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The impact of parental migration on children's school performance in rural China[☆]

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ABSTRACT

A substantial proportion of China's rapid economic growth is attributed to its large number of rural to urban migrants, but most of these migrants' children are left behind in rural areas, mainly due to China's household registration system. Any attempt to identify the impact of parental migration on children's school performance may encounter the problem of endogeneity. We use unique survey data from more than 7600 4th and 5th grade students from 74 rural elementary schools. Using an instrumental variable estimation, our results indicated that having migrant parents can marginally reduce a child's math score rank by 15.60%, which implies that the current economic growth in China partially jeopardizes the future of the next rural generation. Based on a bivariate probit model, the results show that compared to neither parents being migrants, migration of the father reduces the rank of a child's math score by 8.37%, and migration of the mother reduces the rank by 23.30%.

1. Introduction

A substantial proportion of China's rapid economic growth is attributed to the exodus of a massive number of hard working rural people to urban areas. According to the National Bureau of Statistics of China (NBSC, 2012), there were more than 200 million emigrants in 2011, which is double the figure from a decade ago (Taylor & Martin, 2001). Migration, which is tightly linked to labor productivity growth, is a significant contributor to rapid economic growth rates and long run national welfare (De Haan, 2000; Glauben, Herzfeld, & Wang, 2008; Taylor & Martin, 2001; Tian & Yu, 2012; Wang, Herzfeld, & Glauben, 2007, Wang, Huang, Zhang, & Rozelle, 2011).

Under constraints from institutional arrangements, such as the Household Registration System (*hukou*), in China, rural migrant families who live in cities benefit little from the available human resource service programs that fund education and health. One example of these families' problems is that their children cannot be enrolled in urban public schools without them having to pay

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more than the parents of the children who have urban *hukou* have to pay, and they usually cannot afford this cost (Lai et al., 2009). The latest research indicates that migrant students who are unable to enroll in public schools perform significantly worse than their more fortunate counterparts (Chen & Feng, 2013). Although there are a number of private and for profit schools that the children of rural to urban migrants can attend in some cities, the high tuition of these schools is accompanied by poor facilities and under-qualified, demotivated teachers. Furthermore, most of these schools, which are not certified by the government, run the risk of being shut down. Thus, in most cases, these families' school aged children are left behind in villages when the parents move to the city for work (Wu et al., 2004). According to the census that was conducted in 2005, 58 million children, accounting for 21.7% of the 0–17 age cohort of children, were left in villages by their migratory parents (NBSC, 2005). The Sixth National Population Census indicated that this number increased again from 3 million to 61 million in 2010, which represents 37.7% of rural children (NBSC, 2011). At the compulsory education stage (elementary and junior high school), the number of children who are left behind is 22.7 million (MOE, 2011).

The consequences of rural to urban migration are described in the recent literature and have been amplified, given the increased trend. There are many articles on the impact of parental migration on left-behind children in the context of international migration. There are two types of effects: positive and negative.

First, migration not only imparts significant benefits to individuals through higher returns for working capability, but also has strong and transformative impacts on the rural families and the communities from which the migrants come (Ellis, 2003). The results from many empirical studies in different countries show that a mixture of individualistic and familial motives explains the impact of remittances on children's schooling (Kuhn, 2006, in Bangladesh; Amuedo-Dorantes & Pozo, 2010, in the Dominican Republic; Calero, Bedi, & Sparrow, 2009, in Ecuador; Edwards & Ureta, 2003, in El Salvador; Yang, 2008, in the Philippines; Alcaraz, Chiquiar, & Salcedo, 2012, in Mexico; Antman, 2012, in Mexico; Lu & Treiman, 2011, in South Africa). According to these researches, migrants can increase their own level of economic livelihood, and these families can, thus, invest more in certain aspects of their children's education. For example, Antman (2012) estimated the causal effect of parental migration on children's educational attainment by looking within the family to measure variation in siblings' ages at the time of parental migration. She found a statistically significant positive effect of parental U.S. migration on educational attainment for girls and found that the absence of fathers does not play a major role in determining children's educational outcomes. Instead, the results suggested that the marginal dollars from U.S. migrant remittances appear to enable families to be able to further educate their daughters.

Second, parents' migration, which is usually undertaken without the consent of their children, can be expected to lead to various inconsistencies in children's school performance. Parental migration could result in a lack of adult labor in the home, and the left-behind children have to perform household works, which may lead the children to complete less total schooling than children in non-migrant families (McKenzie & Rapoport, 2007, in Mexico) or may restrict their access to school households (McKenzie & Rapoport, 2011 in Mexico; Mansuri, 2006 in Pakistan). McKenzie and Rapoport examined the impact of migration on educational attainment in rural Mexico. By employing historical state migration rates as instruments, they found evidence of a significant negative effect of migration on school attendance and attainment. Furthermore, the absence of a parent results in the loss of parental attention and supervision over the children, which leads to poorer school performance. Particularly, the absence of a parent may negatively affect the left-behind children's psychological wellbeing and, thus, lead to academic, behavioral, and emotional problems (Lahaie, Hayes, Piper, & Heymann, 2009, in Mexico). This conclusion is consistent with the findings of the study by Spera (2005), which suggested that parental involvement and monitoring are robust predictors of children's academic achievement.

