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Effect of parental migration on the noncognitive abilities of left-behind school-going children in rural China

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This paper explores the question of whether parental migration is a significant source of human capital development or whether it is harmful to non-cognitive ability development. In light of this, a research question was raised: what is the effect of different statuses of parental migration on the non-cognitive abilities of left-behind children in rural China? To answer this research question, the study uses the China Education Panel Survey (CEPS) data wave-I and employs the Propensity Score Matching (PSM) method. The findings revealed that the decision of one or both parents to migrate hurts the non-cognitive abilities of the left-behind school-going children. The results imply that parental migration of one or both parents in rural China is detrimental to the non-cognitive abilities of the left-behind children (LBCs). Therefore, parents should stay or move with their children instead of leaving them with relatives or grandparents. Furthermore, the government must concentrate on removing obstacles to education, especially for migrants, by undertaking initiatives like expanding the number of schools for LBCs and waiving tuition fees. Moreover, the government needs to take action to improve the lives of LBCs and find solutions to their problems. Lastly, the authorities need to promote economic change to create a more balanced economy.

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Introduction

Migration between countries, regions and rural to urban areas is a significant way to enhance employment prospects (e.g., Malamud and Wozniak, 2012; Grogger and Hanson, 2011). China has experienced significant rural-to-urban migration in recent years. The National Bureau of Statistics (NBS) of China conducted a nationally representative rural household survey, which revealed that 118 million people left the countryside in 2004 and 137 million left the countryside in 2007 (NBS, 2009). In 2003, it was estimated that rural migrants made up 21% of the rural labor force and that 43% of rural residents lived in homes where at least one migrant was present (World Bank, 2009). In China's thriving coastal regions, where off-farm employment is in high demand, rapid industrialization and urbanization are being sped up by mass migration; <10% of migrant workers in China bring their families with them (World Bank, 2009).

As people migrate from the agricultural sector, which has a low marginal output of labor, they move toward urban, industrial, and service sectors, with a low marginal output of labor. This massive rural-to-urban migration can help reduce rural poverty and improve the economic efficiency of the Chinese economy. The well-being of the children of the migrant population is also significantly impacted by high labor intensity. Therefore, migration frequently involves a family separation between migrating parents and children left behind. The detrimental effects of prolonged parental absence from a child's life may outweigh the benefits of higher household income frequently associated with immigration. In addition, concerns about the abuse of children who are left behind in rural China have been voiced by numerous commentators (see Chen et al., 2009; Ma et al., 2020). Families affected by internal or external migration worldwide should pay equal attention to this issue (Brantl et al. 2021).

Recent economic research has revealed that non-cognitive skills can be broadly categorized as personality traits or patterns of thinking, emotion, and behavior. However, the particular skill sets mentioned vary depending on the field of study. For instance, the "Big Five" categories of openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism are used by psychologists to categorize non-cognitive skills (Heckman et al., 2006; Bernstein et al., 2007; Borghans et al., 2008). In addition, non-cognitive abilities that are directly connected to academic success are frequently the focus of educators. For example, the Chicago Schools Research Consortium at the University of Chicago found that academic behavior (such as participation in class and attendance), academic perseverance (such as persistence and self-discipline), academic mentality (such as belonging to the world and believing that competence can be improved through effort), and learning strategies (such as meta-cognition) are the non-cognitive skills most strongly associated with academic performance (Farrington et al., 2012). Thus, a broad category of abilities known as non-cognitive skills includes a wide range of abilities, including affective (such as "growth mindset") and behavioral traits (such as regular attendance at school). Hence this study examines the effects of different parental migration statuses on the non-cognitive abilities of left-behind school-going children in rural China.

Parental migration for employment can be an effective means of increasing income and lowering unemployment in a nation. Children who stay at home may also experience positive or negative effects from immigration. On the one hand, parents frequently obtain higher-paying employment abroad, enabling them to give their kids access to more financial and educational resources and fostering social and developmental growth. On the other hand, a child's development, including non-cognitive skills, can suffer from the absence of a primary caregiver.

The phenomenon of LBCs has drawn more attention in the literature. As a result, researchers have thoroughly examined how children's academic performance is affected by the "left behind" status brought on by parents' immigration, for example, (Chang et al., 2019; Bai et al., 2019; Chen et al., 2009; McKenzie and Rapoport, 2011; Xu, 2018; Zhang et al., 2014), educational outcomes (Wang et al., 2014), physical health (Murphy et al., 2016; Yu et al., 2014) and mental health (Chang et al. 2019; Gao, 2010; Zhou et al., 2005). However, due to a lack of reliable data, research on how parental migration affects the non-cognitive development of children who are left behind is still in its infancy. Furthermore, we need to learn more about the underlying mechanisms that parental migration has on a child's development. Very few studies have looked at the effects of parental migration on the non-cognitive skills of left-behind children, including different personality traits frequently thought to be significant factors for success in life, such as persistence and motivation.

Furthermore, children lose their adult role models and experience parental absence early. This situation has a more negative effect on children's upbringing and can cause irreversible damage to the attachment between children and parents. It is almost impossible to disentangle these effects because of the extensive challenges involved in separating them due to the upsurge in income on the one hand and the impact of parental absence on the other (Zhou, 2016; Keijer, 2021; Fu et al., 2022). Parental absence has been shown to cause some displacement, changes, and interruptions in family arrangements meant to facilitate caregiving (Lam and Yeoh, 2019). Despite its original purpose, that migration is intended to improve the parents' financial status. In return, this will trickle down to boost the development of the children; parental migration still results in numerous challenges affecting the development and psychological well-being of the children (Rashmi et al., 2022; Zhao, 2017). In most cases, children experiencing parental absence are more likely to score low on their non-cognitive abilities and possibly other aspects of their life.

Some researchers concluded that parental migration caused a significant decline in left-behind children's development; others hypothesized that more resources aided better outcomes, and others concluded that there was no discernible impact. However, empirical research on parental absence and non-cognitive abilities is currently in its infancy. It still needs to catch up despite the importance of non-cognitive abilities as a source of human capital development. Therefore, the non-cognitive abilities of children, especially those in the rural areas whose parents migrated, may be negatively affected, primarily because extensive research has established the disadvantages of LBCs in human capital development. Furthermore, evidence on non-cognitive abilities needs to be more extensive, particularly in identifying causal impacts. Though several studies have been conducted to understand better the negative consequences of parental migration on LBCs from a variety of angles, including Zhao and Chen (2022), Lee and Park (2010), Wu and Zhang (2017), Zhao et al. (2018), Hanchen and Xi (2019), Liu et al. (2021), Yuna (2014), and Nguyen et al. (2019). In the context of China, research tends to have largely ignored the parental gender aspects of the migrating parent. However, for parental migration and sound policy perspectives, research on the possible dissimilar impacts of paternal and maternal impacts on non-cognitive development of children is still scarce.

