

**Parental Migration and Left-Behind Children's Cognitive and Academic
Performances**

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Introduction

Millions of children are resided in their home communities but separated from their parents as either one or both parents have migrated for work (Antia et al., 2020). These are the so-called “left behind children.” They are common in migrant-sending regions, such as Latin America, Sub-Sahara Africa, East Europe, and large parts of Asia. Researchers estimated that one-sixth of Mexican children (DeWaard et al., 2018), one-fifth of Bulgarian children, (Popova, 2018), and one-fourth of Chinese children were living apart from their migrating parents (NBS et al., 2017).

How are children faring when parents have migrated? Scholars have obtained mixed results due to the differential effects of parental migration. Consider children’s education. (Van Hook & Glick, 2020) labor migrants send remittances back home, which can fund children’s schooling as well as improve their nutritional and living conditions. The inflow of remittances, however, cannot substitute for the loss of parental care. Parental migration decreases the amount and quality of parental guidance, protection, and support. It is uncertain how these two opposing effects together shape children’s educational performance, which merits empirical investigation.

A challenge arises in when we want to assess the causality between parental migration and children’s education. Experiments can unveil causal relations, but it is unfeasible and unethical to design an experiment that randomly assigns parents to migrate without their children. Alternatively, we can infer causality from a quasi-experimental design – that is, when the cause is on par with random assignment to participants in the analysis, conditional on identification assumptions (Cunningham, 2021).

To what extent do parental migration affect the cognitive development and academic performance of left-behind children in the short term? I analyze the data from a

nationally representative two-wave panel survey. The sample includes children in both urban and rural areas. I develop a difference-in-differences design for causal inference. The dependent variables include children's cognitive test score and Chinese, mathematics, and English exam scores.

Literature Review

Theoretical Framework

Between parental migration and children's education, the mechanisms trace to two theoretical frameworks. One model, the resource generation model, holds that parental migration brings forth greater resources in the form of economic capital. Economic capital is, in Bourdieu's words, "immediately and directly convertible into money and may be institutionalized in the form of property rights" (2002, p. 16). Economic capital is transferable to human capital, which is the stock of "skills, talents, health, and expertise" in people that enhance their productivity (Botev et al., 2019; Goldin, 2016). (D. Yang, 2008) noted that a depreciation of Filipino peso increased the amount of foreign remittances, which subsequently boosted children's school enrollment and educational expenditure. In China, (Chang et al., 2019) interviewed migrant workers and their family members. Oftentimes, they found that labor migration presented the only way to sustain their children's education and livelihood.

The other theoretical model is the family disruption model. Children flourish under parental nurturing care. This term refers to the "stable environments that promote health and adequate nutrition, protect from threats, and provide opportunities for learning and responsive, emotionally supportive and developmentally enriching relationships" (Black et al., 2021, p. 1). Parental migration decreases nurturing care, thereby hindering children's developmental outcomes. The loss of nurturing care slows children's accumulation of human capital. Hong talked to a group of left behind children at a rural school (Hong & Fuller, 2019). These students expressed the utter sense of loneliness "with no advocate, no support and with no one looking out for them" (p. 13). Many of them felt indifferent to school grades, and some even longed to ditch school to pursue a free, independent life (p. 14).

Researchers obtained mixed results regarding how parental migration affects

children's education. (Botezat & Pfeiffer, 2020) studied the case of Romania and found a positive effect of parents' migration on academic grades of adolescents aged eleven to fifteen. (Wang et al., 2019) collected data from junior high school students in central China and found no effect of parental on left-behind children's achievement in mathematical test. Studying four Chinese provinces, (Brauw & Giles, 2017) showed that as ample migration opportunities appeared in villages, enrollment to senior high school decreased. (Nguyen, 2016) demonstrated that parental migration was associated with lower cognitive capabilities among Indian and Vietnamese children aged five to eight. The inconsistency can result from factors such as the left-behind children's age and gender, the migrant parent's original domicile and eventual destination, and the arrangement of which parent migrate for how long.

Parental migration immediately disrupts family structure, which in turn lowers academic performance of children. It takes longer time for parental migration to generate resources that improve children's performance at school. I propose the first hypothesis:

H_1 In the short term, parental migration negatively affect the cognitive development and academic performance of children left behind.

