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Academic Development and Mental Health of Left-behind Children in Rural China: A Study Using Propensity Score Matching Techniques and a Nationally-Representative Dataset

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy

in Education

by

Jue Liao

2022

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ABSTRACT OF THE DISSERTATION

Academic Development and Mental Health of Left-behind Children in Rural China:
A Study Using Propensity Score Matching Techniques and a Nationally-Representative Dataset

by

Jue Liao

Doctor of Philosophy in Education

University of California, Los Angeles, 2022

Professor Michael H. Seltzer, Chair

China's massive rural-to-urban migration in the past three decades has resulted in more than 60 million children left behind in rural villages by their migrating parents. While parental migration brings extra income via remittance, it also disrupts the family structure and strips children of parental care and supervision, thus exposing them to higher developmental risks. Using propensity score matching techniques and a nationally-representative panel dataset, this study examines the impact of parental migration on the academic development and mental health of China's left-behind children. Findings show left-behind children faring no worse than the rural native children in terms of school grade and cognitive ability but reporting significantly lower subjective well-being and higher psychological distress. Treatment effect variation by gender and by parental migration mode reveals left-behind boys and children left behind by mothers and by both parents to be more vulnerable to the harmful effects of parental migration. The results

suggest that while the increased household income via remittance may buffer the negative consequences of parental separation on left-behind children's academic development, it does not alleviate the adverse effects in the mental health domain. Matched data using the propensity score suggest that left-behind children's mental health is related to the strength of parental bonding and the level of tension within the family. These findings call for policy intervention to address left-behind children's mental health.

The dissertation of Jue Liao is approved.

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2022

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Chapter 1

Introduction

On the night of June 9th, 2015, in a small rural village in Guizhou Province, a muffled dropping sound alerted villager Zhang. Turning on the flashlight, he followed the sound to a small three-floor house about 30 meters from his own and found in front of the house a boy lying on the ground, motionless. Villager Zhang, as well as everyone else in the village, knew the house was occupied by four siblings: a 13-year-old brother and three younger sisters, ages 9, 8, and 5. They lived all by themselves, with no adults looking after them. Although first responders arrived at the scene shortly, the older brother was already dying, and the three sisters who were found in a 3rd-floor bedroom died later in the hospital after failed rescue attempts. It was later confirmed that the siblings committed group suicide by drinking pesticides. Before their suicidal act, they burned all their school books and stationaries and left behind no notes to explain their actions. According to the villagers, the siblings lived on their own: their father was a migrant worker who lived and worked away from the home the vast majority of the time, and their mother abandoned the family a year earlier. Contrary to speculation, the siblings had sufficient food in stock and 3,500 RMB in their bank account to support daily living. They did, however, severely lack parental supervision and care, as recalled by distant family members and neighbors, and were reserved and unsocial, rarely engaging in conversations with outsiders. When reports (Bai, 2015) on the incident came out two days later, the parents were still nowhere to be found but the news shook the Chinese society and exposed the shocking hardship faced by a large group of vulnerable children known as the “left-behind” children.

Left-behind children (LBC, hereafter), by definition, are children who stay behind in their rural villages while one or both of their parents move into the cities to fill primarily low-wage jobs and are absent from home for a significant amount of time. According to an official report by All China Women's Federation (2013), there were 61 million LBC in China in 2010, which constitutes 22% of all China's children; the actual number may be a lot higher today. They fall into all developmental stages: 38% between ages 0-5, 32% between ages 6-11, and 30% between ages 12-17. Almost half of all LBC are separated from both parents and left under the custody of either aging grandparents or other caregivers such as older siblings or extended family members. Three percent of LBC are left completely on their own (All China Women's Federation, 2013).

The presence of LBC is closely linked to China's labor migration. Although labor migration and LBC are common in developing countries as a result of economic development, the key feature that distinguishes China from other countries such as the Philippines, Bangladesh, and Thailand (Asis, 2006; Kuhn, 2006; Jampaklay, 2006) is the nation's unique household registration system known as the hukou system. Instituted in 1958 to regulate internal population mobility, the hukou system classifies every Chinese citizen as either "rural" or "urban" and the status is passed down through the maternal line. This classification not only determines one's residence but also the benefits he or she would receive from the government, including education, food, employment, health insurance, housing, and social security (Solinger, 1999), so that rural residents without an urban hukou would have no access to state-provided resources had they moved into the urban cities. The hukou system had long been successful in constraining rural-to-urban migration; however, since the nation's 1979 economic reform, a widening income gap between the rural and the urban, coupled with a surplus of rural farmers due to increased agricultural productivity, drove millions of rural workers into China's urban centers despite the

many restrictions imposed by the hukou system. According to the sixth Chinese Census, China's migration population reached 274 million in 2014 (National Bureau of Statistics of China, 2015), creating the largest peacetime migration in human history (Rozelle et al., 1999). Although the hukou system failed to restrain the influx of rural workers into the cities, the institutional barriers it poses, however, were successful in keeping the majority of rural workers from bringing their family members. In 2011, only 21 percent of rural migrants brought along their entire family (National Bureau of Statistics of China, 2012); the rest chose to leave behind their loved ones, thus giving rise to a large population of LBC.

Because parental migration disrupts LBC's family structure and deprives them of parental supervision and care, LBC are considered to be at much higher risk of educational, health, behavioral, and psychological issues (Liang, 2016; Fan, 2013). This is in line with the predictions of child developmental theories in the field of psychology (McLanahan & Sanderfur, 1994), which underscore the harmful consequences of parental separation for a range of child outcomes. However, from an economist's point of view, labor migration is seen as a strategy to improve the socioeconomic circumstances of the entire household, potentially bringing benefits to everyone in the family (the household strategy theory, Stark & Bloom, 1985).

Although it is unclear how exactly the lives of LBC are being affected by parental rural-to-urban migration, the magnitude and severity of the issues facing them have caught enough attention to spur the Chinese government and the research community into action. As early as 2001, the Chinese central government announced that the local government and public schools in destination cities are to bear the key responsibilities for the education of rural children who migrate into the cities with their migrant parents, thus alleviating some of the institutional barriers hindering migrants from bringing their children (Zhou, 2014). When China announced

its urbanization blueprints for 2014-2020, one of the goals was to grant 100 million urban hukou to rural migrants before 2020 (Liang, 2016). These transformative undertakings show a glimpse of China's pursuit of "balanced development" to narrow the nation's persistent rural-urban gap and help the rural-to-urban migrants assimilate in destination cities. In the research community, scholars nationally and internationally have zoomed in on China's LBC (i.e., Ye & Murray, 2005; Ye & Pan, 2008; Jordan, Ren, & Falkingham, 2014; Xu & Xie, 2015; Yeung & Gu, 2016). Using different disciplinary lens, data sources, and methodologies, a growing body of research has examined the lives of LBC and yielded valuable information on how and why they are being affected by parental migration in a range of domains, all of which are important for policymaking.

This study contributes to this ongoing effort by examining the impact of parental migration on the academic development and mental health of LBC. Using 2010, 2012, 2014, and 2016 waves of the China Family Panel Studies (CFPS), a high-quality longitudinal dataset, and propensity score matching techniques, this study seeks to answer four research questions:

1. What are the characteristics of LBC?
2. What is the impact of parental migration on LBC in terms of academic development and mental health?
3. Do these effects vary by gender?
4. Do these effects vary by parental migration mode?

This study contributes to the current body of research on LBC in several ways. First, it uses data from four waves of the CFPS, which to the author's knowledge is the largest number of waves used in a single study. Second, it examines four child outcomes in two developmental domains (two in the academic domain and two in the mental health domain); the measures used

for these outcomes are strong measures: except for school grade, the other three are all single numeric summaries of multi-item scales or tests. Third, it uses propensity score matching to eliminate some selection bias. Fourth, it examines substantively important subgroups by gender and by parental migration mode. Lastly, it offers plausible explanations on how the two contrasting theories might be at work to predict LBC's outcomes in different domains as a consequence of parental migration; it also proposes potential factors that will mitigate some of the negative effects.

The rest of the paper is organized as follows: Chapter 2 reviews the literature examining similar research questions. Chapter 3 introduces the data source, methods, key measures, and analytical samples. Chapters 4-7 present the analysis and results for each of the four research questions. Chapter 8 presents the discussions, policy recommendations, and future work.

Chapter 2

Literature review

2.1 Contrasting theories

How would rural-to-urban parental migration impact LBC's developmental well-being? Two theories offer contrasting predictions.