Moreover, from existing studies, empirical studies on the effect of parental migration on children's non-cognitive abilities in China are limited in the aspect of concentrating on rural areas where migration mainly occurs, and specifically on school-going

children who are the potential source of the future labor force. However, the findings of some of the existing studies are not likely reliable because of the quality of the methodologies used; if not, the majority of the existing studies on such a relationship need to be revised, considering the nature of the data used in the analysis. In addition, most studies ignored the discussion of empirical causal effects in the relationship. Additionally, a potential problem that could arise in empirical research on the topic of Chinese left-behind school-going children is that prior research is needed to have control in terms of sampling selection biases, which could lead to inconsistent estimates and a likely misleading conclusion. Still, many related studies are limited to cross-section data, which will inevitably cause endogenous problems such as sampling selection bias and missing values. As a result, more research is required to determine how different parental migration statuses affect children's non-cognitive abilities.

However, a number of studies have been conducted on such relations. Then, how does this study extend or contribute to the existing studies? The contribution of this paper is as follows. First, the paper contributes to the existing literature by examining the effect of different parental migration statuses on the non-cognitive abilities of the left-behind school-going children in rural China based on three faces, i.e., different parental migration statuses where only the father migrated, only the mother migrated, and both parents migrated. Second, as an alternative to using different indicators of non-cognitive development of children within the analyses, this paper considers comparatively comprehensive non-cognitive indices to quantify the non-cognitive abilities, i.e., the children's emotional stability, agreeableness, and conscientiousness, which are the representation of the "Big Five personality traits" in the China Education Panel Survey (CEPS). Third, the abundance of information in the CEPS data provides fertile ground for determining the potential mechanisms via which parental migration affects the non-cognitive capacities of LBCs. The unique context of the data enables us to fully comprehend how parental migration affects the human capital accumulation of LBCs in rural China, particularly non-cognitive abilities, in collaboration with other control variables that could help to estimate the relationship accurately. Fourth, to the best of the author's knowledge, this is one of the few studies, if not the first, that applies the propensity score matching (PSM) technique to such relationships, and the reason for choosing it out of the other alternative techniques that can estimate such relations is that it accounts for the possible endogeneity issues in the survey data. This technique could mitigate the sample selection bias issues associated with cross-sectional data.

Thus, the key aim of this paper is to investigate the impact of parental migration on the non-cognitive abilities of left-behind school-going children in rural China with different statuses of parental migration; namely, where only fathers migrate, only mothers migrate, and both parents migrate.

The rest of the paper is designed as follows: Section "Literature review" discusses the related theoretical and empirical literature reviews; section "Methodology" deliberates on the methodology used; section "Results" presents the findings obtained from the empirical analyses; section "Discussion of the results" discusses the results; and section "Conclusion and policy recommendations" concludes the paper.

Literature review

Theoretical review. Following the theory of human capital, economists started recognizing other types of ability, such as the non-cognitive ability for human capital development. Non-

cognitive abilities are equally or even more significant than cognitive features in the educational process and for employment prospects, according to education researchers (Hull and Norris, 2020). Non-cognitive characteristics are frequently emphasized when discussing the personal attributes required to perform appropriately in the 21st century. In recent years, initiatives have been increasing to examine the impact of non-cognitive elements on academic performance. There are numerous phraseological collocations for the concept of 'non-cognitive'. Constructs, qualities, talents, abilities, variables, outcomes, attributes, and predictors have widely used collocations. A plethora of other particular skills have also been classified as non-cognitive. Among those typically mentioned in the literature are grit, tenacity, curiosity, attitudes, self-concept, self-efficacy, anxiety, coping mechanisms, motivation, perseverance, and confidence. Non-cognitive variables are sometimes considered multidimensional. Some people refer to them as affective domain soft skills and personal qualities for forming human capital (Heckman et al., 2006; Khine and Aarepattamannil, 2016). However, the idea of non-cognitive abilities arises as economic practitioners and researchers dig down on how they will be used and how they can contribute to economic development. This includes working in groups, maintaining good interpersonal relationships and a positive attitude, impulse control, and exhibiting acceptable behaviors to everyone in the working area. This may generate a high rate of productivity. Economist James Heckman pointed out the importance of these skills, originally called "non-cognitive" skills, for economic development in 2006 (Kautz et al., 2014). In addition, there is growing evidence that non-cognitive skills affecting individuals' economic and social outcomes (Bütikofer and Peri, 2017; Hull and Norris, 2020).

On the other hand, in forming human capital, many factors need to be considered in producing high-quality and equipped individuals, including the presence and guidance of parents. To support this idea, many works of literature (Johnson and Turner, 2003; Mohler, 2002; Björklund and Salvanes, 2011) explained the family's role in developing their children to become the human capital of an economy. Furthermore, some theoretical models state that the family has chosen to accelerate their children's growth preparation to become human capital. Using the ideas established by Heckman and co-author, followed by Currie and Almond (2011), who explained it by using a detailed model of how family decisions affect the growth of their children's non-cognitive abilities, develop a large body of analysis, and provided some forms of evidence (Björklund and Salvanes, 2011).

Empirical evidence. Much prior empirical research explored the relationship between parental migration and various issues such as children's educational attainment, health outcomes, cognitive and non-cognitive abilities, and the development of children in China's context. According to Tong et al. (2015), children who are left behind suffer from more mental illnesses and psychological issues than kids who live with their parents. Zhang et al. (2014) discovered that children who were left behind had significantly lower learning and contemporary achievement due to the absence of their migrant parents. The impact of missing just one parent, though, was minimal. Parental immigration, according to Meng and Yamauchi (2015), has a significant negative impact on children's educational and health outcomes. According to research by Biavaschi et al. (2015), the presence of older siblings, particularly older sisters, can partially offset the negative effects of parental immigration on children's educational achievement. On the other hand, some scholars believe that the absence of parental companionship and discipline will have a negative impact on the academic and psychosocial development