Researchers have studied whether the impact differ between mother absence and father absence in the context of labor migration. Xu and others (2019) adopted a fixed-effects propensity score weighting model on cross-sectional data collected from seventh and ninth graders in rural areas across China. They found that the absence of father only or both parents had "little or no association with negative outcomes" on children's academic and cognitive performances. Only-mother absence, however, showed a "strong association with negative outcomes" (p. 1646). Chen and others (2019) conducted structural equation modeling on the cross-sectional data collected from fourth to seventh graders in the countryside of one province. They found that mother migration was "negatively associated with children's social competence and academic performance," while

father migration had no direct effects on the two outcomes (pp. 860-861).

The social norms designate men as breadwinners and women as caregivers. Studies noted that in some Asian and Latin American societies, children are more likely to accept fathers' migration than mothers' (Murphy, 2022). Left behind children may even resent their migrant mothers, viewing them as transgressing on the expected care-giving roles. I propose the second hypothesis:

H_2 In the short term, mother migration negatively affect the cognitive development and academic performance of children left behind, while father migration does not show a effect.

China's Context

Three features make China a suitable case for studying left behind children. The first feature is the huge scale of internal labor migration. According to the National Bureau of Statistics, the year 2021 recorded 292.5 million in-country migrant workers (NBS, 2022). The number of left behind Chinese children reached 68.7 million in 2015 (NBS et al., 2017). The second feature is the neoliberal welfare regime. Neoliberalism extends the logic of the market to most spheres of human life. Driven by the neoliberal doctrine, the government shifts its responsibilities of social services and welfare to individuals and communities. Since China initiated pro-market reforms in the 1980s, the state has reduced its welfare provisions and passed them to individuals and families (Zhan, 2020). The third feature is the authoritarian control against citizens. According to Gu (2021), the hukou (household registration) system controls people's mobility by binding a household's public welfare access with its place of registry. One can move to another place freely but cannot change hukou freely. For a rural household member moving to the city, it takes much time and effort to apply for urban hukou status. Without an urban hukou they cannot send children to public school in the host city. Facing financial and policy constraints, many migrant laborers have to leave children in their original domiciles.

The research on China's left behind children has three major shortcomings. First, most literature focuses on children left behind in rural areas while neglecting the urban counterparts. (NBS et al., 2017) stated that the number of urban left behind children had been growing and expected that the trend would continue. The second shortcoming lies in data and sampling. Some studies draw from cross-sectional data, making it hard to infer causal relations (Jin et al., 2020; Zhou et al., 2014). Others suffer from a limited sample size of less than one thousand participants or a limited geographic coverage of one or a few towns (Jin et al., 2020; Liu et al., 2021; Shu, 2021; F. Yang et al., 2022). The third shortcoming lies in the selection and measurement of outcome. (Chang et al., 2019; Wang et al., 2019) measured students' educational performance with the test score of only one academic subject, namely mathematics. The test results of multiple subjects should be included to measure comprehensive academic achievement.

Methods

Participants

I obtained the data from the China Education Panel Survey (CEPS) (NSRC, n.d.). It is a nationally representative, school-based survey featuring junior high school students. The survey administrator is the National Survey Research Center at Renmin University of China. The research team adopted multi-stage stratified probability proportional to size sampling and administered a paper-and-pencil questionnaire to each participant. The baseline survey took place in the 2013-2014 academic year with a sample size of about twenty thousand students in the seventh and ninth grades. These students were nested in 438 classrooms of 112 schools in 28 urban districts or rural counties. The follow-up survey in the 2014-2015 academic year lost track of the ninth grade cohort and only surveyed 9449 of the seventh grade cohort. I further restricted the sample to students staying with both parents at the original domicile at the baseline survey. To deal with missing values, I adopted list-wise deletion for dependent, independent, and control variables. The final sample size amounted to 4088 .

Measurement

I explored two categories of adolescence development: cognitive and academic abilities. One key dependent variable, the student's cognitive skill, was measured by a fifteen-minute standardized test. The test covered three types of reasoning: verbal, visuospatial, and numerical. The CEPS research team calculated the raw score based on the Item Response Theory and then standardized the score with a mean of zero and standard deviation of one.

