China's Left-Behind Children: A New Look at the Impact of Intergenerational Care on Cognitive and Non-Cognitive Performance

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Abstract

Migrated workers from rural to urban cities have been an important contributor to the development of Chinese economy. The performance of children in rural areas left behind by their migrated parents has received increasing attention. In particular, very little is known about the performance of those who were brought up by grandparents. This paper provides a detailed examination of the impact of intergenerational care on left-behind children's physical, cognitive, and social development. Funded by China Agricultural University, we collected data from two largest inland migrated-worker-exporting provinces in China and surveyed 5641 rural children among 60 rural public primary schools in 2017. We estimate the impact of grandparent care on children's physical, cognitive, and social performance in different living status. A close examination of the role of grandparent care is provided in situations where both parents migrated, only father migrated, and only mother migrated, for different set of comparison groups. Empirical results show that left-behind children perform worse in standardized math tests, at the same time appear to feel more depressed and less esteemed as compared to non-left-behind children, after controlling for personal characteristics and the school and cohort fixed effects. The sole provision of grandparent care does not improve this outcome, however, the availability of grandparent care on top of the in-home parent's guidance helps to erase the performance gap between left-behind and non-left-behind children. Additionally, by exploring the within-group heterogeneity among left-behind families, we find that the complementary support of grandparent care has a positive impact on left-behind children when compared to their counterparts.

JEL classifications: J01, J13, J60, O15, O53, I30
Keywords: grandparents care, migration, left-behind, cognitive, non-cognitive, rural China

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1. Introduction

Approximately 214 million people or about three percent of the world's population is currently living outside their countries of origin. Migration is important for the transfer of manpower and skills and provides the needed knowledge and innovation for global growth.[1] In China, domestic migrant labor has made significant contribution to promote and sustain economic growth (Wang et al., 2011; Tian & Yu, 2012; He et al., 2016; Jia et al., 2017). The flow of migrated worker has witnessed a better allocation of resources in the labor market. However, the children left behind by their migrated parents have become a social problem and their development receive increasingly economy-wide attention (Zhao et al., 2014; Huang et al., 2015; Liu et al., 2015; Ren & Treiman, 2016; Chang et al., 2017; Li et al., 2017).

There have been studies showing that left-behind children in Mexico are negatively affected in terms of psychological wellbeing and, thus, tend to have academic, behavioral, and emotional problems (Lahaie et al., 2009). Previous research in Mexico and Pakistan also shows that parental migration could result in a lack of adult labor in the home, which may lead the left-behind children to perform household works and complete less total schooling than children in non-migrant families (McKenzie and Rapoport, 2007, 2011; Mansuri, 2006). A 2014 study of Zhao et al. shows that having migrant parents can reduce a child's math performance, which implies that the current economic growth in China partially jeopardizes next generation's human capital accumulation. Other studies, including Lee (2011), Meyerhoefer and Chen (2011), and Wen and Lin (2012), also find that children whose parents had migrated were worse off in terms of school enrollment and years of schooling.

[1] United Nations Department of Economic and social Affairs.
http://www.un.org/en/development/desa/news/population/importance-of-migration.html

In China, due to various institutional barriers, it is hard for the migrated parents to enroll their children in urban labor-receiving cities. Thus, these children are often left behind in rural areas and live with their grandparents. Very few research have been undertaken with respect to the impact of living with grandparents on left-behind children. Left-behind children who were brought up by grandparents, or having poor economic status, bad relationship and low frequency of communication with parents were prone to encounter more as well as more severe loneliness (Jia & Tian, 2010). Biao (2007) has found that grandparents tend to be poorly-educated and are unable to substitute the roles of the parents. Wang et al (2006) and Zhang et al. (2007) show that grandparents may either spoil the children or fail to provide enough emotional care. Zeng & Xie (2014) pointed out that grandparents do exert a direct effect on their grandchildren, which is characterized by the interaction between grandparents' education and living arrangements.

Built upon the previous research, we contribute to the literature by providing a close examination of the impact of intergenerational care on rural left-behind children. We construct a unique and representative sample by surveying 60 rural primary schools in one of the two largest inland labor-exporting provinces in China. Our measurement of cognitive skills is undertaken through a standardized math test. The advantage of using this measure over a direct track of academic school work is to avoid the performance gap resulted from time spent after class. We also explore the impact of intergenerational care on children's non-cognitive performance and health status. We examine the role of grandparent care in different family settings, including left-behind children living with grandparents only (both parents migrated), left-behind children living with in-home mother and grandparents (father migrated), and left-behind children living with in-home father and grandparents (mother migrated). In addition to the comparison between left-

behind and non-left-behind children, we further investigate in the within-group heterogeneity among left-behind children.

Empirical results show that left-behind children perform worse in standardized math tests, at the same time appear to feel more depressed and less esteemed as compared to non-left-behind children, after controlling for personal characteristics and the school and cohort fixed effects. The sole provision of grandparent care does not improve this outcome, however, the availability of grandparent care on top of the in-home parent's guidance helps to erase the performance gap between left-behind and non-left-behind children. The within-group heterogeneity results show that the complementary support of grandparent care has a positive impact on left-behind children when compared to their counterparts.

The remainder of the paper is structured as follows. Section 2 introduces the survey and sample and provides a descriptive statistic of the data. In Section 3, the methodology is discussed, followed by Section 4 which shows the empirical results. Section 5 concludes and discusses policy implications.

2. Sample and Data Descriptions

2.1 Survey and Descriptive Statistics

The data used in this analysis is collected by authors in 2017 from two largest inland migrated-worker-exporting provinces in China, Anhui and Henan. For each province, we surveyed 5 counties which hold the largest number of migrated workers. For each county, we surveyed 6 rural primary schools located in 6 different towns. For each school, we surveyed one class of 3rd grade and one class or 4th grade students. All students in each sample class participated in the survey. In total, we surveyed 60 rural primary schools and the sample consists of 5641 rural children, aged 9 to 12 years old.