of children who are left behind. In addition, studies in Albania and Mexico have revealed that parental labor migration significantly lowers the enrollment and graduation rates of children who are left behind (Giannelli and Mangiavacchi, 2010; McKenzie and Rapoport, 2011). It may even result in emotional and behavioral issues like resentment, low self-esteem, depression, or school violence. Lee and Park (2010) researched the impact of parental migration on child development in China, utilizing non-cognitive skills in terms of data gathered from the first and second-wave surveys in 2000 and 2004, respectively, and found that the migration of fathers harms boys' and girls' psychosocial wellbeing. Yuna (2014) investigated the impact of parental labor migration on the non-cognitive development of children left behind in China by using the Propensity Scores Matching (PSM) technique and selecting 6150 youngsters from 2008 surveys on primary schooling in western districts. According to the findings, parental relocation improves the self-esteem of left-behind children, which leads to emotional and behavioral difficulties in boys. Wu and Zhang (2017) used a random sampling technique to select 3600 students from second to fifth grade from 38 primary schools in Longhui City, a county in Hunan Province, to estimate the effect of parental absence on child development in rural China. The survey was conducted twice, specifically in 2012 and 2013. Using fixed-effects estimates, it was discovered that children's non-cognitive development was primarily negatively impacted by parental absence during early childhood development. Zhao et al. (2018) used the ordinary least squares (OLS) method to perform a study on China's migrants and left-behind children (LBCs): the connection of parental migration on non-cognitive abilities using a sample of 9824 students. The findings reveal that parental relocation is inversely connected to left-behind children's non-cognitive performance. On the other hand, rural children whose mothers migrate out of the province are disproportionately affected. Hanchen and Xi (2019) used survey data from the first wave (2000) and the second wave (2004) surveys to investigate how parents react to diversity in non-cognitive skills in their families in the regional rural province of China. The method utilized is a Fixed Effects model, and the results show that parental migration has a considerable detrimental impact on children's non-cognitive development. Nguyen et al. (2019) used the commutative value-added regression (CVAR) model and the Oaxaca-Blinder decomposition approach (OBD) to compare the non-cognitive abilities of Asian immigrants' children and those of Australian-born parents to examine the non-cognitive development of children and adolescents. They discovered that Asian immigrant children performed well in almost all non-cognitive abilities. Based on survey data, Liu et al. (2021) used ordinary least squares (OLS) to analyze the effect of parental absence on the non-cognitive skills of left-behind children in Northwest China. Due to the fact that mothers are frequently the primary caregivers, which makes the environment less environmentally friendly, they discovered that maternal migration was particularly harmful to children's non-cognitive development. Long-term results showed that LBCs with immigrant mothers had higher levels of neuroticism and lower levels of perseverance (or lower levels of emotional stability). However, in the short term, conscientiousness, agreeableness, and openness were lower in children of migrant mothers. Ao et al. (2021) investigated the effect of grandparental care on Chinese children's non-cognitive skills using data from the China Family Panel Studies (CFPS) by employing the 2-stage least squares (2SLS) estimation and found that children in the care of their grandparents have a more external Locus of Control than do children in the care of their parents. Zhao and Chen (2022) studied 4636 rural students in grades seven and nine from 2643 middle schools to explore the underlying mechanisms and determine the causal

link between parental migration and non-cognitive decline in children who are left behind. An endogenous treatment effect model with instrumental variables (IV) was used to identify causal relationships by building a composite index measuring children's non-cognitive abilities based on the China Education Panel Survey (CEPS) in the 2013–2014 academic year. With regard to the Big Five personality model, the findings demonstrated that rural left-behind children's non-cognitive abilities are significantly impaired by parental absence.

Going off the reviewed literature, there are numerous studies that have concentrated on the impact of parental absence on child education attainment, well-being, health status, and cognitive indicators of LBCs. The outcomes of a composite comparison of these three indices need to be better understood. In addition, these studies examined the traits of rural LBCs and contrasted them with children who were not left behind. However, there are few empirical studies on the impact of parental migration on children's non-cognitive abilities in China that focus on rural areas, where migration occurs most frequently, particularly in school-aged children, who are a potential source for the future labor force. Furthermore, the formation of skills and personality traits is strongly influenced by environmental factors, including parental involvement during childhood and adolescence, according to research from various disciplines (Heckman et al., 2006). Similarly, to how there is only limited and narrowly focused direct evidence on parental migration and broad non-cognitive abilities, developmental psychologists' findings indicate that children's relationships with their parents and the quality of time spent with them have a significant impact on parent-child relationships, risky behaviors, interpersonal abilities, and coping mechanisms. These studies have examined various non-cognitive abilities and found somewhat conflicting results. More consideration should be given to this subject, given the wide range of non-cognitive skills. Therefore, more investigation into the impact of parental migration on non-cognitive skills, which can be assessed using more comprehensive scales, is necessary. Moreover, the quality of the methodologies used in some, if not most, of the existing studies on this relationship is insufficient, given the nature of the data used in the analysis, so the results of some of the existing studies are not likely to be reliable, or most studies avoided discussing the relationship's empirical causal effects. Besides, a potential problem that could arise in empirical research on the topic of Chinese left-behind school-going children is that prior research needed to have control in terms of sampling selection biases, which could lead to inconsistent estimates, including a likely misleading conclusion. Also, many related studies are limited to cross-section data, which will inevitably cause endogenous problems such as sampling selection bias and missing values. In contrast, such studies ignore employing techniques that can handle such weaknesses in the data. To fill such gaps, our study's primary contributions are the following. First, this paper contributes to the body of literature by examining the impact of various parental migration statuses—including only the father, only the mother, or both parents migrating—on the non-cognitive abilities of the LBCs. Second, this paper considers relatively comprehensive non-cognitive indices to quantify the non-cognitive abilities, i.e., the children's emotional stability, agreeableness, and conscientiousness, which represent the “Big Five personality traits”.

Methodology

Data. The data used in this paper is sourced from the China Education Panel Survey (CEPS), which involves a large-scale nationally representative survey of 2013/2014 (wave-1) on Grades 7 and 9 students from 31 Chinese provinces, autonomous regions

and municipalities, excluding Hong Kong, Macao, Taiwan; 28 county-level units of 112 schools comprising of a total of 438 classes and consisting of 19487 students. The final data used is only on rural students, which makes the total sample of 4102 students. Though the CEPS data has a follow-up survey in 2014/2015 (i.e., wave II), this paper decides to use the wave-I survey because the paper is not a comparison between two periods, nor a policy intervention study.

Variables measurement

The dependent variable. The dependent variable is non-cognitive abilities; to measure them, the paper uses the “Big Five personality” model. It chose to use it because the “Big Five Personality” model is currently an internationally recognized indicator for measuring non-cognitive abilities across disciplines due to its comprehensive, diverse characteristics and complex personality traits. Also, domestic academic circles have not formed a unified definition and measurement tools for non-cognitive abilities; hence, empirical researchers employed the “Big Five personality” model to measure non-cognitive abilities. Therefore, following Heckman and Kautz (2013), Costa et al. (1992), John et al. (2008), Duckworth et al. (2007), Goldberg (1990, 1992), Wen et al. (2015), Wu and Zhang (2017), Lee and Park (2010), Yuna (2014), Zhao et al. (2018), Hanchen and Xi (2019), Nguyen et al. (2019) and Liu et al. (2021); either in part or in whole, this study made use of the “Big Five Personality” traits. However, to measure the “Big Five Personality” traits, the CEPS questionnaire was designed with the following questions:

- *Emotional stability:* The questionnaire asked students whether they had the following feelings in the past seven days: feeling blue, depression, unhappiness, lack of interest in life, and sadness, on a five-point scale where never = 1, Seldom = 2, sometimes = 3, often = 4, and always = 5.
- *Agreeableness:* Questions include: “the class most of the students very friendly to me”, “I often participate in school activities or the class organization”, and “I feel close to people at this school” based on a four-point scale where strongly disagree = 1, somewhat disagree = 2, somewhat agree = 3, and strongly agree = 4.
- *Conscientiousness:* Questions include: “Even if you are a bit uncomfortable or have other reasons to stay at home, you still go to school as much as possible,” “Even if you do not like your homework, you will do your best, and “Even if homework takes a long time to finish, I will continue to do my best” based on a four-point scale where strongly disagree = 1, somewhat disagree = 2, somewhat agree = 3, and strongly agree = 4.

