ELSEVIER

## Full Length Article

Contents lists available at ScienceDirect

# Journal of Asian Economics



# The impact of parental migration on non-cognitive abilities of left behind children in northwestern China



## Han Liu<sup>a</sup>, Fang Chang<sup>a</sup>, Hannah Corn<sup>b</sup>, Yi Zhang<sup>a</sup>, Yaojiang Shi<sup>a,\*</sup>

<sup>a</sup> Shaanxi Normal University, Center for Experimental Economics in Education, 620 West Chang'an Ave, Xi'an, Shaanxi, China <sup>b</sup> The George Washington University, International Affairs, Mandarin Chinese, 1957 E St NW, Washington, DC, United States

#### ARTICLE INFO

Article history: Received 24 June 2020 Received in revised form 25 October 2020 Accepted 7 November 2020 Available online 22 November 2020

JEL classification: 012 015

Keywords: Left behind children Non-cognitive ability Parental migration Big Five Grit

#### ABSTRACT

Despite the vast literature surrounding various aspects of left behind children (LBC)'s development in China, very few studies have examined the development of, and impact on their non-cognitive abilities as a result of parental migration. Using survey data consisting of 5002 eighth graders from 160 middle schools in northwestern China, this paper investigates how parental migration affects children's non-cognitive abilities, as is measured by Big Five components of conscientiousness, extraversion, neuroticism, agreeableness, and openness, as well as children's grit. We narrow our analysis to long run and short run migration subsamples and use the propensity score matching method to address the potential selection bias issue. Our results show that mother's migration is particularly harmful to the development of children's non-cognitive abilities, as mother is usually the primary caregiver and mother's migration makes less economic contribution to the family. In the long run, LBC with migrant mother tend to have lower levels of conscientiousness, agreeableness, and openness, agreeableness and openness.

© 2020 Elsevier Inc. All rights reserved.

## 1. Introduction

In recent decades China has witnessed fast-paced industrialization and concomitant workforce migration from rural to urban areas (Chan, 2013). This unprecedented rural-urban internal migration began in the late 1980s (Zhao, 1999), as laborers sought greater economic opportunities in urban areas. China's internal migration has since increased from tens of millions of workers in the 1980s to hundreds of millions of workers in the recent decade. According to a report published by the National Bureau of Statistics in 2017 there were 287 million rural workers and among them 171 million were migrant workers (National Bureau of Statistics, 2018)<sup>1</sup>.

An important feature of China's large-scale migration is that very few migrants are able to migrate with their entire family, leaving a large number of children left behind in rural areas. A recent study using 2010 census data identified approximately 61 million children as "left behind children (LBC)" (Duan, Lv, Guo, & Wang, 2013). As a result, scholars have made intensive efforts to examine the impact of the "left behind" status, as a result of parental migration, on a child's

\* Corresponding author.

<sup>1</sup> http://www.stats.gov.cn/tjsj/zxfb/201804/t20180427\_1596389.html.

http://dx.doi.org/10.1016/j.asieco.2020.101261 1049-0078/© 2020 Elsevier Inc. All rights reserved.

*E-mail addresses*: liuhanecon@163.com (H. Liu), changfang4421@163.com (F. Chang), Hcorn145@gmail.com (H. Corn), zhangyiceee@163.com (Y. Zhang), shiyaojiang7@gmail.com (Y. Shi).

academic achievement (Chang et al., 2019, Bai et al., 2018; Chen, Huang, Rozelle, Shi, & Zhang, 2009; McKenzie & Rapoport, 2011; Xu, 2018; Zhang, Behrman, Fan, Wei, & Zhang, 2014), educational outcomes (Wang, 2014), physical health (Jia, Shi, Cao, Delancey, & Tian, 2010; Murphy, Zhou, & Tao, 2016), behavior (Murphy et al., 2016; Yu, Dai, Li, Wang, & Li, 2014), and mental health (Chang et al., 2019, Gao, 2010; Liu, Li, & Ge, 2009; Zhou, Sun, Liu, & Zhou, 2005) etc. The results are mixed. Some conclude that parental absence caused by migration led to substantial decrease in LBC's well-beings, while others find that the increase in resource availability contribute to improve their outcomes; some find no significant results of parental migration.

Despite the vast literature surrounding various aspects of LBC's development, very few studies have examined the development of, and impact on their non-cognitive abilities as a result of parental migration. Apart from cognitive ability (or intelligence), non-cognitive abilities include a variety of personality traits often deemed as important factors for success in life, such as persistence and motivation as well as competences (Heckman, Stixrud, & Urzua, 2006). A series of studies in recent years, examining both children and adults, have shown that an individual's non-cognitive ability, even after controlling for intelligence and academic achievement, has a significant positive impact on educational attainment, labor market performance, and adult health conditions (Carneiro, Crawford, & Goodman, 2007; Cheng & Li, 2017; Duncan & Magnuson, 2011; Hall & Farkas, 2011; Heckman & Rubinstein, 2001; Kuhn & Weinberger, 2005). Additionally, the development of non-cognitive traits such as empathy, self-control, perseverance, and self-esteem, has been found to reduce antisocial behavior and crime (Heckman et al., 2006). Therefore, the development or lack of non-cognitive skills amongst LBC in rural China is not only crucial to their future success, but also China's human capital accumulation and economic growth.

Parental presence, as an indicator of parental time investment, is closely linked to a child's development (Del Boca, Piazzalunga, & Pronzato, 2014; Radl, Salazar, & Cebolla-Boado, 2017). Antman (2012) suggests the net effect of parental migration depends on the balance between the positive effects of increased income and the negative effects of parental absence. However, empirical evidence regarding the impact of parental migration on LBC's non-cognitive abilities remains inconclusive among scholars.

Based on an extensive literature review, the majority of studies concerning non-cognitive ability of LBC focuses on their self-concept (see Luo, Wang, & Gao, 2009 and Wang et al., 2014 for reviews; Wu & Zhang, 2017) and conclude that LBC are associated with lower self-concept scores. Only three previous articles were found to explicitly measure other dimensions of non-cognitive abilities. Lee and Park (2010) find that parental absence due to migration results in more serious internalizing and externalizing problems (anxiety, withdrawal, and destructive behavior etc.) for LBC. Using field experiments, Dong and Zhao (2019) find that LBC are more reluctant to take part in competition due to the lack of parental company. Wen, Su, Li, and Lin (2015) utilize the Five C's Model (competence, confidence, caring, character, and peer-, school-, family-based connection constructs) to examine the impacts of parental migration on "positive youth development". They find little difference between LBC and non-LBC. In these studies the respective dimensions of non-cognitive ability measurement are pulled largely from incomprehensive indicators or tests. As non-cognitive ability involves various aspects of individual characteristics that are not closely correlated (Deke & Haimson, 2006), economists believe it is difficult to define or measure non-cognitive ability with limited indicators or tests (Heckman & Kautz, 2013). Therefore, it is controvertible to draw conclusions on the overall impacts of parental migration on non-cognitive development, when using a measurement tool quite narrow in scope.

It is therefore necessary to further explore the relationship between children's left-behind status as a result of parental migration and their combined non-cognitive abilities, as are measured by a more inclusive scale of individuals' personality traits. Despite the broad spectrum of non-cognitive abilities, Heckman and Kautz (2013) maintain that using the Big Five<sup>2</sup>, a measurement intensively studied by psychologists, can serve as such an assessment tool. The Big Five personality traits include extraversion, agreeableness, conscientiousness, neuroticism, and openness. Another indicator of non-cognitive ability, grit, measures the level of effort, persistence and enthusiasm for long-term goals and has well been documented to have good predictive power on children's future achievement (Duckworth, Peterson, Matthews, & Kelly, 2007). The objective of this paper is to establish links between parental migration status and children's non-cognitive abilities, specifically looking at the Big Five components as well as children's grit.