[Insert Table 1 Here]

Table 1 shows the nature of our sample. Out of the 5,641 rural children, 4,058 are left-behind and 1,583 are not left-behind. Table 2 provides some basic descriptive statistics of rural children in our sample. We define left-behind children as those who have at least one of their parents migrated to urban cities. Left-behind children may live with the mother or father in the home, or with grandparents, or in very few cases, with someone else. We define non-left-behind children as those with neither of their parents migrated and living in rural areas with both of their parents. There are no substantial differences in age and gender among the two groups of children, while left-behind children seem to slightly fall short of their counterparts in terms of weight and height. Left-behind children also have a lower rate (about 2.2 percentage points) of attending preschool education on average. Family background varies between the two groups too. Left-behind families hold a much lower family asset as compared to normal non-left-behind families.[2]

[2] The asset indicator is constructed to proxy household durable assets. It is difficult for grade three or grade four children to estimate their household assets. Following the principal components analysis that was proposed by

However, parents from left-behind families appear to be younger in age. These parents also appear to have higher educational attainment, though not statistically different from the non-left-behind families.

[Insert Table 2 Here]

2.2 Variable Generation

In our analysis, we provide a comprehensive comparison of left-behind children under grandparent care with their counterparts from three aspects, namely, cognitive performance, non-cognitive behavioral development, and health status.

Standardized Math Test. To measure the cognitive skill in this study, we adopt a standardized math test. The test questions for the standardized math exam were chosen from the TIMSS test data bank. The TIMSS test is one of most common instruments for measuring academic performance for math for primary school students in the world (Mullis et al., 2012) and in China (Zhao et al., 2014; Tsui, 2007).The advantage of relying on scores generated by a standardized math test rather than school grades is to avoid the influence of implicit time students spent after class for coursework, thus, to provide a more justified measurement of a student's cognitive skill. There was a separate test for grade 3 and grade 4 students. Each child was given a test with a full score of 30, one point for each tested item. During the examination, students were closely proctored to prevent cheating. A time limit was also strictly enforced. To generate a dependent variable that could be used in our analysis, we standardized the test scores according to

Filmer and Pritchett (2001), we used the possession of certain rural durable assets as a proxy of household wealth. First, we asked about the household's ownership status of 6 assets, including television, microwave oven or hotplate, refrigerator, computer, air-conditioning and washing machine. If a household owned a specific asset, it was recorded as 1; otherwise, it was recorded as 0. Second, by using the principal components analysis, we calculated the scoring factors for 6 assets. We used the first component as the proxy of assets, following the example of Filmer and Pritchett (2001).

the score distributions in each survey. We generated the variable *Standardized Math Score*, which we present in terms of standard deviation.

Depression. We constructed a scale consisting of six items adopted from the widely used CES-D scale (Radloff, 1991), which is one of the most widely used method to measure depressive symptoms and has been validated for studies of Chinese adolescents (Chen et al., 2009). For each item, respondents were asked how often they felt this way during the past week: five to seven times a week, three or four times a week, once or twice a week, or never. The response categories were scored from 1 ("never") to 5 ("five to seven times a week"). The scale was constructed by standardizing each item. A score above 17 is defined to be depress (=1), and below 17 is defined to be normal (=0).

Esteem. The RSES scale, compiled by Rosenberg, was originally used to assess teenagers' overall feelings about self-worth and acceptance (Rosenberg, 1965). At present, the scale is one of the most widely used self-esteem measurement tools in psychology. The original version consists of five forward scoring and five reverse scoring questions and each question is divided into four levels. We use the questionnaire after adjusting from the China Family Panel Studies, which includes 14 questions. Each question was divided into five grades: absolutely disagreed, disagreed, neither agreed nor opposed, agreed, and absolutely agreed. The full score is 70, the higher the final score, the higher the degree of self-esteem.

Grit. Grit is defined as perseverance and passion for long-term goals by Duckworth in 2007. Grit entails working strenuously toward challenges, maintaining effort and interest over years despite failure, adversity, and plateaus in progress (Duckworth et al., 2007). Individuals high in grit characteristically do not swerve from their goals, even in the absence of positive feedback (McClelland, 1985). The Short Grit Scale (Grit–S) retains the 2-factor structure of the original Grit

Scale (Duckworth et al., 2007) with 4 fewer items and improved psychometric properties. Our questionnaire includes 8 questions, each question was divided into five grades: very much like me, mostly like me, somewhat like me, not much like me, and not like me at all. The full score is 5 (extremely gritty), and the lowest score on this scale is 1 (not at all gritty).

BMI z-score and HAZ. We use BMI z-score and HAZ as the indicators of children's health status, according to the definition by the World Health Organization (WHO).[3] BMI z-score is a measure of relative weight adjusted for children's age and gender. BMI z-score is calculated as the difference between the children's BMI and the mean BMI divided by the standard deviation of the cohort BMI for each gender (Feeley et al., 2013). HAZ is the height-for-age index.

Figures 1 to 6 depict the performance comparison between non-left-behind and left-behind children for the aforementioned indicators. Left-behind children are visibly lagged behind in terms of both cognitive and non-cognitive measurements. We will discuss detailed empirical analyses in Section 4 with respect to the performance comparison with the inclusion of school and cohort fixed effects and controlling for personal and family characteristics.