The independent variables: Migration. The chosen independent variable is migration, where students were asked to report on whether both parents were at home, or only the mother was at home and the father migrated, or only the father was at home and the mother migrated, and neither parents were at home, which will be coded as a dummy (i.e., 0 and 1) for each of the four forms of migration.

Other variables (Control variables). This paper made use of the following control variables, namely gender, age, student household registration, whether the student has an irresponsible friend, siblings, ethnic minority, computer and internet access at home, mother education, father education, and financial status of the parent.

Model specification. The model specification states a relationship between a dependent and independent variable (s). In other

words, it is a way of stating a functional form between two or more variables. The empirical model specification of this paper is in the form of a production function intending to evaluate the impact of different statuses of parental migration on the non-cognitive abilities of left-behind school-going children in rural China. Thus, the empirical model specification can be stated in a way that the children’s non-cognitive abilities are a function of different statuses of parental migration and control variables as follows:

$$y_{i,s} = f(MIG_{i,s}, X_{i,s}) \tag{1}$$

By appropriately manipulating or re-arranging Eq. (1) more technically in the econometric term, we shall arrive at Eq. (2).

$$y_{i,s} = \beta_0 + \beta_1 MIG_{i,s} + \beta_2 X_{i,s} + \epsilon_{i,s} \tag{2}$$

where y is the dependent variable which represents the children’s non-cognitive abilities, MIG (dummy variable) is the migration status, X is a vector of control variables, i denotes student in school s , β_0 , β_1 , and β_2 are the respective coefficients, and ϵ is the error term. The theoretical expectation, i.e., the a priori expectation of the relationship between the different statuses of parental migration: only the father migrates, only the mother migrates, and both parents migrate, and the non-cognitive abilities of their left-behind school-going children are negative.

Estimation techniques. The estimation techniques employed by this paper include the following. First, it uses descriptive statistics to understand the statistical characteristics of the variables under the study, thereby obtaining basic information about the variables. Second, it conducts a balance test and standard support hypothesis testing since estimating the Propensity Score Matching model requires such tests. Third, it estimates the impact of different statuses of parental migration on the students’ non-cognitive abilities of left-behind school-going children in rural China using the propensity score matching model.

Propensity score matching model. The PSM model emerged to reduce bias in estimating the effects between two groups: the control group (children living with their parents) and the treatment group (children with migrated parents), where children living with parents are the control group for each type of treatment (only the mother migrated, only the father migrated, and both parents migrated). Suppose that D is a binary variable that takes 0 if the children live with their parents and a value of 1 if the children belong to the migrated family. The propensity score is the conditional probability of receiving a treatment given the presence of pre-treatment characteristics (Rosenbaum and Rubin, 1985). This can be stated as follows:

$$P(X) = P_r[D = 1|X] = E[D|X] \tag{3}$$

where X is the vector of characteristics of the control group and D is the indicator variable. If we can get the propensity score, the average treatment effect on the treated (ATT) can be estimated by the difference between the outcomes of the treatment group and the control group using the following equation; where Y_{1i} and Y_{0i} represent the outcomes of the treatment group and control group, respectively.

$$\begin{aligned} ATT &= E[Y_{1i} - Y_{0i} | D_i = 1] \\ &= E[E[Y_{1i} - Y_{0i} | D_i = 1, P(X_i)]] - E[E[Y_{0i} | D_i = 0, P(X_i)]] \end{aligned} \tag{4}$$

Table 1 Basic characteristics of sample students.

Variables	Observations	Percentage	Mean	Standard deviation	Minimum	Maximum
Gender	4102		0.5204778	0.4996414	0	1
Boys (1)	1967	47.95				
Girls (0)	2135	52.05				
Age	4102		13.60044	0.7384185	12	18
Whether the student is the only child	4102		0.2779132	0.448025	0	1
No (0)	2962	72.21				
Yes (1)	1140	27.97				
Ethnic minority	4102		0.0760605	0.2651271	0	1
Not minority (0)	3790	92.39				
Minority (1)	312	7.61				
Bad companion	4102		0.2686494	0.4433112	0	1
No (0)	3000	73.14				
Yes (1)	1102	26.86				
Mother's education	4102		3.567284	1.30769	0	8
0	162	3.95				
1	1057	25.77				
2	128	3.12				
3	2109	51.41				
4	493	12.02				
5	42	1.02				
6	71	1.73				
7	37	0.90				
8	3	0.07				
Father's education	4102		3.88981	1.203526	0	8
0	22	0.54				
1	753	18.36				
2	160	3.90				
3	2288	55.78				
4	676	16.48				
5	68	1.66				
6	80	1.95				
7	47	1.15				
8	8	0.20				
Financial condition of the family	4102		2.724037	0.626881	1	5
Very poor (1)	197	4.80				
Poor (2)	928	22.62				
Middle class (3)	2796	68.16				
Rich (4)	172	4.19				
Very rich (5)	9	0.22				
Computer and internet access at home	4102		1.091906	0.9483557	0	2
No (0)	1673	40.78				
Only computer (1)	379	9.24				
With internet (2)	2050	49.98				

Source: Author's computation.

Results

The analysis began with descriptive statistics to understand the variables' statistical characteristics, and then proceeded to the estimation of the balance test using matching and standard support hypothesis testing. The former is to confirm that the characteristics of the control group individuals are not different from the experimental group as well as to resolve the endogenous problems caused by sample self-selection bias, thereby satisfying the parallel trend hypothesis, while the latter is to ensure that the control group individuals are comprehensive for the analysis.

Table 1 presents the result of the essential characteristics of sample students in the baseline period. While Table 2 reports the results of the description of sample parental migration. The number of students whose parents are at home is 3026; where only the father migrates is 399, where only the mother migrates is 143, and where both parents migrate is 534, where the total observations are 4102. However, the mean and standard of the migration are 1.557533 and 1.047741, respectively, and since the former is greater than the latter, it means the distribution is normal.