In the case of China, the empirical result of the effect of parental migration on the educational outcomes of left-behind children is also mixed. Liang and Chen (2007) indicated that temporary parental migration into cities or suburban areas in the Guangdong province significantly decreased children's school enrollment rate due to the absence of parental fiduciary. Many migrants leave their children with grandparents in the village. However, studies have found that the children are usually looked after by poorly-educated grandparents who are unable to substitute the roles of the parents (Biao, 2007). Grandparents may either spoil the children or fail to provide enough emotional care (Wang, Zhang, Sun, & Zhang, 2006; Zhang et al., 2007). Further, living with grandparents is often negatively correlated with certain health outcomes (Gao et al., 2010). Other studies, including the ones by Lee (2011), Meyerhoefer and Chen (2011) and Wen and Lin (2012), found that children whose parents had migrated were worse off in terms of school enrollment and years of schooling than children whose parents had not migrated.

In contrast, migrants remit a large share of their income, and the amount of these remittances is responsive to the needs of other family members (Du, Park, & Wang, 2005; Taylor, Rozelle, & De Brauw, 2003). Thus, migrants can invest more in certain aspects of their children's education, such as tutoring, computer assisted learning and other academic resources that effectively improve the children's intellectual performance (Lai et al., 2009; Li, Han, Rozelle, & Zhang, 2010). Chen, Huang, Rozelle, Shi, and Zhang (2009) studied left-behind children in the Shaanxi Province in China, and they did not find evidence that parental migration affected school performance (average Chinese and math test scores) negatively. They actually found that having a migrant father improved the left-behind children's school performance. However, these results, as noted by the authors of the paper, might not be robust.

The main hurdle in conducting ideal research on this topic is the problem of endogeneity. Omitted variables that are correlated both with migration and children's outcomes may cause problems, but endogeneity can also result from the possible reverse causalities between children's school performance and parental migration. Rather than there being a possible negative impact of parental migration on children's school performance, it could be that parents alter their decision to migrate to improve their children's school performance.

In summary, this study examines whether the effect of parental migration on children's school performance is positive or negative, identifies whether the migration decision is exogenous, and determines whether there are differences in the impact of a migrating mother versus a migrating father on school performance. By using a bivariate probit model, this study proposes instrumental variable (IV) estimations to answer these questions. The study is based on unique survey data that were obtained from a sample of 7648 4th and 5th grade pupils in the rural areas of the Ningxia Autonomous Region and the Qinghai province in northwest China.

The rest of the paper is organized as follows: We first introduce the survey methods and present the data descriptions. We then provide the econometric models and identification strategies, which are followed by the estimation results and discussion. Finally, we conclude by summarizing the findings and offering policy implications.

2. Survey region and data

The survey that was used was conducted in October 2009, and the sample included 7648 4th and 5th grade pupils from 74 rural primary schools in 10 counties in the Ningxia Autonomous Region and the Qinghai Province. Fig. 1 maps the location of each school. The two regions are located in northwestern China and have distinct geographic features. Ningxia contains many arid, dry deserts, while Qinghai has a massive mountain range that surrounds the Tibetan Plateau. According to official statistics (NBSC, 2010a), per capita incomes of rural households in Ningxia and Qinghai are 21.4% and 35.1% lower than the national average level, respectively, due to their disadvantaged geographic locations. Additionally, a fair amount of the population in both provinces belongs to ethnic minorities. For instance, 46.3% of the population in the Qinghai province are Tibetan and Hui, and 36% in the Ningxia autonomous region are of Hui ethnicity (NBSC, 2010a).

By using an income stratified sampling method, we randomly selected 31 towns from each province, according to the local per capita gross value of industrial output (GVIO) (Rozelle, 1996). In each township, only the schools that taught 4th and 5th grade classes and enrolled more than 400 students were selected for this project. In total, 74 schools (38 in Qinghai and 36 in Ningxia) were involved in our project, and 7648 students in the 4th and 5th grades were selected. Our sample indicates that 4115 students have at least one migratory parent, which accounts for 53.80% of the sample. Furthermore, within this group, 1089 students have two migratory parents, which imply that parental migration is highly prevalent in both provinces.

We conducted three different surveys, which included a survey on schools, a survey on teachers, and a survey on students and their families. Each survey team consisted of six members, with one member conducting the surveys on school information, which included the principal's information and information about school facilities. Two members personally interviewed all of the 4th and 5th grade teachers to gather information about them, including their educational background and teaching experience. The remaining three members administered a survey that included a standardized math test and collected students' characteristics. Furthermore, students also took questionnaires home to their adult family members to collect information about their parents, such as migratory status, educational level, and age. For those students whose parents were migrants, the survey form was completed by relatives who took care of the students.

