

Impact of Migration on Children's Cognitive  
Development and School Enrollment in China:  
A Comparison by Rural and Urban Origin

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## Abstract

Using the China Education Panel Survey, the first nationally representative survey of junior high school students in China, this study offers important insights on how children of urban origin might be affected in the era of massive migration and how the impact of parental migration and child migration on children's cognitive development and school enrollment might vary by the children's urban/rural origin. While prior studies have focused exclusively on left-behind children of rural origin affected by massive migration in China, this study shows that urban left-behind are not immune to the potential adverse impact of parental migration. Although the impact of migration on children's cognitive development is limited after adjusting for selection of migration, children left-behind, particularly those completely left-behind, are much more likely to drop out of junior high school compared to their counterparts in non-migrant families and those who migrate with their parents, regardless of urban/rural *hukou* type. The adverse impact of being left-behind is shown to be even stronger for children of urban *hukou*, as they are less likely to have extended family support networks and might be less adjusted to the migration culture prevalent in rural communities. This study also suggests a significant gendered impact of parental migration. Girls overall are more likely to be negatively impacted by parental migration when they are left-behind. Meanwhile, children migrating with their parents significantly outperform their peers remaining in the origin. Causal analysis adjusting for selection of child migration suggest that policies enabling more children to migrate with their parents and enroll in urban public schools would significantly benefit those left-behind by their migrate parents.

## Introduction

China has witnessed the largest waves of internal migration in human history during the past three decades. At the end of 2016, the migrant population in China has reached 245 million, accounting for 16% of the total population (National Bureau of Statistics of China 2017). Despite the massive flow of rural migrants seeking better opportunities in cities, China has kept a stringent household registration system which prevents the vast majority of migrants from becoming full citizens and thus enjoying the same social benefits (Liang 2016; Wu 2011). Massive migration of young adults and the strict hukou policy not only affect migrants themselves, but also their children—both those who are left-behind in the origin when one or both their parents migrate out, and also those who are brought along by their migrant parents to migration destinations. According to the latest mid-decade population survey done in 2015, 103 million children, which is about 38% of the total children population, are affected by migration, including 69 million left-behind children, and 34 million migrant children (UNICEF 2017).

The impact of rural-to-urban migration on children with rural hukou has been widely studied in recent years, though the results are mixed depending on scale and study site of the survey and aspects of children's well-being measured. However, all the literature on impact of migration on children have been focused exclusively on children of rural origin only, which is understandable, since most of the migration in China during the past few decades has been largely driven by rural-to-urban migration and rural-to-urban migrants often face more structural and social barriers due to the long-standing inequality between rural and urban hukou holders. While the well-being of rural left-behind and brought-along migrant children is still of great importance, as they are still faced with various challenges due to their hukou and their migrant status, it is also worth noting that more and more children of urban origin<sup>1</sup> are also affected by the migration process in China. Among the total 69 million left-behind children in 2015, 28.26 million (41% of the total) are in fact urban left-behind (UNICEF 2017). As China is becoming more urban overall—regardless of whether it is due to rural-urban hukou reclassification or *in situ* urbanization—it is expected that the number of urban left-behind will continue to grow in the near future since there is still large regional variation in terms of economic development.

While previous studies and policies have largely focused on the rural children affected by parental migration, this study argues that urban left-behind children also deserves scholarly and public policy attention, as they might also face challenges resulted from absence of parents due to migration. As shown in Figure 1, based on the first nationally representative survey on adolescents in junior high school, while 29% of the rural children are left-behind (with 15.8% *completely left-behind* with both parents having migrated and 13.4% *left-behind with one migrant parent* respectively), 20% of the urban children are also left-behind (with 9.8% *completely left-behind* with both parents having migrated and 10% *left-behind with one migrant parent* respectively). The share of migrant children is even slightly higher among urban children than that among rural children, with the share of migrants being 9% and 8% among urban children and rural children respectively. Building on the literature of migration, intergeneration transfer of inequality, sociology of education, this paper uses the first two waves of the first nationally representative education survey—China Education Panel Survey

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<sup>1</sup> Urban/Rural in this paper is defined by the type of household registration, which is often regarded as a key structural determinant for inequality in access to education, health care and other public resources (Liang 2016; Wu 2011).

and aims to examine the following research questions: 1) How does migration<sup>2</sup> (both parental migration and children's own migration) affect adolescents' cognitive development and school enrollment? 2) Does the effect of parental and child migration on children's developmental outcomes vary by urban/rural origin of the children? In particular, I investigate whether children benefit from being brought along rather than being left-behind, and whether the potential impact of migration varies by the hukou origin of students, and how parental capital and school-context factors contribute to shaping educational inequalities between migrant and non-migrant students and also by rural and urban origin.

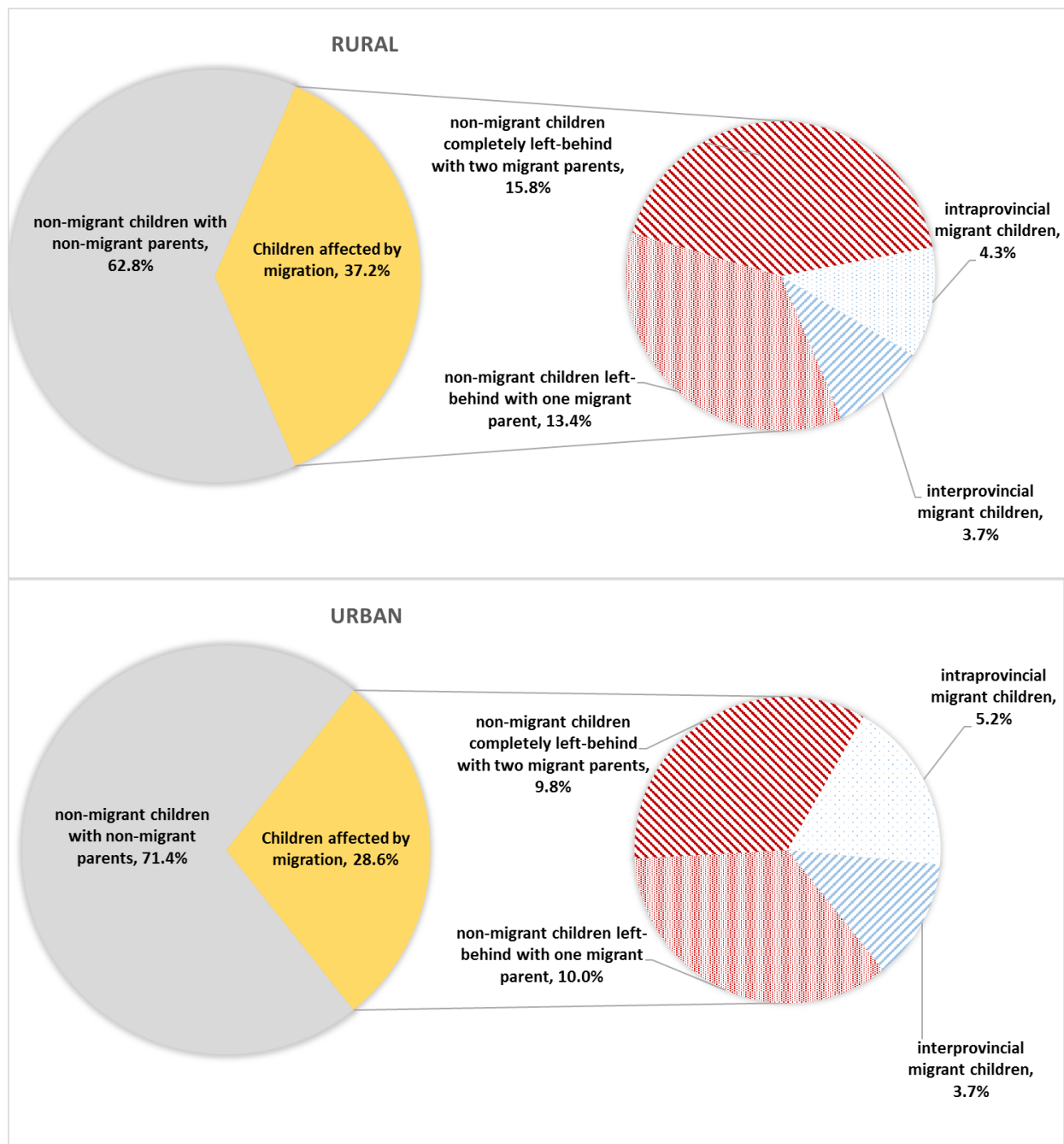
This study is unique in several aspects. First, it utilizes longitudinal data from the first nationally representative education survey done in China that collects information from both children, parents and schools, which helps to depict the complex process how migration affects children's cognitive development and educational outcomes through varied access to family and school capital. Second, it is the first study to bring attention to urban migrant children and urban left-behind children who have been increasingly affected by migration but are still absent in previous literature on migration and children in China. Third, this study compares the impact of parental migration and child migration by rural/urban status, contributing to the limited understanding of how the impact of migration on education might vary by urban/rural status of origin and selectivity of migrant parents.

This paper is organized as follows: First I present a review of the multiple influences migration might have on children's cognitive abilities and educational outcomes. This is followed by a description of data and analysis method. Finally, descriptive statistics, regression analysis and estimated causal effects of migration on children's cognitive development and dropout probability are presented. I conclude with a summary of key findings and discussion for further research and policy.

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<sup>2</sup> Migration in this paper only includes migration to urban areas. Based on the China Education Panel Survey (CEPS) baseline survey, less than 2% of the total student sample are affected by migration to rural areas (defined by their migrant parents working as farmers). There is no direct measure of area type (rural/urban) for the destination provided in CEPS. This study adopts the approach taken by Xu et al (2018). Another study by Hao and Yu (2017) assumes all migration would be migration to urban areas.

Figure 1: Distribution of 7th Grade Students by Migration and Urban/Rural Hukou Status



Source: China Education Panel Survey 2013-2014.

## Theoretical Context

### Impact of Parental Migration

#### *Migration, Remittance and Children's Outcomes*

A substantial part of recent literature on migration in developing countries have been devoted to understand the well-being of the millions of left-behind children in migrant-sending origin. Depending on the outcome measure used and also the regional or societal contexts, whether left-behind children benefit from or are negatively impacted by parental migration is still much debated. The new economics of migration theory suggest that migration is essentially a strategy of the family not only to increase income but also to diversify risk profile (Stark and Lucas 1988; Massey et al, 1993; Taylor 1999). It suggests that migration is not only to maximize the needs of the migrants, but for the collective benefits of the whole family including both migrants and stayers. In the context of rural China, migration is a strategy adopted by the poor and lower income families to overcome economic difficulties in the place of origin (Du et al 2005; Liang and Ma 2014; Liang 2016). One of the most important mechanisms through which migration affects the families left behind is through remittance. A few studies have provided evidence that remittance from migration increases investment in education among children in migrant families and the pattern is consistently found across societies (Bai et al 2018; Kandel and Kao 2001; Roy et al 2015). In the Chinese context, Bai et al (2018) find that primary school students with migrant parents in rural areas have better educational performance measured by standardized English test scores than their peers who have non-migrant parents. The positive impact of remittance on improving educational opportunities is also found in other societies. For instance, remittances are shown to significantly increase black students' school enrollment and thus remittances might contribute help to create opportunities for education equality in South Africa (Lu and Treiman 2011). Roy et al (2015) also show find that remittances makes those left-behind in rural villages in India more likely to enroll in school.

#### *Migration, Parental Social Capital and Children's Developmental Outcomes*

While remittance might be associated with higher household income and investment in educational resources, more studies have painted a less optimistic picture of the potential impact of migration on the left-behind children. The potential negative impact of parental migration on left-behind children due to parent-child separation is consistent with the vast literature on family structure and children's well-being. Studies on family functioning and children's outcomes in developed countries often suggest that children living in single-parent households or having divorced parents are often more likely to have emotional or behavior problems or worse educational outcomes, as absence of parent(s) is often associated with less effective parenting or lower levels of total parental engagement for children (Brown 2004; Freistadt and Strohschein; Kim 2011 ; McLanahan & Sandefur 1994). Literature on social capital also suggests that parental social capital, such as parent-child interaction, parental supervision, parental school enrollment are beneficial for students' educational outcomes (Coleman 1988; Coleman 1990; Jackson 2015; Kao 2004; Kao and Rutherford 2007; Liu and White 2017; Parcel et al 2010; White and Glick 2000). In the migration literature, children left-behind in rural China are often found to receive less parental supervision and lower levels of emotional support, which is associated with deleterious educational outcomes and emotional well-being (Chen et al 2008; Chen et al 2017; Lee 2011; Lu 2012; Meng and

Yamauchi 2017; Wu et al 2015; Zhao et al 2014; Zhou et al 2014). While previous studies have focused exclusively on rural children, this paper expands previous literature on migration and children's well-being by including urban children who are left-behind as urban children are also likely to be affected due to parent-child separation and they are also likely to be disadvantaged in terms of access to parental social capital which might have adverse impact on their cognitive development and educational outcomes.