We use survey data of 5002 eighth graders from 160 rural middle schools in northwestern China to investigate the relationship between parental migration status and children's non-cognitive abilities (measured by Big Five and grit). Different parental migration status include father migrated only, mother migrated only, both parents migrated, and no parent migrated. Several waves of surveys were conducted to obtain detailed parental migration status and non-cognitive abilities. To better understand the impact of parental migration on non-cognitive abilities in long run and short run, we narrow our analysis to two sub-samples: the first subsample consists of students whose mother and father's migration status remained unchanged respectively during the two survey waves, therefore the differences between always-LBC and non-LBC represent the association between parents' migration status and non-cognitive abilities in relatively long run. The second consists of students whose parents were at home at the baseline survey. We use this subsample's parental migration status at endline survey to identify newly left-behind children and the impact of parental migration in short run. We use the propensity score matching (PSM) method to address the potential selection bias of parental migration.

<sup>&</sup>lt;sup>2</sup> The Big Five personality traits, also known as the five-factor model (FFM), is well recognized by psychologists as a robust taxonomy of personality across different theoretical models, using different tools and in different cultures (McCrae & Costa, 1987; Mount & Barrick, 1998).

Our results show that parental migration has different impact on children's non-cognitive abilities. Mother's migration is crucial. In the long run, LBC with migrant mother tend to have lower levels of conscientiousness and grit; they also have higher level of neuroticism (or lower level of emotional stability). Causal inference using PSM method shows the same pattern. The reason why mother's migration is more harmful is that mother is usually the primary caregiver and that mother's migration make less economic contribution to the family. In the short run, when mother migrates, children also tend to have lower levels of agreeableness, conscientiousness and openness.

This paper provides contributions to two strands of literature: first, it expands the boundaries of children's outcomes affected by parental migration by using a comprehensive scale of personality traits. Plus, the discussion on which parent migrated is useful, for only a small proportion of studies pertaining to LBC have examined the different impact of paternal and maternal migration (Murphy et al., 2016). The second strand of literature concerns the development of children's noncognitive abilities. A burgeoning literature tries to understand factors affecting the formation of children's noncognitive abilities while evidence in China is relatively scarce (Gong, Yi, & Song, 2018; Gong, Lu, & Song, 2019). Previous papers find that family environment, including parenting style, parental time, and material investment plays a strong part in the production of non-cognitive abilities (Deng & Tong, 2020; Fiorini & Keane, 2014). Our paper provides a contribution by linking the two strands of literature.

The remaining parts of this paper proceed in the following way: Section 2 reviews literature on non-cognitive ability and discusses the possible channels through which parental migration status of a child can affect her non-cognitive ability. Section 3 presents data, method and provides descriptive statistics. Section 4 describes our results using OLS regressions and propensity score matching methods. Lastly, Section 5 summarizes our findings and makes further discussions.

## 2. Literature review

## 2.1. Measurement of non-cognitive ability

"Cognitive ability" is often defined as intelligence and the ability to solve abstract problems. Measurements of such capabilities have been refined by psychologists and usually include IQ tests and standardized achievement tests on subjects such as science, mathematics and reading (Heckman & Kautz, 2013). Since all aspects of cognitive ability, including fluid reasoning, comprehension knowledge, working memory, and visual processing etc., are highly correlated, literature often uses a single dimension measurement such as intelligence test scores as a proxy for cognitive ability (Brunello & Schlotter, 2011).

The term, "non-cognitive ability", is more complex. It is a relatively new term used by economists to refer to all abilities unrelated to cognitive ability yet can also predict later-life success. These abilities include motivation, personality traits, social skills, and persistence etc.<sup>3</sup> Because these abilities involve different aspects of individuals and are less interrelated (Deke & Haimson, 2006), economists believe it is difficult to define or measure non-cognitive abilities with a single indicator or test (Heckman & Kautz, 2013). In an early discussion of the impact of non-cognitive ability by Heckman and Rubinstein (2001), it is highlighted that economists' neglect of non-cognitive ability is largely due to the "lack of reliable measurement tools." In fact, the measurements of non-cognitive ability used in prior empirical research were usually reliant on the availability of measurements in a specific dataset (Brunello & Schlotter, 2011).

The most common non-cognitive skills addressed in the existing economic literature include: self-perception, which includes the locus of control (Goldsmith, Veum, & Darity, 1997), self-respect (Heckman et al., 2006), and identity (Blattman, Jamison, & Sheridan, 2017); interpersonal skills such as leadership (Kuhn & Weinberger, 2005), personality openness (Cheng & Li, 2017; Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007), and social adaptability (Carneiro et al., 2007); motivation (Goldsmith et al., 1997); grit (Duckworth et al., 2007) ; responsibility (Almlund, Duckworth, Heckman, & Kautz, 2011; Borghans, Duckworth, Heckman, & Ter Weel, 2008); risk appetite and time preference (Blattman et al., 2017).

Despite the broad spectrum of non-cognitive abilities, Heckman and Kautz (2013) maintain that using the Big Five, a measurement intensively studied by psychologists, can serve as an inclusive assessment of individuals' personality traits. The Big Five personality traits include extraversion, agreeableness, conscientiousness, neuroticism, and openness. With decades of refinement by psychologists, the five dimensions are considered relatively independent domains that combined capture human personalities. Furthermore, all the aforementioned non-cognitive abilities, except risk appetite and time preference, are related to the Big Five<sup>4</sup>. For example, conscientiousness defined as "the tendency to be organized, responsible and, hardworking" by the American Psychology Association is related to perseverance and self-control; extraversion contains facets of interpersonal skills; neuroticism is related to internal/external locus of control and self-perception, and so on (Heckman & Kautz, 2013). Although there are several other taxonomies for measuring behavior and non-cognitive skills, the great overlap between the Big Five and the non-cognitive skills measured in extensive literature further warrant its use as a comprehensive measurement for individuals.

<sup>&</sup>lt;sup>3</sup> Economists also call this kind of abilities soft skills, personality traits, characters or socio-emotional skills. See Almlund et al. (2011) and Borghans et al. (2008) for a discussion on the use of different taxonomies.

<sup>&</sup>lt;sup>4</sup> See Heckman and Kautz (2013) Table 1 for a complete description of all Big Five Personality Factors including their facets, related skills, and analogous childhood temperament skills.

## 2.2. Parental absence and children's non-cognitive ability

Researchers primarily emphasize two major roles of parents during a child's transition into adulthood: the role of provider and the role of caregiver. The provider offers economic resources for a child to pursue opportunities through adequate nutrition, high quality education, safe environment, and additional resources for skill building (Wen, 2008). The caregiver forges emotional links between themselves and their children, contributing to children's healthy development and process of socialization (Maccoby, 1992; Moretti & Peled, 2004). Accordingly, the impact of parental migration on children are two-fold: the potential increase in income can provide more resources to the child, while parental absence can deteriorate the caregivers' support, affecting the child's ability to acquire habits, skills, values and motives that are key for them to develop into adults.

Evidence from various disciplines proves that environmental factors including parents' engagement in childhood and adolescence play a pivotal role in development of skills and formation of personality traits (Knudsen, Heckman, Cameron, & Shonkoff, 2006). Likewise, though direct evidence on parental migration and broad-based non-cognitive abilities is limited and narrow in scope, findings from developmental psychologists suggest that the amount and quality of time children spent with parents have significant impact on the parent-child bond,<sup>5</sup> and therefore impact the child's risk behavior, social skills, and coping strategies. There are several empirical papers building direct links between parenting and the Big Five. In a meta-analysis, Prinzie, Stams, Deković, Reijntjes, and Belsky (2009) conclude that responsive parenting style is associated with higher levels of extraversion, agreeableness, conscientiousness, and openness and lower levels of neuroticism. Using a sample of 553 adults from 18 to 56 years old, Robinson, Lopez, and Ramos (2014) find that retrospective childhood parental neglect is related to lower conscientiousness, openness, extraversion and agreeableness as well as higher neuroticism. Schofield et al. (2012) assess 451 white adolescents and their parents, finding that the parent's personalities and positive parenting practices rather than parental migration, the current literature's findings are consistent and provide a mechanism through which parental absence' impact on LBC's personalities and development can be interpreted.