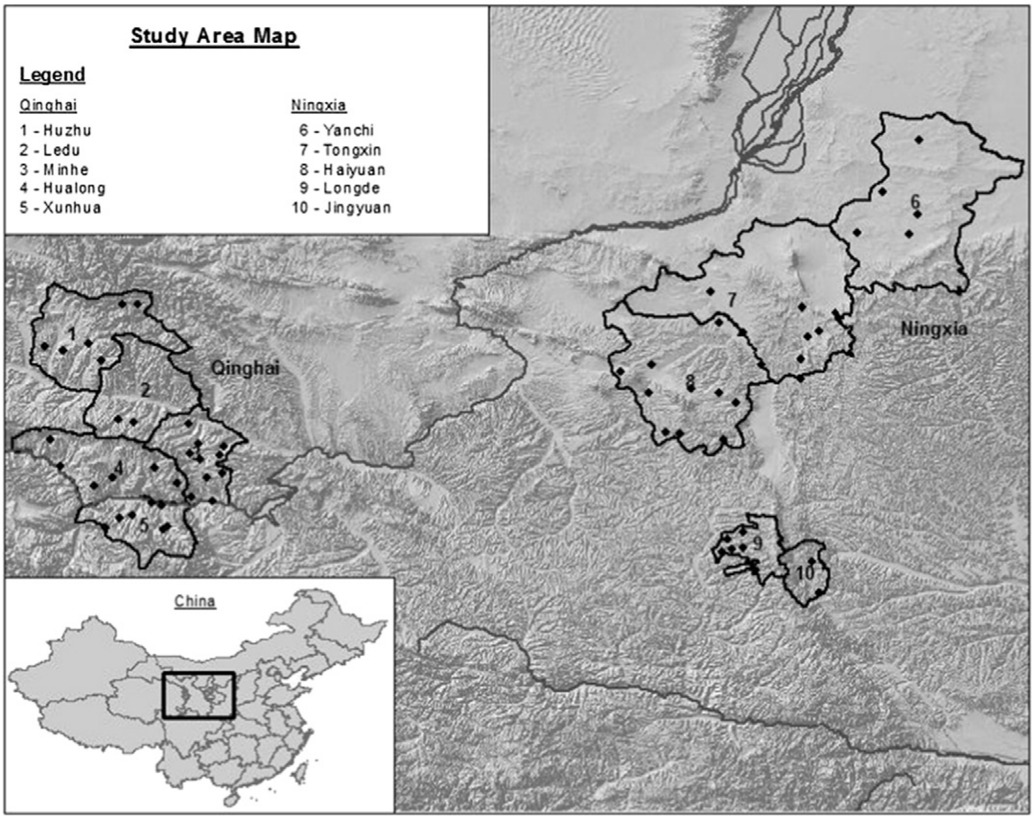

Fig. 1. Location of sampled schools.

In addition to collecting the students' personal characteristics, we also recorded their scores on a standardized math test. The math test was based on questions, which were drawn from a pool of questions that were originally created for the Trends in International Mathematics and Science Study (TIMSS). There are many ways to measure school performance, but most studies prefer to use test scores for math and language (Alderman, Orazem, & Paterno, 2001; Chen et al., 2009). In Chinese elementary schools, Chinese language and math are the main courses, but we only use standardized math test scores to measure school performance in this study because Chinese language tests might not be comparable across ethnic minorities. Certain ethnic minorities, such as Tibetan students, only began studying the Chinese language in the 3rd grade. After obtaining the math test scores, we calculated the percentile of each student's score within his/her grade for comparison purposes. The percentile rank is widely used as an indicator of school performance in the current literature (Gould, Lavy, & Paserman, 2004; Kuhn & Weinberger, 2005; Lipscomb, 2007). This rank identifies whether the test taker performs better or worse than their counterparts, but it does not indicate whether the test taker knows more or less material than is necessary for a given purpose. This operation is able to make students' school performances for different subjects, different grades and classes, different periods, or different cohorts comparable.

Table 1 presents the definition and descriptive statistics from the variables, and it tabulates the samples with and without migratory parents separately. The variables not only include student characteristics, such as gender, grade, and family/parental information, but also include the background of their math teachers and the school's information, which will be detailed in the next section. The results from the t tests indicate statistically significant differences for most of the variables (except for grade, the distance from home to school, the number of siblings and the father's education in families both with and without migrant parents).

3. Statistical methods

3.1. Basic model

There are many difficulties that impede the identification of the effect of parental migration on children's school performance (Antman, 2012; Chen et al., 2009). The sample's selection plays an obstructive role. In a study on the urban Guangdong province of China, Liang and Chen (2007) found that temporary parental migration can significantly decrease a child's school enrollment rate. However, it is possible that a sample selectivity bias may occur in this study because students who are performing poorly may drop out of school earlier. Liang and Chen's (2007) samples were collected from urban areas, and the students who were contained in the samples were from different grades, ranging from 1st grade in elementary schools to senior students in middle schools. China has enforced a policy of nine years of compulsory education since 1986, with few drop outs occurring in elementary schools (NPCSC, 2006). Drop outs from elementary schools (younger than 13 years old) are too young to work in the labor market. The graduation rates of the elementary school in Qinghai and in Ningxia were 99.9% and 97.7% in 2009, while the average graduation rates in our sample counties were 98.6% and 95.5%, respectively, which are slightly lower than the provincial level (NBSC, 2010b, 2010c). We can presume that sample selectivity is not a substantial problem in this particular study.

We specify the econometric model as follows:

$$y_i = \alpha_i + \beta M_i + \gamma X_i + u_i \tag{1}$$

Table 1
Definitions and descriptive statistics of variables.
Source: Authors' own survey.

Variables	Description	Migration = 1		Migration = 0		P value of the t test
		Mean	Std. dev.	Mean	Std. dev.	
Math score	Dependent variable; standard math tests, 29 questions for 4th grade and 20 questions for 5th grade. Percentile rank used.	0.50	0.28	0.51	0.29	0.0218**
Grade	Dummy; 0 = 4th grade; 1 = 5th grade	0.51	0.50	0.52	0.50	0.2848
Gender	Dummy; 0 = female; 1 = male	0.50	0.50	0.53	0.50	0.0003***
Ethnic	Dummy; 0 = ethnic groups, such as Hui and Tibetan; 1 = Han	0.64	0.48	0.65	0.48	0.6953
Siblings	The number of siblings	2.40	1.26	2.49	1.32	0.0010***
Distance	The distance from home to school (km)	6.26	12.16	6.27	11.20	0.9830
Asset	Principal components analysis used to get the proxy of household durable assets	−0.03	1.82	0.04	1.98	0.1315
edu_father	The educational years of father	6.43	3.73	6.55	3.84	0.1582
edu_mother	The educational years of mother	3.59	3.89	3.86	4.01	0.0031**
age_father	The age of father	37.98	4.85	38.61	5.47	0.0001***
age_mother	The age of mother	35.49	4.33	36.00	4.76	0.0001***
Diploma	The educational years of math teacher	15.00	0.89	14.94	0.90	0.0055***
Teaching year	Math teacher's experience, which is measured by teaching years	13.01	9.72	13.03	9.80	0.9604
Library	Dummy; 1 = have library in school; 0 = no library	0.41	0.49	0.37	0.48	0.0009***
Computer room	Dummy; 1 = have computer room in school; 0 = no computer room	0.54	0.50	0.55	0.50	0.5408
Migration	Dummy; 0 = both parents at home; 1 = either father or mother migrant, or both migrants					