Meanwhile, some other studies find no significant impact of parental migration on children's academic performance or educational attainment, as the potential adverse impact of parental absence due to migration might be buffered by the presence of other forms of support such as grandparents (Xu and Xie 2015; Chen et al 2009; Hu 2017; Zhou et al 2015). Xu and Xie (2015) find that children left-behind do not have lower educational outcomes compared to their counterparts with non-migrant parents in the rural origin, using the China Family Panel Study. One possible reason for the lack of statistically significant impact of parental migration on left-behind children is that most of the left-behind children still reside with the grandparents (Xu and Xie 2015), although some studies argue that grandparents in rural areas are mostly not well-educated or exhausted with other household work and thus they often fail to provide sufficient emotional support or supervision for academic success besides minimum living support and caregiving (Lee et al 2011; Pan and Ye 2011; Wu et al 2015). With data on presence of grandparents and whether students are enrolled in boarding schools, this study will be able to provide empirical evidence on the potential buffering effects of non-parental support networks on the impact of parental migration on children's well-being.

### Impact of Child Migrating with Parents

Whether leaving children behind or bringing them along is a weighty decision parents have to make. While leaving children behind might be harmful for children's well-being due to lack of parent-child interaction and parental supervision, bringing children along to urban destinations often pose additional challenges. Migrant children themselves often lose access to original friendship support systems, and are confronted with difficulties and discrimination in access to urban social welfare such as access to local public schools and health care services (Fu et al 2008; Gong et al 2012; Hao and Yu 2017; Lu 2007; Lu and Zhou 2013; Liang and Chen 2010). Hukou is one of the key drivers, arguably the most important structural factor for disparity in education in contemporary China (Hao et al 2014; Wu 2011; Zhang 2017). Due to the hukou registration system and limited public school educational resources in destinations, students are often required to have local hukou (registration place is the same as the current place of residence) to enroll in local public schools, although there are some variation in terms of strictness of what kind of documentations are required for migrant students (without local hukou) to enroll in public schools of the destination. Top migrant-receiving places such as Beijing and those in coastal regions often have more stringent policies towards migrant and migrant students, while some other cities are less restrictive towards school enrollment of migrant students (Hao and Yu 2017; Lu and Zhou 2013). Even in places with less restrictive requirement on hukou registration place, migrant students often have to pay extra fees to enroll in local schools (Hao and Yu 2017). Due to the structural barriers posed by hukou registration place, migrant children are often segregated in private schools for children of migrants, or lower-quality schools that locals do not want to attend (Hao and Yu 2017; Lu and Zhou 2013).

The school segregation faced by migrant students is likely to have adverse impact on migrant students' well-being in terms of both academic outcomes and psychological well-being (Wang et al 2017a; Wang et al 2017b; Lu and Zhou 2013). Wang et al (2017a) show that



migrating with parents and attending private migrant schools in urban areas has a significant negative effect on students' math scores, even compared to those left-behind. Lu and Zhou (2013) find that students enrolled in migrant schools in Beijing are more likely to have poorer academic performances and higher levels of loneliness, while another study by Wang et al (2017) also find that migrant students enrolled in migrant schools in Shanghai show higher levels of learning anxiety. But some other studies with migrant students not only in migrant schools find children who are brought along by their migrant parents receive more education investment and have better academic outcomes measured by math test scores compared to their peers remaining in the origin Xu and Xie (2015). Liang et al (2008) also find that migrant children have relatively adequate level of school enrollment based on a Nine-City Survey of Migrant Children in 2002. The duration of migration and selection of migrant parents also matter for the impact of migrating with parents on children's educational outcomes. While migrant children who have only been in the destination for a short period of time (ie, one year) are much less likely to be enrolled in school compared to local children, migrant children who have been in the destination for longer periods of time are more likely to be enrolled in school than local children, due to the more positive selective nature of long-term migrant parents (Liang and Chen 2010). Lu and Zhou (2013) also show that migrant students enrolled in regular public schools in Beijing are not significantly different from native urban students.

Besides structural barriers that might prevent migrants from being enrolled in schools in the destination, the possibility of viewing migration as another alternative to upward mobility rather than education might be a mechanism through which child migration affects adolescents' education aspirations and school enrollment (Kandel and Kao 2001; Liang et al 2008). Liang et al (2008) show that adolescent migrant children in China, particularly migrant girls are more likely to participate in paid labor. Roy et al (2015) find that children who migrate with parents in India are more likely to drop out and become child labor migrants. Overall, previous studies have provided mixed evidence on how rural migrant students compare to left-behind rural students and native urban students. With data on school-level factors, as well as types of migration by rural/urban origin and distance, this study will provide more advanced understanding of how school factors as well as selectivity of parents contribute to varied trajectories of migrant and left-behind students by rural and urban origin.

### Varied Impact of Parental and Child Migration by Gender

The potential adverse impact of parental migration might also vary by gender, with more adverse effects often observed for girls (Antman 2012; Chang et al 2011; Meyerhoefer and Chen; Hu 2012 and 2013). One of the key mechanisms through which parental migration might have more adverse impact on girls left-behind is that girls are more likely to burden with household chores. Due to the traditional son preference, girls are often more likely to share responsibilities of household chores (Short et al 2001). When parents migrate out, girls are also expected to spend extra time spent on household work rather than school work in rural households, which results in lower test scores, school enrollment and attendance found in left-behind girls than left-behind boys (Meyerhoefer and Chen 2011, Hu 2012 and 2013). However, Zhou et al (2014) find that the negative effect of parental migration on children's educational outcomes measured by Chinese and mathematics test scores is stronger for boys than for girls, and that girls are more likely to benefit from increase in family income since they might be affected by availability of resources without migration, based on a randomized survey conducted in four counties in the major labor-exporting provinces of Anhui and Jiangxi. Meanwhile, Lu (2007) finds that there is no significant difference by gender in the educational status of migrant children in China, despite of strong son preference in rural origins where migrants come from. This study aims to contribute to the literature on gendered effects of



parental migration on children by examining whether girls of urban origin are less likely to be adversely affected by parental migration as they might be less subject to the traditional son preference.

The effect of parental migration also varies across different societal contexts and different types of migration. In the context of other countries, Nguyen (2016) finds that although parental migration helps families increase per capita consumption, it does not improve health and cognitive ability of left-behind children, based on a cross-country comparison study of Ethiopia, India, Peru, and Vietnam. In Ethiopia, parental migration does not have a significant effect on children. However, parental migration reduces health outcomes of children in other three countries and decreases cognitive ability test scores in India and Vietnam. Lu (2014) found the negative impact of parental international migration on children's educational outcomes (measured by highest grade completed) is significant in Mexico but only marginally significant in Indonesia. As no previous studies on migration on China have examined the impact of parental migration on children in urban areas, this study expands previous literature on migration in China by comparing the impact of different types of internal migration by migration origin (rural-to-urban vs urban-to-urban) and migration distance (intraprovincial migration vs interprovincial migration), as they might reflect various levels of selection and contexts (ie, varied gendered effects by rural/urban origin).

## Data, Variables and Method

### Data

This analysis uses the first two waves of the China Education Longitudinal Survey (CEPS) collected during the 2013-2014 and 2014-2015 academic year. CEPS is a nationally representative longitudinal study of junior high students in China, with similar features as widely used U.S. longitudinal education surveys such as the Education Longitudinal Study of 2002 and High School Longitudinal Study of 2009. CEPS uses a multistage, PPS sampling method (CEPS, 2015). Samples are drawn in four stages. In the first stage, 28 PSUs are selected from 2870 counties with PPS. In the second stage, 4 schools are selected from each sample county/district with PPS. In the third stage, 2 classrooms from 7th grade and 2 classrooms from 9th grade are randomly selected from each sample school. In the last stage, all students from the selected classrooms are included in the survey. The 2011 baseline CEPS includes 10,279 students in the 7th grade and 9,208 students in the 9th grade from 112 schools across 28 county-level units. The 7th graders are followed annually until their graduate junior high school while the 9th graders are not followed, so this study restricts the sample to the 7th graders with two waves of data in order to estimate the improvement in cognitive development and dropout probability by the second wave after controlling for baseline characteristics. The first follow-up was conducted in fall 2014 and spring 2015 when students are in the 8th grade. 9,449 students (91.9%) of the baseline 7th grade sample are followed-up in the second wave. CEPS administered questionnaires not only to students, but also their parents, homeroom teachers, main subject teachers and school principals. Detailed information on parental engagement, students' prior academic performance before junior high school, school-level factors are collected besides student and parental migration status, which makes it ideal to study the complex process of how family dynamics and school contexts shape adolescent children's cognitive development and educational outcomes.

In order to differentiate the impact of parent-child separation due to migration rather than divorce of parents, this study restrict the analytical sample to those who have both married biological parents during the two CEPS waves -(who should have been in intact families if not for migration). Out of the 10,279 students in 7<sup>th</sup> grade surveyed in the baseline survey, 779 (7.5% of the total sample) students whose parents are not married (either never married or have divorced) are excluded in order to examine the impact of absence of parents due to migration but not due to divorce. Another 117 individuals have missing on key variables including migration status, parental education and family financial condition, and thus are also excluded from the final analysis, as those variables are also key variables used to impute missing on other variables such as parental engagement score, and school-level factors. 904 observations (9.8%) of all eligible observations have missing on some of the independent variables, but they are included in the regression analysis. Multiple imputation using the chained imputation method is used to impute values for those observations for all regression analyses. Finally, another 176 students (less than 2% of total sample) who migrate to rural areas are also excluded from the analysis since this study focus on migration to urban areas only, as the barriers in access to schooling due to migration is more pertinent in urban settings. 77 (less than 1% of total sample) students who migrate to urban destinations alone without their parents are also excluded for simplification purpose, as they might perform differently from those the typical migrant children who migrate with parents.

The final analytical sample for analyses on baseline cognitive test score and also dropout probability by the second wave include 9,130 students, while the analyses involving cognitive test score in the follow-up survey include 8,437 students that are in both waves of the survey. The key sample descriptive statistics for the whole baseline sample and by urban/rural hukou status are presented in Table 1. Overall, 53% of the students in the baseline are males. 37% (weighted) of the sample have urban hukou, while 67% have rural hukou. The vast majority (91%) of 7<sup>th</sup> graders are enrolled in public schools. As expected, large disparities are observed for almost all aspects of children's outcomes, family SES and school-level contexts by hukou status. Students with urban hukou are more likely to have higher standardized cognitive test scores and lower probability of dropping out of junior high schools. They are also less likely to have repeated grades in primary school. In terms of family background, urban students are much more likely to have parents with college education and higher SES. They are also more likely to report higher levels of parental engagement and spend less time on chores. School-level characteristics also varies among urban students and rural students. Students with urban hukou are much more likely to be enrolled public schools with higher ranks and better school environment (measured by facilities available and number of student misconduct having occurred during the past week). All the characteristics by rural/urban hukou status are significantly different ( $p < 0.01$ ) except for number of facilities available and proportion male. The key characteristics of the sample also vary greatly by the migration statuses of the children and their parents, which will be discussed in detail in the section on descriptive results below.

## Variables

### *Outcome Variables*

This study focus on two domains of child development: standardized cognitive ability test score (in the 8<sup>th</sup> grade follow-up wave) and dropout status (follow-up wave). Both measures are crucial determinants of ultimate educational attainment and human capital, which carry long-term consequences for individual development.

**Standardized cognitive ability test score:** Cognitive ability has long been established as a strong predictor of educational attainment and labor market outcomes (Cawley et al 2001; Heckman et al 2006). Standardized cognitive ability tests are administered in both the baseline survey and the follow-up survey. The baseline cognitive ability test includes 20 questions to evaluate students' logical reasoning and problem solving abilities in language, math and graphical forms independent of specific curriculum content taught in schools (Hao and Yu 2017). It is designed to reflect overall knowledge level of students and the scores are comparable across schools and regions. The cognitive ability test in the follow-up survey consists of 35 questions, but it also evaluates the same dimensions of students' knowledge as in the baseline wave. Standardized cognitive ability test scores in both waves are created based on three-parameter logistic model and item response theory (IRT) scale scores (Hao and Yu 2017). As shown in Table 1, the baseline standardized cognitive ability test score has a weighted mean of -0.14 (the unweighted mean is 0) and a standard deviation of 0.87 in the analytical sample while the follow-up standardized cognitive ability test score has a weighted mean of 0.15 and standard deviation of 0.84. Since baseline cognitive test score is controlled for estimating wave 2 cognitive ability, the key outcome is cognitive development to be exact.