Table 3 describes the sample non-cognitive abilities and their three components: emotional stability, agreeableness, and conscientiousness. The non-cognitive abilities are the summation of these three components. The number of students who responded to the questions on their non-cognitive abilities is 4102, with 32.35836 and 4.434167 as the mean and standard deviation, respectively, which depicted that the distribution is normal. Furthermore, 4102 students respond to the questions on their emotional stability with 10.0156 and 3.705345 as the mean and standard deviation, respectively, which show that the distribution is normal. Moreover, 4102 students respond to their agreeableness with 12.00244 and 2.79652 as the mean and standard deviation, respectively, indicating that the distribution is normal. Besides, 4102 students respond to the question on their conscientiousness with 10.34032 and 1.760807 as the mean and standard deviation, respectively, which specify that the distribution is normal.

Table 4 reports the matching balance test of the model where only the father migrates. The result shows that all the control

Table 2 Description of sample parental migration.

Variables	Observations	Mean	Standard deviation	Minimum	Maximum
Both parents at home	3026	1.557533	1.047741	1	4
Only father migrates	399				
Only mother migrates	143				
Both parents migrate	534				
Total observations	4102				

Source: Author's computation.

Table 3 Description of sample non-cognitive abilities.

Variables	Observations	Mean	Standard deviation	Minimum	Maximum
Non-cognitive abilities	4102	32.35836	4.434167	12	53
Emotional stability	4102	10.0156	3.705345	5	25
Agreeableness	4102	12.00244	2.79652	4	16
Conscientiousness	4102	10.34032	1.760807	3	12

Source: Author's computation.

Table 4 Matching balance test on the model of only father migrates.

Covariate	Experimental group	Control group	%bias	t-test	p > t
<i>Age</i>					
U	13.652	13.595	7.4	1.460	0.145
M	13.652	13.596	7.2	1.010	0.313
<i>Gender</i>					
U	0.541	0.518	4.7	0.900	0.370
M	0.541	0.539	0.5	0.070	0.943
<i>Whether the student is the only child</i>					
U	0.221	0.283	-14.400	-2.650	0.008***
M	0.221	0.211	2.3	0.340	0.731
<i>Ethnic minority</i>					
U	0.080	0.076	1.7	0.330	0.741
M	0.080	0.075	1.9	-8.700	0.260
<i>Bad companion</i>					
U	0.276	0.267	1.9	0.350	0.723
M	0.276	0.261	3.4	0.480	0.632
<i>Mother education</i>					
U	3.479	3.571	-7.100	-1.350	0.178
M	3.479	3.549	-5.400	-0.770	0.439
<i>Father education</i>					
U	3.825	3.890	-5.400	-1.040	0.296
M	3.825	3.897	-6.000	-0.850	0.393
<i>Financial status of the family</i>					
U	2.611	2.730	-19.100	-3.650	0.000***
M	2.611	2.604	1.2	0.170	0.864
<i>Computer and internet access at home</i>					
U	0.910	1.109	-21.100	-4.000	0.000***
M	0.910	0.950	-4.200	-0.590	0.553
Sample 4102	$P_S R^2$		LR chi2		$p > \chi^2$
Unmatched (U)	0.010		27.420		0.001***
Matched (M)	0.002		2.520		0.980

Source: Author's computation.
 ***Indicates statistical significance at 1% level.

variables under the analysis fit the selection after matching the experimental and control groups. The percentage bias between the experimental and control groups is low, where the least is 0.5% while the highest is 7.2%. Therefore, the model passed the selection bias test. Moreover, from the overall model fit statistics goodness of the model, one can see that before matching, both the Pseudo- R^2 value and the LR statistic are significant at the 1% level, although they are no longer significant after the matching

but were reduced from 0.010 to 0.002 and 27.420 to 2.520, respectively, which implies that the control variables distribution of the experimental group and the control group is consistent after the matching, and the parallel trend hypothesis is fulfilled.

Table 5 reports the matching balance test on the model of the only mother migrates. The result shows that all the control variables under the analysis fit the selection after matching the experimental and control groups. The percentage bias between

Table 5 Matching balance test on the model of only mother migrates.

Covariate	Experimental group	Control group	%bias	t-test	p > t
<i>Age</i>					
U	13.811	13.601	28.100	3.300	0.001***
M	13.811	13.846	-4.700	-0.390	0.698
<i>Gender</i>					
U	0.629	0.510	24.300	2.810	0.005***
M	0.629	0.629	0	0.000	1.000
<i>Whether the student is the only child</i>					
U	0.378	0.259	25.600	3.160	0.002***
M	0.378	0.399	-4.500	-0.360	0.717
<i>Ethnic minority</i>					
U	0.091	0.079	4.4	0.530	0.595
M	0.091	0.091	0	0.000	1.000
<i>Bad companion</i>					
U	0.378	0.266	24.000	2.940	0.003***
M	0.378	0.343	7.5	0.610	0.540
<i>Mother education</i>					
U	3.441	3.426	1.3	0.150	0.880
M	3.441	3.580	-12.400	-1.090	0.276
<i>Father education</i>					
U	3.762	3.751	1.1	0.120	0.901
M	3.762	3.699	6.2	0.540	0.591
<i>Financial status of the family</i>					
U	2.441	2.663	-34.700	-4.560	0.000***
M	2.441	2.462	-3.300	-0.250	0.801
<i>Computer and internet access at home</i>					
U	0.874	1.048	-18.500	-2.150	0.032**
M	0.874	0.860	1.5	0.130	0.900
Sample 4102	Ps R ²		LR chi2		
Unmatched (U)	0.044		53.600		
Matched (M)	0.008		3.130		

Source: Author's computation.
 *** and ** indicate statistical significance at 1% and 5%, respectively.

the experimental and control groups is shallow, where the least is 0.0%, while the highest is 7.5%. Therefore, the model passed the selection bias test. Moreover, from the overall model fit statistics goodness of the model, it can glance that before matching, both the Pseudo-R² value and the LR statistic are significant at the 1% level though no longer significant after the matching but were reduced from 0.044 to 0.008 and 53.600 to 3.130, respectively, which implies that the control variables distribution of the experimental group and the control group is consistent after the matching, and the parallel trend hypothesis is fulfilled.

Table 6 displays the matching balance test on both parents' migration models. The result shows that all the control variables under the analysis fit the selection after matching the experimental and control groups. The percentage bias between the experimental and control groups is low, where the least is 0.0%, while the highest is 4.2%. Therefore, the model passed the selection bias test. Additionally, from the overall model fit statistics goodness of the model, it can glance that before matching, the Pseudo-R² value and the LR statistic were significant at the 1% level. However, they were no longer significant after the matching. Still, they were reduced from 0.050 to 0.001 and 156.750 to 1.030, respectively, which implies that the control variables distribution of the experimental and control groups is consistent after the matching, and the parallel trend hypothesis is fulfilled.