*** Indicate significance level of 1%.
** Indicate significance level of 5%.
* Indicate significance level of 10%.

where y denotes the percentile rank of the standardized math test score, and M is a dummy variable that denotes whether there is a migratory parent for this student or not. Specifically, if either the father or the mother is a migrant, then M is 1 (including if both of the parents are migrants). Otherwise, M is 0. The coefficient β is the coefficient for migration, in which we are interested, and measures the marginal impact of parental migration on children's school performance. The vector X is a vector of exogenous control variables, such as grade, gender, ethnicity, number of siblings, distance from home to school, both parents' educational levels, and both parents' age, and γ is the related coefficient vector. The coefficient α is the intercept, and u is a random error that exists in a normal distribution. Here, i represents each of the observations.

Furthermore, we also control for the unobservable heterogeneities from the dimensions of classes, schools and counties. Between classes, we add the educational background and the teaching year of the math teacher, which are the proxy variables for the quality of the teacher. At the school level, two dummy variables are included that represent a school's facilities (whether the school has a library or a computer room or not), which are believed to be related to students' performance (Lai et al., 2009). Finally, county dummies are added to capture the invariant factors that differ between counties. Thus, Eq. (1) is extended to the following form:

$$y_{ijk} = \alpha_0 + \beta M_{ijk} + yX_{ijk} + \delta T_{jk} + \eta S_k + \lambda C + u_{ijk} \tag{2}$$

where i denotes student, j denotes class, and k denotes school. Compared to Eq. (1), we include T as the educational year and the teaching year of the math teacher and S as the dummy of whether a school has a library or computer room. The county effect is captured by λ, and once again, u is a random error that exists in a normal distribution.

3.2. Extended model

Zhu (2002) found that the urban to rural income gap is larger for women than for men, which suggests that women receive larger monetary returns from migration than men do. Due to this, the proportion of female migrant workers keeps increasing. According to "2011 China Development Report", by the end of 2010, the proportion of migrant women was 34.9%. The third survey of Chinese women's social status in 2010 reported that this proportion is 14.7% higher than it was a decade ago. We should note that recent evidence demonstrates that more women are not only migrating, but also migrating after getting married (Connelly, Roberts, & Zheng, 2011), which means that more migrant women left their children behind. It is possible that the absence of the mother may require the child to undertake more extra household chores, which has been shown to have a negative effect on the child's school performance. For example, from a survey conducted in 2006 in Sri Lanka, researchers found that children of migrant mothers had poorer attendance and performance than the children of non-working mothers (Save the Children, 2006). Thus, one can speculate that the roles of the mother and the father might be different in such a relationship.

Therefore, we test the hypothesis of whether and to what extent differences exist regarding the school performance of children in families where the father migrates and in families where the mother migrates. In our survey, the proportion of students who only experienced father migration accounted for 49.62%, with 18.42% only experiencing mother migration, and 14.24% experiencing the migration of both parents. We included two dummy variables to represent the migratory status of the father and the mother of a family.

Eq. (2), thus, can be further extended into:

$$y_{ijk} = \alpha_0 + \beta_1 Fa_{ijk} + \beta_2 Mo_{ijk} + \gamma X_{ijk} + \delta T_{jk} + \eta S_k + \lambda C + u_{ijk} \tag{3}$$

where migratory status of the parents is separately denoted by two dummy variables, Fa and Mo, which denote father migration and mother migration, respectively. Specifically, if both parents are migrants, both dummies equal 1; if only the father is a migrant, Fa equals 1, and Mo equals 0, and vice versa; if neither of the parents are migrants, both values equal 0. Coefficients β_1 and β_2 are the coefficients for parental migration, and they measure the marginal impacts of migration status on children's school performance for the father's and mother's migration statuses, respectively.

3.3. Endogeneity and identity strategy

If reverse causality exists between parents' migration decisions and the students' school performance in Eqs. (2) and (3), which would lead to a problem of endogeneity, the OLS estimations would not be consistent. An instrumental variable estimation should be used to address this problem. To identify the impact of parental migration on children's school performance, we propose using the cluster effect of parents' migration across school as the instrument for migration (Benjamin, 1992; Ji, Yu, & Zhong, 2012).

The cluster-effect instruments that are used regarding the parental migration decision include the average migration probability of the neighboring parents of this student. Here, "neighboring" is defined as parents of all of the other children who are studying at the same school. This term is valid (instrumental validity) as a proxy for the local migration situation and satisfies the following restrictions: On the one hand, current studies show that the network that is established by neighbors plays a significant role in facilitating migration employment (Zhao, 2000, 2003). On the other hand, the migration status of neighborhood children's parents is presumed to not directly affect the child's school performance. Instrumental validity significantly hinges on the robustness of the results.