Another dependent variables concerned students' academic performance. This was measured by the total scores of mid-term exams in Chinese, mathematics, and English as provided by each school. These three subjects constitute the core parts in the senior high school entrance exam. Within one particular school, teachers of the same subject use the

same syllabus, administering the same exams during a given assessment period. Therefore, test scores for core subjects are reliable indicators of learning performance in the same school and cohort. I aligned different grading scales (full mark of 100, 120, and 150 for one subject) to the hundred-point scale. Accordingly, the total score of three subjects has a 300-point scale.

The key independent variable, the parental migration status, was identified by two items in the parent survey. In both the baseline and the follow-up surveys, parents specified the family members living in the same household at the time. I constructed four treatment dummy variables measuring migration arrangements: any parents absent, only father absent, only mother absent, and both parents absent. These arrangements are mutually exclusive. The control group consisted of parents staying with their children throughout at both the baseline and the follow-up surveys. I then removed the observations that reported parental divorce or death. These type of parental absence are irrelevant to migration.

Data analysis

I adopted R (Version 4.2.0; R Core Team, 2022) and the R-packages *papaja* (Version 0.1.0.9999; Aust & Barth, 2020), and *tinylabels* (Version 0.2.3; Barth, 2022) for all the analyses, the *fixest* package for building the econometric models (Bergé, 2018), and the *modelsummary* package for presenting the results (Arel-Bundock, 2022). I built a two-way fixed effect model in a difference-in-differences (DID) design, following Bai and colleagues' (2018; 2020) approach. The model served to analyze the educational outcome of children newly left behind by parents vis-a-vis that of children staying together with parents. I first specified an unrestricted and unadjusted model:

$$\Delta score_{i,j} = \alpha + \beta \cdot migr_i + \gamma \cdot C_1 + \lambda \cdot C_2 + \theta \cdot score_{i,j;1} + \varepsilon_{i,j}$$

For student i taking the test of type j , $\Delta score_{i,j}$ is the change in test score between baseline and follow-up surveys, $migr_i$ is the treatment dummy variable, C_1 and C_2 are respectively the classroom fixed-effects at baseline and follow-up, and $score_{i,j;1}$ is the test

score at baseline. The model is unrestricted because it does not restrict on the coefficient associated with the baseline scores. The model is unadjusted as it does not adjust for additional covariates. Theoretically, it is unnecessary to include covariates that vary over group but remain constant over time; They would cancel out in the two-way fixed effect model (Huntington-Klein, n.d.). The standard errors were clustered at the classroom level.

In addition, I present an unrestricted and adjusted DID model:

$$\Delta score_{i,j} = \alpha + \beta \cdot migr_i + \gamma \cdot C_1 + \lambda \cdot C_2 + \theta \cdot score_{i,j;1} + \zeta \cdot X_i + \varepsilon_{i,j}$$

where X_i is the vector of covariates capturing the characteristics of children, their parents, and their households. The control variables were measured in the baseline survey. This version of model lifts the restriction that covariates from the baseline survey would be associated with a coefficient that equals one.

Results

Descriptive Statistics

The table below summarizes the changes in migration status in the sample. All 4088 children were living together with parents in one household in baseline, but about fifteen percent saw at least one parent migrated during the two waves of survey. In these new migrant households, only-mother migration and only-father migration each accounted for two out of five cases. The remaining one-fifth was both-parents migration.

Table 1

Parental migration status at follow-up survey.

		N	%
Parental Migration	No	3452	84.4
	Yes	636	15.6
Parental Migration Type	Both Parents At Home	3452	84.4
	Both Parents Migrated	131	3.2
	Only Father Migrated	251	6.1
	Only Mother Migrated	254	6.2

The table below provides the summary statistics.

Table 2

The independent variables

	Mean	SD	Min	Max
migr	0.16	0.36	0.00	1.00
Cognitive score difference	0.27	0.80	-2.88	4.03
Cognitive score at wave 1	0.15	0.85	-2.03	2.33
Cognitive score at wave 2	0.42	0.78	-3.14	2.06

	Mean	SD	Min	Max
Academic exam score difference	-8.82	33.21	-207.50	166.00
Academic exam score at wave 1	213.11	49.46	19.33	297.50
Academic exam score at wave 2	204.29	55.41	0.00	293.33