[Insert Figure 1 Here]

[Insert Figure 2 Here]

[Insert Figure 3 Here]

[Insert Figure 4 Here]

[Insert Figure 5 Here]

[Insert Figure 6 Here]

[3] According to the WHO, weight-for-height and height-for-age are interpreted by using the z-score or standard deviation classification system. http://www.who.int/nutgrowthdb/about/introduction/en/index4.html

3. Methodology

We start the analysis by focusing on left-behind children living only with their grandparents in the rural areas. Specifically, we compare left-behind children whose both parents have migrated with non-left-behind children in the sample. A model employing the OLS method is implemented, as shown in equation (1):

$$(1) \qquad Y_{i,s,g} = \alpha + \beta LB\_Grand_{i,s,g} + X_i\gamma + \delta_s + \delta_g + \varepsilon_{i,s,g}$$

where $Y_{i,s,g}$ is a set of indicators, which measure the corresponding performance of a child *i* who enrolls in school *s* and grade g. The indicator measures children performance in cognitive skills, behavioral development, and health status, respectively. A detailed description of how the dependent variable indicators are constructed is discussed in the previous section (Section 2.2 Variable Generation). $LB\_Grand_{i,s,g}$ is a dummy variable indicating whether a child is left behind and is taken care of by grandparents. It equals one if a child is left behind in rural areas by migrated parents and lives with grandparents, and equals zero if a child lives in rural areas with both of their parents (non-left-behind children). The vector X accounts for a number of individual level characteristics likely affecting children performance, such as age, gender, pre-school attainment, proxy family assets, father and mother's ages, and father and mother's education years. The model also includes time invariant fixed effects for the school a child is attending, δ_s To account for the development variances faced by students enrolled in different grades in school, we also include grade cohort fixed-effects, δ_g . The main coefficient of interest, β , gauges how the intergenerational care might have impacted a left-behind child's performance.

Next, we extend the analysis to a detailed examination of left-behind children with different living statuses with parents, and study whether the integrational care would help improve left-behind children's performance as compared to their counterparts, on top of the care provided by the in-home parent. We implement such an exercise by adding an interaction term, as shown in equation (2):

$$(2) \qquad Y_{i,s,g} = \alpha + \beta_1 LB_{i,s,g} + \beta_2 Grand_{i,s,g} + \beta_3 LB * Grand + X_i\gamma + \delta_s + \delta_g + \varepsilon_{i,s,g}$$

where $LB_{i,s,g}$ is a dummy variable indicating whether a child is left behind (1 for left-behind children, 0 otherwise). $Grand_{i,s,g}$ is a dummy variable indicating whether a child is living with grandparents (1 if living with grandparents, 0 otherwise). All other controls remain the same as in equation (1). The key coefficient of interest is β_3. Specifically, we study the impact of intergenerational care on those left-behind children with migrated mother, or father, respectively. We will discuss the empirical results in details in Section 4.

Lastly, we are interested to explore the within-group heterogeneity of the impact of intergenerational care for left-behind children. We then focus on a subsample which includes left-behind children only. The treatment group consists of left-behind children with one of their parents migrated, at the same time under the provision of intergenerational care. The control group consists of left-behind children who live with the in-home parent only, i.e. without the provision of integrational care. We estimate the model according to equation (3):

$$(3) \qquad Y_{i,s,g} = \alpha + \beta Grand_{i,s,g} + X_i\gamma + \delta_s + \delta_g + \varepsilon_{i,s,g}$$

where $Grand_{i,s,g}$ is a dummy variable indicating whether a left-behind child is under the provision of intergenerational care. All the other model specifications remain the same as in equation (1).

4. Empirical Results

4.1 Non-left-behind vs. Left-behind: Living with Grandparents Only

We start the analysis by focusing on left-behind children living only with their grandparents in the rural areas. This allows us to examine the role that intergenerational care plays in left-behind families. Table 2 presents the results from estimating a number of model specifications of equation (1). With all the personal characteristic controls and the school and cohort fixed effects included, it is found that left-behind children living in rural areas with grandparents only were worse off than children whose parents had not migrated. Specifically, left-behind children perform worse in terms of the standardized math test, at the same time they are more likely to feel depressed and less likely to find esteem and grit, as compared to non-left-behind children. Left-behind children also statistically fall short of their counterparts in terms of health status, measured by BMI-Z-score and HAZ.

Our findings in this section indicate that even though leaving children under grandparent care seems to be a common and easiest option when both parents migrated, it can lead to a negative impact on children with respect to their cognitive, non-cognitive, and health status. Our implications in the comparison of left-behind and non-left-behind children are consistent with what were undertaken in the past literature. Studies have found that poorly-educated grandparents are unable to substitute the roles of parents (Biao, 2007), and living with grandparents is often negatively correlated with certain health outcomes (Gao et al., 2010) as well as school performance (Lee, 2011; Meyerhoefer and Chen, 2011; Wen and Lin, 2012). Additionally, grandparents may

either spoil the children or fail to provide emotional care, which may be a potentially important contributor to explain the worse non-cognitive performance.

[Insert Table 3 Here]

4.2 Non-left-behind vs. Left-behind: Living with Mother/Father plus Grandparents

In the above section, it is shown that in absence of the parent care, the sole provision of grandparent care does not enhance left-behind children's performance in any way. In this section, we would like to extend the analysis to a detailed examination of the performance of left-behind children with different living status with parents. We will examine left-behind children living with mother and grandparents, and those living with father and grandparents, separately. By comparing their performance with the non-left-behind, we would be able to infer whether the intergenerational care would help improve left-behind children's performance, on top of the care provided by the in-home parent. We implement such an exercise by using an interaction term as in equation (2).

Table 4 shows the empirical results from the estimation of the first group, namely, the comparison between non-left-behind children with left-behind children living with mother and grandparents. The coefficients of left-behind dummy variable show that left-behind children perform worse in terms of standardized math test, esteem, depression, and HAZ. The coefficients of living with grandparents dummy show that left-behind children is worse in terms of grit. Interestingly, the interaction term of the two dummy variables yields a series of results that are not statistically different from zero. This suggests that under the condition of mother staying at home and providing regular care, the existence of grandparent care is a plus to the left-behind family because now the left-behind children do not perform worse than their non-left-behind peers.

[Insert Table 4 Here]

Table 5 presents a similar set of exercise with another group, namely, the comparison between non-left-behind children with left-behind children living with father and grandparents. Again, we can tell from the left-behind dummy that left-behind children fall behind in terms of standardized math test, esteem, depression, grit, and HAZ measurements. However, it is worth noting that the interaction term suggests improving performance. Specifically, left-behind children are better than their non-left-behind peers in terms of standardized math test, esteem, and grit indicators. This important finding implies that under the condition of father staying at home and providing regular care, the existence of grandparent care can substantially help to improve the cognitive and non-cognitive performance of left-behind children.