**Drop out status:** Dropout status has long been used as a key indicator of educational outcomes and the negative impacts of dropping out of high school on labor market outcomes and upward mobility has been documented extensively in previous literature. In this study, drop out status is measured at the time of the follow-up survey when students are or would have been in the 8<sup>th</sup> grade. Dropout status is created based on the question detailing the reason why the children is not included in the follow-up survey. All students still enrolled in the baseline school are automatically included in the follow-up survey. Detailed reasons are provided for students who do not participate in the follow-up survey. One of the key reasons is that students have dropped out of the school by the time of the second wave (when students should have been in the 8<sup>th</sup> grade), which is used to construct the dropout status variable. The Chinese government has implemented the Law of Nine-Year Compulsory Education that encourages local government to guarantee school-age children to receive a minimum of nine years of schooling (6 years of primary education and 3 years of secondary education). As expected, the overall dropout rate among junior high school students is very low with only 2% of 7<sup>th</sup> graders having dropped out by the 8<sup>th</sup> grade. However, the dropout rate varies substantially among students by rural/urban hukou status and also migration statuses of the students and their parents. Among rural left-behind children with both parents being away, 5% of them have dropped out between 7<sup>th</sup> and 8<sup>th</sup> grade.

### *Key Independent variables*

**Urban/rural hukou status and migration status.** I categorize students by *rural status* (agriculture hukou and non-agriculture hukou [reference]), by *parental migration status* (completely left-behind with two migrant parents, left-behind with one migrant parent) and also by *child migration status* (intraprovincial migrant, interprovincial migrant, and non-migrant children with both parents present in the household [reference]). They are all created based on students' self-report of registration (hukou) type, hukou place, and presence of parents in the household in the baseline survey. Migration distance is only differentiated for children who have migrated with parents, as no specific current place of residence is reported by the student if they do not migrate with their parents. In the descriptive statistics (means comparison) as shown in Table 2, children are classified into 10 mutually exclusive categories: *urban non-migrant children with both parents around*, *urban left-behind children with one migrant parent*, *urban completely left-behind children with two migrant parents*, *urban intraprovincial migrant*

*children, urban interprovincial migrant children, rural non-migrant children with both parents around , rural left-behind children with one migrant parent, rural completely left-behind children with two migrant parents, rural intraprovincial migrant children, rural interprovincial migrant children.* As shown in Figure 1, while the majority of children are non-migrants with both parents around among both rural and urban hukou holders, the share of children left-behind by migrant parent(s) is also non-trivial for both rural and urban hukou holders, with 20% of children with urban hukou and 29% of children with rural hukou being left-behind by at least one migrant parent. The share of migrant children is similar by rural/urban hukou type, with rural migrant children being slightly more likely to migrate across provinces (8% among rural hukou children and 9% among urban hukou children respectively).

### *Other variables of interest*

*Parental engagement:* The score of parental engagement is constructed through principle factor analysis as a single factor score based on twenty-two items asked in the questionnaire for children in the CEPS baseline survey. Among the twenty-two items, eight items tap *parental monitoring and supervision:* whether parent care and are strict with children's homework and examination, behavior at school, attendance at school everyday, attendances at school everyday, time when children get home everyday, whom children make friends with, dress style, time spent on the Internet, time spent on watching TV. Each item is originally measured by an ordinal scale ranging from 1 to 3 (1=parents do not care; 2=they do care about it, but are not strict; 3=they are very strict about it). *Parent-child communication* is measured based on children's responses to a series of ten items regarding how often their mother and father discuss with them on things happen at school, relationship between the children and their friends, the relationship between the children and teachers, the children's feeling, the children's worries and troubles. Each item is measured based on an ordinal scale from 1-3 (1=never, 2=sometime, 3=often). *Parental extracurricular participation in students' activities* is measured based on children's responses to a series of four questions regarding how often they do the following with their parents: 1) reading, 2) playing sports, 3) visiting museums, zoos, science museums; 4) going out to watch movies, shows, sports games. The four items are originally measured based on a scale ranging from 1-6 (1=never, 2=once a year, 3=once every half year; 4=once a month, 5=once a week; 6=more than once a week), but they are recoded into a 1-3 scale (1=never, 2=sometimes (once a year or once every half year; 3=often (once a month or once a week or more than once a week)) so that the scoring coefficients of all items for the final factor score are comparable. In exploratory analysis I separated the three dimensions of parental engagement, but since all the items are highly correlated, the final factor score is constructed with all twenty-two items and a single overarching factor to capture the overall parental engagement. Only one factor of parental engagement is retained, which has the highest eigenvalue of 5.7 and explains about 60 % of the total variance. All of the response items are positively related to the final factor score, while parent-child communication have more weights in the parental engagement score. The complete list of items used for constructing the factor score and their scoring coefficient is presented in Appendix 1.

*School-level characteristics:* School-level contexts such as school type, school rank, school physical resources, adverse school learning environment are also included to minimize the potential confounding and also mediating effects of school characteristics on education outcomes. School-level factors such as school type and learning resources are strong predictors of educational outcomes (Coleman et al 1982; Hao and Pong 2008). School type is originally classified by four categories: regular public schools, private schools subsidized by public

funding, regular private schools, private schools for migrant students. However, since there are only 1 private school subsidized by public funding, 5 regular private school and 2 migrant school included in the sample, while the rest (104 out of 112 schools) are all public schools. To have sufficient cell size for each type of school, private schools subsidized by public funding are combined into the public school category. School rank is originally reported by a 4-point scale: below average, average, above average, among the best, but since the majority of the schools are reported to be “above average” by the principle, this analysis combines the below average and average to be one category “medium and below”, so there are only three categories in the regression analyses. School physical resources is measured by a summary score of whether the school has the following ten facilities: laboratory, computer room, library, music room, student activity room, psychological counseling room, student cafeteria, playground, gymnasium, swimming pool. Adverse school learning environment is measured based on a summary score of whether the following six types of bad behaviors happened in the school during the past week: students fight with each other, students’ vandalism, students smoke, students drinking, gang activities within or outside the campus, chaotic classroom atmosphere. All school-level characteristics are reported by the school principle surveyed in the baseline CEPS.

*Other potential mechanism variables and moderating factors of interest:* average hours spent on helping with housework, and whether the student lives on campus (attending boarding school) are included as potential factors that might mediate the impact of parental and child migration on children’s cognitive development and dropout probability. Presence of grandparents is included as it might buffer some of the potential negative impact of parental migration on left-behind. Even in non-migrant households with both parents around, grandparents might also affect children’s development by helping with household chores and providing children with more care.

### *Control variables*

Individual characteristics of gender, base-year standardized cognitive ability test score, family financial conditions, and number of siblings are included as control variables. Previous research suggests that those are the measures of individual and family characteristics that influence educational outcomes (Glick and White 2004; Kao and Rutherford 2007; Liu and White 2017). In the CEPS, family financial condition is measured through an ordinal scale (1=very poor, 2=somewhat poor; 3=moderate; 4=somewhat rich; 5=very rich). In this analysis, “very poor” and “somewhat poor” are combined into one “poor” category, and somewhat rich and very rich are combined into one “rich” category in order to retain larger sample size for each category. Besides family financial conditions, I also control for number of siblings, as students living in households with more siblings may face extra barriers in getting parental attention or migrating with parents. I also control for students’ prior cognitive ability (standardized cognitive test score in the 7th grade) to accurately capture the effects of parental and child migration on cognitive development.

## Method

I begin with a descriptive comparison (Table 2) of cognitive abilities and educational outcomes, family background characteristics, parental engagement and school-level characteristics by rural/urban hukou type and migration statuses of children and their parents. I then utilize mixed-effects models to estimate the effects of parental and child migration on wave 2 cognitive ability (Table 3) and probability of dropping out of junior high school (Table



4) for the whole sample and also by gender, after controlling for base year cognitive ability, educational performance in primary school, and other parental capital, school context characteristics. The models are built sequentially, to determine how the predicted effects of rural/urban hukou and migration are altered by additional covariates. Lastly, inverse probability weighting regression adjustment method is used in an effort to estimate the causal effect of migration statuses by urban/rural hukou type, after adjusting for selection of parental and child migration due to family economic conditions and parental human capital.

Mixed-effects models are used to better estimate the effects of both individual and school-level factors, while addressing the issue of correlated errors at the school level. First of all, students are often not randomly distributed across schools. Students with similar background characteristics are clustered within schools and the errors for individuals in the same school are likely to be correlated. Previous studies on students in immigrant families in the United States often find that they are more likely to enroll in schools with higher immigrant stock (Portes and Hao 2004; Liu and White 2017). Studies on migrant students in China also suggest that they are more likely to be segregated in private migrant schools with poorer educational resources (Lu and Zhou 2013). Therefore, multilevel model is necessary to adjust for correlated errors. Also, multilevel models allowing a random intercept at the school level will help to account for some of the unmeasured characteristics such as teacher quality at the school level that might affect educational outcomes, though it does not help to account for confounding factors that might affect both migration of children and cognitive development and educational outcomes.

Using the standardized cognitive test score as an example, the full mixed-effects model is specified as:

$$Y_{ij} = \beta_{0j} + \beta_1 X_{1ij} + \beta_2 X_{2ij} + \beta_3 X_{1ij} * X_{2ij} + \beta_4 V_{ij} + \beta_5 Z_j + e_{ij},$$

where  $i$  is the student level;  $j$  is the school level;  $X_1$  refers to students' hukou type (rural or urban[reference]);  $X_2$  refers to students' migration status (left-behind with one migrant parent (and the other being around at home); completely left-behind with two migrant parents; intraprovincial migrant; non-migrant students with both parents around[reference]);  $V$  refers to vector of other key individual and family-level characteristics, such as baseline cognitive ability test score, family financial condition, parental education, number of sibling, parental engagement, presence of grandparents, whether attending boarding school;  $Z$  refers to school specific context (school type, school rank, facilities available, learning environment); and  $\beta_{0j} = \gamma_{00} + u_{0j}$  (random intercept by school).

All independent variables are lagged by one wave and they are measured at the baseline survey ( $t_1$ ), while the outcome variables are measured at the follow-up wave ( $t_2$ ) to minimize likelihood of reverse causation (children's cognitive development and educational performance may in turn affect parents' decision of whether bringing the child along when they migrate. A lagged measure of the outcome (children's cognitive ability in the baseline year) is included to capture prior child development and academic potential. The lagged dependent variable approach also helps to address some of the possible selection bias as preexisting differences between children could be captured in the lagged measure, but children or their parents might migrate prior to the survey, so some of the accumulated effect of migration might still be reflected by the variation in baseline cognitive test scores.

Besides using mixed-effects models to adjust for clustering and macro-level unobservable characteristics that might affect proper estimation of the impact of migration on cognitive development and educational outcomes, I also estimate the average “treatment” effect of parental and child migration by rural/urban hukou type through inverse-probability-weighted regression adjustment (IPWRA) to adjust for the self-selection of migration. Migration of both parents and children are likely to be selected based on their family background characteristics such as family financial conditions and parental human capital, while those characteristics are also predictors of children’s educational outcomes. Previous studies have used various methods to adjust for the issue of selection of migration, such as propensity score matching (Xu and Xie, 2015; Xu et al 2018) and instrumental variable approach (Hu 2012; Meng and Yamauchi 2017; Zhao et al 2014). An instrumental variable approach is not always possible as the ideal instrumental variable is difficult to find. Propensity score matching is often used to estimate the “treatment” effect of a binary treatment (eg, the impact of being left-behind vs being non-migrant with both parents), but in this paper, I attempt to compare three different scenarios: children migrate with parents, children being completely left-behind, both children and parents are non-migrants. When there are multivalued treatments, the assumption of propensity score matching that only one treatment and one control group no longer hold. IPWRA, which is often used to address missing data can be used to estimate the average treatment effect of multivalued treatments (Cattaneo 2010; Cattaneo et al 2013; Hogan and Lancaster 2004). Also, IPWRA has a double robust property, which gives consistent estimates as long as one of the outcome model or treatment model is correctly specified. It not only allows for adjustment for selection of migration, but also allows for regression adjustment with covariables that might affect the outcomes besides the key treatment variable of interest, which makes it more suitable for analysis with longitudinal data. Unlike previous studies using cross-sectional data with educational outcomes measured only at one point of time, this study is interested in examining cognitive development and academic trajectory during two waves after controlling for the baseline cognitive test score. Using IPWRA method, the causal effect of migration on change in cognitive development and education trajectory can be estimated after controlling for baseline performance.