From an economics point of view, the household strategy theory (Stark & Bloom, 1985) views emigration as a strategy to improve the socioeconomic circumstances of the entire household; hence, LBC are expected to benefit from their parents' migration. Asis (2006), when examining the 2003 Filipino Children and Family Survey, finds a significantly higher social economic standing of LBC's families. Du, Park, & Wang (2005) find that having a migrant in the family increases the rural household's per capita income by 18 percent. The increase in household income could enable a family to invest in healthier food, safer shelter, a more enriching learning environment, and more quality time with caretakers, all of which are beneficial for child development. The existence of a strong association between higher income and more positive child outcomes has been firmly established in the Western literature (i.e., Duncan et al., 2010; Duncan et al., 2011; Akee, et al., 2010).

From a psychology perspective, theories on child development underscore detrimental consequences of parental separation for a range of child outcomes, including educational, cognitive, and psychological well-being (McLanahan & Sanderfur, 1994); hence, LBC are expected to experience negative effects as a consequence of their parents' migration. Lareau (2003) finds a positive association between parental involvement and a child's long-term development while Demaray et al. (2005) find parental support to be a significant predictor of children's capacity to handle stress, anxiety, and self-regulation. On the flip side, studies report

deficiency in parental supervision and communication in migrant families hampers children's overall development (Bernhard et al., 2009; Kandel & Kao, 2001; Lu, 2012).

2.2 Earlier empirical studies

There is a growing body of empirical studies examining outcomes for China's LBC as a consequence of parental migration. This section presents a review of selective studies published up to 2015, a period when high-quality, large-scale, longitudinal data sources relevant and suitable for addressing this issue are few.

Although not fully consistent, the majority of earlier literature examining the impact of parental migration on the psychosocial and behavioral outcomes of children left behind has found a negative impact. Using survey data from 1,708 adolescents from rural Central China and interviews with 32 left-behind children and their head teachers, Sun et al. (2015) find LBC at a disadvantage regarding emotional adjustment (i.e., lower life satisfaction, lower self-esteem, and higher depression) when compared to their non-left-behind counterparts. A case-control study using the Rutter Children's Behavior Questionnaire by Yang & Zheng (2012) finds LBC have more behavioral problems than rural children from intact families. A meta-analysis by Wang and Mesman (2015) reviews empirical studies on China's LBC published both in English and Chinese and finds LBC showing significantly less favorable emotional and social functioning than other rural children; additionally, it also finds evidence for publication bias against studies published in Chinese that show less favorable outcomes for LBC.

Earlier literature examining the educational outcome of LBC, however, has come to rather neutral conclusions; that is, parental migration does not seem to harm nor benefit the children left behind. Ethnographic work in seven major migrant-sending provinces reveals no

difference in LBC's academic achievement and aspiration when compared to their non-left-behind counterparts (Ye & Murray, 2005; Ye & Pan, 2008). A quantitative study examining the effect of parental migration on a child's academic engagement also finds no significant differences (Chen et al., 2013). Another quantitative study using a longitudinal dataset (Lu, 2012) finds that parental migration has not given children left behind a significant advantage in educational prospects.

2.3 Limitations of earlier literature

The body of literature cited above sheds valuable insight into the issue. However, they are subject to several limitations.

First, the majority of the data used in earlier literature is cross-sectional survey data, which is somewhat limited in addressing the impact of parental migration on children's developmental outcomes because there is usually a lag between the time when children first separate from their parents and the time when changes show up. In addition, most data used is region-specific, limiting its generalizability to the whole nation. According to Wang and Mesman's meta-analysis (2015), out of the 81 studies only 3 used longitudinal data and 75 used region-specific data that is confined to one or a few provinces. High-quality survey data that is nationally-representative and longitudinal would be ideal, but only a handful of such datasets exist in China at the time and not all are publicly available or substantively relevant.

Second, when analyzing these non-experimental data, most studies utilized multiple regression. While useful in identifying factors that are associated with the outcomes of interest, multiple regression is limited in addressing causal impact due to selection bias. A better method is propensity score matching (Rosenbaum & Rubin, 1983), which matches LBC with control

units based on key covariates that affect both the child's chance of being left behind and the outcome of interest, such that the matched groups approximate a randomized experiment with minimal selection bias.

Third, most studies examined a single outcome or several outcomes from a single domain. Because child development is a multi-faceted experience, migration may have differential effects on different domains of a child's well-being (Greenman & Xie, 2008). To capture a fuller picture of the effect, it is ideal to examine a range of outcomes from multiple developmental domains. Furthermore, many of the outcome measures are based on single survey items, i.e., educational attainment as measured by the question "How many years of education did you complete?" (Lu, 2012). While these simple indicators are useful to examine, other outcomes, such as educational achievement, engagement, or cognitive functioning may capture more of a child's academic development above and beyond the number of years spent in school. Data permitting, composite variables constructed from multiple items via factor analysis can provide more robust outcome measures for meaningful and complex concepts that are not directly observable.

2.4 CFPS-based empirical studies

CFPS, a longitudinal and nearly nationally-representative dataset, was launched in 2010 to survey Chinese communities, families, and individuals biennially. The availability of this dataset has enabled the research community to further examine the developmental outcomes of LBC. Table 2.1 summarizes some recent publications that have utilized the CFPS.

Similar to earlier literature, the findings from these CFPS-based studies also find a general lack of impact on educational outcomes (Jordan, Ren, & Falkingham, 2014; Xu & Xie,

2015; Yeung & Gu, 2016) and a negative impact on socio-emotional outcomes (Ding & Buhs, 2017; Tang, 2017; Zhou et al., 2018; Shen & Zhang, 2018) except for Ren & Treiman (2016). Several papers also conclude that the main difference in outcomes does not exist among the different types of rural children but continues to persist between children of rural origins and children of urban origins (Xu & Xie, 2015; Yeung & Gu, 2016).

Another feature of these newer studies, owing to the rich set of variables collected by the CFPS, is the exploration of a few moderators potentially leading to treatment effect variations, i.e., gender (Ding & Buhs, 2017), parental migration mode (father absent vs. mother absent vs. both absent) (Tang, 2017), social support (Tang, 2017), and parenting behaviors (Ding & Buhs, 2017). Using CFPS 2012 to examine the outcome of depression, Ding & Buhs (2017) finds no significant difference between the genders; however, they do find children reporting more positive parenting practices to be associated with fewer depressive symptoms. Using CFPS 2010, Tang (2017) finds living in a three-generation family substantially mitigates the harmful effects of both-parent migration on the mental health of LBC while active communication between the guardians and the children positively impacts the mental health of LBC regardless of parental migration mode. Using CFPS 2014, Man & Cao (2020) finds the likelihood of experiencing psychological distress for LBC significantly decreases with higher levels of self-esteem, academic performance, interpersonal relationships, positive parenting, and a higher level of education for the mother.

Table 2.1 Summary of recent publications examining LBC using the CFPS.

Study	Wave	Method	Outcome	Findings
Jordan, Ren, & Falkingham (2014)	2010	Regression; multi-level modeling	Educational	There is a lack of systematic difference in school pacing between LBC and rural native children after controlling for family structure, SES, and county characteristics. Urban children enjoy a more universal advantage in math and Chinese.
Xu & Xie (2015)	2010	Propensity score matching	A range of child developmental outcomes	Migration has significant positive effects on children's objective well-being but no negative effect on their subjective well-being. There is little difference in outcomes for LBC and their rural counterparts on many outcomes.
Yeung & Gu (2016)	2012	Regression	Educational and socio-emotional	LBC are not significantly different from children from rural intact families and the main gap exists between the rural and the urban.
Ren & Treiman (2016)	2010	Fixed-effects regression	Socio-emotional	LBC or migrant children are not necessarily emotionally worse off than their non-migrant counterparts in the nine aspects of emotional well-being examined.
Ding & Buhs (2017)	2012	Multi-level modeling	Socio-emotional	LBC are more likely to report higher depression. However, positive parenting practices both at the individual and county levels alleviate some of these adverse effect.
Tang (2017)	2010	Regression	Socio-emotional and physical health	Children left behind by both parents experience a negative impact. However, remittance and social support can mitigate this negative impact.
Shen & Zhang (2018)	2014	Regression	Subjective well-being	Parental migration hurts LBC's life satisfaction, relationship quality, and subjective health while benefiting their educational aspiration.
Zhou et al., (2018)	2010, 2014	Difference-in-difference propensity score matching	Socio-emotional	Parental migration significantly increases the depression scores of 10- and 11-year-old children by 2 points and the negative impact due to decreased parental care is stronger than the positive impact due to increased income on depression symptoms.
Man & Cao (2020)	2014	Regression	Socio-emotional	16.1% of the LBC are psychologically distressed. Male LBC and LBC of primary school age show significantly higher levels of psychological distress. Self-esteem, academic performance, interpersonal relationships, positive parenting, and the mother's level of education serve as protective factors.