Researchers have also made efforts on the impact of parental migration, especially for rural-urban migration in China, on non-cognitive abilities. Most studies concerning non-cognitive ability of LBC focuses on their self-concept (see Luo et al., 2009 and Wang et al., 2014 for reviews; Wu & Zhang, 2017) and conclude that LBC are associated with lower scores of self-concept. Lee and Park (2010) find that parental absence due to migration results in more serious internalizing and externalizing problems (anxiety, withdrawal, and destructive behavior etc.) for LBC. Using field experiments, Dong and Zhao (2019) suggest that LBC are more reluctant to take part in competition due to the lack of parental company. Wen et al. (2015) utilized the Five C's Model (competence, confidence, caring, character, and peer-, school-, family-based connection constructs) to examine the impacts of parental migration on "positive youth development". They find little difference between LBC's and non-LBC's.

These studies focus on different aspects of non-cognitive abilities and find quite mixed evidence. Given the broad scope of non-cognitive abilities, there is too little attention on this topic. It is therefore necessary to make further research efforts on how parental migration affects non-cognitive abilities, as are measured by more comprehensive scales that can fully portray one's personality traits.

## 3. Data and method

#### 3.1. Survey and data collection

To gain a better understanding about rural students in Northwestern China, in 2015 and 2016 we conducted junior school student surveys in two prefectures in Shaanxi and Gansu Province. More than 45 % of the population in the first prefecture and more than 67 % of the population in the second are rural in 2016. To ensure sample representativeness, we conducted the sampling process in three steps. First, all 19 counties under the jurisdiction of the two prefectures were included in the study. Second, the list of all 343 middle schools in these counties was obtained. After excluding schools in county towns and schools with less than 20 students in seventh grades, 160 schools were randomly drawn. Finally, one seventh grade class was randomly drawn from each sample school and all students in the class were surveyed. Eventually our sample included 5464 7th-grade students from 160 schools. The data is to some extent representative of rural students in Northwestern China.

We carried out two surveys at September 2015 (baseline survey) and June 2016 (endline survey), when students were at the beginning and the end of their seventh grade, and data on parental migration status and their standardized math performance was obtained. Another follow-up survey was conducted at the beginning of eighth grade (September 2016) to specifically assess their non-cognitive abilities.

<sup>&</sup>lt;sup>5</sup> See A review of adolescent-parent attachment by Moretti and Peled (2004).

## 3.2. Variables of interest

We use the Big Five Inventory (BFI) and Grit scales to measure students' non-cognitive abilities. The BFI was compiled based on a five-factor model (Costa & McCrae, 1992; John, Naumann, & Soto, 2008), which divided personality traits into extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience. The Grit scales measure the level of effort, persistence and enthusiasm for long-term goals (Duckworth et al., 2007). The questions were translated into Chinese and carefully proof-read by multiple bilinguals to ensure accuracy.

The main independent variable of interest is parental migration status. We use the question "in this semester does your father/mother mainly live at home or outside?" and the question "in this semester what does your father/mother do?" simultaneously to identify father/mother's migration status. Only students whose parent works as migrant labor and lives outside are identified as LBC. Since literature has proved that different types of parental migration may have different impact on children, LBC are further divided into three groups: mother migrated only, father migrated only and both parents migrated. Children from single-parent family are dropped from the sample.

Control variables include gender, age, boarding status, parental education level, and poor family (baseline). The distribution of family assets is generated from a series of dummy indicators about whether or not the student's family has vehicles, microwave oven, fridge, etc. Families with the lowest 20 % assets are identified as poor. In the survey, we also conducted 35-minutes standardized math tests to measure students' academic performance in both baseline and endline survey.

After dropping sample with variables mentioned above missing, we eventually got a full sample consisting of 5002 students.

## 3.3. Identification strategy

To explore the correlation between parental migration and non-cognitive abilities, we estimate the following equations using OLS method:

$$Y_i = \beta_0 + \beta_1 M i g_i + \varepsilon_i \tag{1}$$

$$Y_{is} = \beta_0 + \beta_1 M i g_i + \beta_2 X_i + C_s + \varepsilon_{is}$$
<sup>(2)</sup>

Eq. (1) is the baseline model using parental migration status as a regressor. In Eq. (2) a set of covariates  $X_i$  and class fixed effect  $C_s$  are added to capture the effect of student characteristics, their family background, and the impact of schools.

To investigate the impact of parental migration status on non-cognitive ability<sup>6</sup>, we narrow our analysis to two subsamples: long-term migration subsample and short-term migration subsample. The long-term subsample consists of 4016 students, whose father's migration status and mother's migration status remained unchanged across baseline and endline surveys. As parents survey is unavailable and parents' full migration history can hardly be obtained through student survey, we simply asked about parental migration status at the survey point. If we assume individual i's migration status is a random variable with the same distribution across different time periods, those who migrated continuously in observed periods have higher possibility of migration in each single period and their children are more likely to be LBC in more periods. Therefore, the differences between always LBC and always non-LBC represent the association between long-run parental migration status and non-cognitive abilities. The second subsample consists of 2556 students whose parents were at home at the baseline survey. We use this subsample's parental migration status at endline survey to identify change in parental migration status and estimate how a relatively short period of parental absence can affect students' non-cognitive abilities. The control groups, i.e., always non LBC, are identical in long-term subsample and short-term subsample.

The selection bias problem arises when parental migration is not exogenous. Since parents' migration decision depends on their own characteristics and the situation of their children, there could be large dispersion in many characteristics between LBC and non-LBC. Therefore, the coefficients estimated by OLS may not reflect the impact of parental migration, but rather the difference between LBC and non-LBC caused by other factors. We use Propensity Score Matching (PSM) method to correct selection bias on observed characteristics. By calculating the propensity score based on observed characteristics of LBC group and non-LBC group, the method pairs up the two groups and the difference on outcome variables are identified as the effect of parental migration. Also, considering possible bias in ordinary matching method, we use the Bias-Corrected Matching (BCM) estimator developed by Abadie and Imbens (2002) and Abadie, Drukker, Herr, and Imbens (2004). Exact matching at county level is implemented to minimize geographical mismatch. Each treatment observation is matched to

<sup>&</sup>lt;sup>6</sup> Note that the data only contains non-cognitive abilities assessed in September 2016, therefore traditional panel data causal inference method can not be applied. However, repeated assessment of non-cognitive abilities may be redundant due to the following reason: first, unlike other children outcomes sensitive to temporary changes in environment (eg. academic performance), personality traits show relatively high level rank-order stability in adolescence (Roberts & DelVecchio, 2000). Therefore, it is probably hard to detect the variation over the one-year survey span. Second, personality traits scores are particularly susceptible to measurement errors. Even if there is a change in personality traits, it may be created by measurement error, making causal inference taking advantage of time difference within individuals particularly unreliable.

three control observations with replacement (nearest neighbor matching), which is few enough to enable exact matching by county for nearly all observations but enough to reduce the asymptotic efficiency loss (Abadie et al., 2004). The covariates we use in matching include gender, age, baseline boarding status, mother's education, father's education, and family assets.

Another concern arises that as the matching is built upon observed demographic variables, it cannot address selection issue caused by unobserved factors (like poor academic achievement or problem behavior) that are correlated with both parents' migration decision and student abilities. We choose academic achievement as a proxy for unobservables: it is not only indicative of performance at school but is also related to problem behavior (eg. Barriga et al., 2002) and to a large extent affects parents' subjective evaluation on their children in China. We added student's baseline math score as a covariate in matching to partly correct the possible bias resulted from factors other than demographics.