The “treatment” effects of parental and children’s self-migration on the children’s cognitive development and educational trajectory by rural/urban hukou type are estimated through the *teffects ipwra* procedure in Stata15. First, the probability of being selected into each group (eg, children migrate with parents, children completely left-behind) is calculated through a multinomial logit regression and then inverse-probability weights are calculated. The selection model focuses on variables that are suggested in literature to have an impact on parental and children’s self-migration, including proxies to capture prior family financial conditions (before migration), parental education, number of siblings, gender and age of the children. More importantly, each of these variables is also a potential predictor of cognitive development and educational outcomes in its own right. In the second step, separate regression models are performed to estimate the outcome (wave 2 cognitive test score and dropout probability) for each treatment group. Treatment-specific predicted outcomes are estimated for each observation. In the third step, the weighted means of the treatment-specific outcomes are calculated. The differences between the weighed means of outcomes (standardized cognitive test score and dropout probability) by each treatment (children migrate with parents, children left-behind with one parent present, children stay behind with non-migrant children) and the control group (children completely left-behind), are the estimated average treatment effects. This study is interested in comparing the potential different impacts of varied types of migrant parent-child arrangements (children migrating with parents versus children being completely left-behind), so children being left-behind are used as the control group rather than non-migrant



children with non-migrant parents. The selection model used to predict migration status of children and factors affecting selection into migration will be discussed in more detail in the results section.

## Results

This section first describes the observed disparities in child cognitive development and dropout probability by rural/urban status and migration status of the children and their parents. I then present results from multilevel regression analysis to show how migration status and hukou status affect children's cognitive development and school enrollment and how parental engagement and school-level factors mediate the impact of hukou and parental and children's migration on cognitive development and school enrollment. Lastly I discuss the estimated causal effect of parental and child's migration on cognitive development and school enrollment by hukou status, with particular focus on the potential benefits of bringing children along compared to leaving them behind completely.

### Descriptive Statistics

First, I present the descriptive statistics for the analysis sample in Table 1. The descriptive statistics show that CEPS baseline survey provides a diverse sample with 66 % of the students being non-migrants with both parents around, 12% of students being left-behind by one migrant parent, 14% of students being completely left-behind with both parents having migrated, while the rest 5% of the students having migrated along with parents to another city within the same province, and another 4% of the students having migrated along with parents across provinces. The distribution of children by parental and child migration varies by their hukou type. The share of left-behind children is relatively higher among rural hukou holders than among urban hukou holders, with 29% of rural hukou children and 20% of urban hukou children left-behind by at least one migrant parent. However, the share of migrant children does not differ substantially by rural/urban hukou type, though students with rural hukou are slightly more likely to have migrated to a further distance (across provinces) compared to their urban counterparts. Significant differences are observed by rural/urban hukou type in all aspects of individual, family and school-level characteristics ( $p < .05$ , symbols not shown in table for simplification purpose), except for enrollment by gender and number of facilities available in the school. Students with rural hukou are disadvantaged in terms of cognitive abilities, continuous enrollment in high school, as well as family SES and parental engagement, compared to their peers with urban hukou. In terms of school contexts, students with rural hukou are more likely to enroll in private schools and schools with lower academic ranking, and more adverse learning environment (measured by number of student misconduct having occurred in the past week).

Table 2 presents the weighted means of cognitive test scores, school enrollment, family and school-level characteristics by hukou type and migration statuses of parents and children. In terms of child development outcomes, children left-behind perform less well in both cognitive ability tests and school enrollment. Children completely left-behind have lower cognitive test scores and higher dropout rates compared to their peers without migrant parents regardless of their hukou type. In fact, children completely left-behind in urban hukou are just as disadvantaged as their counterparts with rural hukou, if not more. Meanwhile, migrant students with rural hukou, particularly those who have migrated across provinces, seem to be more positively selected or benefit from self-migration compared to their urban migrant

counterparts. While migrant students with urban hukou have lower cognitive test scores than their urban non-migrant counterparts with both parents around, migrant students with rural hukou outperform their rural non-migrant peers with both parents around.

Individual and household-level characteristics also varies by migration statuses of parents and children for both rural and urban students. Interestingly, there is substantial variation in gender composition among children who are left-behind and children who are brought along by migrant parents, particularly among children with rural hukou. Among children with rural hukou, males are much more likely to be brought along rather than to be completely left-behind, which is consistent with traditional son-preference in rural households (Xie and Zhou 2009). Academic performance in primary school also varies by migration statuses of parents and children, but the overall pattern is similar by hukou type. For both urban and rural children, those left-behind are much more likely to have repeated grades in primary school, followed by those who have migrated with parents, while non-migrant children with both parents around are least likely to have retention in primary school ( $p < .01$ , significance not shown in table due to space constraints). In terms of family background characteristics, migrant children are significantly less likely to live in poor households and are more likely to have better educated parents compared to their peers who are left-behind by migrant parents among both urban and rural children. Also, migrant children are more positively selected in terms of parental education compared to their non-migrant counterparts only among the rural groups, and the differences are also highly significant ( $p < .01$ ). Among children with urban hukou, migrant children do not appear to have higher parental education or better financial condition compared to their non-migrant counterparts. As expected, children left-behind on average have more siblings and are much more likely to live with their grandparents compared to their non-migrant or migrant counterparts, regardless of hukou type.

Other factors that might affect children's cognitive development and school enrollment such as parental engagement, time spent on household chores as well school contexts also vary substantially by migration status of parents and children. As shown in Table 2, regardless of hukou type, children left-behind by migrant parents, particularly those who are completely left-behind, have the lowest level of parental engagement, compared to their non-migrant counterparts and also their migrant peers. They are also found to spend the most time on household work and most likely to live on campus. In terms of school-context factors, intraprovincial migrant children are less likely to enroll in regular public schools compared to their non-migrant counterparts with non-migrant parents, and they are also most likely to enroll in schools with the best academic ranking regardless of hukou type. Yet, interprovincial migrant children, particularly those with rural hukou are most likely to enroll in schools with medium and below academic ranking, which shows potential segregation of migrant students in schools with lower quality. Meanwhile, children who are completely left-behind are more likely to enroll in schools with higher levels of student misconduct and fewer physical resources.

Overall, the descriptive statistics suggest that there are substantial disparities among 7<sup>th</sup> graders by hukou type and migration statuses of parents and themselves, with left-behind children much more disadvantaged in terms of both educational outcomes and access to family and school capital, compared to their non-migrant counterparts with both parents around and also migrant counterparts who have migrated with their parents. Meanwhile, the advantages in terms of educational outcomes, family capital and school capital migrant children have over their non-migrant peers with the same hukou type are more prominent among rural children than among urban children.

## Mixed-effects Regression Results

### *Impact of Parental and Child Migration on Cognitive Development*

Table 3 provides results from mixed-effects models predicting wave 2 (when students are in 8<sup>th</sup> grade) standardized cognitive test score, based on students' rural/urban hukou status, migration statuses of both children and their parents, household-level socioeconomic status and composition, parental engagement as well as school-level factors. The models are estimated sequentially and all models adjust for school-level clustering. I first estimate a model with only indicators of hukou type and migration status, age, gender and baseline cognitive ability. As shown in Model 1 in Table 3, before controlling for family economic conditions and parental education, hukou status has a substantial impact on children's cognitive development. Even after controlling for baseline cognitive ability, students with rural hukou living in non-migrant families with both parents present fall further behind during 7<sup>th</sup> grade and 8<sup>th</sup> grade, compared to their non-migrant counterparts with urban hukou ( $p < 0.05$ ). Both parental migration and child migration seem to have a significant impact on children's cognitive development, though the impact of migration varies by whether the child migrate with their parents or not. Regardless of hukou status, children who are completely left-behind are significantly worse off compared to their non-migrant peers with non-migrant parents. The interaction of completely left-behind and rural hukou is not significant, suggesting that the potential negative impact of being completely left-behind does not penalize rural children more than urban children. Both groups are vulnerable to parental migration if they are left-behind. Meanwhile, children who migrate with parents, particularly rural hukou holders who migrate across provinces, show more progress in cognitive development compared to their non-migrant peers with non-migrant peers.

Both hukou status and migration choices of parents and children are closely related to parental resources. To get a better understanding how much of the effects of hukou status and migration status on children's cognitive development might be attributable to parental and family resources, Model 2 introduces indicators of family background characteristics including parental education, financial condition and number of siblings. As expected, parental education is a significant predictor of children's cognitive development. The more education the parents have, the higher cognitive abilities among their children. Meanwhile, family financial resources also matter for children's cognitive development. Children in poor households fare worse compared to those in households with moderate level of financial conditions. Yet, students in rich families are shown to progress less than students in middle-income households. Number of siblings also seem to have a strong impact on children's cognitive development. Students with more siblings have lower cognitive ability, which is likely to be driven by the less access to resources with more siblings. Interestingly, the significant impact of hukou type disappears after controlling for household financial conditions and parental education. Students who migrate with their parents still seem to outperform non-migrant students with non-migrant parents with the same hukou status, even after controlling for family capital. Being left-behind is still negatively associated with cognitive growth, but it is no longer significant after controlling for familial resources. Note that since baseline cognitive ability is controlled for predicting 8<sup>th</sup> grade cognitive test scores in all models presented in Table 3, all the models in fact predict cognitive development trajectories. As shown in Table 2 in Appendix 1, being left-behind completely is highly associated with lower cognitive ability in the baseline (7<sup>th</sup> grade), even after controlling for parental education and familial resources.

To further understand the mechanisms through which parental and child migration might affect children's cognitive development and factors that moderate the impact of being

left-behind on children's well-being, Model 3 adds in parental engagement, whether living with grandparents, hours spent on housework, as well as whether children live on campus. Results from Model 3 suggests that higher levels of parental engagement and living with grandparents are beneficial for children's development, while spending more time on household chores lowers children's cognitive development ( $p < 0.01$ ). Although parents are more likely to put children in boarding schools when they migrate out, it does not seem to have a significant impact on children's cognitive development. The addition of parental engagement, living with grandparents and time spent on chores weakens the impact of parental education, family financial condition and number of siblings, but it does not take away the impact of parental and child migration. On the contrary, after controlling for all those indicators of family capital, being completely left-behind is still significantly associated with lower cognitive development regardless of hukou status. Taking children along when parents migrate is associated with more gains in children's cognitive development, particularly among children with rural hukou and having migrated across provinces.

One of the key drivers or equalizers often discussed in literature on educational inequality is school context (Downey et al 2004). To further understand how access to schools of varied quality moderates or amplifies the impact of hukou status and migration on children's developmental outcomes, Model 4 adds in indicators of school type, school quality and learning environment. As shown in Table 4, after controlling for children's prior academic and cognitive abilities, as well as family capital, school type still has a significant impact for predicting growth in cognitive abilities. Children in migrant schools on average score 0.3 standard deviations (the standard deviation of the weighted sample is 0.8) lower than children in regular public schools. School rank, availability of physical resources, learning environment are not significant predictors of cognitive development, net of 7<sup>th</sup> grade cognitive ability. However, when baseline cognitive abilities of students when they are in 7<sup>th</sup> grade are examined (As shown in Model 5 in Appendix 2), all these school-level factors are significantly associated with baseline cognitive test score. School type is also highly correlated with school quality. Migrant schools are all ranked medium and below (tabulation not shown). By comparing results shown in Model 4 and Model 5 in Appendix 2, inclusion of school rank, physical facilities and student misconduct explains half the effect of migrant school.

Overall, schools are highly selective in terms of initial cognitive abilities, and they are also significant drivers of further disparity in cognitive development, making students in migrant schools much more disadvantaged compared to those in regular public schools or ordinary private schools, as shown by regression results based on Model 4-5 in Appendix 2 and Model 4 in Table 3. Meanwhile, it is worth noting that not all migrant students are enrolled in migrant schools. In the migrant only models (results not shown), it is found that migrant students enrolled in regular public schools are much better off compared to those in migrant schools. The selection into migrant schools among migrants are significantly determined by urban/rural status and parental education (Appendix 3). Migrant children with rural hukou are much more likely to enroll in migrant schools compared to migrant children with urban hukou, and part of the disparity in enrollment in migrant schools are explained by parental education and family SES. After controlling for selection into schools, rural migrant children not only outperform their rural peers remaining in the origin (both left-behind and those with non-migrant parents), but also native urban counterparts.