Chapter 3

Data and method

3.1 Data source

Data used for this study comes from the China Family Panel Studies (CFPS, hereafter), a longitudinal social survey launched in 2010 and conducted every two years by the Institute of Social Science Survey at Peking University. The CFPS is designed similarly to the Panel Survey of Income Dynamics, the National Longitudinal Surveys of Youth, and the Health and Retirement Study in the United States. It collects comprehensive data covering topics from economic activities, educational outcomes, family dynamics and relationships, migration, and health at the individual-, family-, and community-levels (Xie & Lu, 2015). The availability of CFPS to the public enables scholars to address urgent research questions concerning a large variety of social phenomena in contemporary China (Xie & Hu, 2014; Xie et al., 2014).

The CFPS is "nearly" nationally-representative as it samples respondents from 25 provinces in China (excluding Xinjiang, Tibet, Qinghai, Inner Mongolia, Ningxia, and Hainan), a sampling frame that covers 95% of the Chinese population. Using probability proportional to size sampling strategy with multi-stage stratification, the CFPS carries out its sampling process first at the county level, then at the village level, and lastly at the household level. All household members living at home are subsequently interviewed by CFPS staff. Staring from 2012, when a face-to-face interview with core family members is not possible, interviews via telephone or Internet and proxy answers from other family members are adopted to reduce attrition. The CFPS successfully interviewed 14,960 households and 42,590 individuals in its first wave in 2010. Subsequent waves followed up on the same households and individuals as well as added a

small portion of new households to replenish the survey pool. Table 3.1 shows the number of communities, households, and individuals in the first four waves of CFPS.

Table 3.1 Number of communities, households, and individuals in CFPS 2010-2016.

Wave	Community	Household	Individual
2010	635	14,960	42,590
2012	-	13,315	44,339
2014	621	13,946	45,763
2016	-	14,019	45,319

The CFPS administers five questionnaires. The family roster questionnaire and the family questionnaire are administered to the head of the household and collect information on family composition, living conditions, income, expenditures, etc. The adult questionnaire and the child questionnaire are administered to members ages 16+ and ages 0-15 who are economically tied to the household, respectively. The child questionnaire, specifically, consists of two parts: a basic section to be filled out by the main caretaker for all children and an in-depth personal interview for children ages 10-15. This in-depth interview collects information on the adolescent child's education, time use, subjective well-being, mental and physical health, as well as cognitive abilities. Additionally, for every other wave, the CFPS also collects information on the community's basic infrastructure, demographic composition, and standard of living from a community leader via the community questionnaire. While most items on each questionnaire stay the same across the waves, some have been modified, deleted, or newly added.

In this study, children ages 10-15 from 2010, 2012, 2014, and 2016 waves of the CFPS are the subjects of interest, as this is the only age group that receives the in-depth personal interview. Sample sizes for children in this age range are 3463, 2652, 2582, and 2492 in each wave, respectively.

During initial data processing, all relevant variables from each of the five questionnaires are identified and checked. Any invalid data values or inconsistent coding schemes across the waves are corrected. The level of missingness is also checked and found to vary greatly from variable to variable and from wave to wave. For some variables such as age, gender, and school grade, there is barely any missingness. For other variables such as the Rosenberg self-esteem scale and the parental bonding instrument, more than half is missing in each of the four waves. There are also items administered every other wave, such as the Kessler psychological distress scale (K-6) and the Center for Epidemiologic Studies depression scale (CES-D), so that missingness alternates from 0% to 100% depending on which wave we look at. In general, variables about individuals with higher chances of being absent from home, i.e., parents of LBC, are subject to greater missingness. Hence, missingness is more related to absence at the time of the interview and less related to the actual missing values. To reduce some of the missingness, imputation across waves is performed for time-invariant variables such as the child's birth location, age when first starting to talk, and parent's highest level of education. Even after this imputation, the level of missingness is still concerning for many (Table 3.2). This bids us to think carefully about how to strike a balance between substantive relevance and data feasibility and be strategic in choosing matching and outcome variables and forming analytical samples.

Table 3.2 Percentage of missingness for LBC for selective variables in CFPS 2010-2016.

Variable	2010	2012	2014	2016
(Sample size)	(391)	(278)	(244)	(213)
Age	0%	0%	0%	0%
Gender	0%	0%	0%	0%
Birth location	2%	11%	16%	17%
Preschool attendance	0%	10%	16%	26%
Birth province	0%	12%	18%	18%
Education expectation	3%	0%	4%	0%
School grade	3%	5%	4%	4%
Word test	1%	100%	1%	100%
Math test	1%	100%	1%	100%
Word recall	100%	1%	100%	4%
Number series	100%	27%	100%	4%
K-6	2%	100%	2%	100%
CES-D	100%	0%	100%	82%
Subjective well-being	1%	3%	5%	100%
Self-efficacy	100%	12%	11%	100%
Positive behavior scale	72%	71%	74%	100%
Parental bonding	82%	46%	45%	100%
Parental education engagement	2%	4%	3%	12%
Rosenberg self-esteem scale	87%	56%	38%	52%
Father's level of education	85%	2%	1%	4%
Mother's level of education	43%	3%	2%	2%
Family size	0%	0%	0%	0%
Per capita family income	6%	4%	5%	0%
Remittance	23%	0%	23%	22%
Total household expenditure	17%	18%	0%	0%
Education expenditure	1%	0%	9%	8%
Community agricultural labor	2%	6%	3%	15%
Population working as migrants	1%	5%	2%	14%

3.2 Define migration status

The CFPS does not contain a variable that directly tells us whether a child is an LBC. An essential first step then is to define the migration status for every child. This is essentially the treatment variable: children defined as LBC are the treatment group. Because our data are longitudinal, we first define migration status in individual waves, and then define migration patterns across waves.

3.2.1 Individual-wave migration status

Based on each child's hukou type (rural vs. urban), current residency (rural vs. urban), inter-county migration status (yes vs. no), whether each parent is absent from home, and whether each parent's absence is due to migrant work, we define four individual-wave migration statuses of interest (Table 3.3): the urban natives have urban hukou, live in urban cities, and have both parents residing with them; the rural migrants have rural hukou, live in urban cities, and have at least one parent residing with them; the rural natives have rural hukou, live in rural villages, have not engaged in inter-county migration, and have both parents residing with them; and the rural left-behind have rural hukou, live in rural villages, have not engaged in inter-county migration, and have at least one parent residing away from home for the reason of migrant work. Individuals with migration statuses other than these four are discarded because they are irrelevant to this study. Also excluded from the sample are 6.5% of individuals with undefined migration statuses due to missing data on any of the seven variables used for the definition and a very small number of individuals with unmatched parental IDs across waves or who have deceased.

Table 3.3 Definition of four individual-wave migration statuses.

Migration status	Hukou type	Residency	Inter-county migration	Parental residency	Reason for parental absence
Urban native	Urban	Urban	-	Both home	-
Rural migrant	Rural	Urban	-	One or both home	-
Rural native	Rural	Rural	No	Both home	-
Rural left-behind	Rural	Rural	No	One or both	Migrant work

Table 3.4 presents the final sample size and proportion by wave for each migration status. The total number of rural-origin children (the rural migrant, the rural native, and the rural left-behind) far outnumber that of the urban children. This is reflective of China's population distribution, with the majority of its citizens residing in the rural countryside. Among the three rural-origin groups, the rural natives is the largest, followed by the rural migrants. The rural left-behind is the smallest group by size, constitution 15.9% of all rural children in 2010 and 12.4% in 2016. Looking across the waves, the proportion of rural migrants rises while the proportion of LBC drops. A downward trend is also observed in the proportion of rural native children across the waves. These changes capture a shift in China's migrating scene: more rural families are migrating into the urban cities and more migrating parents are bringing along their children.

Table 3.4 Sample size and proportion by wave for each migration status.

Wave	Total N	Urban	Rural-origin		
		Urban native	Rural migrant (%)	Rural native (%)	Rural left-behind (%)
2010	2979	527	619 (25.2)	1442 (58.8)	391 (15.9)
2012	2138	404	461 (26.6)	995 (57.4)	278 (16.0)
2014	2163	390	535 (30.2)	994 (56.1)	244 (13.8)
2016	2047	328	545 (31.7)	961 (55.9)	213 (12.4)

* Proportions in parentheses are proportions of that group among all rural-origin children.

3.2.2 Across-wave migration pattern

Because the CFPS follows the same set of families and individuals across waves, many children appear in multiple waves. Adolescents from the 2010 wave may exit the sample via attrition or growth into adulthood; in subsequent waves, new adolescents may enter the sample via growth into adolescence or being part of a family newly added to replenish the survey pool. Because the CFPS is collected every two years, an adolescent child between the ages of 10 and 15 may appear in our sample three times at the most: he or she may either be interviewed at ages 10, 12, and 14, or ages 11, 13, and 15. In our sample, 2988 children appear in one wave, 1872 appear in two waves, and 857 children appear in three waves.