[Insert Table 5 Here]

To make a further comparison of the results in Table 4 and Table 5, one would note that the situation of having father migrated is not as good as the situation of having mother migrated. One potential reason underlying this pattern may be that the burden of housework falls more heavily on the child if the father were away. Left-behind children with father migrated may need to take more household responsibilities due to the lack a male adult labor at home. Another fact not to be overlooked is that mothers who choose to migrate may have more outstanding qualities than the in-home ones. Additionally, mothers always appear to play a more important role in interacting and communicating with young children than fathers, even being far from home. As a

result, left-behind children may be greater positively influenced by their outstanding migrated mothers compared with those whose mothers stayed at home.

Comparing the results from Section 4.1 and 4.2, it can be concluded that the sole provision of grandparent care is unlikely to help left-behind children to better develop whereas the existence of grandparent care has a significant positive effect on left-behind children when one of the parent stays at home. The improved performance of left-behind children may be explained as a mixture of the wealth effect brought by the migrated parent and the assistance of grandparent supports in addition. According to previous studies, migrants can increase their own level of economic livelihood, and these families can, thus, invest more in certain aspects of their children's education. For example, Antman (2012) showed that the marginal dollars from U.S. migrant remittances appear to enable families to further educate their daughters in Mexico. While the opportunity cost of gaining remittances might be the lack of half of the parent care at home, our findings here show that the assistance of grandparent care can be a way to make up.

4.3 Within-group Heterogeneity: Left-behind with Either Parent – Living with vs. without Grandparents

In Section 4.1 and 4.2, we provide a close examination of the performance of left-behind children with different living status as opposed to non-left-behind children, and compare the role of grandparent care in different settings. In this section, we are interested to further explore the within-group heterogeneity of the impact of intergenerational care for left-behind children. We restrict the sample to left-behind children with one of their parents migrated. We would like to compare left-behind children with one of their parents migrated, at the same time under the provision of intergenerational care, with those other left-behind children who live with the in-home parent only, i.e. without the provision of integrational care. This exercise would enable us to further

assess the role of grandparent care in different left-behind families. We estimate the model according to equation (3) and the empirical results are presented in Table 6.

With all the personal characteristic controls and the school and cohort fixed effects included, we compare the left-behind children defined in the treatment group (those living with the in-home parent plus grandparents) with the left-behind children defined in the control group (those living with the in-home parent only). The coefficients of grandparent care dummy variable show that left-behind children with grandparent care perform statistically better in standardized math test, as compared to those left-behind children without grandparent care. With the assistance of grandparent care, left-behind children are also more likely to recognize esteem. These positive effects indicate that within the left-behind families (one of the parents migrated), children having access to grandparent care perform better both cognitively and non-cognitively than those left behind with the in-home parent only, thus, the availability of grandparent care could be a great plus to the family.

[Insert Table 6 Here]

5. Conclusion

In this paper, we contribute to the literature by examining the impact of intergenerational care on left-behind children's physical, cognitive, and social development. By collecting data from two largest inland migrated-worker-exporting provinces in China, we surveyed 5641 rural children among 60 rural primary schools in 2017. We undertake a detailed examination of the role of grandparent care in different migrated families. Specifically, we look into the impact of grandparent care on left-behind children with both parents migrated, as well as for those having only father or mother migrated. In addition to the comparison between left-behind and non-left-

behind children, we also investigate in the impact of grandparent care among different left-behind children groups. Empirical results show that left-behind children fall behind of their non-left-behind counterparts in terms of cognitive, non-cognitive, and health indicators, if they are taken care of by grandparents only. However, in the case of one parent migrated and one parent at home, the existence of grandparent care in addition to the in-home parent care helps to erase the performance gap between left-behind and non-left-behind children. We further extend the analysis to test the within-group heterogeneity for left-behind children in the sample. We compare left-behind children living with the in-home parent as well as grandparents with those left-behind children living with the in-home parent only, and find that the complementary support of grandparent care helps to enhance performance significantly.

In summary, while the sole provision of grandparent care is unlikely to improve left-behind children's performance, the assistance of grandparent support to the in-home parent generates a significant positive impact on left-behind children. Our results imply that the involvement of grandparent care may be one option for left-behind families to internally resolve the difficulties that come along with raising left-behind children. However, we believe it should not be a substitute for external supports. Government policies such as reducing institutional barriers for rural children to move with their migrated parents and to enroll in urban schools would help those children to access a better education. Targeted and customized educational services in rural areas in the labor-exporting provinces can be another avenue to ensure the accumulation of human capital. Since the grandparent care in China appears to be the most convenient and the least costly option adopted by most left-behind families, a subsidy could be promoted in order to assist these families to raise a better future generation.

