 13.2 for those living in three-generation households. About 45% of the children in both types of households are female. Consistent with previous research {Chu et al. 2011}, two-generation and three-generation households have a similar socioeconomic profile. In 2002, the mean household income was 10,774 *yuan* for two-generation households and 11,348 *yuan* for multigenerational households. Fathers in two-generation households average 7.6 years of schooling, compared to 7.9 for those in three-generation households. The mean years of schooling for mothers is just over 6 years for both types of households. Thirty-two percent of the fathers in two-generation households are farmers, 51% are manual laborers, and the remaining 16% are white-collar workers. The corresponding figures for three-generation

households are 39%, 43%, and 18% respectively.¹¹ The vast majority of the mothers in this rural sample are farmers or homemakers. Approximately 15% of the mothers are manual laborers, and 5% are white-collar workers in both two-generation and three-generation households. Table 1 also displays the mean years of schooling of grandparents, calculated from the education of all parents of householders and spouses, regardless of their survival status and living arrangement. Grandparents in rural China have very little education. The mean years of schooling for grandparents is about 3 for grandfathers and 1.5 for grandmothers. Again, there are no significant differences between two and three-generation households.

[Table 1 About Here]

Because our main goal is to compare the effect of grandparent's education on children's educational attainment by survival status and living arrangement, next we examine the characteristics of three types of grandparents—deceased, non-coresident (those who are alive but not living with sampled households) and coresident (those living with sampled households). Out of the complete set of grandparents in 4,533 households ($4 \times 4,533$), 35% are deceased, nearly 60% are non-coresident, and only 6% are coresident. As Table 2 shows, 57% of the coresident grandparents are paternal grandmothers and 38% are paternal grandfathers. This is consistent with past research which shows that children are far more likely to live with paternal grandparents than with maternal grandparents {e.g., Zhang 2004; Chu et al. 2011}. Among deceased grandparents, grandfathers outnumber grandmothers, and paternal grandparents outnumber maternal grandparents. This is due to women's longer life

¹¹ The original measure of occupation has 12 categories. They have been collapsed to three major occupation groups because many of the non-farming occupations have very low frequencies.

expectancies and the fact that paternal grandparents tend to be older than maternal grandparents.

[Table 2 About Here]

As we might expect, deceased grandparents on average were born a few years earlier than grandparents who are alive. Coresident grandparents are about three years older than non-coresident grandparents. This can be attributed to the tendency to live with paternal grandparents, who are on average older than maternal grandparents. The pattern is also consistent with the previous research finding that the rate of coresidence increases as grandparents age and need more support {Zeng 2004; Chen 2005}. About forty percent of deceased grandparents, 55% of non-coresident grandparents, and 60% of coresident grandparents are female. Reflecting these sex and cohort compositional differences, the mean years of schooling is highest for non-coresident grandparents and lowest for deceased grandparents. When we adjust for sex and cohort compositions using the percentile score as the measure of education, coresident grandparents have a slight advantage, with a mean percentile score of 47 compared to 40.6 for deceased grandparents and 42.6 for non-coresident grandparents.

Grandparent Effects on Dropout

Figure 1 displays the Kaplan-Meier estimates of cumulative dropout rates at each grade level for children in two-generation and three-generation households. Attrition rates are relatively low during primary-school years (1st-6th grade), with an overall graduation rate of 96%. Ninety-seven percent of the primary-school graduates continue on to junior high school (7th-9^h grade), but only 80% of those who attended junior high schools graduate. In comparison, only 76% of the junior-high graduates make the transition to the next level

(10th-12th grade), but 89% of them graduate from senior high school. The figure shows that children living with grandparents are somewhat less likely to leave school than those not living with grandparents. For example, it is estimated that 81% and 57% of the children living with grandparents graduate from junior high and senior high schools, respectively, compared to 77% and 51% of those not living with grandparents.