Because families live in changing environments and decisions are fluid, many different migration patterns exist when we combine individual migration statuses across the waves. For example, a rural native in 2010 may become an LBC in 2012 if one or both parents decide to leave home for migrant work; this child may even become a rural migrant if in 2014 the parents decide to bring him or her to the city. With four individual migration statuses in each wave coupled with different entry and exit years, there is a very large number of possible migration patterns across the four waves. For the interest of this study, we define four "always" and one "switch" migration patterns for children who appear in three waves: the always urban native, the always rural migrant, the always rural native, the always rural left-behind, and the rural native to left-behind. The four "always" migration patterns are defined as someone who takes the same individual migration status in three consecutive waves. This definition excludes patterns with only one or two migration statuses because they offer minimal longitudinal information; it also excludes potentially problematic cases with missing migration statuses in the middle waves. The "switch" migration pattern of the rural native to left-behind requires someone to start as a rural

native and become an LBC in a later wave with no missing migration statuses in the middle. Coding the urban native as a 1, the rural migrant as a 2, the rural native as a 3, and the rural left-behind as a 4, Table 3.5 lists the combinations of migration statuses across the four waves for each migration pattern and their corresponding sample sizes. The sample sizes for the always rural left-behind and the rural native to left-behind are extremely small at 25 and 33 each.

Table 3.5 Definition of relevant migration patterns and corresponding sample sizes.

Migration Pattern	Individual migration status				N
	2010	2012	2014	2016	
Always urban native	1	1	1	-	146
	-	1	1	1	
Always rural migrant	2	2	2	-	152
	-	2	2	2	
Always rural native	3	3	3	-	319
	-	3	3	3	
Always rural left-behind	4	4	4	-	25
	-	4	4	4	
Rural native to left-behind	3	3	4	-	33
	3	4	4	-	
	-	3	3	4	
	-	3	4	4	

* 1=urban native, 2=rural migrant, 3=rural native, 4=LBC

3.2.3 Longitudinal vs. cross-sectional analyses

Although the CFPS is longitudinal, a preliminary exploration of the dataset suggests it is not suited for longitudinal analyses for this study. As shown in Table 3.5, the sample size before accounting for missing data for the always rural left-behind is 25, excluding the possibility of reliable statistical analyses.

Additionally, the CFPS does not contain information on when a child first becomes an LBC. Although we were able to pinpoint this time for a subset of children (last row in Table 3.5) by capturing a change in their individual migration status from being rural native first and then to rural left-behind, the sample size for children with this unique migration pattern before accounting for missing data is 33, again too small for reliable statistical analyses.

Given the small sample size of the dataset to investigate changes over time, we decide instead to examine cross-sectional patterns by pooling together all four waves of the CFPS. The advantage of this approach is increased sample size, especially considering the substantial amount of missing data on some outcome and matching variables. Because it is safe to assume a minimal change in the broader social and environmental factors from 2010 to 2016, it is reasonable to pool data collected in four different waves as if they were collected at the same time. Furthermore, because children can experience substantial growth from one wave to the next in two years, for the 30% of children who are interviewed twice and the 15% of children who are interviewed three times in the four waves of data, it is reasonable to treat the repeated measures as independent observations as each data collection in time contributes meaningful and unique information to the sample. After pooling the waves together, the sample includes 9327 data units coming from 5723 unique individuals.

3.3 Method

3.3.1 Research question 1

To examine the characteristics of LBC, a descriptive analysis is conducted by producing summary statistics for a range of variables at the child-, parent-, family-, and community-levels. Specifically, for continuous variables, means and standard deviations are computed; for

categorical variables, proportions are computed. To help put into perspective the numbers concerning the LBC, summary statistics for the urban natives, the rural migrants, and the rural natives are sometimes used for comparison. Because each variable is subject to varying degrees of missing data, summary statistics are computed on cases with valid data values and presented along with the corresponding sample size.

3.3.2 Research question 2

Research question two examines whether parental migration has any impact on LBC in terms of academic development and mental health. The target estimand involved is an average treatment effect for the treated (ATT), namely, the average effect of parental migration on children who are left behind. To obtain an estimate for this effect, we use the propensity score matching technique, a rigorous methodology developed by Rosenbaum and Rubin (1983) to reduce selection bias when making causal inferences with non-experimental survey data.

Propensity score matching, in a nutshell, "preprocesses" the raw non-experimental data and minimizes pre-treatment differences between the treatment group and the control group by first forming a one-number summary, known as the propensity score, of all the pre-treatment covariates of interest, known as the matching variables. The estimation of the propensity score is usually done via logistic regression, and the propensity score, in essence, is the predicted probability of being in the treatment group given all the matching variables. Having formed the propensity scores, one then selects subsets of individuals from the original treatment and control groups based on this propensity score. According to Rosenbaum and Rubin (1983), propensity scores have balancing properties such that matching based on the propensity scores can effectively achieve covariate balance between the treatment and control groups, which is crucial

because covariate balance reduces the dependence of the effect estimate on the correct specification of the outcome model (Ho et al., 2007). Because the estimation of propensity scores does not involve any use of the outcome variables, we can try as many combinations of matching variables and matching methods as needed without inflating Type I errors (Ho et al., 2007). This simple yet powerful method can also be followed up with multiple regression to improve estimation precision and power (Stuart, 2010).

Specifically in this study, after selecting a list of matching variables based on literature and data feasibility (please refer to Section 3.4.3 for details on the matching variables), we first check the initial imbalance in our data and then compare several matching specifications to arrive at one that produces the best balance while preserving adequate sample size. There are many options for a matching specification, and the choice of the best one depends on the unique qualities of the dataset as well as the goals of the analysis. The matching methods and features used in this study include:

- Nearest neighbor matching, also known as greedy matching, involves going through a list of treatment units and selecting the closest eligible control unit to be paired based on a distant measure. The distance measure most often used is the difference between the propensity scores between the treatment and control units (Stuart, 2010). Because it forms pairs without considering how future units will be paired, the order in which the treatment units are paired matters. However, if we allow the reuse of control units after they have already been paired, as in the option of matching with replacement, then the matching order does not matter. Nearest neighbor matching is the most common form of matching (Thoemmes & Kim, 2011) and is appropriate for estimating the ATT.

- Matching with replacement, when specified together with nearest neighbor matching, allows control units to be reused and matched to multiple treatment units. Because replacement avoids the problem of "running out" of close control matches, it tends to yield better balance, though this occurs at the expense of decreased precision because the effective sample size of the control units has also dropped. In addition to decreased precision, special standard error estimators are also required for estimating treatment effects because some control units have been used multiple times (Austin & Cafri, 2020).
- While the most common matching ratio is 1:1, 1:k matching allows the pairing of up to k control units with each treatment unit. This can preserve precision by preventing too many control units from being unmatched and subsequently dropped from the matched sample, counteracting the effect of allowing matching with replacement.
- Implementing common support restriction by discarding units that fall outside of the region where treatment and control groups overlap. This prevents units with outlying propensity scores from getting matched and included in the matched sample, thus reducing the potential for extrapolation and overly distant matches. If units are discarded, we request the program to re-estimate the propensity scores for the remaining units. To be noted is that if any unit from the treatment group is discarded, the final estimand is no longer the ATT because the treatment group has been altered. However, the result may still be worthwhile if the purpose of the estimation is to explore treatment effects.

There are two criteria for assessing and comparing the performance of different matching specifications. First, a good matching specification should preserve as many units as possible so that the sample size remains adequate after matching. Second, a good matching specification

should achieve a good balance on the matching variables. To assess the second criterion on covariate balance, we jointly consider three metrics:

1) Standardized mean difference (SMD), which is the difference in the means of each matching variable between the treatment and control groups standardized by the standard deviation of the matching variable in the unmatched treatment group. SMDs close to zero indicate good balance and a value of 0.10 is the recommended threshold (Stuart et al., 2013).
2) Variance ratio, which is the ratio of the variance of a matching variable in the treatment group to that in the control group; values close to one indicate good balance (Austin 2009), and a commonly used recommendation is for its values to fall between 0.5 and 2.0. To be noted is that variance ratios are not computed for binary matching variables.
3) Empirical cumulative density function statistics (eCDF), which is the difference in the overall distributions of the matching variables between the treatment and control groups; values close to zero indicate good balance (Austin & Stuart, 2015).

Once a matching specification is selected and balanced groups of adequate sample size are formed based on the propensity score, we run the outcome model on the matched dataset to estimate treatment effects. Because all our outcome variables are continuous, we use multiple regression and include the matching variables as covariates, as doing so can reduce bias due to a slight residual imbalance between the treatment and the control as well as improve precision. Nguyen et al. (2017) show covariate adjustment is most helpful for matching variables with standard mean differences greater than 0.10. Because we use 1:k matching in our matching specification, weights for each unit are included in the effect estimation. Because we also allow matching with replacement, special standard error estimation is needed to account for the

repeated use of some control units (multiplicity) as well as these control units belonging to multiple pairs at the same time (clustering) (Hill & Reiter, 2006; Austin & Cafri, 2020). In this study, we use the cluster-robust standard errors (Liang & Zeger, 1986) with pair membership as the cluster. The cluster-robust standard error is a special type of robust standard error and demonstrates good validity for post-matching samples (Abadie & Spiess, 2019).