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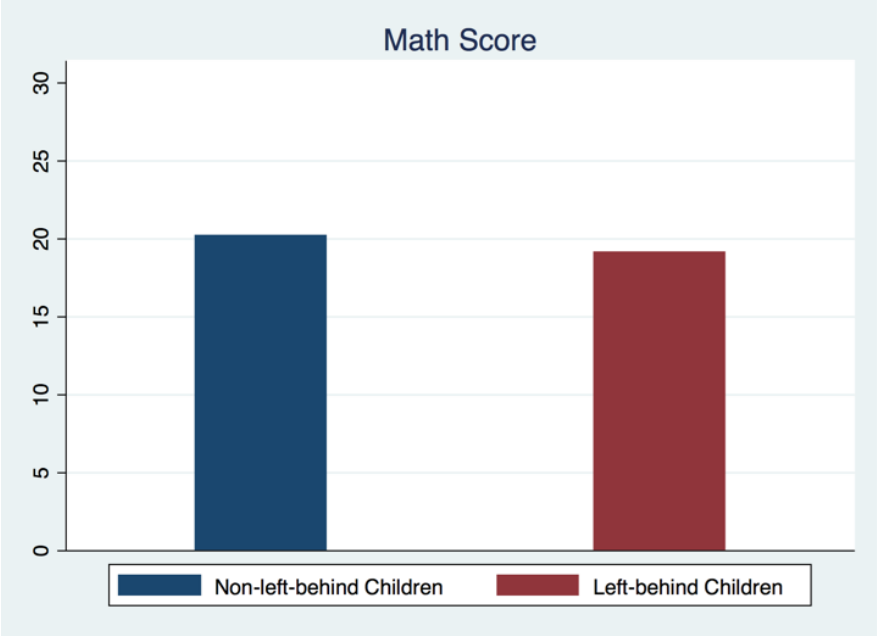
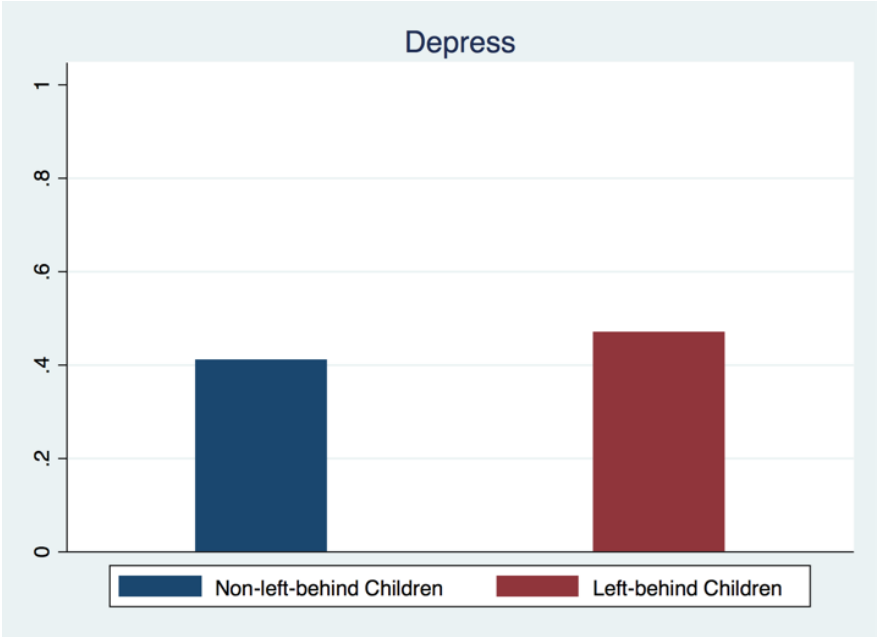
Figure 1. The Performance Comparison between Non-left-behind and Left-behind Children: Math.



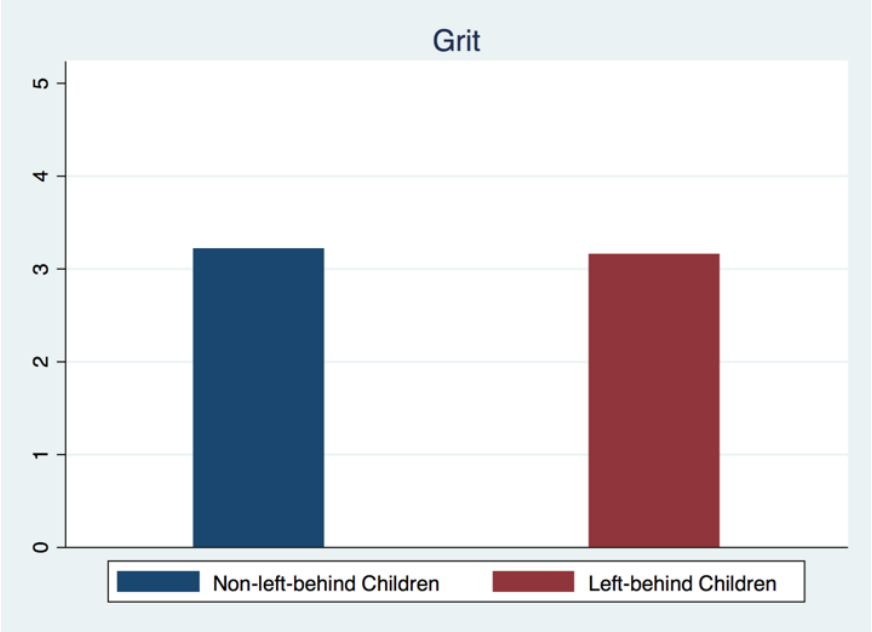
Note: Author's calculation. The sample consists of 5641 rural students, with ages 9 to 12 years old. There are 4058 left-behind children and 1583 non-left-behind children.

Figure 2. The Performance Comparison between Non-left-behind and Left-behind Children: Depress.



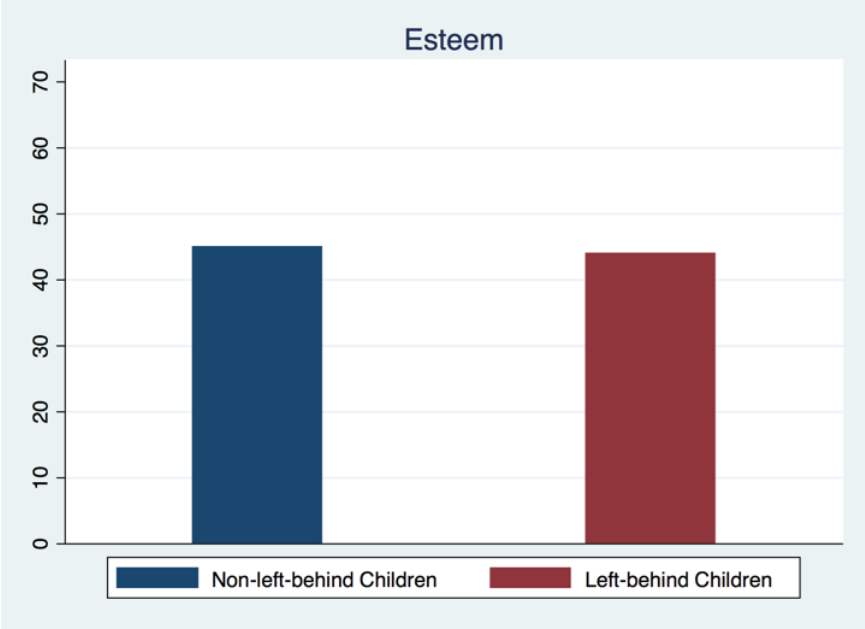
Note: Author's calculation. The sample consists of 5641 rural students, with ages 9 to 12 years old. There are 4058 left-behind children and 1583 non-left-behind children.