Figure 1 displays the graphical balancing diagnostic test of all the various migration models: only the father migrates, only the mother migrates, and both parents migrate. Figure 1 illustrates the simulated distributions of the covariate for the two groups. It reveals that in all graphs, the covariate distributions are

considerably different and the only point in the distribution where there is no divergence between groups is at the mean, i.e., where the standardized percentage bias across covariates is zero (0). Therefore, the covariates are balanced, hence; satisfying the parallel trend hypothesis.

Figure 2 presents a comparison of propensity scores between the treatment group and control group to test for the joint support hypothesis on the matched samples across the models of the various forms of different statuses of parental migration to ensure that there is overlap in the range of propensity scores across treatment and comparison groups (called "common support which is subjectively assessed by examining a graph of propensity scores across treatment and comparison groups"). From the figure, when matching the sample size of the treatment group and control groups, the distribution is sufficiently similar, with a minimal proportion of samples that fall outside the common support domain. Therefore, the propensity score has a sufficient common support domain in the treatment and control groups, satisfying the common support hypothesis.

Table 7 shows the impact of fathers' migration on their children's non-cognitive abilities based on the aggregate non-cognitive abilities of its sub-indices, namely emotional stability, agreeableness, and conscientiousness. From the table, the ATTs of the aggregate non-cognitive abilities, agreeableness, and conscientiousness reveals that fathers' migration negatively affects the non-cognitive abilities of their left-behind school-going children. The effects are statistically significant at 5%, 1%, and 10%, respectively. However, emotional stability is not significant. This implies that fathers' action to migrate is detrimental to their children's non-cognitive abilities and the findings are in line with

Table 6 Matching balance test on the model of both parent's migrate.

Covariate	Experimental group	Control group	%bias	t-test	p > t
Age					
U	13.684	13.591	11.900	2.700	0.007***
M	13.684	13.670	1.7	0.270	0.786
Gender					
U	0.5	0.525	-5.000	-1.070	0.286
M	0.5	0.507	-1.500	-0.240	0.807
Whether the student is the only child					
U	0.189	0.287	-23.100	-4.720	0.000***
M	0.189	0.180	2.2	0.390	0.694
Ethnic minority					
U	0.122	0.069	17.900	4.270	0.000***
M	0.122	0.122	0	0.000	1.000
Bad companion					
U	0.288	0.267	4.7	1.020	0.308
M	0.288	0.270	4.2	0.680	0.496
Mother education					
U	3.288	3.571	-22.100	-4.830	0.000***
M	3.288	3.275	1	0.160	0.872
Father education					
U	3.693	3.853	-14.800	-3.120	0.002***
M	3.693	3.672	1.9	0.320	0.750
Financial status of the family					
U	2.599	2.737	-21.400	-4.750	0.000***
M	2.599	2.603	-0.600	-0.090	0.927
Computer and internet access at home					
U	0.637	1.151	-56.400	-11.870	0.000***
M	0.637	0.640	-0.400	-0.070	0.945
Sample 4102	Ps R ²		LR chi ²		p > chi ²
Unmatched (U)	0.050		156.750		0.000***
Matched (M)	0.001		1.030		0.999

Source: Author's computation.
 *** indicates statistical significance at a 1% level.

previous studies (Luo et al., 2009; Wang et al., 2014; Wu and Zhang, 2017; Ban et al., 2017; Dai and Chu, 2018; Li et al., 2015; Meyerhoefer and Chen, 2011). This may be because children whose fathers migrated may feel helpless, lonely, and depressed. For instance, most children experience psychological stress and anxiety, negatively impacting other areas of the children's well-being, such as noncognitive abilities.

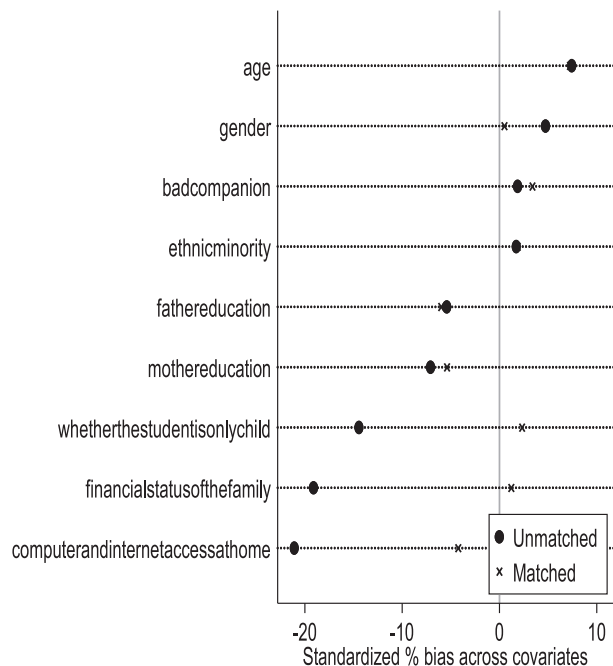
Table 8 displays the impact of mothers' migration on their children's non-cognitive abilities based on the aggregate non-cognitive abilities of its sub-indices, namely emotional stability, agreeableness, and conscientiousness. The ATTs of the children's non-cognitive abilities and emotional stability were positive. However, only emotional stability is significant at the 5% level. At the same time, the ATTs of agreeableness and conscientiousness are negatively related to the children's non-cognitive abilities, but only conscientiousness is significant at 5%. However, out of the four measures, two support positives while two support negatives with equal degrees of significance; the paper chooses the ones that align with the theoretical expectation, i.e., the a priori expectation. Hence, the paper chooses the ones that support the adverse effect. This indicates that mothers' migration is detrimental to their children's non-cognitive abilities. The results align with previous studies (Chen et al., 2009; Jordan and Graham, 2012; Liu et al., 2021; Xu, 2018). Consequently, children whose mothers have migrated may experience feelings of helplessness, loneliness, and depression. The majority of children, for instance, experience psychological stress and anxiety, which hurts children's well-being in other areas like noncognitive abilities.