Once the output of the outcome model is produced, the coefficient on the treatment indicator is taken to be the treatment effect, and a 95% confidence interval is constructed using the cluster-robust standard errors. To understand how meaningful the treatment effects are, Cohen's d is computed using the standard deviation of the outcome variable in the pre-matching treatment group as the standardizing factor. An effect size of 0.2 is taken as a small effect, 0.5 as a medium, and 0.8 as a large (Sullivan & Feinn, 2012). It is to be noted that coefficients and uncertainty measures on the matching variables are not to be interpreted because they may be subject to confounding even if the treatment coefficient is not; inappropriately interpreting them is known as the Table 2 fallacy (Westreich & Greenland, 2013).

All propensity score matching is done in R using the MatchIt package (Ho et al., 2011). Specifically, the interface get_matches() is used to extract the matched dataset after matching with replacement. Regression models are run using the lm() function in base R and coefficients and confidence intervals are computed using coeftest() function from the lmtest package (Hothorn, 2002). Cluster-robust standard errors are computed using the vcovCL() function in the sandwich package (Zeileis, 2004; Zeileis, Köll, & Graham, 2020).

3.3.3 Research questions 3 and 4

Research questions three and four involve moderation analysis, which seeks to examine whether the treatment effects identified in research question two differ across levels of another variable, namely, gender and parental migration mode. We continue to use propensity score matching here to achieve balance within subgroups formed on the moderating variable. One could do so either by performing matching in the full dataset with exact matching on the moderator or performing separate analyses in each subgroup. We choose the second option because one of the moderators (parental migration mode) only applies to the treatment units. Hence for parental migration mode, we will do matching and effect estimation in three subgroups: 1) father-absent LBC, 2) mother-absent LBC, and 3) both-absent LBC, all using rural natives as their control group. Similarly for gender, we will do matching and effect estimation in two subgroups: 1) left-behind boys, and 2) left-behind girls, each using rural natives of the same gender as their control group. Matching specification, balance assessment, and effect estimation for the moderation analysis all follow the same procedure as described above.

3.4 Measures

3.4.1 Cognitive tests and psychological scales

The CFPS contains several cognitive tests and psychological scales. We briefly go over the ones used in this study.

The CFPS administers two cognitive tests every wave to children ages 10-15 and all adults, one on Chinese and the other on math. In the 2010 and 2014 waves, the tests administered are the 34-item Chinese word test and the 24-item math test. In the 2012 and 2016 waves, the tests administered are the Chinese character recall, scored out of 10, and the numerical series, scored out of 15; the Chinese character recall includes two parts: immediate recall and delayed

recall. Raw scores on these tests are given in the CFPS, with scores of the same test administered in a later wave weighted to be comparable to the scores in the original administration.

Developed by Kessler et al. (2002), the Kessler distress scale (K-6) has demonstrated robust psychometric properties among adolescents (Mewton et al., 2015) and has been validated for studies of Chinese adolescents (Xu et al., 2013). Available in CFPS 2010 and 2014 for both children ages 10-15 and all adults, the K-6 asks the respondent to rate the frequency of having six feelings in the past 30 days (e.g., "Feeling nervous," "Feeling hopeless) on a five-point Likert scale ranging from "all the time" to "none of the time". Factor scores are calculated from a one-factor confirmatory model with higher scores indicating lower symptoms of psychological distress. The factor model shows a reasonably good fit to the data with CFI equal to 0.97, TLI equal to 0.95, and a slightly large RMSEA of 0.07 in the 2010 wave for children ages 10-15; the model fitness is similar in the 2014 data for children but slightly poorer in both 2010 and 2014 for adults. Items show good internal consistency with Cronbach's α equal to 0.79 in both waves for children and 0.86 in both waves for adults. Since the construct is of substantive importance and the scale is well-established, we proceed using the factor scores produced by the one-factor model for children as well as for adults.

The Center for Epidemiological Studies depression scale (CES-D) is developed by Randloff (1991) and has been validated for studies of Chinese adolescents (Chen, Yang, & Li, 2009). Available in CFPS 2012 and 2016 for both children ages 10-15 and all adults, the CES-D asks the respondent to rate the frequency of having twenty feelings in the past week (e.g., "I was bothered by things that usually don't bother me," "I did not feel like eating; my appetite was poor") on a four-point Likert scale ranging from "most or all of the time" to "rarely or none of the time". Radloff (1991) extracts four factors within the scale: somatic symptoms (7 items),

depressed effect (7 items), positive effect (4 items), and interpersonal problems (2 items). Guarnaccia et al. (1989) extract three factors by combining the somatic symptoms and depressed effect into one. Our data fit Guarnaccia's three-factor model better so we decided to focus on the combined somatic symptoms and depressed effect. Exploratory factor analysis shows three out of the 14 items (items 13, 17, and 20) that are supposed to load on somatic symptoms and depressed effect do not load very well in our data, so we discarded them and used the remaining 11 items as a CES-D subscale. Items on this subscale are very similar to those on the K-6. Factor scores are then calculated using a one-factor confirmatory model on the subscale with higher scores indicating lower symptoms of depression. The factor model shows a good fit to the data with CFI equal to 0.95, TLI equal to 0.94, and RMSEA equal to 0.05 in the 2012 wave for children ages 10-15; model fitness is slightly better in the 2016 waves for children and comparable in both waves for adults. Items show good internal consistency with Cronbach's α around 0.80 for children and 0.85 for adults in both waves.

Available in CFPS 2010, 2012, and 2014 for children ages 10-15, subjective well-being is measured by four self-reported items (e.g., "How popular are you?" "How happy do you feel?") on a ten-point Likert scale ranging from 1 to 10. Factor scores are calculated from a one-factor confirmatory model with higher scores indicating higher subjective well-being. The factor model shows a mediocre fit to the data with CFI equal to 0.97, TLI equal to 0.91, and a large RMSEA of 0.10 in the 2010 wave; model fitness is similar in the 2012 and 2014 waves. Items show good internal consistency with Cronbach's α ranging from 0.70 to 0.79 in the three waves. Since the construct is of substantive importance and the items are given as a scale in the dataset, we proceed using the factor scores produced by the one-factor model.

Available in CFPS 2012 and 2014 for children ages 10-15, self-efficacy is measured by nine self-reported items (e.g., "I am always prepared," "I pay attention to details") on a four-point Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree). Factor scores are calculated from a one-factor confirmatory model with higher scores indicating higher self-efficacy. The factor model shows a reasonably good fit to the data with CFI equal to 0.94, TLI equal to 0.92, and a slightly large RMSEA at 0.06 in the 2012 data; model fitness is comparable in the 2014 data. Items show good internal consistency with Cronbach's α equal to 0.79 in the 2012 data and 0.82 in the 2014 data.

Available in CFPS 2010, 2012, and 2014 for children ages 10-15, parental bonding is measured by eight child-reported items (e.g., My parents encourage me to work hard," "My parents talk to me in a calm way") on a five-point Likert scale ranging from 1 (never) to 5 (always). Factor scores are calculated from a one-factor confirmatory model with higher scores indicating more positive parenting behaviors. The factor model shows an excellent fit to the data with CFI equal to 0.99, TLI equal to 0.98, and RMSEA equal to 0.04 in the 2010 wave; model fitness is similar in the 2012 and 2014 waves. Items show good internal consistency with Cronbach's α ranging from 0.76 to 0.80 in the three waves.

Available in CFPS 2010, 2012, and 2014 for children ages 10-15, parental education engagement is measured by five child-reported items (e.g., My parents ask me about my school," "My parents check my homework) on a five-point Likert scale ranging from 1 (never) to 5 (always). Factor scores are calculated from a one-factor confirmatory model with higher scores indicating more parental education engagement. The factor model shows a reasonably good fit to the data with CFI equal to 0.98, TLI equal to 0.96, and a slightly large RMSEA at 0.06 in the

2010 data; model fitness is slightly worse in the 2012 and 2014 waves. Items show acceptable internal consistency with Cronbach's α ranging from 0.65 to 0.70 in the three waves.

A list of all the items on each of the psychological scales can be found in Appendix B.

3.4.2 Treatment variable

A child's migration status is the treatment variable. LBC are the treated group. Among the other three groups of children, we choose the rural natives as the control group as they resemble the LBC the most but live in intact families.