Figure 3. The Performance Comparison between Non-left-behind and Left-behind Children: Grit.



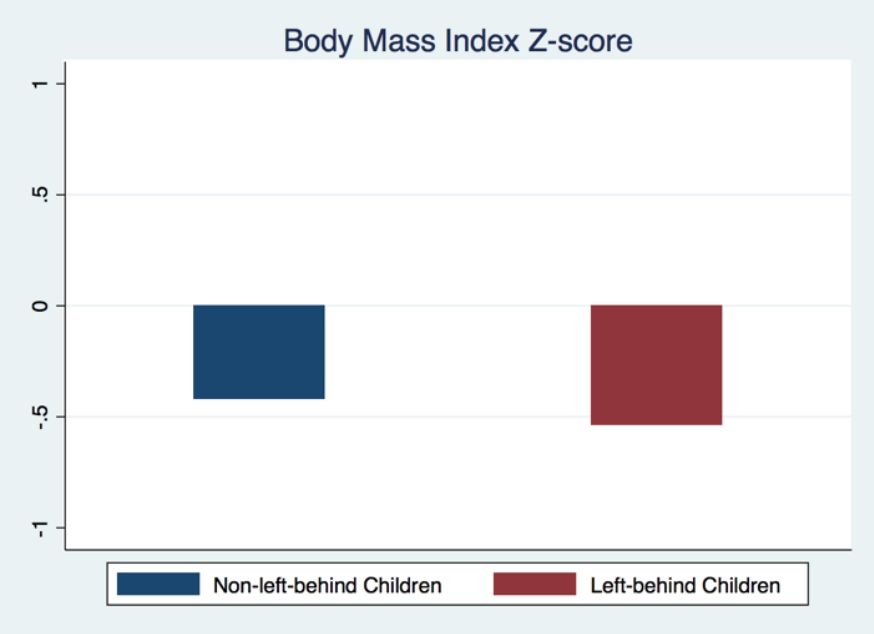
Note: Author's calculation. The sample consists of 5641 rural students, with ages 9 to 12 years old. There are 4058 left-behind children and 1583 non-left-behind children.

Figure 4. The Performance Comparison between Non-left-behind and Left-behind Children: Esteem.



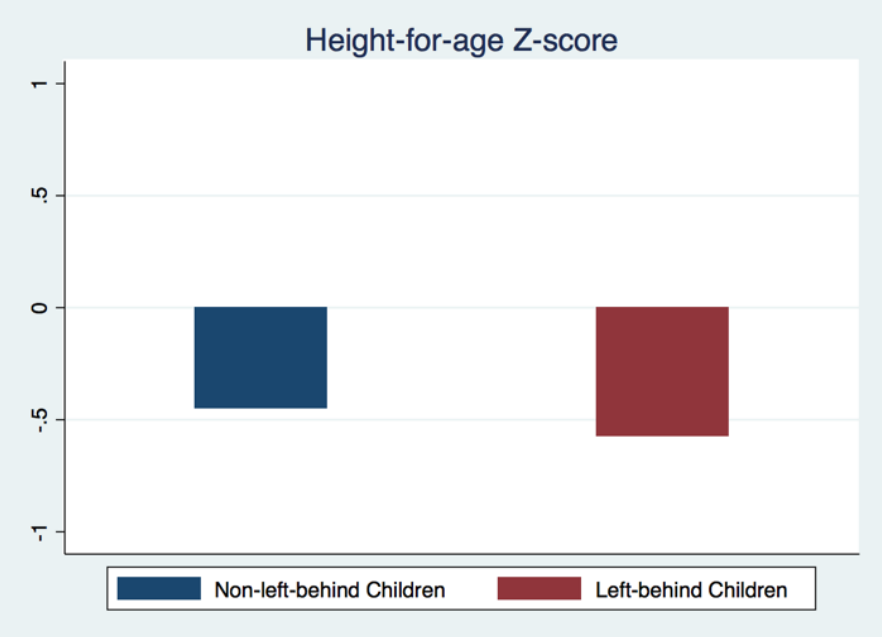
Note: Author's calculation. The sample consists of 5641 rural students, with ages 9 to 12 years old. There are 4058 left-behind children and 1583 non-left-behind children.

Figure 5. The Performance Comparison between Non-left-behind and Left-behind Children: BMI z-score.



Note: Author's calculation. The sample consists of 5641 rural students, with ages 9 to 12 years old. There are 4058 left-behind children and 1583 non-left-behind children.

Figure 6. The Performance Comparison between Non-left-behind and Left-behind Children: HAZ.



Note: Author's calculation. The sample consists of 5641 rural students, with ages 9 to 12 years old. There are 4058 left-behind children and 1583 non-left-behind children.

Table 1. The nature of the datasets.

Nature of the samples	Number of students		
	Total	Rural Public Schools in	
		Henan	Anhui
Left-behind children	4,058	2,070	1,988
with neither of the parents	2,743	1,339	1,404
with mother only	1,025	587	438
with father only	290	144	146
Non-left-behind children	1,583	834	749

Source: Authors' survey.

Table 2. Definitions and descriptive statistics of variables.