Table 1 shows summary statistics of variables, including children's non-cognitive ability measurement scores, individual characteristics, and family background. Column (2) and (3) are the comparison between always non-LBC and LBC in the long-term subsample. Column (2) and (4) are the comparison between always non-LBC and new LBC in the short-term subsample<sup>7</sup>. The results imply that there's large gap between always non-LBC and always LBC on most characteristics, but the differences are subtle between always non-LBC and new LBC. It corroborates the necessity of using PSM at least in long-run effect estimation. Common support region is required to successfully implement the matching method. We regress parents' migration decision on matching covariates using Probit model and then use predicted value as the propensity score. Fig. 1 shows the propensity scores in both long-term migration and short-term migration subsamples. The overlap between LBC and non-LBC samples indicates that propensity matching score method is well grounded.

## 4. Results

## 4.1. OLS regression using full sample

Table 2 shows the regression results based on the full sample, with and without control variables. The left-behind status is measured by parental migration status at endline survey. Panel a and b show that, in general there's no significant difference in non-cognitive abilities between LBC and non-LBC. In addition, gender is closely related to personality traits: other things equal, girls are significantly less extroverted (0.07 point, 0.125 SD), more agreeable (0.123 point, 0.229 SD) and neurotic (0.095 point, 0.152 SD), and have higher grit score (0.091 point, 0.157 SD). On the scale of conscientiousness, boys and girls are similar. Children living in school dormitory are less agreeable. Though literature suggests that children undergo relatively more drastic change in personality traits during adolescence as they get mature (Soto, John, Gosling, & Potter, 2011), the results show that in our sample the linear association between age and personality traits is only significant on the extraversion domain. Mother's higher education level is significantly (and consistently) associated with higher extroversion, conscientiousness, openness and grit. However, these patterns do not surface between father's education level and children's personalities. The results imply that mothers are usually primary caregivers. Children born in poor family are less extroverted and open but are more agreeable than other children.

Literature suggests that different types of parental migration may have different impact on children. We divide LBC into three different groups: mother migrated only, father migrated only and both parents migrated. Table 3 shows that mother's migration is significantly correlated with several aspects of Big Five and Grit. It is negatively associated with conscientiousness, agreeableness and grit, which are generally considered as positive aspect of personality (or indicator of socialization); it is positively associated with neuroticism, which is generally considered as bad aspect of personality (or reverse indicator of socialization). The results, combined with the tighter association between mother's education level and non-cognitive abilities, imply that the presence of mother may play an important role in the development of children's personalities.

## 4.2. Long-term migration and non-cognitive ability

To investigate the links between long term parental migration and children's non-cognitive ability, we use the subsample containing children whose mother's migration status and father's migration status remained unchanged in the two periods. Table 4 shows that when only mother migrated for a relatively long period, children exhibit significantly lower level of conscientiousness (0.125 point, 0.219 SD) and grit (0.105 point, 0.182 SD) and higher level of neuroticism (0.122 point, 0.215 SD), i.e., lower emotional stability. Since neuroticism is related to self-concept (Heckman & Kautz, 2013), this finding is consistent with research on LBC's self-concept (see Luo et al., 2009 and Wang et al., 2014 for reviews; Wu & Zhang, 2017). Father's absence alone, on the other hand, is associated with higher level of children's extraversion and openness. This is probably because father's migration increased family income and thus made children more extraverted and open. Compared to non-LBC, children with both parents migrated have lower level of agreeableness and conscientiousness.

To address the issue of selection bias, we use BCM to examine the impact of parental migration on non-cognitive abilities. As BCM is the matching between two groups, we estimate the gap between different types of LBC against always non-LBC (Column 2 in Table 2). Since mother's migration status seems to play an important role in determining children's

<sup>&</sup>lt;sup>7</sup> For more detailed comparison between different types of parental migration, see Table A1.

#### Table 1

Characteristics of the full sample and subsamples.

	(1)	(2)	(3)	(4)	P-values	(2)-(4)
	Full Sample	Always non-LBC	Always LBC	new LBC at endline	(2)-(3)	
Extraversion	3.348	3.339	3.369	3.326	0.098	0.741
	(0.56)	(0.552)	(0.574)	(0.576)		
Agreeableness	3.744	3.742	3.760	3.660	0.298	0.028
	(0.536)	(0.543)	(0.513)	(0.594)		
Conscient	3.281	3.281	3.286	3.246	0.751	0.369
-iousness	(0.571)	(0.566)	(0.561)	(0.604)		
Neuroticism	2.911	2.906	2.920	2.898	0.477	0.853
	(0.626)	(0.636)	(0.611)	(0.618)		
Openness	3.409	3.400	3.425	3.309	0.18	0.022
	(0.568)	(0.581)	(0.553)	(0.575)		
Grit	3.384	3.381	3.388	3.320	0.71	0.126
	(0.578)	(0.580)	(0.572)	(0.579)		
Female	0.502	0.489	0.512	0.459	0.141	0.393
	(0.500)	(0.500)	(0.500)	(0.499)		
Age	13.250	13.193	13.293	13.299	0.001	0.094
	(0.949)	(0.916)	(0.980)	(0.985)		
Boarding	0.455	0.527	0.381	0.541	0.000	0.686
	(0.498)	(0.499)	(0.486)	(0.499)		
Father's education						
no school	5.3 %	6.3 %	3.9 %	5.2 %	0.000	0.255
Primary school	41.1 %	39.6 %	40.5 %	41.6 %		
Middle school	45.5 %	44.4 %	48.4 %	47.2 %		
High school and above	8.1 %	9.6 %	7.2 %	6%		
Mother's education						
no school	22.2 %	22.6 %	20.4 %	18.9 %	0.110	0.062
Primary school	46.9 %	44.7 %	48.0 %	48.9 %		
Middle school	26.2 %	27.2 %	27.1 %	30.0 %		
High school and above	4.8 %	5.5 %	4.6 %	2.1 %		
Asset_poor	0.233	0.171	0.284	0.215	0.000	0.098
	(0.423)	(0.377)	(0.451)	(0.411)		
Math score	0.000	0.069	-0.069	0.016	0.000	0.444
(baseline)	(1.000)	(1.017)	(0.986)	(0.969)		
N	5002	2323	1693	233		

Note: \* significant at 10 %; \*\* significant at 5 %; \*\*\* significant at 1 %. Source: author's survey.

development, we also estimate the effect of mother migrating against mother staying at home. In related estimations, the control group are students whose mother stayed at home, with or without father's migration. Exact matching on father's migration status is also applied.

We report the matching quality by comparing the standardized bias before and after the matching in Table A2, following Sianesi (2001) and Caliendo, Hujer, and Thomsen (2008). For each covariate, standardized bias is the difference in sample mean between the treatment and control groups divided by the square root of the average of the variance in both groups. It is a widely used indicator measuring the distance between treatment and control observations. The matching quality can be evaluated by the decrease in standardized bias after the matching. Chi-square test of joint significance and pseudo R-squares using probit model before and after matching are also reported. Table A2 shows that statistics improved after the matching.

Table 5 shows the matching estimation of the impact of different types of parental migration. The results in row 1) shows the estimators using BCM. Estimation in row 2) added student baseline score to control for unobservables. The results are consistent with previous ones that mother's migration has negative impact on conscientiousness, emotional stability, and grit. When mother migrated only, the child's conscientiousness decreases by 0.125 point (0.219 SD), grit decreases by 0.103 point (0.178 SD), and neuroticism increases by 0.113 point (0.18 SD). As father's migration has no impact on any of the non-cognitive ability measurements, the results combined suggest that mother plays more important role in formation of personalities for rural children in northwestern China.

The results echo other papers which conclude mother's migration has more deleterious effects on LBC's outcomes like academic performance and mental health (Chen et al., 2009; Jordan & Graham, 2012; Liu et al., 2009; Xu, 2018). Consider the two-folded effect of parental migration: the negative effect caused by lack of role model/parental attention/adult labor that prompts psychological and behavioral problems, and the positive effect caused by relieved financial stress. In both respects, mother's migration may be more harmful/less beneficial than father's: in rural areas women take more family responsibilities including caregiving and housework, therefore the absence of mother is more likely to decrease parent-child interaction and increase children's housework burden. Meanwhile, as women earn less than men in the labor market, mother's migration makes less economic contribution to the family. Though the mechanism seems quite clear, due to data limitation very few papers have examined the difference between mother's migration and father's migration explicitly (Xu, 2018).