3.4.3 Matching variables

VanderWeele (2019) gives the following guidelines in confounder selection for causal inference: variables to be controlled for need to be measured prior to treatment or otherwise be unaffected by treatment; they should be those that cause variation in the outcome as well as selection into treatment group; ideally, they should also be measured without error and are free of missingness. Following his advice, we select matching variables that both affect a child's chance of being left behind as well as his or her academic and mental outcomes. Because variables in our data are subject to varying degrees of missingness, we try to select ones with comparably low levels of missingness. Because the CFPS collects all the variables in a wave at the same time, we also verify our matching variables either pertain to conditions of an earlier time point (e.g., early childhood) or are unaffected by parental migration.

Using Xu & Xie (2015) as a reference, we choose the following individual-, family-, and community-level socioeconomic and demographic characteristics as our matching variables. First, we include age and gender to control for a child's basic demographic characteristics. To

control for a family's socioeconomic status, we follow the advice of Xu & Xie (2015) and refrain from using household income or parents' occupation because they are likely to be contaminated by the event of parental migration. Instead, we use two dichotomous variables that serve as a proxy to a family's socioeconomic condition when the child was young: the child's birth location (in a hospital or a health clinic vs. at home) and whether the child has ever attended preschool, an uncommon life event in rural China. To control for a family's more recent socioeconomic condition, we use parents' level of education. Instead of using parents' years of schooling, which is available in the CFPS but subject to a high level of missingness, we use the categorical variable parent's highest educational level for both the father and the mother. To capture family structure, Xu & Xie (2015) uses the dichotomous indicator of whether a child has at least one brother or sister, because the presence of siblings may dilute family resources. Because multi-generational co-residence is very common in rural China and having grandparents living in the same household provides significant help in housework and childcare, Xu & Xie (2015) also adds the dichotomous indicator of whether there is one living paternal or maternal grandparents. These two dichotomous family structure indicators, however, are not readily available in our data and would be difficult to construct; instead, we use family size to capture the presence of siblings and/or grandparents, as they affect the family's labor migration decisions and caretaking patterns in the absence of the parents. At the broader social and environment level, we control for the percentage of agricultural labor, the percentage of the population migrating for work, and the geographic region in a child's county of birth to capture socioeconomic conditions and propensity for migrating in the community. Per Jordan et al. (2014), we also include the age when a child first started to talk to control for early childhood development. We do not include education expenditure, as suggested by Yeung & Gu (2016), because the education expenditure

variable in our dataset is more likely a post-treatment variable rather than a pre-treatment variable.

3.4.4 Outcome variables

We study four child outcome variables in the domains of academic development and mental health: school grade, cognitive ability, subjective well-being, and psychological distress.

We use school grade to measure LBC's academic performance within the school system. The variable school grade is constructed by averaging a child's grade in Chinese and in Math, the two main subjects in China's grade schools. It ranges from 4 to 1, equivalent to a letter grade of A to D.

We use a composite cognitive score to measure LBC's cognitive ability. As mentioned earlier, the CFPS alternates the administration of specific cognitive tests: in 2010 and 2014, a 34-item Chinese word test and a 24-item math test are used; in 2012 and 2016, a Chinese character recall test and a numerical series test are used. To avoid losing sample units due to test alternation across waves and to avoid overly complicated presentation, a composite cognitive score is constructed as follows: in waves 2010 and 2014, it is equal to the weighted average of the Chinese word test score and the math test score converted to a z-score; in waves 2012 and 2016, it is equal to the weighted average of the Chinese character recall score and the numerical series score converted to a z-score. Higher composite cognitive scores indicate higher cognitive functioning. Separate analyses using just the 2010 and 2014 data and just the 2012 and 2016 data yield similar impact analysis results as those using the composite cognitive score, verifying the validity of forming the composite using different test scores across waves.

We use subjective well-being as one of the measures for LBC's mental health. The variable, subjective well-being, as introduced earlier, is a factor score extracted from four self-reported items (e.g., "How popular are you?" "How happy do you feel?") on a ten-point Likert scale ranging from 1 to 10, with higher scores indicating higher subjective well-being.

Another measure of LBC's mental health is the composite psychological distress score. Similar to the cognitive tests, the CFPS alternates the administration of specific depression scales: in 2010 and 2014, the Kessler distress scale (K-6) are used; in 2012 and 2016, the Center for Epidemiological Studies depression scale (CES-D) is used. As mentioned earlier, the items on the 11-item CES-D subscale targeting the combined latent variable of somatic symptoms and depressed effect share similarities with the items on the K-6. Therefore, to avoid losing sample units due to test alternation across waves and to avoid overly complicated presentation, a composite psychological distress score is constructed by combining the K-6 and CES-D subscale factor scores: in waves 2010 and 2014, it takes the value of the K-6 factor score converted to a z-score; in waves 2012 and 2016, it takes the value of the CES-D subscale factor score converted to a z-score. Separate analyses using just the K-6 factor scores and just the CES-D subscale factor scores yield impact analysis results in the same direction. Though it would be ideal to further examine the validity of combining the two factor scores, for the current study we proceed using the composite score.

3.4.5 Moderating variables

We explore two substantively important moderators: gender and parental migration mode. Parental migration mode refers to the household decision on which parent to send for migrant work; it takes on one of the three levels: father migrant, mother migrant, and both migrant. Based

on parental migration mode, LBC can be divided into three subgroups: the father-absent, the mother-absent, and the both-absent.

3.5 Analytical samples

The analytical sample used for research question 1 consists of a total of 9,327 children ages 10-15 from the pooled dataset of CFPS 2010, 2012, 2014, and 2016. Out of the 9,327 children, 1,649 are urban natives, 2,160 are rural migrants, 4,392 are rural natives, and 1,126 are LBC.

The analytical sample for research questions 2-4 requires no missing data on the matching variables and the outcome variables. To address this issue, we use listwise deletion to remove cases with any missingness on the matching or outcome variables. Listwise deletion is a valuable and simple approach to handle missing data as it leads to unbiased estimates of the treatment effect in situations where the probability of missingness on the outcome and matching variables does not depend on the values of the outcome variables (Allison, 2002; Little, 1992). Thinking carefully about our data, cases are missing mostly because 1) items are not administered in a particular wave; 2) the respondent is absent from home, likely due to migrant work, at the time of survey collection, both of which are not dependent on the value of the outcomes, hence making listwise deletion a viable approach to use. Xu & Xie (2015) also used listwise deletion to address missing data in their study.

We could arrive at one single analytical sample by listwise deleting all cases with missingness on matching variables and all four outcome variables; however, the sample size would decrease drastically. To preserve as many units as possible, despite the increased complexity, we choose to use one analytical sample per outcome variable, such that the analytical sample on a specific outcome will have no missing data on the matching variables and

that particular outcome variable but may still have missing data on the other three outcome variables. Mean and standard deviation comparisons on key covariates pre- and post-listwise deletion reveal little differences in all four analytical samples (Table 3.6). Absolute standardized bias, defined as the absolute value of the mean difference in a covariate divided by the standard deviation of that covariate in the treatment group, is well below the recommended threshold of 0.25 (Stuart, 2007) for the majority of the key covariates.

Table 3.7 shows the sample size of the treatment group (LBC) and control group (the rural natives) before listwise deletion (Column "Original") and post-deletion in each of the four analytical samples, as a whole and also by each of the two moderators. Because the situation of missing data is moderately severe in our data, we, unfortunately, lose more than half of the control units from the original sample after listwise deletion. In each post-listwise deletion analytical sample, the control group is significantly larger than the treatment group, a situation that is ideal for matching, especially 1:k matching. Note the sample sizes drop considerably when we divide the LBC into subgroups by parental migration mode, especially for the mother-absent subgroup.

Table 3.6 Mean and standard deviation comparisons on key variables for LBC pre- and post-listwise deletion.