Variables	Units	Different types			Difference (T-test)
		Total	Left-behind	Non-left-behind	Mean(2)-Mean(3)
		(1)	(2)	(3)	(4)
Age	years	10.547	10.560	10.512	0.048*
Gender	the proportion of boys	0.513	0.515	0.508	0.007
Weight	kilogram	31.061	30.878	31.529	-0.652***
Height	centimeter	137.566	137.414	137.953	-0.539***
Preschool	attend preschool: 1=yes, 0=no	0.937	0.931	0.953	-0.022***
Assets	principal components analysis used to proxy household durable assets	-0.038	-0.114	0.156	-0.271***
Father's age	years	37.058	36.670	38.052	-1.382***
Mother's age	years	35.703	35.341	36.630	-1.289***
Father's education years	years	9.447	9.450	9.438	0.012
Mother's education years	years	8.872	8.913	8.769	0.144
Observations		5,641	4,058	1,583	

Source: Authors' survey.

Table 3. Non-left-behind vs. Left-behind – living with grandparents only.

Variables	Cognitive	Non-cognitive			Health status	
	Standardized Math Score	Esteem	Depression	Grit	BMI z-score	HAZ
	（1）	（2）	（3）	（4）	（5）	（6）
Grandparent care [a]	-0.109***	-0.470*	0.038**	-0.037*	-0.117***	-0.079**
	(0.031)	(0.285)	(0.017)	(0.022)	(0.041)	(0.033)
Control variables						
Age	-0.106***	-0.728***	0.023**	-0.034***	-0.207***	-0.602***
	(0.018)	(0.165)	(0.010)	(0.013)	(0.024)	(0.019)
Male	0.055**	0.540**	0.000	-0.046**	0.383***	0.347***
	(0.028)	(0.260)	(0.015)	(0.020)	(0.037)	(0.030)
Preschool	0.057	0.981*	-0.068**	0.113***	0.018	0.094
	(0.060)	(0.552)	(0.033)	(0.043)	(0.079)	(0.063)
Assets	0.013	0.196	-0.007	0.005	0.032*	0.014
	(0.014)	(0.124)	(0.007)	(0.010)	(0.018)	(0.014)
Father's age	-0.008*	-0.051	-0.001	-0.004	-0.005	-0.004
	(0.004)	(0.041)	(0.002)	(0.003)	(0.006)	(0.005)
Mother's age	0.004	0.032	0.002	0.007**	-0.010*	-0.001
	(0.005)	(0.043)	(0.003)	(0.003)	(0.006)	(0.005)
Father's education years	0.002	0.052	-0.002	0.007**	-0.001	-0.004
	(0.005)	(0.043)	(0.003)	(0.003)	(0.006)	(0.005)
Mother's education years	-0.003	0.049	0.002	0.006**	-0.002	0.002
	(0.004)	(0.037)	(0.002)	(0.003)	(0.005)	(0.004)
Constant	1.218***	44.016***	0.468***	2.885***	1.157***	3.419***
	(0.261)	(2.402)	(0.142)	(0.185)	(0.345)	(0.276)
School Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Cohort Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,227	4,227	4,227	4,227	4,227	4,227
R-squared	0.187	0.052	0.031	0.045	0.082	0.264

Note: The sample consists of all non-left-behind children and the left-behind children who live with their grandparents only (both parents migrated).

[a] The treatment group consists of children living in rural areas with neither of their parents but living with grandparents. The control group consists of children who live in rural areas with both of their parents (non-left-behind children).

Source: Authors' survey.

Table 4. Non-left-behind vs. Left-behind – living with mother plus grandparents.

Variables	Cognitive	Non-cognitive			Health status	
	Standardized Math Score	Esteem	Depression	Grit	BMI z-score	HAZ
	（1）	（2）	（3）	（4）	（5）	（6）
Left-behind*Grandparent care	0.121	1.094	-0.031	0.031	-0.084	0.047
	(0.076)	(0.721)	(0.042)	(0.055)	(0.105)	(0.083)
Left-behind [a]	-0.124***	-1.310***	0.049*	-0.042	-0.035	-0.083*
	(0.045)	(0.432)	(0.025)	(0.033)	(0.063)	(0.050)
Grandparent care [b]	0.024	-0.519	0.021	-0.077**	0.105	-0.011
	(0.048)	(0.458)	(0.027)	(0.035)	(0.067)	(0.052)
Male	-0.023	-0.118	-0.017	-0.129***	0.381***	0.350***
	(0.035)	(0.337)	(0.020)	(0.026)	(0.049)	(0.039)
Age	-0.108***	-0.678***	0.003	-0.017	-0.236***	-0.620***
	(0.023)	(0.214)	(0.012)	(0.016)	(0.031)	(0.025)
Preschool	0.161*	0.568	-0.011	0.075	0.011	-0.045
	(0.086)	(0.815)	(0.048)	(0.062)	(0.119)	(0.093)
Assets	0.021	0.194	-0.002	0.019	0.040*	0.030*
	(0.016)	(0.155)	(0.009)	(0.012)	(0.023)	(0.018)
Father's age	-0.000	-0.050	-0.001	-0.005	-0.004	-0.000
	(0.005)	(0.050)	(0.003)	(0.004)	(0.007)	(0.006)
Mother's age	-0.000	0.026	0.003	0.004	-0.009	-0.004
	(0.005)	(0.052)	(0.003)	(0.004)	(0.008)	(0.006)
Father's education years	0.003	0.143***	-0.001	0.010**	-0.011	-0.014**
	(0.006)	(0.055)	(0.003)	(0.004)	(0.008)	(0.006)
Mother's education years	0.001	0.066	-0.004	0.004	0.002	0.005
	(0.005)	(0.048)	(0.003)	(0.004)	(0.007)	(0.006)
Constant	1.021***	46.194***	0.545***	3.160***	1.958***	3.678***
	(0.316)	(3.002)	(0.175)	(0.229)	(0.438)	(0.344)
School Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Cohort Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,608	2,608	2,608	2,608	2,608	2,608
R-squared	0.172	0.072	0.032	0.070	0.083	0.264

Note: The sample consists of all non-left-behind children and the left-behind children who live with their mothers at home (father migrated).
[a] Dummy: 1= left-behind children living in rural areas with their mothers; 0= non-left-behind children living in rural areas with both of their parents.
[b] Dummy: 1=living with grandparents; 0= not living with grandparents.