Estimated propensity score: long run Graphs by 0=non-LBC; 1=father migrated only



Estimated propensity score: long run Graphs by 0=non-LBC; 1=mother migrated only





Estimated propensity score: short run Graphs by 0=non-LBC; 1=father migrated only



Estimated propensity score: short run Graphs by 0=non-LBC; 1=mother migrated only





**Fig. 1.** Estimated propensity score by types of migration in long run and short run subsamples. Source: author's survey.

#### Table 2

Parental migration and non-cognitive ability: full sample.

	Extraversion	Agreeableness	Conscientiousness	Neuroticism	Openness	Grit		
Panel a								
LBC	0.026	0.009	0.008	0.006	0.012	-0.003		
	(0.019)	(0.019)	(0.018)	(0.019)	(0.018)	(0.019)		
R2	0.001	0.000	0.000	0.000	0.000	0.000		
Panel b								
LBC	0.034	-0.024	-0.001	0.029	0.025	-0.004		
	(0.021)	(0.018)	(0.020)	(0.021)	(0.018)	(0.020)		
Female	-0.070***	0.123***	0.006	0.095***	-0.009	0.091***		
	(0.017)	(0.017)	(0.018)	(0.018)	(0.017)	(0.018)		
Age	-0.023**	0.000	0.009	0.013	-0.009	-0.009		
-	(0.010)	(0.008)	(0.009)	(0.009)	(0.010)	(0.009)		
Boarding	0.029	-0.056**	-0.000	-0.019	-0.033	-0.012		
C	(0.027)	(0.026)	(0.029)	(0.028)	(0.026)	(0.025)		
Father's education (Base = no	education)		( ,					
Primary school	-0.053	-0.018	0.081*	-0.048	0.022	0.024		
-	(0.039)	(0.035)	(0.041)	(0.044)	(0.044)	(0.044)		
Middle school	-0.029	-0.017	0.082*	-0.079*	0.036	0.035		
	(0.039)	(0.037)	(0.043)	(0.044)	(0.046)	(0.046)		
High school and above	-0.021	-0.075	0.026	-0.049	0.076	-0.002		
-	(0.048)	(0.046)	(0.053)	(0.052)	(0.054)	(0.056)		
Mother's education (Base = n	o education)							
Primary school	0.025	0.014	-0.001	-0.012	0.032	0.024		
-	(0.019)	(0.021)	(0.022)	(0.024)	(0.022)	(0.023)		
Middle school	0.029	0.044*	0.035	-0.044	0.073***	0.075***		
	(0.028)	(0.024)	(0.027)	(0.029)	(0.025)	(0.027)		
High school and above	0.076*	0.041	0.081*	-0.069	0.148***	0.107**		
-	(0.042)	(0.040)	(0.049)	(0.050)	(0.041)	(0.050)		
Asset_poor	-0.083***	0.041**	-0.007	0.034	-0.05***	0.008		
*	(0.019)	(0.019)	(0.021)	(0.024)	(0.020)	(0.022)		
Class fixed effect	Yes	Yes	Yes	Yes	Yes	Yes		
R2	0.048	0.090	0.067	0.073	0.066	0.066		
Ν	5002	5002	5002	5002	5002	5002		

Note: \* significant at 10 %; \*\* significant at 5 %; \*\*\* significant at 1 %. Robust standard errors in parentheses clustered at class level. Class fixed effects added. Source: author's survey.

To verify the mechanism, we compare the differences among the four different types of families in parent-child communication, family assets, and the proportion living with grandmother (at the endline). Parent-child communication is an index generated from two questions about how often parents tutor the child/discuss what happened at school with the child (more detailed data on other aspects of parent-child relationship is unavailable). Higher value represents higher frequency. Table 6 shows that there is no difference in the frequency of parent-child communication between non-LBC families and LBC families with father migrated only. However, the difference between non-LBC families and LBC families with father migrated only. However, the difference between non-LBC families and LBC families with grandmother. The evidence suggests that mothers usually take more child-caring responsibilities. Families with mother migrated only also have the lowest level of assets, indicating the positive wealth effect of migration is the lowest for this type of families.

#### Table 3

Parental migration type and non-cognitive ability: full sample.

	Extraversion	Agreeableness	Conscientiousness	Neuroticism	Openness	Grit
Father	0.041*	-0.006	0.029	0.014	0.033	0.017
migrated only	(0.022)	(0.020)	(0.023)	(0.022)	(0.020)	(0.023)
Mother	0.058	-0.059*	-0.073**	0.088**	0.007	-0.063*
migrated only	(0.042)	(0.035)	(0.034)	(0.038)	(0.042)	(0.035)
Both parents	-0.008	-0.066**	-0.063**	0.047	0.011	-0.045
migrated	(0.032)	(0.030)	(0.030)	(0.037)	(0.030)	(0.034)
Student characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Class fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.049	0.091	0.069	0.074	0.066	0.067
Ν	5002	5002	5002	5002	5002	5002

*Note*: \* significant at 10 %; \*\* significant at 5 %; \*\*\* significant at 1 %. Robust standard errors in parentheses clustered at class level. Student characteristics include gender, age, baseline boarding status, mother's education, father's education, and family assets. Coefficients on constant and student characteristics are not reported but is available from the author upon request. Source: author's survey.

## Journal of Asian Economics 72 (2021) 101261

#### Table 4

Parental migration type and non-cognitive ability: long term subsample.

	Extraversion	Agreeableness	Conscientiousness	Neuroticism	Openness	Grit
Father	0.043*	-0.011	0.030	0.017	0.051**	0.027
migrated only	(0.025)	(0.022)	(0.025)	(0.027)	(0.024)	(0.026)
Mother	0.072	-0.063	-0.125***	0.122**	0.046	-0.105**
migrated only	(0.056)	(0.047)	(0.042)	(0.051)	(0.053)	(0.049)
Both parents	-0.012	-0.074**	$-0.064^{*}$	0.066	0.043	-0.033
migrated	(0.035)	(0.033)	(0.034)	(0.042)	(0.032)	(0.038)
Student characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Class fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.055	0.098	0.077	0.082	0.071	0.077
Ν	4016	4016	4016	4016	4016	4016

*Note*: \* significant at 10 %; \*\* significant at 5 %; \*\*\*\* significant at 1 %. Robust standard errors in parentheses clustered at class level. Student characteristics include gender, age, baseline boarding status, mother's education, father's education, and family assets. Coefficients on constant and student characteristics are not reported but is available from the author upon request. Source: author's survey.

#### Table 5

Impact of different types of parental migration on non-cognitive abilities in long term subsample: average treatment effect on treated.

	Extraversion	Agreeableness	Conscientiousness	Neuroticcism	Openness	Grit	
a. Father Migrated Only							
a1) BCM	0.026	-0.015	0.032	0.031	0.040	-0.010	
	(0.027)	(0.025)	(0.027)	(0.029)	(0.027)	(0.028)	
a2) BCM with	0.025	-0.029	0.037	0.032	0.031	-0.013	
baseline score	(0.027)	(0.025)	(0.027)	(0.029)	(0.027)	(0.028)	
Ν	3493	3493	3493	3493	3493	3493	
b. Mother Migrated	Only						
b1) BCM	0.094*	-0.060	-0.090*	0.106*	0.052	-0.083	
	(0.057)	(0.052)	(0.054)	(0.059)	(0.055)	(0.053)	
b2) BCM with	0.080	-0.080	-0.125**	0.113*	0.047	$-0.103^{*}$	
baseline score	(0.056)	(0.052)	(0.053)	(0.059)	(0.054)	(0.053)	
Ν	2468	2468	2468	2468	2468	2468	
c. Both Parents Mig	ated						
c1) BCM	0.005	-0.002	-0.050	0.000	0.054	$-0.069^{*}$	
	(0.040)	(0.039)	(0.039)	(0.044)	(0.041)	(0.040)	
c2) BCM with	-0.010	-0.003	-0.059	0.006	0.049	$-0.078^{**}$	
baseline score	(0.040)	(0.039)	(0.039)	(0.044)	(0.041)	(0.039)	
Ν	2701	2701	2701	2701	2701	2701	
d. Mother Migrated							
d1) BCM	-0.012	-0.044	-0.079**	0.058*	0.027	-0.045	
	(0.034)	(0.029)	(0.032)	(0.034)	(0.031)	(0.032)	
d2) BCM with	-0.024	-0.061**	$-0.084^{***}$	0.059*	0.017	$-0.056^{*}$	
baseline score	(0.034)	(0.030)	(0.032)	(0.034)	(0.031)	(0.033)	
Ν	4016	4016	4016	4016	4016	4016	