To understand whether girls and boys are affected differently by parental and self-migration in terms of cognitive development, Model 4F and 5M in Table 3 presents results based on models stratified by gender. Based on the CEPS data, girls and boys seem to similarly

affected by hukou type, parental education, family financial condition, parental engagement, but the impact of parental migration on cognitive development trajectory seems to be stronger for girls. Even after controlling for baseline cognitive ability and grade retention in primary school, as well as other family capital and school-level characteristics, girls left-behind still show slower progression in cognitive development compared to their peers in non-migrant families, regardless of hukou type. Interestingly, being left-behind does not have a more deleterious impact on girls with rural hukou than on girls with urban hukou, as indicated by the insignificant coefficient of the interaction of rural hukou and completely left-behind. Meanwhile, neither rural or urban boys left-behind by migrant parents are not significantly worse off compared to their counterparts with non-migrant parents in terms of cognitive development between the 7<sup>th</sup> and 8<sup>th</sup> grade. But boys' cognitive development is significantly related to school type. However, being left-behind is significantly associated with lower baseline cognitive test scores among both boys and girls, regardless of hukou status (Model 4F and 4M in Appendix 2). The magnitude of effect of time spent on household chores also seems to be larger for girls than for boys, which is consistent with previous research suggesting that girls are often more burdened with chores than boys (Meyerhoefer and Chen 2011; Short et al 2015). While number of siblings does not seem to have an impact on boys' baseline cognitive ability or cognitive growth trajectory between two waves, it is however negatively associated with girls' cognitive ability in the baseline year when they are in 7<sup>th</sup> grade, which might be attributable to the fact that girls are more likely to be in households with multiple children than boys and thus are more likely to compete for parental resources. Girls are also more penalized by their rural status. While rural status does not have a significant impact on boys' baseline cognitive test score, it has a marginally significant adverse impact on baseline cognitive test score among girls ( $p < .01$ ).

#### *Impact of Parental and Child Migration on Dropout Status*

While children's cognitive development has long been considered as a key determinant of future human capital, dropout status is a direct measure of educational attainment. Table 4 presents results from mixed-effects logit regression predicting likelihood of dropping out of junior high school by between 7<sup>th</sup> and 8<sup>th</sup> grade based on students' individual, household and school-level characteristics measured when students are in 7<sup>th</sup> grade. Models are estimated according to the same sequence as presented in the above section. Consistent with findings on cognitive development, both hukou and parental migration are significantly related with adolescents' probability of dropping out of high school. As shown in Model 1 in Table 4, students in non-migrant families with rural hukou on average are far more likely to drop out of junior high school compared to their counterparts with urban hukou. Students who are left-behind (whether by one parent or both parents) are considerably more likely to drop out regardless of hukou status. Surprisingly, children with rural hukou are less penalized by being left-behind compared to their counterparts with urban hukou, as indicated by the negative coefficient of the interactions of left-behind (with one parent around, or completely left behind) and rural hukou. Also, while interprovincial migrant children tend to have higher wave 2 cognitive test scores, they are not significantly better off in terms of continuous enrollment in junior high school, regardless of hukou type. Meanwhile, higher cognitive test score in 7<sup>th</sup> grade and no grade retention in primary school decreases likelihood of dropout in junior high school. Gender does not seem to have a significant impact on dropout. Children who are older are also more likely to dropout, as students in the same grade but older are more likely to have repeated grades or had interrupted school in primary school.

In keeping with previous literature, parental education is a powerful predictor for dropout status of children. Children whose parents have senior high or college education are far more likely to dropout compared to their peers with less educated parents (as shown in Model 2 in Table 4). While family financial condition is highly associated with baseline and follow-up cognitive abilities, the impact is not significant for predicting dropout rate. It is also worth noticing that the financial condition is self-reported by the students or their parents (when the students failed to), and the categories are relatively coarse. Also, junior high education is essentially free to non-migrant students if they are willing to stay in school, thus the impact of financial condition on dropout might be less important. Meanwhile, number of siblings seem to increase odds of dropping out among junior high students. While the introduction of parental and family capital characteristics largely removes the significance of hukou type and parental migration on cognitive development, the same pattern is not observed for predicting dropout probability. Even after controlling for measures of parental and family capital, children completely left-behind are much more likely to drop out compared to their peers in non-migrant families and the impact of being left-behind does not vary by hukou type. Yet, being left-behind by one migrant parent seems to have a more deleterious impact on urban children compared to rural children ( $p < .05$ ).

While parental engagement does not have a significant impact on preventing students from dropping out of school for the overall sample (as shown in Table 3), it has a significant impact for predicting dropout probability among migrant students ( $p < 0.05$ ). However, the presence of grandparents also does not have a significant impact on preventing students from dropping out, which might be explained by findings from qualitative studies that grandparents might not be able to provide sufficient educational aspiration or supervision. Consistent with findings on cognitive development, time spent on household chores increase odds of dropout among junior high school students. Putting students in boarding schools also does not seem to buffer the potential negative impact of parental migration on driving children to drop out of junior high school. After controlling for all these potential moderating factors, the impacts of hukou type and migration status are still robust, but they decrease some of the observed impact of parental education and family financial condition on dropout status.

School contexts are not only selective in terms of initial cognitive ability, but also are important drivers for further inequality in terms of educational attainment. Results presented by Model 4 in Table 4 suggest that students in migrant schools have much higher odds of dropping out before finishing junior high education, after controlling for prior academic performance and other individual and family-level characteristics. Students in schools with higher academic ranking, physical resources (measured by number of facilities available) or lower levels of student misconduct are also less likely to drop out. While these school-context factors take away some of the observed impacts of other individual and family-level characteristics such as hukou type and parental education on school enrollment of children, the negative impact of migrants leaving children behind is still highly significant. Being completely left-behind having the same deleterious impact on keeping adolescent in school for both rural and urban hukou holders, while being left-behind by one migrant parent has a larger impact on driving adolescents out of junior high school among urban hukou holders than among rural hukou holders.

Similar to the gendered effect of parental migration found on cognitive development as discussed in the section above, the impact of parental migration on predicting junior high school dropout also varies by gender. By comparing the results shown by Model 4F (Female model) and Model 4M (Male model) in Table 4, I find that girls seem to be more penalized by



being left-behind regardless of hukou status. Girls also seem to be more affected by their hukou type, with non-migrant girls with non-migrant parents with rural hukou having a much higher odds of dropping out compared to their counterparts with urban hukou. However, hukou type does not have a significant impact on boys probability of dropping out after controlling for other family and school-level characteristics. The impact of being left-behind also varies by urban/rural hukou type only among girls. Among girls, while both urban and rural hukou holders are significantly affected by being left-behind by their migrant parent(s), the adverse impact of being left-behind on school enrollment is smaller among urban hukou holders than among rural hukou holders. This finding is not entirely surprising, as rural children are more likely to live with grandparents or stay in boarding schools when their parents migrate (as shown by descriptive statistics in Table 2), which might buffer some of the potential negative impact of parental migration. Also, previous qualitative studies on experiences of children in rural migrant sending communities suggest that there is high acceptance among rural left-behind children towards their parents' absence due to migration, as they are often told that their parents migrate for the sake of providing them with better education (Hu 2017).

Parental education, time spent on chores as well as whether living on campus also seem to have a gendered effect for predicting dropout status. Parental educational attainment is a more significant factor for predicting whether girls keep staying in school than for boys, which might be explained by the fact that parents with more education are less likely to have son preference or have more resources to allow girls to stay in school. As expected, time spent on household chores only matters for girls, as girls are more likely to be asked to share responsibilities for household chores, especially among migrant families. Staying in boarding schools has a marginally significant impact for preventing girls from dropping out of junior high school, but it does not have a significant impact on boys. Regarding school contexts, both school type and physical resources have an important impact for both boys and girls.

Overall, regression results predicting dropout probability by gender suggest that girls seem to be more responsive to hukou status, parental migration and family capital than boys in term of school enrollment, as they might be more vulnerable to restrictions in family resources due to traditional son preference, particularly among rural hukou holders. As evident in the descriptive statistics, girls with rural hukou are more likely to be completely left-behind while boys are much more likely to be brought along by migrant parents. Both the results on cognitive development and school enrollment calls for attention on the vulnerability faced by girls in migrant families. While urban girls in non-migrant families on average have lower odds of dropping out of junior high school compared to girls with rural hukou, girls with urban hukou but left-behind in fact are more penalized by their parents' migration compared to girls with rural hukou. While no prior study has paid attention to left-behind adolescents with urban hukou, they might be particularly vulnerable, as they might lack the same level of understanding towards their parents' migration and extended family network to support them compared to those with rural hukou who might be more used to parental migration.

#### *Average "Treatment" Effects of Parental and Child Migration on Cognitive Development and School Enrollment*

Results from mixed-effects models suggest that the impact of parental migration varies by whether bringing children along with them. Students who are left-behind by migrant parents, particularly those who are completely left-behind, on average tend to have lower cognitive abilities and slower cognitive development, as well as higher dropout rates compared to those who live in non-migrant families regardless of hukou status. Meanwhile, children who migrate



with parents fare better than all groups of their non-migrant counterparts, and the pattern is observed for both urban and rural hukou students. Students with rural hukou, are not only doing much better than their non-migrant counterparts living in rural origin, but also outperform urban native students in terms of growth in cognitive development after controlling for school characteristics. To understand how the potential policy implications of restricts on access to education faced by migrant families to bring along their children, this section focuses on examining the “treatment” effect of migrating along with parents compared to being left-behind, after adjusting for selection into migrating with parents. Regression results suggest that the impact of migration also seems to vary by the urban/rural hukou type of the children, with being left-behind having a larger negative impact on dropout status among children with urban hukou , while migrating with parents having a bigger positive impact on cognitive development among children with rural hukou. The varied selection process among migrants with rural hukou and migrants with urban hukou also makes it necessary to examine the impacts of parental and child migration on children’s cognitive development and school enrollment separately. Therefore, causal effects are estimated for rural and urban children separately. To retain sufficient sample size for all groups of parent and child migration arrangements and also by rural/urban hukou status, the estimations are not further stratified by gender.

Before estimating the casual effect of migration statuses, it is valuable to examine the selectivity of students into various migration statuses. Selection models (Appendix 4) used to predict whether children would migrate with parents or be left-behind suggest that children who migrate with parents are more positively selected in terms of both childhood financial condition, parental education and academic performances in primary school compared to their peers who are completely left-behind, although some of the positive selection is only significant for rural hukou holders. As shown in Model 1 in Appendix 1, among children with rural hukou, the odds of migrating along with parents versus being left-behind is 4.87 times higher when fathers have college education compared to when fathers only have primary or less education. Mother’s education is also associated with higher odds of rural children migrating with parents, but it is not statistically significant. Whether children with rural hukou are left-behind or brought along is also highly determined by prior family financial conditions (measured by family financial condition before the child started primary school and also whether the child attended kindergarten before primary school). (The average duration of migration among migrant children is over 6 years, so financial condition when the child is younger (likely prior to migration) rather than the current family SES is used to predict the migration status of the children. The current family SES is also very much likely to be affected by migration.) Children with rural hukou who attended kindergarten (indicating higher SES) are also more likely to have migrated with parents in 7<sup>th</sup> grade. Rural children who have inferior academic performance (having repeated grades) in primary school are also less likely to have been brought along by their migrant parents compared to be completely left-behind. As expected, rural children with siblings are also less likely to be brought along compared to their peers who are the only child.

While the differences between the migrant children and completely left-behind children in terms of gender, parental education attainment, family financial conditions, prior academic performance are quite striking among children with rural hukou, the differences in those characteristic between left-behind children and migrant children among urban hukou holders are less significant. Higher education of mothers is associated with higher odds of children migrating with parents versus being completely left-behind among children with urban hukou, but childhood economic status (most likely to be prior to migration) or primary school academic performance do not seem to be key determinants of whether urban children are left-

behind or brought along. The gender effect also varies by rural/urban hukou type in terms of odds of being brought along versus being completely left-behind. While among rural hukou holders, boys on average have a 30% higher odds of migrating with parents than girls ( $p < 0.1$ ), the association is not significant among children with urban hukou.

The average treatment effects of migration statuses are more detectable for school enrollment than for cognitive development. After adjusting for selection of parental and child migration based on children's gender, age, number of siblings, father and mother's education, childhood financial condition, as well as prior academic performance, I find that children would benefit from migrating with parents in terms of school enrollment, regardless of hukou status. As shown in Table 5, after controlling for selection into migration, rural children could have much lower probability of dropping out of junior high school if they migrate with parents compared to when they were completely left-behind. The estimated treatment effect for the treated suggest that the probability of dropping out of junior high school is 2.8 percentage point lower (a 76% decrease) when they migrate with their parents compared to when they were completely left-behind, among children who migrated with their parents. A similar pattern is found among children with urban hukou. Among urban children who actually migrated with parents, their probability of dropping out of high school is 1 percentage point lower (a 52% decrease) compared to when they were to be left-behind. At the same time, having non-migrant parents would also decrease probability of dropping out compared to being completely left-behind, regardless of hukou status. Compared to being completely left-behind, living with non-migrant parents could potentially decrease the probability of dropping out by 1.7 percentage points (a 45% decrease) and 1.2 percentage points (a 62% decrease) for rural hukou children and urban children respectively. Overall the regression results based on inverse probability weighting regression adjustment method adjusting for selection of parental and child migration suggest that children are more likely to stay in school if they could migrate with parents if their parents migrate, compared to being left-behind.