Table 3*The control variables*

		N	%
migr	0	3452	84.4
	1	636	15.6
child.is.girl	0	2002	49.0
	1	2086	51.0
child.has.rural.hukou	0	2221	54.3
	1	1867	45.7
child.in.boarding.school	0	2906	71.1
	1	1182	28.9
child.is.ethnic.minority	0	3800	93.0
	1	288	7.0
child.had.skipped.grade	0	4042	98.9
	1	46	1.1
child.had.repeated.grade	0	3700	90.5
	1	388	9.5
child.went.to.preschool	0	639	15.6
	1	3449	84.4
parent.has.white.collar.job	0	3238	79.2
	1	850	20.8

		N	%
home.has.internet	0	1316	32.2
	1	2772	67.8
child.health.self.rated	Very poor	21	0.5
	Not very good	113	2.8
	Moderate	807	19.7
	Good	1383	33.8
	Very good	1764	43.2
child.educational.aspiration	Junior high school	140	3.4
	Senior high school	418	10.2
	Associate college	616	15.1
	University	1205	29.5
	Postgraduate	1709	41.8
parent.educational.level	Primary school and below	248	6.1
	Junior high school	1580	38.6
	Senior high school	1254	30.7
	Associate college	385	9.4
	University	543	13.3
	Postgraduate	78	1.9
parent.expectation.on.child	Junior high school	36	0.9
	Senior high school	257	6.3
	Associate college	426	10.4
	University	1574	38.5
	Postgraduate	1795	43.9
home.extracurricular.book	Very few	395	9.7
	Not many	414	10.1

		N	%
home.economic.resource	Some	1312	32.1
	Quite a few	1111	27.2
	A great number	856	20.9
	Very poor	115	2.8
	Somewhat poor	598	14.6
	Moderate	3124	76.4
	Somewhat rich	239	5.8
	Very rich	12	0.3

Regression Analysis

The unrestricted DID models support my hypothesis one – newly left behind adolescents are more likely to perform worse in cognitive and academic abilities than their non left behind counterparts. If a household sees any parent migrated, the child's cognitive test score and total exam grade would decrease relative to that of children whose parents stay with them, holding everything else constant. Parental migration is linked to is -0.09 SD in cognitive test score and -0.09 points in academic exam grades. Both relationships are slight in strength.

The results only partially support the hypothesis two – mother migration has a more negative effect than father migration. This holds true for academic abilities. Children from only mother migrate households are associated with -0.04 points relative to that of children whose parents stay along. The performances of children with both parents migrated or only father migrated do not show statistically significant difference from the non left behind children. Regarding cognitive abilities, the reverse is true. Children with only mother migrated do not show statistically significant difference from the non left behind children. Children with only father absent are associated with (-0.14 SD), and both

parents absent (-0.10 SD) compared to the non left behind children.

Table 4

Parental migration's effect on children's cognitive abilities

	Any Parent	Only Mother	Only Father	Both Parents
	Absent	Absent	Absent	Absent
Explanator	-0.09** (0.03)	-0.04 (0.05)	-0.14** (0.04)	-0.10 (0.06)
W1 score	-0.62*** (0.02)	-0.63*** (0.02)	-0.62*** (0.02)	-0.62*** (0.02)
Num.Obs.	4088	3706	3703	3583
R2	0.494	0.502	0.505	0.499
R2 Adj.	0.424	0.426	0.430	0.419
R2 Within	0.370	0.378	0.378	0.374
FE: clsids	X	X	X	X
FE: w2clsids	X	X	X	X

Note: $\hat{\tau}$ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Table 5

Parental migration's effect on children's academic abilities

	Any Parent	Only Mother	Only Father	Both Parents
	Absent	Absent	Absent	Absent
Explanator	-2.67* (1.26)	-5.85* (2.36)	-0.25 (1.66)	-1.13 (2.28)
W1 score	0.04 (0.02)	0.04† (0.02)	0.04† (0.02)	0.04 (0.02)

	Any Parent	Only Mother	Only Father	Both Parents
	Absent	Absent	Absent	Absent
Num.Obs.	4088	3706	3703	3583
R2	0.562	0.577	0.566	0.577
R2 Adj.	0.501	0.513	0.500	0.510
R2 Within	0.005	0.009	0.004	0.004
FE: clsids	X	X	X	X
FE: w2clsids	X	X	X	X

Note: $\hat{\tau}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The adjusted DID models produce similar results compared to the unadjusted models, with only one exception. That is, for the cognitive skills, the both-parent-absent coefficient saw a change of statistical significance level from five percent level to ten percent level.