[Figure 1 About Here]

Table 3 presents estimates from Cox models of dropout with robust standard errors, which account for the clustering of children within households. Models 1 and 2 test the main effect of living with grandparents using different parameterizations of grandparent statuses. Both models support our hypothesis of a positive coresidence effect. Model 1 shows that living with one or more grandparents reduces the hazard of dropout by 17% ($1 - \exp(-0.184)$), controlling for the child's sex and age, parental education, and parental occupations. The effect is statistically significant. In Model 2, the hazard of dropout decreases with the number of coresident grandparents, but does not vary by the number of non-coresident grandparents. This suggests that grandparents' survival status *per se* does not affect children's educational outcome; what matters is living arrangement.

[Table 3 About Here]

Model 3 tests the hypothesis that overall grandparent education decreases the risk of school dropout. As expected, the coefficient of grandparents' education is negative (-0.108). All else being equal, changing one grandparent's education from the bottom of the distribution to the top (that is, from 0 percentile to 100 percentile) reduces the risk of dropout by 10% ($1 - \exp(-0.108)$). Although significant, this effect is very small. Note that the coefficient of father's education, which was measured also as a percentile score, is -0.717

and the coefficient of mother's education is -0.674 . This suggests that the influence of a parent is more than 6 times that of a grandparent. Specifically, we estimate that increasing the education of one parent from 0 percentile to 100 percentile will halve the risk of dropout, while increasing *all four* grandparents' education from 0 percentile to 100 percentile will reduce the risk by one third only.

Model 4 tests Hypothesis 3, which states that the education of coresident grandparents has a greater effect on the educational attainment of grandchildren than that of non-coresident and deceased grandparents. The coefficient of the education of coresident grandparents is -0.712 , which is equivalent to the effects of father's and mother's education. Note that this equivalence is between one coresident grandparent and one parent. In contrast, the effects of the education of non-coresident and deceased grandparents are much smaller and not statistically significant. These results suggest that grandparents play an important role in their grandchildren's schooling *only if* they live under the same roof. The p -values of the null hypotheses that the coefficient of E_C equals those of E_{NC} and E_D are 0.053 and 0.052, respectively. Although Hypothesis 3 is technically rejected at 0.05 level, the results are in fact very favorable to our hypothesis when we consider the sizes of the three grandparents' education effects.

The coefficients of the numbers of coresident and non-coresident grandparents in Model 4 are small and insignificant. This means that when a grandparent has little education, his survival status or living arrangement does not affect grandchildren's educational attainment. However, because children's educational outcome improves with coresident grandparents' education (but not with non-coresident or deceased grandparents' education), multigenerational coresidence becomes beneficial when the grandparent is relatively well-educated. For example, holding a grandparent's education constant at a percentile score of

100, coresidence reduces the dropout rate by 42% ($1 - \exp(0.081 - 0.712 + 0.092)$) relative to having a deceased grandparent, while survival status *per se* still does not matter. Earlier in Model 1 we find that multigenerational coresidence is associated with a reduction of 17% in the hazard of dropout. The results from Model 4 show that the 17% reduction is an average effect; the actual benefit of living with grandparents increases substantially with grandparent's education, as we might expect.

To ensure that the results in Table 3 are robust to our measures of E_{CG} , E_{NCG} and E_{DG} , we re-estimated Model 4 with alternative measures. In Model 5, E_{CG} , E_{NCG} and E_{DG} are measured as the *mean* percentile scores of CG, NCG, and DG, respectively. In Model 6, they are measured as the *maximum* percentile score of CG, NCG, and DG, respectively. Finally, in Model 7 E_{CG} , E_{NCG} and E_{DG} are measured as the sums of years of schooling instead of the percentile scores within each type of grandparents. The coefficients indicating the various grandparental and parental education effects are presented in Table 4. The results are remarkably similar to those of Model 4. In all three models, the effect of coresident grandparents' education is equivalent to that of parental education, while the education of NCG and DG is inconsequential. We observe that in Model 7 the coefficients of all education variables are much smaller, but the pattern remains the same. This is due to the change from the percentile score to years of schooling as the measure of education.