However, there are two endogeneity variables in Eq. (3) that require at least two instrumental variables for identification. The study by Huffman and Lange (1989) suggested that the off farm employment decision of the husband and wife is a simultaneous decision, and thus, the probabilities of migration for the mother and the father can be estimated by a bivariate probit model based on whether the residuals of the two decisions are allowed to be correlated. We proposed two steps for estimating Eq. (3): Step 1 will construct instruments for the mother's and father's migration decisions from the predicted results of the bivariate probit model. Step 2 will estimate Eq. (3) with these instruments.

The bivariate probit estimation estimates the following two equations simultaneously:

$$P_{Fa} = P_r\left(\alpha_{Fa} + \gamma_{Fa}X + \pi_{Fa}Z^{Fa}\right) \tag{4.a}$$

Table 2
Estimation results of migrants' effect on students' math scores.
Source: Authors' own survey.

Independent variables	Dependent variable: percent of math score		
	(1) OLS	(2) Adjusted OLS	(3) IV
Migration	−0.0125*	−0.0077	−0.156***
	(1.96)	(1.28)	(3.21)
Student characteristics			
Grade (1 = 5th grade; 0 = 4th grade)	−0.0067	−0.0060	−0.0081
	(1.05)	(1.00)	(1.30)
Gender (1 = male; 0 = female)	0.0299***	0.0294***	0.0248***
	(4.67)	(4.90)	(3.87)
Ethnic (1 = non-Han; 0 = Han)	−0.111***	−0.0076	−0.0113
	(15.53)	(0.94)	(1.34)
Family characteristics			
Siblings (no.)	0.0068***	−0.0016	−0.0013
	(2.61)	(0.60)	(0.50)
Distance (km)	−0.0005*	−0.0005*	−0.0004
	(1.74)	(1.79)	(1.64)
Education of father (year)	0.0041***	0.0037***	0.0035***
	(4.51)	(4.36)	(3.92)
Education of mother (year)	0.0032***	0.0013	0.0006
	(3.60)	(1.56)	(0.63)
Age of father (year)	−0.002**	−0.0014	−0.0022**
	(2.15)	(1.58)	(2.33)
Age of mother (year)	0.0022**	−0.0004	−0.0006
	(2.00)	(0.38)	(0.57)
Class and school characteristics			
Diploma (year)		0.0108**	0.0114***
		(2.57)	(2.63)
Teaching year (year)		0.0026***	0.0025***
		(6.07)	(5.62)
Library (1 = yes; 0 = no)		0.0535***	0.0562***
		(7.25)	(7.29)
Computer room (1 = yes; 0 = no)		0.0139**	0.0102
		(1.98)	(1.37)
County dummies	N	Y	Y
Constant	0.521***	0.106	0.2172**
	(17.82)	(1.43)	(2.50)
Adjusted R-square	0.0522	0.1686	0.1023
Observations	7648	7648	7648

Model diagnostics: results of hypothesis tests
1. Joint hypotheses test
H_0: the unobserved factors across counties are not correlated with the explanatory variables
$F(9,7624) = 116.3$
P-value < 0.001
2. Endogeneity test of endogenous regressors
H_0: migration can actually be treated as exogenous
Chi-sq(2) = 10.251
P-value < 0.01
3. Weak instrumental variable test
H_0: the coefficients on the instruments equal zero in the first stage of the two stage least squares test
$F(23,7624) = 15.86$
P-value < 0.001

Note: The value of t statistics is reported in parentheses. The definitions for each of the variables are available in Table 1.
*** Indicate significance level of 1%.
** Indicate significance level of 5%.
* Indicate significance level of 10%.

$$P_{Mo} = P_r\left(\alpha_{Mo} + \gamma_{Mo}X + \pi_{Mo}Z^{Mo}\right) \tag{4.b}$$

where P_r is the probability of the migration decision for the mother or the father. In the second step, the predicted migration probabilities for the mother and the father from Eqs. (4.a) and (4.b) are used as instruments to estimate Eq. (3). Given that explicitly carrying out the two-step procedure may lead to harmful mistakes (for example, the standard errors that are reported from the first stage regression will be incorrect (Wooldridge, 2010)), we use a software package (STATA13) with a 2SLS command rather than using the two-step procedure.

4. Empirical results

4.1. Model comparison

Before discussing the main results, we provide an overview of selected diagnostic tests that are reported in Table 2. First, we test the null hypotheses that the unobserved factors across counties are not significantly different in estimating the impact of migration on children's school performance. The F test statistic is F(9,7624) = 116.3 and it is statistically significant at the 1% level, which indicates that the county dummies should be included in the estimation.

Table 3
Estimation results of the difference between father and mother migrants.
Source: Authors' own survey.

Independent variables	Dependent variable: percent of math score
Father migrant	−0.0837**
	(2.04)
Mother migrant	−0.233***
	(4.01)
Student characteristics	
Grade (1 = 5th grade; 0 = 4th grade)	−0.0041
	(0.66)
Gender (1 = male; 0 = female)	0.0312***
	(4.86)
Ethnic (1 = non-Han; 0 = Han)	0.0009
	(0.10)
Family characteristics	
Siblings (no.)	−0.0012
	(0.43)
Distance (km)	−0.0003
	(1.01)
Education of father (year)	0.0031***
	(3.44)
Education of mother (year)	0.0027***
	(2.81)
Age of father (year)	−0.001
	(1.03)
Age of mother (year)	−0.0007
	(0.67)
Class and school characteristics	
Diploma (year)	0.0105**
	(2.41)
Teaching year (year)	0.0025***
	(5.51)
Library (1 = yes; 0 = no)	0.0542***
	(7.00)
Computer room (1 = yes; 0 = no)	0.0162**
	(2.18)
County dummies	Y
Constant	0.105
	(1.27)
Endogeneity test	15.122***
Cragg-Donald Wald F statistic	77.44***
Observations	7648

Note: The value of t statistics is reported in parentheses. The definitions for each of the variables are available in Table 1.
*** Indicate significance level of 1%.
** Indicate significance level of 5%.
* Indicate significance level of 10%.