Table 9 reports the impact of both parents' migration on their children's non-cognitive abilities based on the aggregate non-

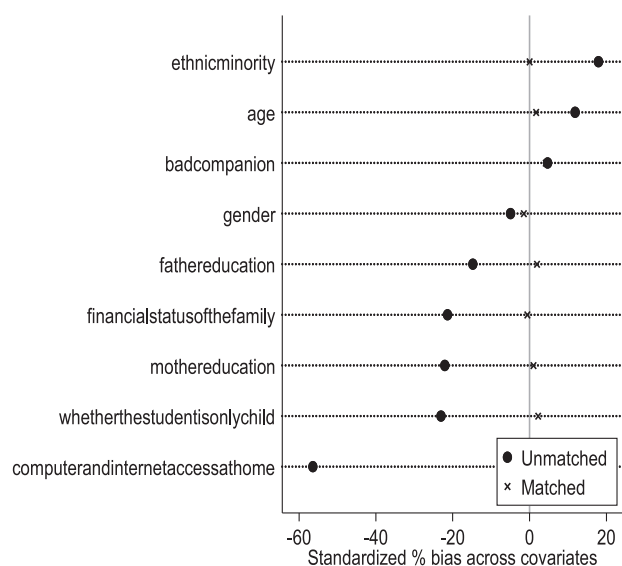
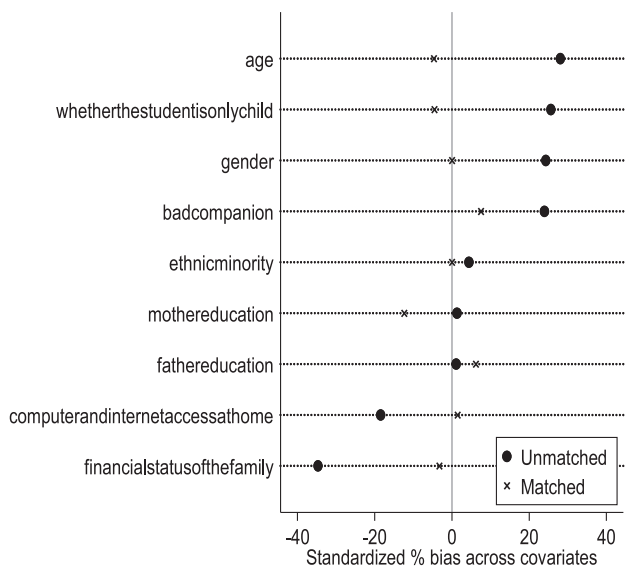
cognitive abilities and their sub-indices: emotional stability, agreeableness, and conscientiousness. The ATTs of the children's non-cognitive abilities, agreeableness, and conscientiousness are negative. However, agreeableness is only significant at 1%, while the ATT of emotional stability is positive and significant at 1%. However, since the two significant measures are of an equal degree of significance, the paper chooses the one that is in line with the theoretical expectation. Therefore, the paper chooses the one that supports the adverse effect. This designates that the migration of both parents is harmful to their children's non-cognitive abilities. Due to a lack of upbringing, which is crucial in the early stages of non-cognitive development, children whose parents both abandon them are most at risk of psychological trauma.

Discussion of the results

The welfare of rural left-behind children has gradually come to the attention of researchers and policymakers as an important issue as more parents relocate to cities for employment. Children left behind after their parents split up may encounter more disruptions in their daily lives, which could harm their development. It is well-known that moving to a new place can be stressful. LBCs must develop new routines, adapt to new surroundings, deal with the disruption of their old friendship networks, and make new friends (Ren and Treiman, 2016). Therefore, we investigated the effects of different parental migration statuses on students' non-cognitive abilities in rural China. Looking at the results (Tables 7-9), it can be asserted that the decision of fathers, mothers, or both parents to migrate harms the non-cognitive abilities of the LBC's school-going children in rural China. This proposes that the migration of



Only Father Migrates



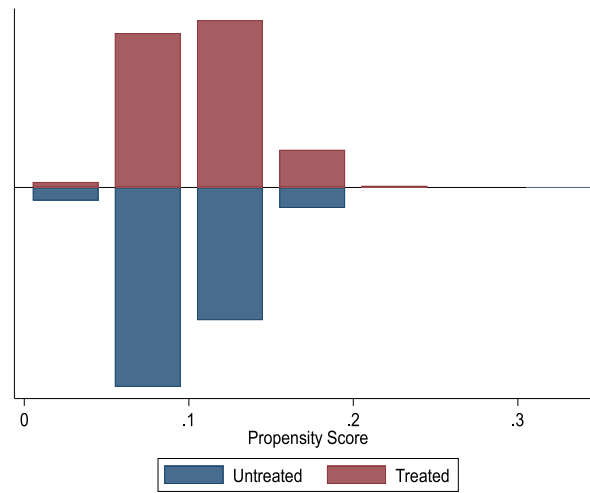
Only Mother Migrates

Both Parents Migrate

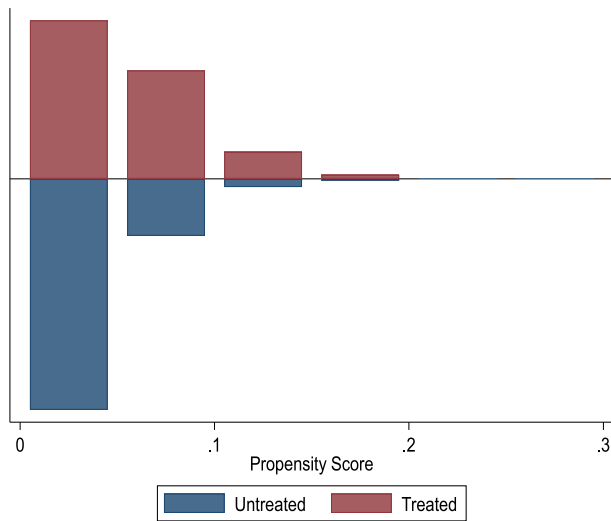
Fig. 1 Graphical balance diagnostic test. Graphical balancing diagnostic test of all the various migration models, namely only the father migrates, only the mother migrates, and both parents migrate.

fathers, mothers, or both parents in rural China harms their left-behind school-going children’s non-cognitive abilities. It may be due to parental migration brought on by immigration means less supervision, guidance, and emotional support, which may hurt children’s non-cognitive abilities, and developmental outcomes and make them more susceptible to being exploited and recruited by criminals (Rubio, 2020). In addition, disruptions in the family can lead to poor eating habits and increased psychological problems. Migration may lessen incentives for education if the perceived return on future education is thought to be low as a result of migration expectations. Relatives who remain behind, particularly women, have lower labor force participation rates due to