[Table 4 About Here]

The different parameterizations of grandparent education—as the sum, the mean, or the max—have different implications. The model using the sum-score measures assumes that a child's educational outcome depends on the total human capital stock of grandparents in the household. For children who live with two grandparents, moving a coresident grandparent out of the household—regardless of her education—always reduces the human capital stock

of the household, and therefore increases the child's risk of dropout. The model using the mean-score measures assumes that the child's outcome depends on the average human capital stock of grandparents in the household. When the coresident grandparent with higher education moves out of the household, the mean education of coresident grandparents decreases, increasing the risk of dropout increases; when the grandparent with lower education moves out, the mean education of coresident grandparents increases, reducing the risk of dropout. The model using the max-score measures assumes that the outcome depends on the best-educated grandparent in the household. An argument can be made that, within a household, the grandparent with more education exerts more influence on the child's educational outcomes than the one with less education. Thus, as long as the status of the best-educated coresident grandparent does not change, the configuration of the less-educated grandparents does not matter. Based on the available data, it is not possible to tell empirically which model assumptions are better. But as far as our key research question—how does the grandparent effect vary by coresidence and survival status—is concerned, this sensitivity analysis has convincingly shown that the various parameterizations lead to the same conclusion: only coresident grandparents matter.

Discussion and Conclusion

Does grandparents' education directly influence their grandchildren's educational attainment after controlling for parents' characteristics? Our analysis of the 2002 CHIP data shows that it does, but the effect is contingent upon living arrangement. The effect of coresident grandparents' education is large and significant, but the education of non-coresident grandparents and deceased grandparents does not matter at all. This result leads us to the conclusion that coresidence is a necessary condition of the grandparents' education effect. Stated alternatively, the benefit of living with grandparents varies by grandparents' education:

while living with grandparents of little education does not affect children's educational attainment, living with well-educated grandparents significantly reduces children's likelihood of school dropout. In sum, our results show that grandparents do exert a direct effect on their grandchildren, and that "the grandparent effect" is characterized by the interaction between grandparents' education and living arrangement.

Of particular note is the finding that the effect of coresident grandparents' education is as large as that of parental education. This not only indicates that grandparents can play a role as important as that of parents in socializing children but also suggests that our findings are unlikely to be mere artifacts resulting from poor measurement. Two measurement-related objections could be raised against our study. First, the controls of parental education and occupations may not fully capture family background. As a result, the coefficient of grandparents' education may have picked up the effects of unobserved parental characteristics correlated with both children's schooling and grandparents' education (e.g., household income and parental involvement). While this criticism might overturn our result of a weak overall grandparents' education effect in Model 3, unobserved parental characteristics are unlikely to fully account for such a large effect of coresident grandparents' education as we observed in Model 4. Furthermore, as we argued earlier, an omitted variable bias will be manifested in the effect of deceased grandparents' education because deceased grandparents are unlikely to exert a direct causal effect on their grandchildren's outcome. But as Model 4 shows, deceased grandparents do not affect school dropout, suggesting the absence of a significant omitted variable bias.

A second potential criticism of our study is that there may be more measurement errors in the education of non-coresident and deceased grandparents than in the education of household members. These measurement errors could have suppressed the effects of non-

coresident and deceased grandparents' education, which explains why non-coresident and deceased grandparents do not exert the same influence upon their grandchildren as coresident grandparents do. However, the measurement of parental education should be as good as that of coresident grandparents' education; yet, we find that coresident grandparents are as influential as parents. Therefore, our main finding--*coresident grandparents exert a significant direct effect on grandchildren's educational outcomes*--must be true.

In conclusion, our study has several implications for social mobility research. First, it demonstrates that the dominant two-generation paradigm, which ignores the direct grandparent effect, is not suited for social contexts where multigenerational coresidence is common. Based on this study, we suspect that the null finding of the grandparent effect in the U.S. is related to the low prevalence of multigenerational coresidence. In the U.S., only 9% of children live with grandparents, compared to over a quarter of Chinese children living in multigenerational households. Future work can test our conjecture when appropriate U.S. data becomes available.