*Note*: \* significant at 10 %; \*\*\* significant at 5 %; \*\*\*\* significant at 1 %. Robust standard errors in parentheses clustered at class level. We use Bias-Corrected Matching (BCM) estimator and each treatment observation is matched to three control observations with replacement (nearest neighbor matching). Exact matching by county is implemented to minimize geographical mismatch. The covariates we use in matching include gender, age, baseline boarding status, mother's education, father's education, and family assets. In panel d, father's migration status is also added to matching covariates. Source: author's survey.

## Table 6

Characteristics of four types of families: long term subsample.

	Parent-child communication	Family Assets	Living with grandmother
a. Non-LBC	0.099	-0.001	23.7 %
	(1.323)	(1.131)	
b. Father migrated only	0.088	-0.361	27.9 %
	(1.294)	(0.927)	
c. Mother migrated only	-0.108	-0.45	48.6 %
	(1.381)	(0.9)	
d. Both parents migrated	-0.83	-0.297	77.0 %
	(1.427)	(0.988)	

Source: author's survey.

#### Table 7

Parental migration type and non-cognitive ability: short term subsample.

	Extraver -sion	Agreeable -ness	Conscient -iousness	Neuroti -cism	Open -ness	Grit
Father	-0.043	-0.071	-0.039	0.047	-0.073*	-0.065
migrated only	(0.049)	(0.045)	(0.050)	(0.048)	(0.040)	(0.047)
Mother	0.152	-0.260**	-0.123	-0.019	-0.223*	-0.024
migrated only	(0.100)	(0.111)	(0.091)	(0.103)	(0.128)	(0.092)
Both parents	-0.064	-0.200	-0.137	0.229	-0.172	-0.124
migrated	(0.166)	(0.153)	(0.141)	(0.148)	(0.118)	(0.172)
Student characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Class fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.083	0.123	0.099	0.117	0.098	0.098
N	2556	2556	2556	2556	2556	2556

*Note*: \* significant at 10 %; \*\* significant at 5 %; \*\*\*\* significant at 1 %. Robust standard errors in parentheses clustered at class level. Student characteristics include gender, age, baseline boarding status, mother's education, father's education, and family assets. Coefficients on constant and student characteristics are not reported but is available from the author upon request. Source: author's survey.

#### Table 8

Impact of different types of parental migration on non-cognitive abilities in short term subsample: average treatment effect on treated.

	Extraver	Agreeable	Conscient	Neurotic	Open	Grit
	-sion	-ness	-iousness	-cism	-ness	
a. Father migrated only						
a1) BCM	-0.063	-0.105**	-0.000	0.065	-0.060	-0.052
	(0.050)	(0.048)	(0.052)	(0.055)	(0.049)	(0.050)
a2) BCM with	-0.068	-0.105**	0.008	0.060	-0.063	-0.048
baseline score	(0.050)	(0.048)	(0.052)	(0.055)	(0.050)	(0.050)
Ν	2509	2509	2509	2509	2509	2509
b. Mother migrated only						
b1) BCM	0.083	$-0.224^{*}$	-0.195*	-0.009	-0.316**	-0.110
	(0.116)	(0.119)	(0.111)	(0.109)	(0.138)	(0.111)
b2) BCM with	0.129	-0.259**	-0.156	-0.036	-0.278**	-0.070
baseline score	(0.107)	(0.120)	(0.108)	(0.106)	(0.136)	(0.110)
Ν	2354	2354	2354	2354	2354	2354
c. Both parents migrated						
c1) BCM	0.218	-0.081	0.012	0.184	-0.216	-0.021
	(0.176)	(0.149)	(0.136)	(0.159)	(0.163)	(0.159)
c2) BCM with	0.070	-0.179	-0.090	0.083	-0.249	-0.032
baseline score	(0.152)	(0.146)	(0.149)	(0.156)	(0.163)	(0.163)
Ν	2339	2339	2339	2339	2339	2339
d. Mother migrated						
d1) BCM	0.084	$-0.186^{*}$	-0.106	0.137	-0.275**	-0.097
	(0.102)	(0.106)	(0.104)	(0.108)	(0.112)	(0.097)
d2) BCM with	0.086	-0.035	-0.177*	-0.011	-0.146	0.024
baseline score	(0.091)	(0.122)	(0.100)	(0.101)	(0.109)	(0.092)
Ν	2556	2556	2556	2556	2556	2556

*Note*: \* significant at 10 %; \*\* significant at 5 %; \*\*\* significant at 1 %. Robust standard errors in parentheses clustered at class level. We use Bias-Corrected Matching (BCM) estimator and each treatment observation is matched to three control observations with replacement (nearest neighbor matching). Exact matching by county is implemented to minimize geographical mismatch. The covariates we use in matching include gender, age, baseline boarding status, mother's education, father's education, and family assets. In panel d, father's migration status is also added to matching covariates.Source: author's survey.

The results in Table 5 also show that when both parents migrate, LBC do not have lower level of conscientiousness or higher level of neuroticism compared to LBC. Why do children with mother absent are less conscientious and emotionally stable while children with both parents absent are not? One explanation is that the migration of both parents can better help the improvement of economic conditions, as is shown in Table 6, family assets column. Another possible reason is the participation of grandparents when both parents are absent (Murphy et al., 2016; Xu, 2018). Table 6 reveals that children with both parents migrated are much more likely to live with grandparents than those with migrant mother only. It suggests that families' living arrangement adjusts with migration decisions and can further compensates for the loss caused by parental absence. The overall effect becomes that children whose mother migrated only fare worse than all other children.

#### 4.3. Short-term migration and non-cognitive ability

It is worth noting that previous literature pertaining to parental absence and big-five personality traits mainly considers the effect in the long run, partly because the big five personality traits are relatively stable across age (Cobb-Clark & Schurer, 2012; Hampson & Goldberg, 2006). However, consider its lower short-term stability among children and adolescents

(Hampson & Goldberg, 2006; Roberts & DelVecchio, 2000), it is meaningful to examine the immediate impact of parental migration on Big Five. We use the subsample containing children whose parents were at home at the baseline survey. Table 7 shows that compared to children whose parents stayed at home across two waves, those whose mother migrated by endline survey appear less agreeable and open. In the short run, father's absence is also related to lower level of children's openness.

To address the issue of selection bias, we use BCM to examine the impact of parental migration on non-cognitive abilities. Table 8 shows the results using bias corrected nearest neighbor matching. Since mother's migration status seems to play an important role in determining children's development, we also report the effect of mother migrating against mother staying home. Statistics on matching quality (Table A3) indicate that the BCM method successfully reduced selection bias caused by observed factors.

The results show that apart from negative impact on conscientiousness, mother's migration also has negative impact on agreeableness and openness in the short run. In addition, father's migration is also harmful to children's agreeableness. Compared to the long-run results, the dimensions of non-cognitive ability affected by parental migration are different. However, as barely any paper investigated the change of personality traits over a short span (1 year), by far no explanation can be provided. Further research is needed to explore whether the impact on agreeableness and openness in the short run is simply a temporary shock caused by temporary parental absence that could be appeased during the course of socialization, or a lurking damage on children that may manifest in the future.