Source: Authors' survey.

Table 5. Non-left-behind vs. Left-behind – living with father plus grandparents.

Variables	Cognitive	Non-cognitive			Health status	
	Standardized Math Score	Esteem	Depression	Grit	BMI z-score	HAZ
	（1）	（2）	（3）	（4）	（5）	（6）
Left-behind*Grandparent care	0.381***	4.305***	-0.046	0.280***	-0.107	0.125
	(0.118)	(1.120)	(0.065)	(0.085)	(0.159)	(0.128)
Left-behind [a]	-0.469***	-3.921***	0.129***	-0.253***	-0.066	-0.210**
	(0.083)	(0.787)	(0.046)	(0.059)	(0.112)	(0.090)
Grandparent care [b]	0.027	-0.472	0.027	-0.080**	0.095	-0.012
	(0.049)	(0.469)	(0.027)	(0.035)	(0.067)	(0.053)
Male	0.016	0.398	-0.031	-0.080***	0.486***	0.364***
	(0.043)	(0.406)	(0.023)	(0.031)	(0.058)	(0.046)
Age	-0.131***	-0.798***	0.020	-0.033*	-0.220***	-0.609***
	(0.027)	(0.259)	(0.015)	(0.020)	(0.037)	(0.030)
Preschool	0.175*	0.918	0.028	0.056	-0.040	-0.066
	(0.101)	(0.959)	(0.056)	(0.072)	(0.136)	(0.110)
Assets	0.039*	0.446**	-0.016	0.035**	0.035	0.041*
	(0.020)	(0.192)	(0.011)	(0.014)	(0.027)	(0.022)
Father's age	-0.002	-0.015	-0.002	-0.002	-0.005	-0.006
	(0.006)	(0.059)	(0.003)	(0.004)	(0.008)	(0.007)
Mother's age	0.006	0.054	0.004	0.001	-0.010	0.005
	(0.006)	(0.061)	(0.004)	(0.005)	(0.009)	(0.007)
Father's education years	0.009	0.187***	-0.000	0.011**	-0.013	-0.021***
	(0.007)	(0.068)	(0.004)	(0.005)	(0.010)	(0.008)
Mother's education years	-0.005	0.001	-0.001	0.006	0.006	0.012*
	(0.006)	(0.059)	(0.003)	(0.004)	(0.008)	(0.007)
Constant	1.053***	43.805***	0.361*	3.284***	1.726***	3.455***
	(0.377)	(3.588)	(0.208)	(0.271)	(0.510)	(0.409)
School Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Cohort Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,873	1,873	1,873	1,873	1,873	1,873
R-squared	0.208	0.089	0.044	0.084	0.093	0.265

Note: The sample consists of all non-left-behind children and the left-behind children who live with their fathers at home (mother migrated).

[a] Dummy: 1= left-behind children living in rural areas with their fathers; 0= non-left-behind children living in rural areas with both of their parents.

[b] Dummy: 1=living with grandparents; 0= not living with grandparents.

Source: Authors' survey.

Table 6. Within-group heterogeneity: Left-behind with either parent – living with vs. without grandparents.

Variables	Cognitive	Non-cognitive			Health status	
	Standardized Math Score	Esteem	Depression	Grit	BMI z-score	HAZ
	(1)	(2)	(3)	(4)	(5)	(6)
Grandparent care [a]	0.178***	1.169**	0.014	0.007	0.022	0.051
	(0.057)	(0.552)	(0.030)	(0.042)	(0.075)	(0.058)
Age	-0.090***	-0.606*	0.010	0.015	-0.266***	-0.656***
	(0.033)	(0.322)	(0.018)	(0.025)	(0.044)	(0.034)
Male	-0.085	-1.058**	-0.008	-0.234***	0.352***	0.403***
	(0.053)	(0.512)	(0.028)	(0.039)	(0.070)	(0.054)
Preschool	0.146	0.247	-0.051	-0.037	0.225	-0.034
	(0.122)	(1.183)	(0.065)	(0.090)	(0.161)	(0.124)
Assets	0.052**	0.417*	0.000	0.033*	0.015	0.013
	(0.023)	(0.220)	(0.012)	(0.017)	(0.030)	(0.023)
Father's age	-0.013*	-0.022	0.006	-0.008	0.003	0.006
	(0.007)	(0.072)	(0.004)	(0.005)	(0.010)	(0.008)
Mother's age	0.012	-0.033	-0.002	0.001	-0.009	-0.010
	(0.008)	(0.077)	(0.004)	(0.006)	(0.010)	(0.008)
Father's education years	-0.004	0.109	0.004	0.013**	-0.004	0.000
	(0.008)	(0.078)	(0.004)	(0.006)	(0.011)	(0.008)
Mother's education years	-0.002	-0.038	-0.010**	-0.003	0.002	-0.002
	(0.007)	(0.071)	(0.004)	(0.005)	(0.010)	(0.007)
Constant	0.688	47.454***	0.277	3.306***	1.689***	3.976***
	(0.480)	(4.669)	(0.257)	(0.356)	(0.636)	(0.489)
School Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Cohort Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,315	1,315	1,315	1,315	1,315	1,315
R-squared	0.194	0.100	0.065	0.101	0.113	0.322

Note: The sample consists of left-behind children with one of their parents migrated.

[a] The treatment group consists of left-behind children living in rural areas with the non-migrated parent (can be either mother or father) and grandparents. The control group consists of left-behind children who live in rural areas with the non-migrated parent (can be either mother or father) but not with grandparents.