Some predictors are strong in both models of cognitive and academic abilities. These are children's age and educational aspiration as well as parents' expectation on children. In terms of age, the older students' scores drop relatively more than younger students'. One year older in age is associated with -0.07 SD for standardized cognitive test and -1.23 points for academic exams. Parent's expectation for children completing university and children's own aspiration for finishing university are associated with higher scores. The effect sizes are 0.01 SD and 0.07 SD for standardized cognitive test, respectively; and 0.29 points and 1.82 points for academic exams, respectively.

Several predictors are strong in the model of academic grades but not in that of cognitive scores. These are children's gender and self-reported health, and the years of parental education. Girls outperform boys by 4.49 points in academic exams, but do not

show advantage in cognitive test. Students who consider themselves healthier are associated with higher scores in academic exams. Parents with more education are associated with their children's higher scores in academic exams. If the years of parental education of the best-educated among the two increase by one, it would be linked to a 0.88 points increase in the child's academic exam grade. These three predictors are not significant for cognitive outcomes.

Preschool attendance is associated with higher cognitive outcomes 0.07 SD, but its effect for academic outcomes is not significant.

Table 6

Parental migration's effect on children's cognitive abilities

	Any Parent	Only Mother	Only Father	Both Parents
	Absent	Absent	Absent	Absent
Explanator	-0.09** (0.03)	-0.04 (0.05)	-0.14*** (0.04)	-0.08 (0.06)
W1 score	-0.67*** (0.02)	-0.67*** (0.02)	-0.67*** (0.02)	-0.67*** (0.02)
child.age	-0.07*** (0.02)	-0.06** (0.02)	-0.07*** (0.02)	-0.08*** (0.02)
child.is.girl	-0.01 (0.02)	0.00 (0.02)	0.00 (0.02)	-0.01 (0.02)
child.health.self.rated	-0.02 (0.01)	-0.02 (0.01)	-0.02 (0.01)	-0.02 (0.01)
child.has.rural.hukou	-0.01 (0.02)	0.00 (0.03)	-0.01 (0.03)	0.00 (0.03)
child.number.of.sibling	-0.03 (0.02)	-0.02 (0.02)	-0.02 (0.02)	-0.02 (0.02)

	Any Parent	Only Mother	Only Father	Both Parents
	Absent	Absent	Absent	Absent
child.went.to.preschool	0.07*	0.06†	0.05†	0.07*
	(0.03)	(0.03)	(0.03)	(0.03)
child.had.skipped.grade	-0.17	-0.11	-0.20	-0.10
	(0.12)	(0.12)	(0.12)	(0.12)
child.had.repeated.grade	-0.08*	-0.11**	-0.07†	-0.06
	(0.04)	(0.04)	(0.04)	(0.04)
child.in.boarding.school	0.04	0.02	0.02	0.01
	(0.04)	(0.04)	(0.04)	(0.04)
child.educational.aspiration	0.07***	0.07***	0.07***	0.08***
	(0.01)	(0.01)	(0.01)	(0.01)
child.is.ethnic.minority	0.04	0.04	0.02	0.02
	(0.06)	(0.06)	(0.06)	(0.06)
parent.expectation.on.child	0.08***	0.09***	0.09***	0.09***
	(0.02)	(0.02)	(0.02)	(0.02)
parent.has.white.collar.job	0.01	-0.01	0.01	0.00
	(0.03)	(0.03)	(0.03)	(0.03)
parent.educational.level	0.01	0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)
home.economic.resource	-0.02	-0.01	0.00	0.00
	(0.02)	(0.02)	(0.02)	(0.02)
home.extracurricular.book	0.01	0.00	0.01	0.00
	(0.01)	(0.01)	(0.01)	(0.01)
home.has.internet	-0.01	-0.01	-0.02	-0.02
	(0.03)	(0.03)	(0.03)	(0.03)
Num.Obs.	4088	3706	3703	3583

	Any Parent	Only Mother	Only Father	Both Parents
	Absent	Absent	Absent	Absent
R2	0.525	0.533	0.537	0.530
R2 Adj.	0.458	0.459	0.464	0.452
R2 Within	0.409	0.416	0.418	0.413
FE: clsids	X	X	X	X
FE: w2clsids	X	X	X	X