While the current rate of multigenerational coresidence is low in the U.S., demographers have noted a recent trend reversal towards the traditional multigenerational family (Pew Research Center 2010). From 1940 to 1980, the share of Americans living in such households had declined from 25% to 12%. Since 1980, however, the proportion has gone back up to 16%. Possible underlying reasons for the return of multi-generational households are longer life expectancy, rising cost of living, economic instability, and increasing number of immigrants from societies with a coresidence culture. If this trend continues, the two-generation paradigm that had dominated social mobility research in the U.S. will soon be due for an overhaul.

Our finding that living arrangement is of paramount importance for grandparents' influences indicates that processes of intergenerational transmission of status occur primarily within physical households through daily interactions. This evidence points to the prime importance of the socio-emotional pathway for intergenerational effects, consistent with a renewed emphasis in the literature that parents and grandparents matter mostly because of their roles in rearing and socializing children.

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Kaplan–Meier Survival Estimates

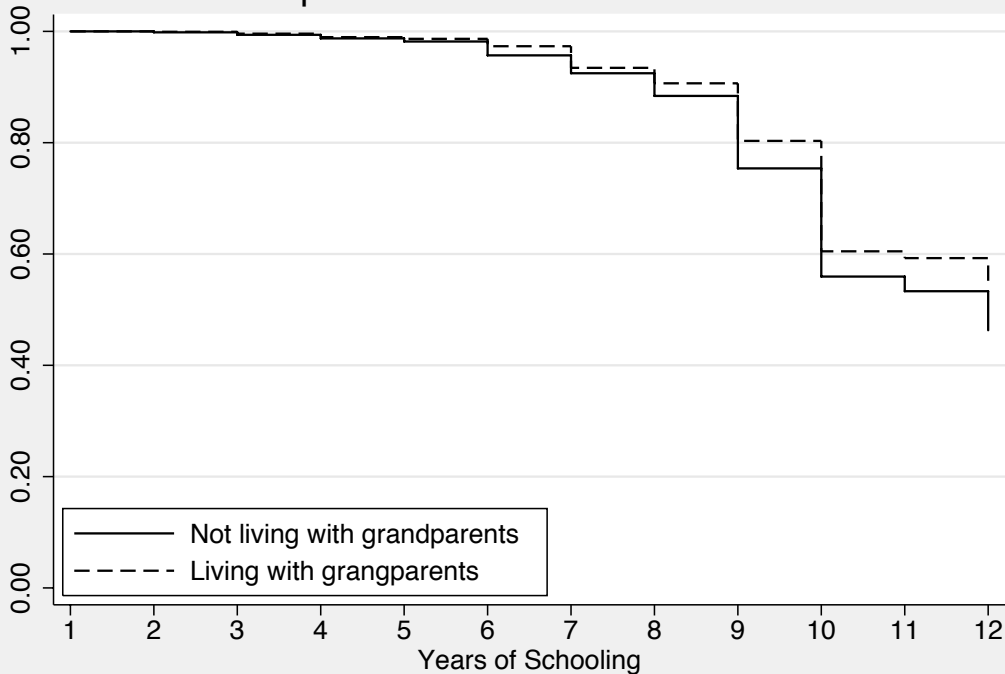


Table 1: Sample Characteristics by Living Arrangement

	<i>Two-generation Households</i>	<i>Three-generation Households</i>
<i>Children's characteristics</i>		
Child's mean age	13.6	13.2
Child's sex (% female)	46.4	45.1
<i>Number of children</i>	<i>5,954</i>	<i>1,290</i>
<i>Household characteristics</i>		
Mean household income in 2002 (<i>Yuan</i>)	10,774	11,348
Father's years of schooling	7.6	7.9
Mother's years of schooling	6.2	6.1
Father's occupation		
% Farmer	32.2	38.7
% Wage laborer	51.4	43.1
% White-collar	16.4	18.2
Mother's occupation		
% Farmer/home keeper	78.8	80.8
% Wage laborer	15.8	15.2
% White-collar	5.4	4.0
Paternal grandfather's years of schooling	3.2	3.1
Paternal grandmother's years of schooling	1.4	1.1
Maternal grandfather's years of schooling	3.1	3.1
Maternal grandmother's years of schooling	1.5	1.6
<i>Number of households</i>	<i>3,704</i>	<i>829</i>