The direct impact of parental and child migration on children's cognitive development is less significant. As shown in Table 5, migrating with parents is associated with higher cognitive ability in the 7<sup>th</sup> grade, but the impact is not significant. The observed positive impact of migrating with parents on cognitive development based on descriptive statistics and mixed-effects regression seems to be largely explained by the positive selection of parental and family capital among migrant children, as shown by results in the selection models predicting migration status of children (Appendix 4). The differences in cognitive growth by whether migrating with parents or being completely left-behind is also not significant for both after controlling for both selection into migration and baseline cognitive ability. Meanwhile, although children completely left-behind with rural hukou do not seem to be worse off in terms of cognitive abilities compared to when they were to stay in non-migrant families with both parents around, children completely left-behind with urban hukou do seem to be penalized by their parents' migration. Compared to being completely left-behind, living with non-migrant parents could potentially increase their 7<sup>th</sup> grade standardized test score by .3 standard deviation (given weighted sample  $SD = 0.8$ ,  $p < .001$ ). Overall, the impact of parental and child migration on cognitive development trajectories seems to be less significant than its impact on school enrollment, after controlling for selection into parental and child migration arrangements.

## Conclusion

Although there is higher share of left-behind children among rural hukou holders, the share of children left-behind among the urban child population has reached 20% and is

expected to grow in the near future. While all prior studies have focused exclusively on children of rural origin affected by the migration process in China, this study offers important insights on how children of urban origin might also be affected in the era of massive migration and how the impact of parental migration and child migration might vary by the children's hukou type. Taking advantage of information collected by CEPS on prior academic performance and inverse probability weighting regression adjustment method adjusting for selection into migration based on parental and family financial conditions, this study finds that children left-behind regardless of urban/rural hukou type, particularly those completely left-behind are much more likely to drop out of junior high school compared to their counterparts in non-migrant families and those who migrate with their parents. This study also shows that girls might be more negatively affected by being left-behind in terms of both cognitive development and educational trajectories regardless of hukou type, as they are more affected by time spent on household chores and number of siblings. Girls with rural hukou are particularly vulnerable to parental migration, as they are significantly less likely to be brought along by their migrant parents than boys.

This is the first study to provide important insights that urban children left-behind are not immune to the potential negative impact of parental migration on education trajectories. In fact, children left-behind of urban origin seems to be even more penalized by parental migration. We might speculate that being left-behind has a larger effect on children of urban origin partly because they might be less accustomed to the migration culture that is prevalent in rural communities. While rural children might have stronger acceptance towards the absence of their parents due to migration, as they often believe their parents migrate for the benefit of their education (Hu 2017), it is unclear how children with urban hukou might perceive their parents' absence due to migration. Another reason for the potential larger impact of being left-behind on children of urban origin is that they seem to be less likely to have other support networks. Descriptive statistics based on the CEPS data suggests that children completely left-behind of urban origin are less likely to live with grandparents or enroll in boarding schools where other social support might be available compared to children completely left-behind of rural origin.

This study also provides important insights on how child migration might affect rural and urban children differently and how this variation might be explained by the selectivity of child migrating with parents of different rural/urban hukou. This study finds that migrant children with rural origin, particularly those who have migrated across provinces, are highly positively selected in terms of parental education, family financial condition compared to their rural non-migrant peers with non-migrant parents, left-behind peers with migrant parents. Meanwhile, migration children from urban origin are positively selected in terms of parental education, family financial condition only compared to their urban counterparts who are left-behind. But they are not advantaged in terms of parental human capital or family financial condition compared to non-migrant students with urban hukou. While migrant children with rural hukou are more selected, the positive impact of migrating with parents also appears to be larger for rural hukou holders than for urban hukou holders. Results based on mixed-effects models controlling for 7<sup>th</sup> grade cognitive abilities, education performance in primary school, as well as family and school capital suggest that being an interprovincial migrant has a larger positive impact on students' cognitive development among migrants of rural hukou than that among migrants of urban hukou.

While this study provides an optimistic view of migrant children, as they outperform their peers who are left-behind or those who live in non-migrant families with both parents present in terms of cognitive development and educational status, the results should be

interpreted with some caution since the CEPS is based on students who are enrolled in the sample school in the baseline year. Students who are not enrolled in schools when they should be 7<sup>th</sup> grade are thus not captured by the survey. There are mixed evidence on whether migrant students are less likely to be enrolled in schools, depending on the urban destinations in the studies (Liang and Chen 2007; Liang et al 2008). Also, migrant students of both rural and urban origin in the CEPS sample on average have lived in the current place of residence for 7 years although they still do not have local hukou, so this study might have captured more long-time migrants rather than temporary migrants. But the analysis presented in this paper also aimed to adjust for the positive selection of migrants enrolled in schools. As shown in the causal analysis, while the positive selection of migrant students based on parental education and family financial condition takes away some of the observed effects of migrating with parents on cognitive development, migrating with parents still has a significant impact for preventing students from dropping out of high school compared to being completely left-behind regardless of hukou status.

This study is also limited by the contemporaneous measure of migration status of parents, the only migration variable available in the CEPS data. Previous studies on cumulative effects of parental migration on left-behind children suggest that the impact of migration might attenuate with duration of parental migration (Meng and Yamauchi 2017), so the estimated impact of parental migration on left-behind children might be underestimated in this paper without being able to taking into account of migration duration. Also, the potential negative impact of parental migration might vary by the gender of the migrant parent if only one parent has migrated (Zhou et al 2014; Zhou et al 2015). While this study has shown that being completely left-behind is more disadvantageous than being left-behind by only one migrant parent, this study is limited in the sense that it does not differentiate the gender of the migrant parent due to limited sample sizes of rural or urban children left-behind with migrant mother but father present.

Despite these limitations, the CEPS is the first nationally representative survey of junior school students and it also purposefully oversampled migrant schools and schools with large migrant population during the sampling stage in order to have sufficient samples of migrant students otherwise might not be possible. Overall, this study provides strong evidence that enabling children to migrate with parents is advantageous for children's cognitive development and school enrollment, regardless of students' urban/rural origin. Local government of major migrant-receiving cities should aim to provide more education opportunities for children who migrate with their parents. Also, significant disparities in both cognitive development and school enrollment are found by urban/rural origin status of children, which is explained by variation in school-context factors. Enabling more rural children to receive education in urban schools or schools with better quality might help to reduce the long-standing urban/rural educational inequality, as suggested by the superior educational outcomes of rural-to-urban migrant students (conditional on that they are enrolled in regular public schools). Lastly, Future studies and urban policy initiatives should pay more attention to left-behind children of urban origin, who account for 1/5 of the total urban-hukou child population. As shown by this study, while this subgroup has been neglected in migration literature on China, they are certainly not immune to the potential negative impact of parental absence due to migration. In fact, they seem to be even more penalized by parental migration compared to their rural counterparts who might have been more adjusted to the migration culture.

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**Table 1: Weighted Descriptive Statistics of Analytical Sample**

	Urban	Rural	Total
<b>Outcome variables</b>			
Wave 2 standardized cognitive test score	0.25	0.09	0.15
Wave 1 standardized cognitive test score	0.01	-0.22	-0.13
Probability of dropout	0.01	0.03	0.02
<b>Migration status of children and their parents</b>			
non-migrant with both parents around	0.71	0.63	0.66
left-behind with one parent around	0.10	0.13	0.12
completely left-behind	0.10	0.16	0.14
intra-provincial migrant	0.05	0.04	0.05
inter-provincial migrant	0.04	0.04	0.04
<b>Individual and household-level characteristics</b>			
Male	0.53	0.53	0.53
Age	12.58	12.71	12.66
Ever repeated grades in primary school	0.14	0.27	0.23
Highest level of parental education			
Junior high or less	0.41	0.74	0.62
Senior high	0.31	0.22	0.26
College or above	0.28	0.03	0.12
Family economic status			
Poor	0.20	0.34	0.29
Moderate	0.74	0.63	0.67
Rich	0.06	0.03	0.04
Number of siblings	0.68	1.05	0.92
Live with grandparents	0.29	0.33	0.32
Parental engagement factor score	0.13	-0.06	0.01
Average number of hours spent on house work (daily)	1.22	1.50	1.40
Whether student living on campus	0.26	0.56	0.45
<b>School-level characteristics</b>			
School type			
Public school	0.95	0.91	0.92
Regular private school <sup>a</sup>	0.05	0.09	0.07
School rank			
Medium and Below	0.12	0.19	0.17
Above average	0.58	0.66	0.63
Among the best	0.30	0.14	0.20
Number of student misconduct in the school (weekly)	1.60	1.91	1.79
Number of facilities available in school	6.85	6.84	6.84
N	4189	4941	9130
Weighted percent of the total sample	37	63	100

Source: China Education Panel Study 2013-2014.

Note: Weighted proportions are calculated for categorical variables, while means are presented for continuous variables (cognitive test scores, age, parental engagement factor score). All the characteristics are statistically different by rural/urban status ( $p < .01$ ), except for proportion male and number of facilities available in school.

<sup>a</sup> Proportion in migrant schools are less than 0.5 % for the overall population, so it's not reported in this table.

**Table 2: Mean Comparison of Individual, Household and School-level Characteristics by Migration Status**

	Urban					Rural				
	Neither parents nor children migrated	Parent migrated, children not migrated		Children migrated with parents		Neither parents nor children migrated	Parent migrated, children not migrated		Children migrated with parents	
	non-migrant with both parents present	left-behind with one parent present	completely left-behind	intra- provincial migrant	inter- provincial migrant	non-migrant with both parents present	left-behind with one parent present	completely left-behind	intra- provincial migrant	inter- provincial migrant
<b>Outcome variables</b>										
Wave 2 standardized cognitive test score	0.33	0.03	-0.10	0.20	0.13	0.10	0.08	0.04	0.12	0.16
Wave 1 standardized cognitive test score	0.10	-0.22	-0.39	-0.11	0.02	-0.20	-0.22	-0.31	-0.23	-0.12
Probability of dropout	0.01	0.05	0.03	0.00	0.00	0.02	0.03	0.05	0.01	0.02
<b>Individual and household-level characteristics</b>										
male	0.51	0.60	0.58	0.58	0.53	0.52	0.59	0.51	0.62	0.57
Ever repeated grades in primary school	0.11	0.28	0.25	0.14	0.11	0.23	0.37	0.37	0.25	0.23
Highest level of parental education										
Junior high or less	0.35	0.55	0.66	0.42	0.42	0.74	0.72	0.78	0.69	0.73
Senior high	0.32	0.26	0.28	0.29	0.35	0.22	0.26	0.20	0.23	0.20
College or above	0.33	0.19	0.06	0.29	0.23	0.04	0.01	0.01	0.08	0.07
Family economic status										
Poor	0.18	0.33	0.27	0.17	0.11	0.33	0.41	0.35	0.23	0.13
Moderate	0.76	0.64	0.65	0.78	0.80	0.63	0.57	0.62	0.75	0.83
Rich	0.06	0.03	0.08	0.05	0.08	0.03	0.02	0.03	0.02	0.04
Number of siblings	0.57	1.02	1.18	0.61	0.78	1.01	1.17	1.17	0.98	1.04
Live with grandparents	0.26	0.25	0.61	0.19	0.23	0.28	0.29	0.66	0.14	0.14
Parental engagement factor score	0.22	-0.19	-0.26	0.20	0.10	0.01	-0.21	-0.24	0.07	-0.14
Average hours spent on house work (daily)	1.19	1.49	1.25	1.21	1.17	1.48	1.67	1.62	1.22	1.08
Whether student living on campus	0.21	0.42	0.48	0.34	0.15	0.57	0.59	0.67	0.36	0.12
<b>School-level characteristics</b>										
School type										
Public school	0.97	0.96	0.80	0.88	0.97	0.94	0.90	0.79	0.85	0.96
Regular private school	0.03	0.04	0.20	0.11	0.02	0.06	0.10	0.21	0.12	0.02
Migrant school	-	-	-	0.01	0.01	-	-	-	0.03	0.02
School rank										
Medium and Below	0.11	0.15	0.13	0.12	0.19	0.18	0.20	0.20	0.26	0.32
Above average	0.57	0.65	0.64	0.52	0.64	0.69	0.66	0.64	0.49	0.49
Among the best	0.32	0.20	0.23	0.36	0.17	0.13	0.14	0.16	0.25	0.19
N of student misconduct in the school (weekly)	1.55	1.57	1.87	1.88	1.42	1.89	1.73	2.14	2.03	1.72
N of facilities available in school	6.82	6.82	6.70	7.32	7.07	6.86	6.83	6.55	7.21	7.28
N	3016	295	257	299	322	2779	518	609	371	664

Source: China Education Panel Study 2013-2014.