The Hausman test of endogeneity for the instrumental validity model rejects the null hypothesis regarding the exogeneity of migration status at the P value less than 0.01. This implies that previous studies that did not consider the endogeneity of parental migration status did not completely evaluate student performance, which suggests that this model is the ideal model to use in future discussions.

Furthermore, even though this instrumental variable is exogenously correlated with a household's decision to migrate, validity should be tested quantitatively to verify whether the instrument is weak (Staiger & Stock, 1997). If the instrument is weak, the normal distribution provides a poor approximation of the sampling distribution of the instrument estimator, even when it contains a large sample size. The F test value of the first stage regression of Eq. (2) in Table A2 is 15.86, which is larger than the usual critical value of 10.

For Eq. (3), Table A2 reports the estimation results for the first stage of the instrumental estimation of Eq. (3). The correlation coefficient, which is reported in Table A2, is 0.46 and is significantly different from zero. Thus, bivariate probit estimations of the migrant decision equations are appropriate. The estimations of Eq. (3) are reported in Table 3.

4.2. Results discussion

The estimation results indicate that all of the coefficients are consistent with our assumptions. The most important parameter is the coefficient for the variable of migration, −0.156, which suggests that when other variables are kept constant, parental migration does have a significant negative impact on a child's school performance. The magnitude of this coefficient provides evidence that the presence of parental migration leads to a marginal decline of 15.60% in math test rankings within the sample. Even without explicitly evaluating the personal economic gains of parental migration, our results show that migration has a negative impact on the next generation's accumulation of human capital. From either an economic perspective or a human rights perspective, the Chinese government should take active measures to remove the institutional barriers between urban and rural areas. For example, the government could allow rural migrants' children to obtain the same level of education as their urban counterparts (i.e., where their parents work) and could facilitate closer supervision of children in migrant families.

Our results also indicate that the gender bias in school performance persists, which is shown by the coefficient for gender (male) being 0.0248 and statistically significant. This implies that boys perform better on math tests, which may result from discrimination towards girls, particularly in undeveloped rural areas (Klasen & Wink, 2003). The insignificance of the grade coefficient, in particular, indicates that there is no significant difference between the 4th and 5th grades for school performance on our survey. The insignificance of the siblings' coefficient indicates that there are no systematical differences for student performance between the students who had more or less siblings.

The coefficients for the educational level of the father and the mother are 0.0035 and 0.0006, respectively, and the former is statistically significant. This implies that having well educated parents can improve a child's school performance, and similar results have been found in the studies of Kochar (2004), Spera (2005) and Chen et al. (2009). One particularly interesting finding in this study is that when a father has one additional year of education, a significant increase of 0.35% in their child's math rank can be observed. As indicated by Spera (2005), increased parental practices and monitoring can have a significantly positive impact on children's school achievement.

The four dummy variables that were used to control the heterogeneities between the different classes and between the different schools are all positive and statistically significant (except for the variable of having a computer room). Specifically, when the math teacher has one additional year of education, the students' math rank increases by 1.14%, and when the teacher has an additional year of teaching experience, this increases the math rank by 0.25%. Students in a school with a library will be 5.62% higher in math rankings than those who do not have a school with a library.

We find that the coefficient for ethnicity is negative and statistically significant in the OLS estimation. However, its magnitude becomes smaller and reaches nonsignificance after adding the county dummies. This implies that the reasons for why minorities do not perform well on math tests when compared to the ethnic majority of Han pupils are not caused by inherent reasons, such as race, but rather, they are caused by geographical and social disadvantages. For example, in our sample, some counties had less minority students, such as Tongxin County, where just 12% of the schools were targeted to minorities. There, the math teachers have an average of 23.79 years of teaching experience, and 82% of schools have a library. However, 61% of schools target minorities in Minhe County, where only one third of the schools have a library, and the average level of teaching experience is only 11.27 years. In minority areas, we found relatively poor education facilities and under-qualified teachers due to the geographic and economic disadvantages. As a policy implication, it would be wise for the Chinese government to invest more heavily in the training and motivation of teachers in these areas.

Finally, Table 3 separately reports the different estimation results regarding school performance for children with a migrant father and for children with a migrant mother. The results show that math test rank was significantly lower, by 8.37% for children with a migrant father, and by 23.30% for children with a migrant mother, when children with migrant parents were compared to children without migrant parents. Other coefficients are consistent with the IV result in Table 2.

4.3. Robustness check

Thus far, the results have shown that parental migration has a significantly negative impact on children's school performance. We now consider the alternative subgroups to check the robustness of the results. The justification of the robustness that was obtained from the estimation for alternative subgroups is presented in Table 4.

We first estimate robustness by using students whose math test scores were ranked lower than 50%. The results in column (1) suggested that the coefficients were consistent with the estimation when the whole sample was used (except for the coefficients of teacher and school characteristics), which shows that for those students who do not perform well on math tests, the effect of teacher quality and school facility is smaller and even statistically insignificant.