Note: $\hat{\tau}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7

Parental migration's effect on children's academic abilities

	Any Parent	Only Mother	Only Father	Both Parents
	Absent	Absent	Absent	Absent
Explanator	-2.65*	-5.87**	-0.20	-0.92
	(1.25)	(2.24)	(1.68)	(2.35)
W1 score	-0.01	-0.01	0.00	-0.01
	(0.02)	(0.03)	(0.02)	(0.02)
child.age	-1.23†	-1.04	-1.21†	-0.96
	(0.65)	(0.68)	(0.70)	(0.70)
child.is.girl	4.49***	4.78***	4.54***	4.43***
	(0.92)	(0.95)	(0.92)	(0.97)
child.health.self.rated	1.05*	1.12*	0.92*	0.85†
	(0.43)	(0.45)	(0.47)	(0.47)
child.has.rural.hukou	1.08	1.50	0.80	0.98
	(1.02)	(1.06)	(1.05)	(1.07)
child.number.of.sibling	1.03†	0.87	1.21*	0.66

	Any Parent	Only Mother	Only Father	Both Parents
	Absent	Absent	Absent	Absent
	(0.58)	(0.59)	(0.60)	(0.62)
child.went.to.preschool	1.65	2.22†	0.85	1.97
	(1.20)	(1.24)	(1.28)	(1.27)
child.had.skipped.grade	-0.73	0.23	-0.98	1.01
	(4.82)	(4.82)	(5.41)	(5.07)
child.had.repeated.grade	-1.81	-1.22	-1.55	-0.20
	(1.85)	(1.98)	(1.89)	(1.81)
child.in.boarding.school	-1.14	-0.19	-0.72	-1.19
	(1.65)	(1.65)	(1.66)	(1.81)
child.educational.aspiration	1.82***	2.08***	1.90***	1.91***
	(0.52)	(0.55)	(0.51)	(0.53)
child.is.ethnic.minority	0.48	-0.24	-0.33	-1.14
	(2.15)	(2.29)	(2.38)	(2.56)
parent.expectation.on.child	0.88†	0.85	0.86	0.96†
	(0.53)	(0.55)	(0.54)	(0.55)
parent.has.white.collar.job	0.29	0.03	0.59	0.42
	(1.19)	(1.23)	(1.21)	(1.25)
parent.educational.level	1.02†	1.14*	1.14*	1.15*
	(0.53)	(0.53)	(0.54)	(0.56)
home.economic.resource	-0.74	-0.18	-0.66	-0.24
	(0.81)	(0.88)	(0.87)	(0.87)
home.extracurricular.book	-0.78†	-1.18*	-0.86†	-0.85†
	(0.45)	(0.46)	(0.45)	(0.46)
home.has.internet	-1.41	-1.65	-1.33	-1.37
	(1.13)	(1.14)	(1.18)	(1.17)

	Any Parent	Only Mother	Only Father	Both Parents
	Absent	Absent	Absent	Absent
Num.Obs.	4088	3706	3703	3583
R2	0.573	0.590	0.578	0.588
R2 Adj.	0.512	0.525	0.512	0.520
R2 Within	0.032	0.039	0.032	0.030
FE: clsids	X	X	X	X
FE: w2clsids	X	X	X	X

Note: $\hat{\tau}$ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Matching

Researchers noted that migrants represent a positively selected group compared to non-migrants (Van Hook & Glick, 2020). One technique to tackle the selectivity issue is matching. This method works by pairing a unit in the treatment group with one or several units in the control group based on observable covariates. Popular choices include coarsened exact matching (CEM) (Waldman, 2022), nearest-neighbor propensity score matching (PSM) (H. Xu & Xie, 2015), and nearest-neighbor Mahalanobis distance matching (MDM) (Guo et al., 2021). CEM is superior in achieving balance as it optimizes the entire joint distribution of covariates. The downside is that it leaves many units without an exact match and discards these unmatched units. The nearest-neighbor matching examines all the treated units and selects the closest eligible control unit to be paired. The eligibility as the “closest” can be determined with the differences in Mahalanobis distance or in propensity score. Propensity score denotes the probability of receiving treatment based on the specified covariates. Nearest-neighbor PSM does not try to optimize any condition as each pairing ignores how other units will be or have been paired. This matching method may result in more “imbalance, model dependence, and

bias” on highly balanced data (King & Nielsen, 2019).