Note: Weighted proportions are calculated for categorical variables, while means are presented for continuous variables (cognitive test scores, age, parental engagement factor score etc).

**Table 3: Mixed-effects Models Predicting Wave 2 (8th Grade) Standardized Cognitive Test Score**

	Full Sample				Female	Male
	Model 1	Model 2	Model 3	Model 4	Model 4F	Model 4M
<b>Individual and Household-level characteristics</b>						
Rural hukou (ref=urban hukou)	-0.0452** (0.0222)	-0.0159 (0.0226)	-0.0159 (0.0222)	-0.0171 (0.0222)	-0.0117 (0.0256)	-0.0246 (0.0324)
<b>Parent and child's migration Status (Ref=non-migrant with both parents present)</b>						
Left-behind with one parent around	-0.0549 (0.0430)	-0.0502 (0.0420)	-0.0464 (0.0399)	-0.0471 (0.0401)	-0.108* (0.0639)	-0.00150 (0.0629)
Completely left-behind	-0.102* (0.0545)	-0.0809 (0.0548)	-0.111** (0.0556)	-0.114** (0.0555)	-0.152** (0.0730)	-0.0935 (0.0781)
Intraprovincial migrant	0.0640* (0.0372)	0.0730** (0.0369)	0.0757** (0.0370)	0.0747** (0.0370)	0.0595 (0.0368)	0.0890 (0.0554)
Interprovincial migrant	0.0192 (0.0427)	0.0405 (0.0433)	0.0477 (0.0430)	0.0457 (0.0429)	0.0397 (0.0590)	0.0579 (0.0672)
<b>Interactions of hukou type and migration statuses</b>						
Left-behind with one parent around * Rural hukou	0.0353 (0.0576)	0.0350 (0.0566)	0.0350 (0.0547)	0.0350 (0.0547)	0.119 (0.0777)	-0.0119 (0.0797)
Complete left-behind * Rural hukou	0.0871 (0.0621)	0.0625 (0.0623)	0.0754 (0.0610)	0.0784 (0.0610)	0.100 (0.0839)	0.0596 (0.0886)
Intraprovincial migrant * Rural hukou	0.0469 (0.0557)	0.0436 (0.0547)	0.0471 (0.0550)	0.0485 (0.0551)	0.0873 (0.0649)	0.0278 (0.0816)
Interprovincial migrant * Rural hukou	0.102** (0.0496)	0.0932* (0.0496)	0.0950* (0.0494)	0.0967** (0.0487)	0.0734 (0.0642)	0.116 (0.0750)
<b>Male</b>	-0.0502*** (0.0145)	-0.0517*** (0.0148)	-0.0522*** (0.0150)	-0.0515*** (0.0150)		
<b>Age (Centered to Mean=13)</b>	-0.105*** (0.0140)	-0.0986*** (0.0139)	-0.0939*** (0.0139)	-0.0939*** (0.0138)	-0.116*** (0.0155)	-0.0749*** (0.0184)
<b>Wave 1 Cognitive Ability Test-Standardized Score</b>	0.414*** (0.0170)	0.409*** (0.0168)	0.398*** (0.0164)	0.397*** (0.0165)	0.377*** (0.0181)	0.420*** (0.0200)
<b>Whether repeated grades in primary school</b>	-0.0728*** (0.0259)	-0.0651** (0.0260)	-0.0573** (0.0251)	-0.0573** (0.0251)	-0.0262 (0.0402)	-0.0924*** (0.0317)
<b>Parents' highest level of education (Ref=no or primary education)</b>						
Junior high		0.0584 (0.0360)	0.0463 (0.0356)	0.0480 (0.0359)	0.0154 (0.0486)	0.0823* (0.0458)
Senior high		0.0727* (0.0387)	0.0531 (0.0379)	0.0552 (0.0383)	0.0309 (0.0517)	0.0959** (0.0488)
college		0.170*** (0.0405)	0.149*** (0.0401)	0.152*** (0.0406)	0.122** (0.0546)	0.212*** (0.0582)
<b>Economic status of students' family (ref=moderate)</b>						
Poor		-0.0367* (0.0206)	-0.0255 (0.0202)	-0.0251 (0.0202)	-0.0500 (0.0319)	-0.0154 (0.0247)
Rich		-0.0972*** (0.0306)	-0.0965*** (0.0303)	-0.0985*** (0.0304)	-0.109** (0.0432)	-0.0860** (0.0434)
<b>Number of siblings</b>		-0.0230** (0.0108)	-0.0158 (0.0107)	-0.00809 (0.0127)	-0.00306 (0.0185)	-0.0230 (0.0194)
<b>Live with Grandparent(s)</b>			0.0622*** (0.0182)	0.0623*** (0.0181)	0.0547*** (0.0211)	0.0699*** (0.0251)
<b>Parental engagement score</b>			0.0300*** (0.00735)	0.0297*** (0.00730)	0.0262** (0.0111)	0.0329*** (0.0104)
<b>Average hours spent on housework (daily)</b>			-0.0420*** (0.00599)	-0.0422*** (0.00597)	-0.0509*** (0.00815)	-0.0384*** (0.00844)
<b>Student live on campus</b>			0.00656 (0.0273)	0.000647 (0.0276)	0.00818 (0.0291)	-0.0116 (0.0423)

**School-level Characteristics****School Type (ref=public school)**

Migrant school	-0.241*	-0.191	-0.294***
	(0.128)	(0.181)	(0.0988)
Private school	0.262***	0.179	0.337***
	(0.0901)	(0.112)	(0.0900)

**School Rank (ref= above average)**

Medium and below	-0.00291	-0.0209	0.0351
	(0.0703)	(0.0707)	(0.0770)
Among the best	0.0551	0.0697	0.0304
	(0.0651)	(0.0701)	(0.0619)

**Number of facilities available**

0.0230	0.0165	0.0263
(0.0180)	(0.0194)	(0.0185)

**Number of student misconduct in the school (weekly)**

-0.0227	-0.00949	-0.0259
(0.0188)	(0.0197)	(0.0188)

Constant	0.332	0.263	0.295	0.133	0.208	0.0247
Intraclass correlation	0.18	0.17	0.16	0.15	0.16	0.13
Observations	8381	8381	8381	8381	3976	4405

Standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**Table 4: Mixed-effects Logit Regression Predicting Dropout Probability by 8th Grade**

	Full Sample				Female	Male
	Model 1	Model 2	Model 3	Model 4	Model 4F	Model 4M
<b>Individual and Household-level characteristics</b>						
Rural hukou (ref=urban hukou)	1.147** (0.521)	1.016* (0.550)	1.037** (0.529)	0.977* (0.515)	1.463* (0.850)	0.587 (0.553)
<b>Parent and child's migration Status (Ref=urban local with both parent)</b>						
Left-behind with one parent around	1.759*** (0.683)	1.579** (0.720)	1.585** (0.724)	1.636** (0.733)	2.642*** (0.849)	1.001 (0.923)
Completely left-behind	1.585*** (0.571)	1.475** (0.577)	1.602*** (0.584)	1.484** (0.578)	2.330*** (0.822)	0.782 (0.733)
Intraprovincial migrant	-0.524 (0.591)	-0.588 (0.595)	-0.568 (0.600)	-0.769 (0.678)	-1.669 (1.985)	-0.303 (0.741)
Interprovincial migrant	-0.531 (0.711)	-0.689 (0.736)	-0.723 (0.743)	-1.413* (0.802)	-1.770 (1.616)	-0.478 (0.954)
<b>Interactions of hukou type and migration statuses</b>						
Left-behind with one parent around * Rural hukou	-1.746** (0.710)	-1.591** (0.723)	-1.612** (0.720)	-1.613** (0.714)	-2.317** (0.900)	-1.105 (0.963)
Complete left-behind * Rural hukou	-1.195* (0.677)	-1.085 (0.681)	-1.118* (0.675)	-1.053 (0.663)	-2.120** (1.051)	0.000719 (0.793)
Intraprovincial migrant * Rural hukou <sup>a</sup>	-	-	-	-	-	-
Interprovincial migrant * Rural hukou <sup>b</sup>	-0.483 (0.737)	-0.389 (0.729)	-0.393 (0.710)	-0.370 (0.693)	-	-1.079 (0.819)
<b>Male</b>						
Age (Centered to Mean=13)	-0.120 (0.227)	-0.0141 (0.242)	-0.00934 (0.234)	-0.0183 (0.230)		
Wave 1 Cognitive Ability Test-Standardized Score	0.670*** (0.128)	0.580*** (0.121)	0.568*** (0.124)	0.528*** (0.122)	0.413** (0.173)	0.541*** (0.112)
Whether repeated grades in primary school	-0.585*** (0.157)	-0.571*** (0.142)	-0.524*** (0.145)	-0.502*** (0.155)	-0.341** (0.152)	-0.619** (0.251)
Parents' highest level of education (Ref=no or primary education)	0.803*** (0.287)	0.742*** (0.286)	0.709** (0.287)	0.687** (0.280)	1.155*** (0.426)	0.557* (0.338)
Junior high		-0.473 (0.292)	-0.452* (0.272)	-0.437 (0.273)	-0.982** (0.434)	0.118 (0.334)
Senior high		-0.726* (0.389)	-0.666* (0.384)	-0.624* (0.378)	-0.684* (0.394)	-0.419 (0.608)
college		-1.398* (0.824)	-1.292 (0.836)	-1.147 (0.838)	-0.485 (1.105)	-
<b>Economic status of students' family (ref=moderate)</b>						
Poor		-0.125 (0.212)	-0.136 (0.210)	-0.177 (0.203)	-0.233 (0.355)	-0.149 (0.253)
Rich		-0.536 (0.765)	-0.526 (0.755)	-0.564 (0.714)	-0.887 (0.726)	-0.751 (0.970)
Number of siblings		0.312*** (0.0791)	0.286*** (0.0867)	0.536*** (0.128)	0.678*** (0.226)	0.457** (0.183)
Live with Grandparent(s)			-0.238 (0.290)	-0.189 (0.287)	0.157 (0.468)	-0.512 (0.400)
Parental engagement score			-0.197 (0.144)	-0.178 (0.137)	-0.176 (0.172)	-0.166 (0.222)
Average hours spent on housework(daily)			0.0791** (0.0318)	0.0806*** (0.0308)	0.0954 (0.0613)	0.0594 (0.0502)
Student live on campus			-0.174 (0.257)	-0.197 (0.286)	-0.513 (0.409)	0.123 (0.365)
<b>School-level Characteristics</b>						
<b>School Type (ref=public school)</b>						
Migrant school				2.835*** (0.663)	4.275*** (1.625)	1.896** (0.900)



Private school				1.043 (0.643)	0.924 (0.758)	1.097 (0.691)
<b>School Rank (ref= Above average)</b>						
Medium and below				-0.326 (0.560)	-0.898 (0.777)	-0.409 (0.679)
Among the best				-0.341 (0.672)	-0.355 (0.801)	-0.648 (0.787)
<b>Number of facilities available</b>				-0.277*** (0.107)	-0.204 (0.126)	-0.313** (0.134)
<b>Number of student misconduct in the school (weekly)</b>				0.0459 (0.145)	0.100 (0.175)	0.0732 (0.147)
Intraclass correlation	0.35	0.34	0.34	0.21	0.12	0.27
Observations	8831	8831	8831	8831	3997	3843

<sup>a</sup> No Children dropped out among urban children who migrate within the province in the full sample, so there is no coefficient estimated for the interaction of hukou and intraprovincial migrants. 299 observations from this category are dropped from the analysis.

<sup>b</sup> no one dropped out among girls who migrate across provinces, so there is no coefficient presented for the category of "interprovincial migrants" for the female model (Model 5F). 157 observations are dropped from this analysis.

<sup>c</sup> no one dropped out among boys whose parents are college-graduates, so there is no coefficient presented for the category of "college" for the male model (Model 5M). 834 observations are dropped from the analysis.

Standard errors in parentheses.\*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**Table 5: Estimated Average "Treatment" Effect of Migration on Adolescents' Cognitive Abilities and Dropout Probability among the Treated\***

Outcomes	7th Grade Standardized Cognitive Test Score		8th Grade Standardized Cognitive Test Score		Probability of Dropout by 8th Grade	
	Rural	Urban	Rural	Urban	Rural	Urban
<b>Children's Migration Status</b>						
Non-migrant with both parents around vs completely left-behind	0.049	.248***	-0.031	0.030	-.017**	-.012**
Left-behind with one parent around vs completely left-behind	0.085*	.106	-0.044	0.003	-0.018*	.014
Children migrate with parents vs completely left-behind	0.083	.126	-0.025	0.000	-.028***	-.010*
Potential outcome mean of completely left-behind	-0.239	-0.131	0.136	0.296	0.037	0.019

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

\* The average treatment effect for the treated (ATET) refers to the average effect of receiving treatment (eg, children migrate with parents) compared to being in control (completely left-behind), among those individuals that actually received treatment (eg, children migrate with parents).