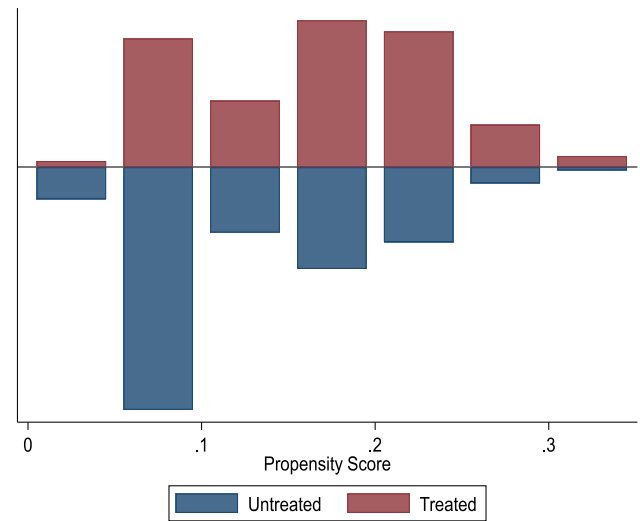
immigration. This finding broadens the scope of the effect of different statuses of parental migration on the non-cognitive abilities of left-behind school-going children, which has received little attention in the literature. Moreover, it indicates that appropriate policies are urgently required to assist migrant parents in relocating with their children. These policies would significantly enhance intergenerational mobility and lower rural-urban disparities. Hence, the findings of this paper have important policy implications for the Chinese government in formulating policies to prevent the impairment of the intellectual function of left-behind school-going children in rural China. For comparison, the finding that parental migration hurts the non-cognitive abilities of rural



Only Father Migrates



Only Mother Migrates



Both Parents Migrate

Fig. 2 Comparison of propensity score between treatment group and control group. Comparison of Propensity Score between Treatment Group and Control Group of all the various migration models, namely only the father migrates, only the mother migrates, and both parents migrate.

Table 7 The results from the PSM exercise for paternal migrating households.

Variables	Treatment group	Control group	Average treatment effect on the treated (ATT)
Non-cognitive ability	2.1629073	33.1278195	-0.964912281
Standard error			0.393128538
t-value			-2.45**
Emotional stability	10.1729323	10.0551378	0.117794486
Standard error			0.326446727
t-value			0.36
Agreeableness	11.716792	12.5488722	-0.832080201
Standard error			0.24696725
t-value			-3.37***
Conscientiousness	10.273183	10.5238095	-0.250626566
Standard error			0.148394871
t-value			-1.69*

Source: Author's computation.
 ***, **, and * indicate statistical significance at 1%, 5%, and 10% levels respectively.

Table 8 The results from the PSM exercise for maternal migrating households.

Variables	Treatment group	Control group	Average treatment effect on the treated (ATT)
Non-cognitive ability	32.6083916	31.972028	0.636363636
Standard error			0.653796845
t-value			0.97
Emotional stability	10.965035	9.74125874	1.22377622
Standard error			0.567594983
t-value			2.16**
Agreeableness	11.6013986	11.7272727	-0.125874126
Standard error			0.423396757
t-value			-0.30
Conscientiousness	10.041958	10.5034965	-0.461538462
Standard error			0.224141025
t-value			-2.06**

Source: Author's computation.

**Indicates statistical significance at 5% level, respectively.

Table 9 The results from the PSM exercise for both parents migrating households.

Variables	Treatment group	Control group	Average treatment effect on the treated (ATT)
Non-cognitive ability	32.659176	32.8689139	-0.209737828
Standard error			0.386157229
t-value			-0.54
Emotional stability	10.9438202	10.076779	0.867041199
Standard error			0.327100109
t-value			2.65***
Agreeableness	11.3595506	12.2790262	-0.919475655
Standard error			0.239927124
t-value			-3.83***
Conscientiousness	10.3558052	10.5131086	-0.157303371
Standard error			0.142920002
t-value			-1.10

Source: Author's computation.

*** Indicates statistical significance at 1% level.

China's left-behind school-going children is consistent with the findings of the studies conducted by Lee and Park (2010), Wu and Zhang (2017), Zhao et al. (2018), Hanchen and Xi (2019), Liu et al. (2021), Zhao and Chen (2022), Yang (2008), Acosta (2006), Hanson and Woodruff (2003), Asis (2006), Kandel and Kao (2001), and Yuna (2014) who demonstrated that parental migration negatively affects children's non-cognitive abilities. In addition, our results of maternal migration on students' non-cognitive abilities are consistent with previous ones that the mother's migration has a negative impact (Chen et al., 2009; Jordan and Graham, 2012; Liu et al., 2021; Xu, 2018). Furthermore, some studies have found that paternal migration has a negative impact on child non-cognitive abilities (see Luo et al., 2009; Wang et al., 2014; Wu and Zhang, 2017, e.g., Ban et al., 2017; Dai and Chu, 2018; Li et al., 2015; Meyerhoefer and Chen, 2011; Wang et al., 2014) and findings are in line with our study. Therefore, the findings of this paper do not conflict with the existing studies' findings about the effect of parental migration on the non-cognitive abilities of left-behind school-going children.

Conclusion and policy recommendations

The dominant question of parental migration is how it affects the development of left-behind children, that is, whether it affects the human capital development within the economy, and how such a paradigm holds in rural China. The results revealed that the decision of parents to migrate, whether it is either parent or both parents, has a negative effect on the non-cognitive abilities of the left-behind school-going children in rural China. So, parental

migration affects the development of left-behind children, and thus, it affects human capital development within the economy.

Therefore, the paper recommends that parents stay or move with their children rather than leave them with relatives, grandparents, or other individuals because being together with their children has a more significant impact on the development of their children's non-cognitive abilities, which means improvement in human capital. Furthermore, the government should improve the living environment in rural areas, thereby discouraging the habit of migrating parents from rural areas. This improvement for the living environment could be made, for instance, by providing social amenities such as qualitative schools, farming opportunities, and other policy incentives for running small, medium, and high-profile businesses. Moreover, authorities should concentrate on removing obstacles to education through initiatives like expanding the number of schools for left-behind children or lowering tuition costs. Besides, the government should take action to enhance welfare and address the issues of left-behind children. Schools should also look after LBCs after either or both parents have migrated. As a result, the government should also create several policies to enhance the supervision of LBCs. Lastly, the authorities must spearhead economic transformation to achieve a more balanced economy that spans provinces, cities, and rural areas. So, instead of traveling to other cities, migrated parents can find employment nearby. Even though it necessitates sustained, long-term work, such development might be the best way to solve the social issues that plague children who are left behind.

However, the limitation of this research is that many studies, including this one, have shown that parental migration is detrimental to the non-cognitive abilities of left-behind children. The CEPS data is quite suitable for children's educational attainment. Despite the fact that we have created a thorough index based on the Big Five personality model to assess children's non-cognitive abilities, the measurement of some sub-items may require improvement in the questionnaire survey. Furthermore, there is yet to be an available survey to investigate why parental migration is negatively affecting the non-cognitive abilities of their left-behind schooling children. Therefore, as a suggestion for future research, we can explore the question of whether data can be collected in this regard and explain why parental migration negatively affects the non-cognitive abilities of their left-behind school-going children in rural China.

Data availability

The data of this study are available upon request.

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Ethical approval

This article does not contain any studies with human participants performed by any of the authors.

Informed consent

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Additional information

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