Additionally, we further estimate robustness by only using the minority students in column (2). The result was also similar to the full sample. However, the magnitude for the coefficients of the teacher and school characteristics become larger, and all of them are statistically significant at the 1% level. This implies that for minority students, teacher ability and the quality of their school facilities contribute significantly to their performance.

We also examined whether systemic differences exist between the 4th and 5th grades and between boys and girls. Column (3) reports the result of the 4th grade, and column (4) shows the results of boys. The results show that the signs and magnitudes of all of the coefficients are consistent with the results from the full sample.

Furthermore, Brown and Park (2002) found that school performance is strongly correlated with household income. However, in this study, we are not able to record income because most households were not willing to reveal their true incomes. Following the principal components analysis that was proposed by Filmer and Pritchett (2001), we used the possession of certain rural durable assets as a proxy of household wealth. First, we asked about the household's ownership status of 21 assets, including bicycles,

Table 4
Robustness estimation results.
Source: Authors' own survey.

Independent variables	Dependent variable: percent of math score				
	(1) Percent < 50%	(2) Minority	(3) 5th grade	(4) Boys	(5) With household asset
Father migrant	−0.0587**	−0.0589	−0.159**	−0.117*	−0.0794*
	(2.01)	(1.00)	(2.48)	(1.76)	(1.93)
Mother migrant	−0.0787*	−0.222***	−0.202***	−0.195**	−0.226***
	(1.78)	(3.63)	(2.79)	(2.37)	(−3.82)
Student characteristics					
Grade (1 = 5th grade; 0 = 4th grade)	0.0076*	0.0113		−0.0092	−0.0045
	(1.68)	(1.46)		(1.02)	(−0.71)
Gender (1 = male; 0 = female)	0.0145***	0.0310***	0.0233**		0.0314***
	(3.19)	(3.82)	(2.50)		(4.91)
Ethnic (1 = non-Han; 0 = Han)	0.002		0.0068	0.0074	0.0021
	(0.34)		(0.56)	(0.57)	(0.25)
Family characteristics					
Siblings (no.)	−0.0057***	0.0012	−0.0077*	0.0018	−0.001
	(2.80)	(0.36)	(1.93)	(0.44)	(−0.35)
Distance (km)	−0.0001	−0.0003	−0.0005	−0.0005	−0.0003
	(0.62)	(0.84)	(1.24)	(1.38)	(−1.04)
Education of father (year)	0.0024***	0.0014	0.0018	0.0026**	0.0034***
	(3.57)	(1.31)	(1.32)	(2.02)	(3.74)
Education of mother (year)	0.0017**	0.001	0.0037***	0.004***	0.0031***
	(2.40)	(0.77)	(2.66)	(2.71)	(3.23)
Age of father (year)	−0.0012*	−0.0003	0.0001	0.0006	−0.0011
	(1.73)	(0.28)	(0.02)	(0.44)	(−1.09)
Age of mother (year)	0.0018**	−0.0011	0.0001	−0.0014	−0.0007
	(2.17)	(0.86)	(0.06)	(0.91)	(−0.68)
Asset (PCA index)					−0.0043**
					(−2.30)
Class and school characteristics					
Diploma (year)	−0.0011	0.0186***	0.0225***	0.0137**	0.0109**
	(0.32)	(3.40)	(3.48)	(2.24)	(2.50)
Teaching year (year)	0.0006*	0.003***	0.0037***	0.0029***	0.0025***
	(1.93)	(5.06)	(5.49)	(4.51)	(5.51)
Library (1 = yes; 0 = no)	0.002	0.0621***	0.0302***	0.0496***	0.0552***
	(0.34)	(6.29)	(2.62)	(4.56)	(7.14)
Computer room (1 = yes; 0 = no)	0.005	0.0294***	0.0152	0.0082	0.0171**
	(0.89)	(3.47)	(1.43)	(0.76)	(2.30)
County dummies	Y	Y	Y	Y	Y
Constant	0.657***	−0.0282	−0.121	0.0283	0.0990
	(10.16)	(0.29)	(0.98)	(0.24)	(1.20)
Observations	3977	4928	3684	3919	7648

Note: The value of t statistics is reported in parentheses. The definitions for each of the variables are available in Table 1.
*** Indicate significance level of 1%.
** Indicate significance level of 5%.
* Indicate significance level of 10%.

refrigerators, televisions, and cameras. If a household owned a specific asset, it was recorded as 1; otherwise, it was recorded as 0. Appendix Table A1 presents a descriptive statistic of the durable assets. Second, by using the principal components analysis, we calculated the scoring factors for 21 assets. We used the first component as the proxy of assets, following the example of Filmer and Pritchett (2001). As shown in column (5), the results remain robust. The robustness checks convince us that the results remain robust with respect to different subgroups.

5. Conclusion

China's rapid economic growth is substantially driven by the large number of migrants from rural to urban areas that are searching for work. As a result, more than 80% of the migrants' children are left behind in rural areas due to China's household registration system. The relationship between parental migration and children's school performance has received a fair amount of attention over the years because it has important policy implications for China's long term economic growth. However, many unsolved problems remain in the current literature. We address this issue by identifying the impact of parents' migration on children's school performance and by examining whether the parents' migration decision is exogenous to this impact.