Variable	Full sample		School grade		Cognitive ability		Subjective well-being		Psychological distress	
	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.
Age	12.48	1.77	12.55	1.76	12.63	1.78	12.66	1.75	12.64	1.74
Gender	0.51	0.50	0.52	0.50	0.51	0.50	0.51	0.50	0.52	0.50
Birth location	0.38	0.49	0.43	0.50	0.43	0.50	0.42	0.49	0.43	0.50
Preschool attendance	0.47	0.50	0.50	0.50	0.50	0.50	0.52	0.50	0.51	0.50
Age to talk (month)	22.24	9.04	21.91	9.07	21.77	8.90	22.25	9.33	22.15	9.38
Chinese grade	2.59	0.95	2.56	0.96	2.60	0.96	2.54	0.96	2.52	0.96
Math grade	2.55	1.02	2.53	1.02	2.57	1.03	2.52	1.02	2.49	1.02
Chinese word test	20.17	7.28	19.86	7.53	19.74	7.69	19.90	7.65	19.82	7.67
Math test	10.16	4.52	10.00	4.74	9.95	4.80	10.08	4.82	9.99	4.80
Chinese character recall	5.76	1.81	5.84	1.80	6.00	1.77	5.92	1.83	5.86	1.91
Numerical series	8.76	3.70	8.74	3.66	8.70	3.66	8.53	3.66	8.48	3.69
Education expenditure	1434	1997	1780	2188	1840	2288	1919	2341	1901	2308
Parental bonding	-0.19	0.93	-0.16	0.91	-0.06	0.86	-0.13	0.94	-0.15	0.93
Parental education engagement	-0.21	0.87	-0.13	0.86	-0.13	0.87	-0.16	0.86	-0.16	0.86
K-6	-0.11	1.02	-0.22	1.08	-0.21	1.07	-0.16	1.04	-0.21	1.07
CES-D	-0.04	0.96	-0.06	0.97	-0.02	0.87	-0.07	0.99	-0.08	0.98
Subjective well-being	-0.12	0.91	-0.22	1.01	-0.18	1.00	-0.23	1.00	-0.22	0.99
Self-efficacy	0.10	0.82	0.12	0.83	0.13	0.85	0.10	0.85	0.10	0.84
Father's cognitive	-0.06	0.75	-0.07	0.75	-0.05	0.74	-0.13	0.73	-0.10	0.74
Mother's cognitive	-0.36	0.89	-0.26	0.90	-0.25	0.88	-0.40	0.85	-0.35	0.90
Father's distress	-0.04	1.03	-0.07	1.10	-0.01	1.07	-0.06	1.10	-0.06	1.11
Mother's distress	-0.28	1.04	-0.35	1.07	-0.27	1.07	-0.30	1.08	-0.31	1.08
Family size	5.60	1.85	5.41	1.76	5.38	1.74	5.36	1.65	5.39	1.67
Community agricultural labor	50.14	22.88	50.83	24.22	50.40	23.98	50.98	23.21	51.05	23.74
Community migrant population	40.21	20.77	41.28	21.89	42.17	22.17	40.14	20.66	40.29	21.12

Table 3.7 Number of treatment and control units in each analytical sample.

	Original	School grade	Cognitive ability	Subjective well-being	Psychological distress
Treatment group					
LBC, all	1125	498	460	393	423
LBC, boys	579	260	233	202	221
LBC, girls	546	238	227	191	202
LBC, father-absent	601	266	248	220	232
LBC, mother-absent	170	81	75	64	68
LBC, both-absent	354	151	137	109	123
Control group					
Rural natives, all	4392	3127	2969	2699	2832
Rural natives, boys	2308	1642	1413	1399	1481
Rural natives, girls	2084	1485	1556	1300	1351

Chapter 4

Characteristics of LBC

Who are the LBC? What kind of lives do they live? Here we present a descriptive analysis of LBC using summary statistics of key variables at the child-, parent-, family-, and community levels. When relevant, LBC are compared to the rural natives, the rural migrants, and the urban natives.

4.1 Child-level characteristics

As shown in Table 4.1, adolescent LBC on average are 12.5 years old, with boys slightly outnumbering girls. This pattern is common to all children groups.

LBC have an average birth weight of 3.1kg and on average start to walk and talk at 15.9 and 22.2 months of age, respectively. These indicators fall behind the other three groups of children, showing delayed early childhood development.

To examine LBC's socioeconomic status, instead of using per capita family income, which is likely to be contaminated by remittance, we use two proxy variables: birth location and preschool attendance. Unlike the Western world where birthing in a hospital or healthcare facility is the norm, many less-advantaged families in rural China give birth at home. While 94% of urban natives and 69% of rural migrants were born in a hospital, only 47% of rural natives and 38% of LBC were born in a hospital. In terms of preschool attendance, only families with enough income afford to send children to preschool to receive early education. In our samples, 47% of LBC ever attended a preschool, in comparison to 51% for rural natives, 79% for rural migrants, and 95% for urban natives. Rural migrants and urban natives may be more likely to

have two working parents, making sending kids to preschool a necessity, while many rural natives and LBC tend to have parents or grandparents with more flexible (i.e., seasonable farm work, street vendors) or no formal jobs. However, even when urban parents have grandparents who could help with childcare, they still tend to value an early education and choose to enroll their children in a variety of learning programs, whereas their rural counterparts tend to leave their children at home to play on their own. Taken together, the pre-migration socioeconomic condition is the worst for LBC's families.

In terms of living arrangements, 72% of LBC report home as their primary residence while the rest board at school. When asked about their primary caretaker at night, only about 38% said their mother while as large as 29% are cared for by their paternal grandparents. This pattern differs significantly from the other three groups of children, the vast majority of whom are cared for by their mothers at night. The low level of parental supervision can also be seen by time living with parents in the past year. While 91% of the urban natives, 72% of the rural migrants, and 67% of the rural natives report spending more than 5 months last year living with their father, only 30% of the LBC report so. 28% of the LBC report 1 month and as high as 13% report hardly any time with their father in the past year. The pattern is similar for time spent with mothers: 20% of the LBC report between 2 and 4 months, 19% report 1 month, and 11% report hardly any time with their mother in the past year. Not surprisingly, LBC also report the lowest score on parenting bonding: -0.2 compared to 0.4 for the urban natives, -0.03 for the rural migrants, and -0.08 for the rural natives.

Physically, LBC are generally healthy, rating themselves a 4.1 out of 5 for their overall health. They have an average body mass index of 18.0 and sleep an average of 9 hours a night. On average, they were sick 0.7 times in the last month and visited the hospital 2.1 times last year

due to sickness. The level of health for LBC is comparable to that for the other three groups of children.

Academically, 98% of the LBC are currently in school and have on average received 5.8 years of schooling. This average falls behind the 6.6 years for the urban natives, 6.1 years for the rural migrants, and 5.9 years for the rural natives, possibly the result of early dropout despite China's Basic Education Law requiring all children to receive nine years of compulsory education, or late enrollment passing the typical age of six. High proportions of rural natives (40%) and LBC (37%) board at school while only 7% of urban natives and 23% of rural migrants do so. This could partially be explained by the long commute for rural students as schools are often scattered where the population is less concentrated. On average LBC spent 22.5 minutes walking to school, compared to 13.9 minutes for the urban natives and 15.5 minutes for the rural migrants. LBC are generally satisfied with their school and teachers, giving average ratings of around 4 out of 5. 30% are involved in student council and 8% participate in student clubs. In terms of performance, LBC on average score a B- in both Chinese and Math, falling slightly behind the other three groups of children. When asked about their educational expectation, 86% of the LBC say they would like to complete at least high school while 40% aspire for a college degree and 9% aspire for a graduate degree. In their spare time, only 3% of LBC engage in tutoring or extracurricular activities, while 41% of the urban natives, 17% of the rural migrants, and 7% of the rural natives do so.

In terms of cognitive ability, LBC on average score 20.2 out of 34 on the Chinese word test and 10.2 out of 24 on the math test, falling behind the other three groups of children, especially the urban natives, scoring an average of 24.5 on the Chinese word test and 12.6 on the math test. A similar pattern is observed for Chinese character recall and numerical series: LBC

on average score 5.8 out of 10 on the immediate character recall, 5.1 out of 10 on the delayed character recall, and 8.8 out of 15 on numerical series, compared to 6.6, 5.8, and 10.6 for the urban natives.

In terms of mental health, LBC report higher symptoms of psychological distress as measured by both the 6-item Kessler distress scale and the 11-item CES-depression subscale. LBC's average factor score on the Kessler distress scale is -0.11, compared to 0.06 for the urban natives, 0.04 for the rural migrants, and 0.00 for the rural natives. Similarly, LBC's average factor score on the CES-depression subscale is -0.04, compared to 0.05 for the urban natives, 0.06 for the rural migrants, and -0.04 for the rural natives. LBC also report lower subjective well-being, receiving an average factor score of -0.12, compared to 0.16 for the urban natives, 0.00 for the rural migrants, and -0.03 for the rural natives.

One aspect that LBC do perform better than others is self-efficacy. Somewhat contrary to expectation, LBC, together with rural natives, score 0.1 and 0.09, respectively, on a 9-item self-efficacy scale while the urban natives and the rural migrants score -0.2 and -0.09, respectively. The reason behind this pattern may be that children growing up in poverty are likely to shoulder more responsibilities at an earlier stage of life and therefore have had more practices regulating themselves.

On more interesting topics, LBC receive a median of 49.2 RMB pocket money per month. 29% own a cell phone and 22% have access to the internet. They spend an average of 1.3 hours on weekdays and 1.7 hours on weekends doing chores around the house, which is similar to those for the rural natives and higher than the urban natives and rural migrants. 24% of LBC have ridden trains before and 2% have been on an airplane. Only 38% and 27% of them correctly

named China's current president and premier, respectively, and 21% correctly named the president of the United States, compared to 59%, 47%, and 64% for the urban natives.

Table 4.1 Child-level summary statistics for LBC.