## 5. Conclusion

Children can undergo vast change in non-cognitive abilities/personality traits (Hampson & Goldberg, 2006). Empirical evidence from various disciplines proves that environmental factors in childhood and adolescence play a pivotal role in development of skills and formation of personality (Knudsen et al., 2006). Though the impact of parental migration has drawn much attention from the public and the academia alike, too little is known about the development of left-behind children's non-cognitive abilities. This paper addresses this topic by estimating the impact of parental migration in the long and short run on middle school students' non-cognitive abilities measured by Big Five Scales and Grit scales.

Our results show that parental migration has different impact on children's non-cognitive abilities. Mother's absence is crucial. In the long run LBC with migrant mothers tend to show lower levels of conscientiousness, agreeableness, and grit; they also have higher level of neuroticism (or lower level of emotional stability). Causal inference using Propensity Score Matching method shows that when mother migrated only, children's conscientiousness and grit level decreased, and neuroticism increased. Conscientiousness assesses personal characteristics such as persistence, dutifulness, and impulse control etc. Literature in psychology has early reached a consensus that among all dimensions of Big Five, the importance of conscientiousness should be emphasized since it is consistently associated with performance and career success among all occupations (Barrick & Mount, 1991; Mount & Barrick, 1998). Conscientiousness is also correlated with a great variety of educational achievement measures, adulthood physical and mental health, and well-beings (e.g., Goodwin & Friedman, 2006; Kern & Friedman, 2008; Poropat, 2009; Steptoe & Wardle, 2017). Therefore, the lack of conscientiousness among LBC, especially for those with migrated mothers, is particularly alarming. The result also shows that LBC with both parents migrate fare similar to non-LBC. It highlights the importance of the family structure in which grandparents can take over looking after children when parents are absent.

In the short run, when mother/both parents migrate, children tend to show decreased levels of agreeableness, conscientiousness, and openness. Father's absence also decreased the level of agreeableness. However, considering the effect on agreeableness and openness is not significant in the long-run regression, further research is needed to explore whether the impact on agreeableness and openness in the short run is simply a temporary shock caused by temporary parental absence that could be appeased during the course of socialization, or a lurking damage on children that may manifest in the future.

## Funding

This work was supported by National Natural Science Foundation of China (No. 71933003), the Youth Project of Humanities and Social Sciencesby Ministry of Education (No. 19YJC790080), and the Fundamental Research Funds for Central Universities (No. 17SZYB02).

## Acknowledgement

The authors thank Li Lemin and two anonymous reviewers for helpful discussions. The authors take responsibility for any errors.

## Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j. asieco.2020.101261.

#### References

- Abadie, A., & Imbens, G. W. (2002). Simple and bias-corrected matching estimators for average treatment effects (No. t0283). National Bureau of Economic Research.
- Abadie, A., Drukker, D., Herr, J. L., & Imbens, G. W. (2004). Implementing matching estimators for average treatment effects in Stata. *The Stata Journal*, 4(3), 290–311.
- Almlund, M., Duckworth, A. L., Heckman, J., & Kautz, T. (2011). Personality psychology and economics. Handbook of the economics of education, Vol. 4, Elsevier, pp. 1–181.
- Antman, F. (2012). The impact of migration on family left behind. International Handbook on the Economics of Migration, 6374, 1-34.
- Bai, Y., Zhang, L., Liu, C., Shi, Y., Mo, D., & Rozelle, S. (2018). Effect of parental migration on the academic performance of left behind children in North Western China. The Journal of Development Studies, 54(7), 1154–1170.
- Barrick, M. R., & Mount, M. K. (1991). The big five personality dimensions and job performance: A meta-analysis. Personnel Psychology, 44(1), 1–26.

Barriga, A. Q., Doran, J. W., Newell, S. B., Morrison, E. M., Barbetti, V., & Dean Robbins, B. (2002). Relationships between problem behaviors and academic achievement in adolescents: The unique role of attention problems. *Journal of Emotional and Behavioral Disorders*, 10(4), 233–240.

Blattman, C., Jamison, J. C., & Sheridan, M. (2017). Reducing crime and violence: Experimental evidence from cognitive behavioral therapy in Liberia. American Economic Review, 107(4), 1165–1206.

Borghans, L., Duckworth, A. L., Heckman, J. J., & Ter Weel, B. (2008). The economics and psychology of personality traits. *Journal of Human Resources*, 43(4), 972–1059.

- Brunello, G., & Schlotter, M. (2011). Non-cognitive skills and personality traits: Labour market relevance and their development in education & training systems (No. 5743). IZA Discussion Papers.
- Caliendo, M., Hujer, R., & Thomsen, S. L. (2008). The employment effects of job creation schemes in Germany: A microeconometric evaluation. In L. Millimet, J. A. Smith, & E. Vytlacil (Eds.), Modelling and evaluating treatment effects in econometrics: (21. pp. 381–428). Modelling and evaluating treatment effects in econometrics, 381–428.

Carneiro, P., Crawford, C., & Goodman, A. (2007). The impact of early cognitive and non-cognitive skills on later outcomes. Centre for the Economics of Education, LSE.

Chan, K. W. (2013). China: Internal migration. The encyclopedia of global human migration. Blackwell Publishing Ltd.

Chang, F., Jiang, Y., Loyalka, P., Chu, J., Shi, Y., Osborn, A., et al. (2019). Parental migration, educational achievement, and mental health of junior high school students in rural China. China Economic Review, 54, 337–349.

Chen, X., Huang, Q., Rozelle, S., Shi, Y., & Zhang, L. (2009). Effect of migration on children's educational performance in rural China. Comparative Economic Studies, 51(3), 323–343.

Cheng, H., & Li, T. (2017). The effects of personality traits on wages: Empirical analyses based on the china employer-employee survey (CEES). Economic Research Journal, 2, 171–186.

Cobb-Clark, D. A., & Schurer, S. (2012). The stability of big-five personality traits. *Economics Letters*, 115(1), 11–15.

Costa, P. T. Jr., & McCrae, R. R. (1992). Four ways five factors are basic. Personality and Individual Differences, 13(6), 653-665.

Deke, J., & Haimson, J. (2006). Valuing student competencies: Which ones predict postsecondary educational attainment and earnings, and for whom? Final report. Mathematica Policy Research, Inc.,

Del Boca, D., Piazzalunga, D., & Pronzato, C. (2014). Early child care and child outcomes: the role of grandparents. IZA Discussion Papers. 8565.

Deng, L., & Tong, T. (2020). Parenting style and the development of noncognitive ability in children. China Economic Review, 62101477.

Dong, Z., & Zhao, J. (2019). "Left-behind" experience and competition preference of children: A field Experimental study from central rural China. *Economic Perspectives (Jingjixue Dongtai)*(4), 4.

Duan, C. R., Lv, L. D., Guo, J., & Wang, Z. P. (2013). Survival and development of left-behind children in rural China: Based on the analysis of sixth census data. *Population Journal*, 35(3), 37–49.

Duckworth, A. L., Peterson, C., Matthews, M. D., & Kelly, D. R. (2007). Grit: Perseverance and passion for long-term goals. Journal of Personality and Social Psychology, 92(6), 1087–1101.

Duncan, G. J., & Magnuson, K. (2011). Early childhood poverty. Pathways winter 2011. Stanford, CA: Stanford University.

Fiorini, M., & Keane, M. P. (2014). How the allocation of children's time affects cognitive and noncognitive development. Journal of Labor Economics, 32(4), 787-836.

Gao, J. (2010). Analysis on the self-consciousness of rural migrant workers' left-behind children and the influencing factors. *China Journal of Health Psychology*, *18*(5).

Goldsmith, A. H., Veum, J. R., & Darity, W. Jr. (1997). The impact of psychological and human capital on wages. Economic Inquiry, 35(4), 815-829.

Gong, J., Yi, L., & Song, H. (2018). The effect of teacher gender on students' academic and noncognitive outcomes. *Journal of Labor Economics*, 36(3), 743–778.
Gong, J., Lu, Y., & Song, H. (2019). Gender peer effects on students' academic and noncognitive outcomes: Evidence and mechanisms. *Journal of Human Resources*0918-9736R2.