By using a survey dataset that was collected in the Qinghai Province and the Ningxia autonomous region in China, which involved more than 7600 4th and 5th grade students from 74 rural elementary schools, we employed instrumental variable estimations and identified that parental rural to urban migration has a significantly negative impact on children's school performance, even though the migration decision is endogenous. This is made clear by the finding that having a migratory parent can reduce a child's math score by 15.60% in percentile rankings. Specifically, by using a bivariate probit model, we separately obtain the effects of father's and mother's migration, which are −8.37% and −23.30%, respectively. This implies that even though migration has short term financial benefits for a family, it has a significantly negative impact on children's accumulation of human capital in the long run. Further, the current economic growth in China partially sacrifices the future of the next generation of Chinese workers as a result. This disadvantage for rural to urban migrants and their children might be created by rural to urban institutional barriers. To make economic growth sustainable and improve human rights, the Chinese government should take active measures to dismantle these barriers, for instance, by abolishing the current household registration system and by creating a better learning environment for the children of migrants.

Other findings include that female students and students in ethnic minority areas do not perform well on math exams, with discrimination against girls, poor educational facilities and unqualified teachers in minority areas possibly being the main reasons. The Chinese government should implement more constructive policies to eliminate gender discrimination and increase investment in schools that are situated in minority areas in order to promote the education of female students and ethnic minorities.

Appendix A

Appendix Table A1
Descriptive statistics of durable assets and its scoring factors.
Source: Authors' own survey.

Durable assets	Ownership rate (%)	Std. dev.	Scoring factors	Scoring factors/SD[a]
1. Bicycle (tricycle)	42	0.49	0.1329	0.27
2. Electric bicycle	5	0.22	0.2096	0.95
3. Motorcycle	62	0.49	0.1227	0.25
4. Tractor	34	0.42	0.0986	0.23
5. Truck	6	0.25	0.2039	0.82
6. Car	8	0.27	0.2183	0.81
7. Phone (fixed line)	50	0.50	0.1345	0.27
8. Mobile phone	82	0.39	0.0955	0.24
9. Tape recorder	35	0.48	0.2006	0.42
10. Stereo system	16	0.37	0.2375	0.64
11. Color telephone	71	0.46	0.1159	0.25
12. VCD/DVD player	38	0.48	0.2469	0.51
13. Gas-oven	20	0.40	0.2547	0.64
14. Micro-wave oven	24	0.43	0.2605	0.61
15. Refrigerator	19	0.39	0.2846	0.73
16. Camera	10	0.30	0.2843	0.95
17. Video camera	5	0.21	0.2613	1.24
18. Computer	6	0.25	0.2660	1.06
19. Electric fan	16	0.36	0.2834	0.79
20. Air-conditioning	4	0.20	0.2386	1.19
21. Washing machine	58	0.49	0.2353	0.48

[a] All of the assets are recorded as 0 or 1, and the interpretation of the weights is that a move from 0 to 1 changes the index by f_{1i} / SD_i here. f_{1i} is calculated from scoring factors, 1 denotes the first component and i ranges from 1 to 21. SD_i is the standard deviation of each durable asset. For example, a household that owns a bicycle has an asset index higher by 0.54 than the one that does not have this item.

Appendix Table A2
Estimated results of the factors that are correlated with the migration decision.
Source: Authors' own survey.

Independent variables	Dependent variable: migration decision		
	First stage regression of Eq. (2)	First stage regression of Eq. (3)	
Migration cluster	0.8964***		
	(11.33)		
Predicted migration_father cluster		1.5299***	0.4298***
		(14.91)	(5.41)
Predicted migration_mother cluster		3.489***	4.1504***
		(8.68)	(13.34)
Grade (1 = grade 5th; 0 = grade 4th)	−0.0175	0.0005	−0.0001
	(1.55)	(0.05)	(0.01)
Gender (1 = male; 0 = female)	−0.0287**	−0.0074	−0.0090
	(2.54)	(0.65)	(1.02)
Ethnic (1 = non-Han; 0 = Han)	−0.0554**	−0.0139	−0.0147
	(3.61)	(0.88)	(1.2)
Siblings (no.)	0.0017	−0.0041	−0.0023
	(0.34)	(0.32)	(0.61)
Distance (km)	−0.0001	0.0001	0.0002
	(0.06)	(0.12)	(0.45)
Education of father (year)	−0.0019	−0.0005	−0.001
	(1.22)	(0.30)	(0.84)
Education of mother (year)	−0.0049**	−0.0026	−0.0022
	(3.07)	(1.47)	(1.60)
Age of father (year)	−0.0050***	−0.002	−0.0026*
	(3.01)	(1.17)	(1.95)
Age of mother (year)	−0.0021	0.0002	0.0007
	(1.12)	(0.12)	(0.5)
Diploma (year)	−0.0007	0.0002	0.0004
	(0.09)	(0.03)	(0.07)
Teaching year (year)	−0.0004	−0.0011	−0.001
	(0.50)	(1.29)	(1.53)
Library (1 = yes; 0 = no)	0.0099	0.0138	0.0143
	(0.71)	(0.99)	(1.33)
Computer room (1 = yes; 0 = no)	−0.018	−0.0065	−0.0075
	(1.36)	(0.48)	(0.72)
County dummies	Y	Y	Y
Constants	0.8008***	−0.0778	−0.022
	(5.75)	0.52	(0.19)
Adjusted R-square	0.0428	0.0551	0.0573
F-value, F(24,7623)	15.86		
Correlation coefficient		0.4585***	
		(20.71)	

Note: The value of t statistics is reported in parentheses. The definitions for each of the variables are available in Table 1.
*** Indicate significance level of 1%.
** Indicate significance level of 5%.
* Indicate significance level of 10%.

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