I conducted matching with all the covariates used in the adjusted DID model. I first attempted CEM, which left most units unmatched and resulted in a tiny sample. Then I combined exact matching (based on the student’s county of residence) and nearest neighbor PSM (based on the other covariates), which is the configuration of Bai and others (2018). Exact matching based on county of residence preserves the original geographic distribution. The propensity score was estimated using a logistic regression of the treatment on the covariates. The matching ratio was set at one treatment unit with up to three control units.

Alike are the results with matching and those without. In the models of cognitive abilities, I obtained negative, statistically significant coefficients on the treatment variables in the any parent migrated household and only father migrated households. In the models of academic abilities, the treatment variables’ coefficients are negative and statistically significant in the any parent migrated households and only mother migrated households. The magnitudes of the coefficients are also similar.

Table 8

Parental migration’s effect on children’s cognitive abilities

	Any Parent	Only Mother	Only Father	Both Parents
	Absent	Absent	Absent	Absent
Explanator	-0.09** (0.03)	-0.05 (0.06)	-0.13* (0.06)	-0.05 (0.11)
W1 score	-0.61*** (0.03)	-0.65*** (0.04)	-0.60*** (0.04)	-0.63*** (0.06)
Num.Obs.	1958	913	897	475
R2	0.528	0.627	0.638	0.646
R2 Adj.	0.375	0.313	0.320	-0.312
R2 Within	0.363	0.407	0.372	0.351

	Any Parent	Only Mother	Only Father	Both Parents
	Absent	Absent	Absent	Absent
FE: clsids	X	X	X	X
FE:	X	X	X	X
w2clsids				

Note: $\hat{\hat{}} \dagger p < 0.1$, $* p < 0.05$, $** p < 0.01$, $*** p < 0.001$

Table 9

Parental migration's effect on children's academic abilities

	Any Parent	Only Mother	Only Father	Both Parents
	Absent	Absent	Absent	Absent
Explanator	-2.65 \dagger	-5.34*	-2.42	-2.45
	(1.47)	(2.67)	(2.56)	(3.96)
W1 score	0.03	0.08 \dagger	0.05	0.03
	(0.03)	(0.04)	(0.04)	(0.06)
Num.Obs.	1958	913	897	475
R2	0.590	0.682	0.637	0.706
R2 Adj.	0.457	0.413	0.319	-0.087
R2 Within	0.006	0.026	0.008	0.005
FE: clsids	X	X	X	X
FE:	X	X	X	X
w2clsids				

Note: $\hat{\hat{}} \dagger p < 0.1$, $* p < 0.05$, $** p < 0.01$, $*** p < 0.001$

Table 10*Parental migration's effect on children's cognitive abilities*

	Any Parent	Only Mother	Only Father	Both Parents
	Absent	Absent	Absent	Absent
Explanator	-0.09** (0.03)	-0.04 (0.06)	-0.15* (0.06)	-0.08 (0.11)
W1 score	-0.67*** (0.03)	-0.67*** (0.04)	-0.67*** (0.04)	-0.69*** (0.06)
child.age	-0.08* (0.03)	-0.02 (0.05)	-0.03 (0.04)	-0.15 (0.10)
child.is.girl	0.02 (0.03)	0.01 (0.05)	0.05 (0.06)	-0.06 (0.10)
child.health.self.rated	0.00 (0.02)	-0.03 (0.03)	-0.02 (0.03)	-0.07 (0.06)
child.has.rural.hukou	0.01 (0.04)	-0.07 (0.07)	0.06 (0.07)	0.04 (0.12)
child.number.of.sibling	-0.07* (0.03)	-0.09* (0.04)	-0.05 (0.04)	-0.10 (0.07)
child.went.to.preschool	0.04 (0.04)	0.08 (0.08)	0.03 (0.06)	0.30* (0.12)
child.had.skipped.grade	-0.08 (0.16)	-0.13 (0.24)	-0.37† (0.19)	0.34 (0.45)
child.had.repeated.grade	-0.08 (0.06)	-0.26* (0.11)	-0.02 (0.11)	0.05 (0.16)
child.in.boarding.school	0.09 (0.07)	0.15 (0.12)	-0.10 (0.11)	-0.02 (0.20)
child.educational.aspiration	0.07***	0.03	0.10**	0.10†