Table 2: Grandparent Characteristics by Survival and Coresidence Statuses			
	<i>Deceased</i>	<i>Non-coresident</i>	<i>Coresident</i>
Composition			
% paternal grandfather	32.2	19.4	38.1
% paternal grandmother	21.5	24.0	56.5
% maternal grandfather	27.2	25.9	2.2
% maternal grandmother	19.0	30.7	3.3
Mean birth year	1926.5	1936.2	1933.1
Mean age	-	66.5	69.8
% female	40.5	54.7	59.7
Mean education			
Years of schooling	1.9	2.6	2.0
Percentile score	40.6	42.6	47.0
<i>Observations</i>	6,407	10,682	1,043

Note: Coresident grandparents and non-coresident grandparents are distinguished by their co-residential relationship with respect to the sampled households.

Table 3: Coefficients from Hazard Models of Dropout				
	<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>	<i>Model 4</i>
Living with grandparents	-0.184*			
	(0.077)			
Number of coresident grandparents		-0.168*	-0.176**	0.081
		(0.065)	(0.066)	(0.138)
Number of non-coresident grandparents		-0.038	-0.039	-0.037
		(0.023)	(0.023)	(0.053)
Grandparents' education			-0.108**	
			(0.039)	
Educ. of coresident grandparents				-0.712*
				(0.310)
Educ. of non-coresident grandparents				-0.097
				(0.064)
Educ. of deceased grandparents				-0.092
				(0.067)
Child's birth year	-0.106***	-0.102***	-0.102***	-0.102***
	(0.022)	(0.022)	(0.022)	(0.022)
Child's sex (female)	0.199***	0.195***	0.199***	0.197***
	(0.052)	(0.052)	(0.052)	(0.052)
Father's education	-0.719***	-0.718***	-0.717***	-0.713***
	(0.110)	(0.109)	(0.109)	(0.110)
Father's occupation (ref = farmer)				
wage laborer	-0.099	-0.095	-0.085	-0.088
	(0.060)	(0.060)	(0.060)	(0.060)
white collar	-0.389***	-0.377***	-0.363***	-0.357***
	(0.095)	(0.095)	(0.095)	(0.095)
Mother's education	-0.718***	-0.716***	-0.674***	-0.668***
	(0.107)	(0.106)	(0.106)	(0.107)
Mother's occupation (ref = farmer/house keeper)				
wage laborer	-0.288***	-0.280**	-0.276**	-0.271**
	(0.086)	(0.086)	(0.086)	(0.087)
white collar	-0.320*	-0.309*	-0.291	-0.294
	(0.154)	(0.154)	(0.154)	(0.154)
<i>Observations</i>	7,195	7,195	7,195	7,195

Note: * p<0.05, ** p<0.01, *** p<0.001. Robust standard errors are in parentheses.

Table 4: Selected Coefficients from Models Using Alternative Measures of Grandparents' Education

	<i>Sum of percentile scores</i>	<i>Mean percentile score</i>	<i>Max percentile score</i>	<i>Sum of years of schooling</i>
	M4	M5	M6	M7
Number of CG	0.081 (0.138)	0.039 (0.103)	0.067 (0.112)	-0.046 (0.075)
Number of NCG	-0.037 (0.053)	-0.049 (0.029)	-0.058 (0.039)	-0.014 (0.032)
Education of CG	-0.712* (0.310)	-0.735** (0.265)	-0.790** (0.276)	-0.069 (0.036)
Education of NCG	-0.097 (0.064)	-0.122 (0.079)	-0.136 (0.130)	-0.004 (0.007)
Education of DG	-0.092 (0.067)	-0.256* (0.125)	-0.238 (0.122)	-0.013 (0.008)
Father's education	-0.713*** (0.110)	-0.728*** (0.110)	-0.715*** (0.110)	-0.063*** (0.012)
Mother's education	-0.668*** (0.107)	-0.667*** (0.108)	-0.678*** (0.106)	-0.067*** (0.010)
<i>Observations</i>	7,195	7,195	7,195	7,195

Note: * p<0.05, ** p<0.01, *** p<0.001. Robust standard errors are in parentheses.