## Appendix 1: Items used to construct factor score of parental engagement

Input Item (all items measured based on an ordinal scale of 1-3)	Scoring coefficient
<b>Parental monitoring and supervision</b>	
<i>Question: Do your parents care and are they strict with you about the following?</i>	
homework and examination	0.053
Your behavior at school	0.057
Attendances at school everyday	0.055
Time when you get home everyday	0.054
Whom you make friends with	0.053
Your dress style	0.048
Time you spend on the Internet	0.046
Time you spend on watching TV	0.052
<b>Parent-child communication</b>	
<i>Question: How often do your parents discuss the following with you?</i>	
Things happened at school-mother	0.082
Things happened at school-father	0.086
The relationship between you and your friends-mother	0.088
The relationship between you and your friends-father	0.101
The relationship between you and your teachers-mother	0.102
The relationship between you and your teachers-father	0.109
Your feelings-mother	0.114
Your feelings-father	0.119
Your worries and troubles-mother	0.112
Your worries and troubles-father	0.121
<b>Parental participation in extracurricular activities</b>	
<i>Question: How often do you do the following with your parents?</i>	
Reading	0.068
Playing sports	0.068
Visiting museums, zoos, science museums	0.073
Going out to watch movies, shows, sports	0.080

**Appendix 2: Mixed-effects Models Predicting Wave 1 (7th Grade) Standardized Cognitive Test Score**

	Full Sample					Female	Male
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 4F	Model 4M
<b>Individual and Household-level characteristics</b>							
Rural hukou (ref=urban hukou)	-0.0767*** (0.0253)	-0.0437* (0.0241)	-0.0442* (0.0234)	-0.0467** (0.0233)	-0.0444* (0.0235)	-0.0602* (0.0350)	-0.0383 (0.0332)
<b>Parent and child's migration Status (Ref=urban local with both parent)</b>							
Left-behind with one parent around	-0.0978* (0.0509)	-0.0905* (0.0506)	-0.0835* (0.0503)	-0.0848* (0.0503)	-0.0846* (0.0504)	-0.126 (0.0823)	-0.0607 (0.0598)
Completely left-behind	-0.183*** (0.0667)	-0.164** (0.0650)	-0.196*** (0.0653)	-0.200*** (0.0659)	-0.199*** (0.0659)	-0.206** (0.0799)	-0.199** (0.0910)
Intraprovincial migrant	-0.0268 (0.0531)	-0.0163 (0.0538)	-0.0136 (0.0538)	-0.0143 (0.0538)	-0.0163 (0.0541)	-0.0271 (0.0733)	-0.00733 (0.0710)
Interprovincial migrant	-0.0622 (0.0423)	-0.0399 (0.0417)	-0.0335 (0.0407)	-0.0377 (0.0408)	-0.0370 (0.0411)	-0.0627 (0.0647)	-0.00197 (0.0582)
<b>Interactions of hukou type and migration statuses</b>							
Left-behind with one parent around * Rural hukou	0.0985* (0.0586)	0.0954* (0.0577)	0.0991* (0.0579)	0.100* (0.0579)	0.100* (0.0580)	0.122 (0.0915)	0.0837 (0.0753)
Complete left-behind * Rural hukou	0.154** (0.0746)	0.131* (0.0735)	0.143* (0.0727)	0.146** (0.0730)	0.147** (0.0732)	0.0863 (0.0846)	0.189* (0.106)
Intraprovincial migrant * Rural hukou	-0.00760 (0.0742)	-0.00923 (0.0737)	-0.00682 (0.0738)	-0.00476 (0.0738)	-0.00599 (0.0735)	0.0108 (0.105)	-0.00354 (0.0971)
Interprovincial migrant * Rural hukou	0.153*** (0.0494)	0.143*** (0.0492)	0.145*** (0.0485)	0.146*** (0.0482)	0.144*** (0.0484)	0.180*** (0.0646)	0.113 (0.0755)
<b>Male</b>	-0.000145 (0.0177)	-0.00173 (0.0177)	-0.00173 (0.0174)	0.000519 (0.0174)	0.000621 (0.0174)		
<b>Age (Centered to Mean=13)</b>	-0.131*** (0.0143)	-0.124*** (0.0144)	-0.114*** (0.0142)	-0.115*** (0.0143)	-0.113*** (0.0143)	-0.142*** (0.0182)	-0.0863*** (0.0188)
<b>Whether repeated grades in primary school</b>	-0.109*** (0.0278)	-0.101*** (0.0273)	-0.0894*** (0.0268)	-0.0894*** (0.0268)	-0.0882*** (0.0267)	-0.0813** (0.0321)	-0.114*** (0.0350)
<b>Parents' highest level of education (Ref=no or primary education)</b>							
Junior high		0.0644* (0.0334)	0.0457 (0.0334)	0.0464 (0.0332)	0.0454 (0.0334)	0.0704* (0.0398)	0.0203 (0.0537)
Senior high		0.0853** (0.0379)	0.0555 (0.0380)	0.0576 (0.0378)	0.0551 (0.0379)	0.0863** (0.0406)	0.0340 (0.0601)
college		0.192*** (0.0444)	0.158*** (0.0442)	0.163*** (0.0440)	0.157*** (0.0444)	0.208*** (0.0553)	0.117* (0.0640)
<b>Economic status of students' family (ref=moderate)</b>							
Poor		-0.0524** (0.0228)	-0.0381* (0.0226)	-0.0395* (0.0227)	-0.0375* (0.0227)	-0.00894 (0.0344)	-0.0627** (0.0308)
Rich		-0.0413 (0.0421)	-0.0396 (0.0413)	-0.0409 (0.0413)	-0.0417 (0.0412)	-0.135** (0.0591)	0.0310 (0.0486)
Number of siblings		-0.0206 (0.0127)	-0.0117 (0.0123)	0.00370 (0.0157)	0.00485 (0.0157)	-0.0130 (0.0202)	0.00349 (0.0202)
<b>Live with Grandparent(s)</b>			0.0698*** (0.0179)	0.0703*** (0.0179)	0.0702*** (0.0180)	0.0616** (0.0254)	0.0691** (0.0269)
<b>Parental engagement score</b>			0.0465*** (0.00928)	0.0469*** (0.00931)	0.0461*** (0.00933)	0.0486*** (0.0136)	0.0463*** (0.0123)
<b>Average hours spent on housework (daily)</b>			-0.0538*** (0.00533)	-0.0542*** (0.00529)	-0.0539*** (0.00534)	-0.0607*** (0.00754)	-0.0507*** (0.00694)
<b>Student live on campus</b>			0.0292 (0.0342)	0.0277 (0.0346)	0.0315 (0.0349)	-0.00253 (0.0418)	0.0388 (0.0474)
<b>School-level Characteristics</b>							
<b>School Type (ref=public school)</b>							
Migrant school				-0.369* (0.204)	-0.176* (0.0979)	-0.229*** (0.0816)	-0.139 (0.112)
Private school				-0.0590 (0.161)	-0.146 (0.157)	-0.0529 (0.135)	-0.197 (0.174)
<b>School Rank (ref= above average)</b>							
Medium and below					-0.128 (0.0792)	-0.114 (0.0738)	-0.130 (0.0862)
Among the best					0.276*** (0.0851)	0.217*** (0.0795)	0.318*** (0.0931)
<b>Number of facilities available</b>					0.0380**	0.0377*	0.0403*

<b>Number of student misconduct in the school (weekly)</b>					(0.0187)	(0.0204)	(0.0219)
					-0.0377*	-0.0252	-0.0422*
					(0.0223)	(0.0204)	(0.0247)
Constant	0.078	-0.00489	0.0367	0.0349	-0.221	-0.209	-0.228
Intraclass correlation	0.22	0.20	0.18	0.18	0.15	0.12	0.17
Observations	9130	9130	9130	9130	9130	4289	4841

Standard errors in parentheses.\*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

### Appendix 3: Logistic Regression (Odds Ratio) Predicting Enrollment in Migrant School among Migrant Students

	Model 1	Model 2
<b>Rural hukou (ref=urban hukou)</b>	2.615*** (0.934)	1.932* (0.710)
<b>Parent and child's migration Status (Ref=Intraprovincial migrant)</b>		
Interprovincial migrant	0.616 (0.254)	0.613 (0.263)
<b>Interaction of Hukou and Migration Type</b>		
Interprovincial migrant * Rural hukou	1.075 (0.512)	1.094 (0.533)
<b>Male</b>	0.963 (0.219)	0.917 (0.214)
<b>Whether repeated grades in primary school</b>	1.299 (0.323)	1.168 (0.296)
<b>Parents' highest level of education (Ref=no or primary education)</b>		
Junior high		0.948 (0.317)
Senior high		0.665 (0.261)
college		0.0277*** (0.0293)
<b>Economic status of students' family before children started primary school (ref=moderate)*</b>		
Poor		1.191 (0.329)
<b>Observations</b>	1656	1555

\*No students in rich households are enrolled in migrant school. 101 observations are dropped from Model 2.

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

#### Appendix 4: Multinomial Logistic Regression (Odds Ratio) Predicting Migration Status of Children\*

	Model 1 (Rural)			Model 2 (Urban)		
	Chid is a non-migrant with non-migrant parents	Chid is left-behind with one migrant parent	Chid migrate with migrant parents	Chid is a non-migrant with non-migrant parents	Chid is left-behind with one migrant parent	Chid migrate with migrant parents
<b>Male</b>	1.001 (0.104)	1.382** (0.187)	1.318* (0.193)	0.789 (0.132)	1.074 (0.232)	0.926 (0.189)
<b>Age (Centered to Mean=13)</b>	0.888* (0.0565)	0.797*** (0.0690)	1.097 (0.0958)	0.956 (0.101)	0.748** (0.101)	0.967 (0.132)
<b>Mother' s highest level of education (Ref=no or primary education)</b>						
junior high	1.375*** (0.162)	1.052 (0.159)	1.109 (0.186)	1.799*** (0.372)	0.925 (0.256)	1.854** (0.520)
senior high	1.101 (0.198)	0.949 (0.219)	0.714 (0.177)	2.003** (0.577)	1.195 (0.434)	1.719 (0.641)
college	1.500 (0.789)	0.873 (0.584)	1.213 (0.818)	4.631*** (1.892)	3.339** (1.690)	4.645*** (2.298)
<b>Father' s highest level of education (Ref=no or primary education)</b>						
Junior high	0.981 (0.126)	1.068 (0.182)	1.120 (0.220)	0.556** (0.144)	0.853 (0.282)	0.496** (0.165)
Senior high	0.952 (0.170)	1.515* (0.346)	1.277 (0.316)	0.959 (0.303)	1.036 (0.410)	0.794 (0.306)
college	2.532* (1.324)	2.062 (1.285)	5.872*** (3.634)	1.605 (0.669)	1.226 (0.652)	1.087 (0.540)
<b>Economic status of students' family before children started primary school (ref=poor)</b>						
Moderate	1.191 (0.151)	0.871 (0.138)	4.646*** (1.123)	1.196 (0.285)	0.594* (0.164)	1.662 (0.581)
Rich	1.589* (0.434)	0.591 (0.232)	7.959*** (3.069)	0.927 (0.334)	0.375** (0.170)	1.966 (0.914)
<b>Attended kindergraten before primary school</b>	1.121 (0.130)	0.973 (0.145)	1.449** (0.256)	0.919 (0.197)	0.731 (0.185)	1.347 (0.379)
<b>Whether repreated grades in primary school</b>	0.661*** (0.0794)	1.184 (0.184)	0.660** (0.116)	0.838 (0.184)	1.722** (0.467)	0.837 (0.249)
<b>Number of siblings (ref=only child)</b>						
one sibling	0.753** (0.102)	0.881 (0.154)	0.671** (0.119)	0.442*** (0.0982)	0.472*** (0.134)	0.675 (0.181)
two or more siblings	0.640*** (0.108)	0.910 (0.196)	0.740 (0.171)	0.282*** (0.0791)	0.605 (0.204)	0.450** (0.159)
<b>Constant</b>	4.114*** (0.840)	0.784 (0.211)	0.110*** (0.0369)	10.57*** (4.275)	2.729** (1.316)	0.636 (0.322)
<b>Observations</b>	4,775	4,775	4,775	4,044	4,044	4,044

\*Base cateogry is children completely left-behind.

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1