Goodwin, R. D., & Friedman, H. S. (2006). Health status and the five-factor personality traits in a nationally representative sample. Journal of Health Psychology, 11(5), 643-654.

Hall, M., & Farkas, G. (2011). Adolescent cognitive skills, attitudinal/behavioral traits and career wages. Social Forces, 89(4), 1261–1285.

Hampson, S. E., & Goldberg, L. R. (2006). A first large cohort study of personality trait stability over the 40 years between elementary school and midlife. *Journal of Personality and Social Psychology*, 91(4), 763–779. http://dx.doi.org/10.1037/0022-3514.91.4.763.

Heckman, J. J., & Kautz, T. (2013). Fostering and measuring skills: Interventions that improve character and cognition (No. w19656). National Bureau of Economic Research.

Heckman, J. J., & Rubinstein, Y. (2001). The importance of noncognitive skills: Lessons from the GED testing program. American Economic Review, 91(2), 145–149.

Heckman, J. J., Stixrud, J., & Urzua, S. (2006). The effects of cognitive and noncognitive abilities on labor market outcomes and social behavior. *Journal of Labor Economics*, 24(3), 411–482.

Jia, Z., Shi, L., Cao, Y., Delancey, J., & Tian, W. (2010). Health-related quality of life of "left-behind children": A cross-sectional survey in rural China. Quality of Life Research, 19(6), 775–780.

John, O. P., Naumann, L. P., & Soto, C. J. (2008). Paradigm shift to the integrative big-five trait taxonomy: History, measurement, and conceptual issues. In O. P. John, R. W. Robins, & L. A. Pervin (Eds.), Handbook of personality: Theory and research (pp. 114–158). New York, NY: Guilford Press.

Jordan, L. P., & Graham, E. (2012). Resilience and well-being among children of migrant parents in South-East Asia. *Child Development*, 83(5), 1672–1688. Kern, M. L., & Friedman, H. S. (2008). Do conscientious individuals live longer? A quantitative review. *Health Psychology*, 27, 505–512.

Knudsen, E. I., Heckman, J. J., Cameron, J. L., & Shonkoff, J. P. (2006). Economic, neurobiological, and behavioral perspectives on building America's future workforce. Proceedings of the National Academy of Sciences, 103(27), 10155–10162.

Kuhn, P., & Weinberger, C. (2005). Leadership skills and wages. Journal of Labor Economics, 23(3), 395-436.

Lee, L., & Park, A. (2010). Parental migration and child development in china (Working Paper). Gansu Survey of Children and Families.

Liu, Z., Li, X., & Ge, X. (2009). Left too early: The effects of age at separation from parents on Chinese rural children's symptoms of anxiety and depression. American Journal of Public Health, 99(11), 2049–2054.

Luo, J., Wang, W., & Gao, W. (2009). Review of the studies on rural left-behind children in China. Advances in Psychological Science, 17(5), 990–995. Maccoby, E. E. (1992). The role of parents in the socialization of children: An historical overview. Developmental Psychology, 28(6), 1006.

McCrae, R. R., & Costa, P. T. (1987). Validation of the five-factor model of personality across instruments and observers. Journal of Personality and Social Psychology, 52(1), 81.

McKenzie, D., & Rapoport, H. (2011). Can migration reduce educational attainment? Evidence from Mexico. Journal of Population Economics, 24(4), 1331– 1358.

Moretti, M. M., & Peled, M. (2004). Adolescent-parent attachment: Bonds that support healthy development. Paediatrics & Child Health, 9(8), 551–555.

Mount, M. K., & Barrick, M. R. (1998). Five reasons why the "big five" article has been frequently cited. *Personnel Psychology*, *51*(4), 849–857. Murphy, R., Zhou, M., & Tao, R. (2016). Parents' migration and children's subjective well-being and health: Evidence from rural china: Evidence from rural

china. Population, Space and Place, 22(8), 766–780.

National Bureau of Statistics (2018). China national statistical yearbook. Beijing: China Statistics Press.

Poropat, A. (2009). A meta-analysis of the five-factor model of personality and academic performance. Psychological Bulletin, 135, 322-328.

Prinzie, P., Stams, G. J. J., Deković, M., Reijntjes, A. H., & Belsky, J. (2009). The relations between parents' Big Five personality factors and parenting: A metaanalytic review. Journal of Personality and Social Psychology, 97(2), 351.

Radl, J., Salazar, L., & Cebolla-Boado, H. (2017). Does living in a fatherless household compromise educational success? A comparative tudy of cognitive and non-cognitive skills. European Journal of Population, 33(2), 217–242.

Roberts, B. W., & DelVecchio, W. F. (2000). The rank-order consistence of personality traits from childhood to old age: A quantitative review of longitudinal studies. *Psychological Bulletin*, 126, 3–25.

Roberts, B. W., Kuncel, N. R., Shiner, R. L., Caspi, A., & Goldberg, L. R. (2007). The power of personality: The comparative validity of personality traits, socioeconomic status, and cognitive ability for predicting important life outcomes. *Perspectives in Psychological Science*, 2(4), 313–345.

Robinson, O. C., Lopez, F. G., & Ramos, K. (2014). Parental antipathy and neglect: Relations with Big five personality traits, cross-context trait variability and authenticity. *Personality and Individual Differences*, 56, 180–185.

Schofield, T. J., Conger, R. D., Donnellan, M. B., Jochem, R., Widaman, K. F., & Conger, K. J. (2012). Parent personality and positive parenting as predictors of positive adolescent personality development over time. *Merrill-Palmer Quarterly (Wayne State University. Press)*, 58(2), 255.

Sianesi, B. (2001). An evaluation of the active labour market programmes in Sweden. The Review of Economics and Statistics, 86(1), 133-155.

Soto, C. J., John, O. P., Gosling, S. D., & Potter, J. (2011). Age differences in personality traits from 10 to 65: Big Five domains and facets in a large cross-sectional sample. Journal of Personality and Social Psychology, 100(2), 330.

Steptoe, A., & Wardle, J. (2017). Life skills, wealth, health, and wellbeing in later life. PNAS, 114(17)201616011.

Wang, S. X. (2014). The effect of parental migration on the educational attainment of their left-behind children in rural China. The BE Journal of Economic Analysis & Policy, 14(3), 1037–1080.

Wang, X., Ling, L., Su, H., Cheng, J., Lin, J., & Sun, Y.-H. (2014). Self-concept of left-behind children in china: A systematic review of the literature. Child Care Health and Development, 41(3).

Wen, M. (2008). Family structure and children's health and behavior: Data from the 1999 National Survey of America's Families. *Journal of Family Issues*, 29 (11), 1492–1519.

Wen, M., Su, S., Li, X., & Lin, D. (2015). Positive youth development in rural China: The role of parental migration. *Social Science & Medicine*, 132, 261–269. Wu, J., & Zhang, J. (2017). The effect of parental absence on child development in rural china. *Asian Economic Policy Review*, 12(1).

Xu, Q. (2018). The impacts of migrating parents on academic performance of the rural left-behind children. Youth Studies (Qingnian Yanjiu)6.

Yu, X., Dai, X., Li, Q., Wang, L. L., & Li, L. G. (2014). Logistic regression analysis on behavior problems and influence factors of left-behind children in rural areas of Ningxia. *China Journal of Health Psychology*, 6, 53.

Zhang, H., Behrman, J. R., Fan, C. S., Wei, X., & Zhang, J. (2014). Does parental absence reduce cognitive achievements? Evidence from rural China. Journal of Development Economics, 111, 181–195.

Zhao, Y. (1999). Labor migration and earnings differences: The case of rural China. Economic Development and Cultural Change, 47(4), 767-782.

Zhou, Z., Sun, X., Liu, Y., & Zhou, D. (2005). Psychological development and education problems of children left in rural areas. Journal of Beijing Normal University (Social Science Edition), 1.