	Any Parent	Only Mother	Only Father	Both Parents
	Absent	Absent	Absent	Absent
	(0.02)	(0.03)	(0.03)	(0.05)
child.is.ethnic.minority	-0.01	0.01	-0.20	0.39
	(0.09)	(0.10)	(0.23)	(0.44)
parent.expectation.on.child	0.07**	0.08†	0.06†	0.01
	(0.03)	(0.05)	(0.03)	(0.06)
parent.has.white.collar.job	0.02	-0.10†	0.03	-0.15
	(0.05)	(0.05)	(0.08)	(0.16)
parent.educational.level	0.01	0.03	0.00	-0.08
	(0.02)	(0.03)	(0.03)	(0.06)
home.economic.resource	-0.05	0.00	0.02	0.05
	(0.03)	(0.05)	(0.05)	(0.08)
home.extracurricular.book	0.01	0.01	0.02	0.01
	(0.02)	(0.03)	(0.03)	(0.05)
home.has.internet	-0.05	-0.07	-0.06	0.05
	(0.04)	(0.08)	(0.07)	(0.11)
Num.Obs.	1958	913	897	475
R2	0.562	0.653	0.672	0.691
R2 Adj.	0.413	0.337	0.361	-0.318
R2 Within	0.409	0.447	0.431	0.435
FE: clsids	X	X	X	X
FE: w2clsids	X	X	X	X

Note: ^† p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Table 11*Parental migration's effect on children's academic abilities*

	Any Parent	Only Mother	Only Father	Both Parents
	Absent	Absent	Absent	Absent
Explanator	-2.91† (1.48)	-5.90* (2.64)	-2.68 (2.56)	-2.94 (4.21)
W1 score	-0.01 (0.03)	0.01 (0.04)	0.00 (0.05)	-0.03 (0.06)
child.age	-0.61 (1.21)	1.45 (2.00)	2.59 (1.99)	-2.15 (3.48)
child.is.girl	4.51** (1.43)	4.40† (2.57)	6.58** (2.41)	3.76 (4.21)
child.health.self.rated	0.71 (0.69)	2.30 (1.42)	1.13 (1.15)	2.38 (2.27)
child.has.rural.hukou	0.85 (1.70)	-0.13 (3.10)	-1.10 (2.97)	-2.75 (4.45)
child.number.of.sibling	1.20 (1.06)	1.92† (1.06)	1.00 (1.61)	-2.50 (2.69)
child.went.to.preschool	1.75 (1.76)	-0.30 (2.47)	-2.26 (2.57)	6.39 (5.13)
child.had.skipped.grade	2.29 (6.62)	-9.76 (11.90)	3.12 (12.03)	32.64 (29.40)
child.had.repeated.grade	-6.07† (3.18)	-13.55† (7.61)	-13.33** (4.86)	-0.09 (5.92)
child.in.boarding.school	-0.64 (3.53)	-0.65 (5.38)	-3.42 (4.25)	-3.10 (8.17)
child.educational.aspiration	1.48†	1.63	0.37	0.44

	Any Parent	Only Mother	Only Father	Both Parents
	Absent	Absent	Absent	Absent
	(0.86)	(1.06)	(1.20)	(1.92)
child.is.ethnic.minority	3.81	4.84	2.79	-2.54
	(4.31)	(4.68)	(6.53)	(7.64)
parent.expectation.on.child	0.19	1.71	1.41	3.97
	(0.83)	(1.49)	(1.35)	(2.49)
parent.has.white.collar.job	-0.85	0.54	2.13	-1.42
	(1.82)	(2.56)	(2.87)	(6.14)
parent.educational.level	1.30	2.30**	1.91	-2.63
	(0.97)	(0.85)	(1.41)	(2.54)
home.economic.resource	-0.23	-1.90	-0.51	-0.54
	(1.23)	(2.24)	(1.81)	(4.05)
home.extracurricular.book	-0.66	-0.66	-1.59	0.08
	(0.71)	(1.24)	(1.01)	(1.93)
home.has.internet	-2.89	-1.61	0.08	3.67
	(1.81)	(2.87)	(3.26)	(4.98)
Num.Obs.	1958	913	897	475
R2	0.603	0.702	0.660	0.731
R2 Adj.	0.468	0.431	0.337	-0.150
R2 Within	0.037	0.088	0.070	0.087
FE: clsids	X	X	X	X
FE: w2clsids	X	X	X	X

Note: ^ ^ † p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Discussion

Results show that parental migration is negatively associated with children's short-term cognitive and academic abilities.

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