Variable	N	Mean (s.d.)	Proportion
Age	1126	12.48 (1.77)	
Gender			
Boys	580		52%
Girls	546		48%
Birth location			
Home	384		62%
Hospital	630		38%
Birth weight (kg)	631	3.12 (0.55)	
Age to walk (month)	1032	15.88 (6.08)	
Age to talk (month)	1027	22.23 (9.04)	
Preschool attendance	1002		47%
Primary residence			
Home	796		72%
School dorm	298		27%
Relative's homes	5		1%
Caretaker at night			
Mother	392		38%
Father	70		7%
Paternal grandparents	297		29%
Maternal grandparents	12		1%
Self	265		26%
Time living with father last year			
Almost all year	101		14%
5-11 months	118		16%
2-4 months	216		29%
1 month	207		28%
Hardly any	93		13%
Time living with mother last year			
Almost all year	277		38%
5-11 months	87		12%
2-4 months	149		20%
1 month	142		19%
Hardly any	80		11%
Parental bonding, factor score (8 items)	357	-0.19 (0.93)	

Table 4.1 Child-level summary statistics for LBC, continued.

Variable	N	Mean (s.d.)	Proportion
Self-rated health (1-5 scale)	1123	4.10 (0.98)	
Body mass index	1008	18.01 (9.18)	
Daily sleep (hour)	1072	8.95 (1.00)	
Number of sicknesses last month	525	0.73 (1.14)	
Number of hospital visits last year	657	2.11 (2.63)	
Currently in school	1126		98%
Years of education	1124	5.78 (1.85)	
School boarding	988		37%
Commute time to school (minute)	946	22.15 (22.14)	
Satisfaction with school (1-5 scale)	1106	3.88 (1.05)	
Satisfaction with the head teacher (1-5 scale)	1105	4.17 (1.01)	
Satisfaction with Chinese teacher (1-5 scale)	1106	4.17 (0.99)	
Satisfaction with Math teacher (1-5 scale)	1104	4.08 (1.03)	
Satisfaction with English teacher (1-5 scale)	1006	3.99 (1.04)	
Student council involvement	1086		30%
Student club participation	948		8%
Chinese grade			
A	226		21%
B	314		29%
C	415		38%
D	126		12%
Math grade			
A	250		23%
B	276		26%
C	373		35%
D	182		17%
Education expectation			
No school	8		1%
Elementary school	22		2%
Middle school	127		12%
High school	323		29%
2-year college	86		8%
4-year college	437		40%
Graduate school	100		9%
Weekly homework help from family (hour)	1109	1.41 (3.29)	
Tutoring activity	1115		3%

Table 4.1 Child-level summary statistics for LBC, continued.

Variable	N	Mean (s.d.)	Proportion
Chinese word test (0-34)	629	20.17 (7.28)	
Math test (0-24)	629	10.16 (4.52)	
Immediate Chinese character recall (0-10)	480	5.76 (1.81)	
Delayed Chinese character recall (0-10)	477	5.09 (2.01)	
Numerical series (0-15)	409	8.76 (3.70)	
Kessler distress scale, factor score (6 items)	623	-0.11 (1.02)	
CES depression scale, factor score (11 Items)	317	-0.04 (0.96)	
Subjective well-being, factor score (4 items)	888	-0.12 (0.91)	
Self-efficacy, factor score (9 items)	461	0.10 (0.82)	
Monthly pocket money (RMB)	865	49.2 (93.2)	
Cell phone ownership	845		29%
Internet usage	845		22%
Chores on weekdays (hour)	450	1.28 (1.60)	
Chores on weekend (hour)	450	1.72 (1.54)	
Ever ride a train	824		24%
Ever ride an airplane	844		2%
Correctly name China's chairman	845		38%
Correctly name China's premier	845		27%
Correctly name the US president	845		27%

4.2 Parent-level characteristics

As shown in Table 4.2, parents of LBC are generally healthy, rating themselves 2.6 and 2.4 out of 3 on a self-rated health item. Around 70% are currently employed while 28% are retired. The vast majority (98%) are married.

In terms of education, parents of the LBC have received the least amount of schooling: 7.0 years for fathers and 4.7 years for mothers. In comparison, the numbers are 11.3 years and 10.8 years for fathers and mothers of the urban natives. Not surprisingly, parents of LBC also score the lowest on all cognitive tests. Although these parents have not received much education themselves, they have high educational expectations for their children: 93% expect high school completion while 61% expect a college degree. However, these high expectations are not met

with actions in real life: LBC report an average of 1.4 hours of homework help from family members, compared to 4.1 hours for the urban natives, 2.5 for the rural migrants, and 2.1 for the rural natives. This lack of parental supervision is also reflected by the parents' low score on the 5-item parental education engagement scale: -0.2 for the LBC, 0.3 for the urban natives, 0.01 for the rural migrants, and -0.04 for the rural natives.

In terms of mental health, mothers of LBC show more symptoms of psychological distress than fathers: the average factor score on the constructed psychological distress composite variable for fathers and mothers is -0.04 and -0.4, respectively. Across the four groups of parents, parents of LBC are the most distressed. In terms of subjective well-being, parents of LBC give an average rating of 3.3 out of 5 for life satisfaction and 3.8 out of 5 for hope toward the future, which is lower than the parents of the other three groups of children.

Table 4.2 Parent-level summary statistics for LBC.

Variable	N	Mean (s.d.)	Proportion
Father's self-rated health (1-3 scale)	751	2.58 (0.69)	
Mother's self-rated health (1-3 scale)	902	2.36 (0.80)	
Father's job status			
Employed	408		69%
Laid off	13		2%
Retired	168		29%
Mother's job status			
Employed	568		72%
Laid off	7		1%
Retired	215		27%
Father's marriage status			
Never married	7		1%
Married	737		98%
Divorced	11		1%
Spouse deceased	0		0%
Mother's marriage status			
Never married	6		1%
Married	895		98%
Divorced	6		1%
Spouse deceased	2		0%
Father's years of education	481	6.93 (3.29)	
Mother's years of education	702	4.66 (3.79)	
Father's cognitive composite (z score)	231	-0.06 (0.75)	
Mother's cognitive composite (z score)	515	-0.36 (0.89)	
Parental education expectation for the child			
Elementary school	16		2%
Middle school	35		5%
High school	112		15%
2-year college	56		7%
4-year college	466		61%
Graduate school	72		9%
Parental education engagement, factor score (5 items)	358	-0.21 (0.87)	
Father's distress composite (z score)	242	-0.04 (1.03)	
Mother's distress composite (z score)	557	-0.28 (1.04)	
Father's satisfaction with life (1-5 scale)	374	3.26 (1.12)	
Mother's satisfaction with life (1-5 scale)	681	3.32 (1.16)	
Father's hope for the future (1-5 scale)	374	3.88 (1.12)	
Mother's hope for the future (1-5 scale)	680	3.74 (1.13)	

4.3 Family-level characteristics

As shown in Table 4.3, LBC tend to come from families larger in size: an average of 5.6 compared to 4.1 for the urban natives, 4.8 for the rural migrants, and 5.1 for the rural natives. The larger family size is mostly due to the multi-generational co-residence, a culture tradition in China, especially in rural China, as adult sons are expected to take care of their aging parents. In reality, however, co-residence is becoming more of a resource-sharing mechanism that responds to practical needs (Ma & Wen, 2016). For some rural households, the availability of grandparents, especially paternal grandparents, makes it possible for both parents to leave home for migrant work while entrusting the childcare tasks to the grandparents.

Table 4.3 Family-level summary statistics for LBC.

Variable	N	Mean (s.d.)	Proportion
Family size	1123	5.60 (1.85)	
Agricultural work	1123		86%
Eligible for welfare	1123		54%
Access to tap water	1122		42%
Per-capita family income (RMB)	1081	6694 (5203)	
Educational fund for child	1122		14%
Family educational expenditure (RMB)	1083	1433 (1996)	

86% of LBC's families work in the agricultural sector, 54% are eligible for governmental welfare, and 42% have access to tap water. Although in general most disadvantaged in terms of family socioeconomic status among the four groups of children, mean and median per-capital family income for LBC are slightly higher than those for the rural natives, perhaps due to the remittances sent home by the migrant parent(s). 14% of LBC's households have set apart money for the child's education, while 38% of the rural native households, 20% of the rural migrant households, and 18% of rural native households also do so. The average education expenditure

for LBC households is 1,433 RMB, falling behind the 4,430 RMB for the urban natives, 2,377 RMB for the rural migrants, and 1,800 RMB for the rural natives.

4.4 Community-level characteristics

As shown in Table 4.4, LBC are mostly concentrated in rural areas in central and western China, though their presence is found everywhere in China. These communities tend to be smaller in size with an average household number of 495 and population of 2,255; agriculture-based with more than half of its labor involved in the sector; and under-developed with only 34% having access to tap water. The vast majority of the residents living in these communities are permanent residents with rural hukou, and around 16% of them are on welfare. These communities tend to have a high proportion of migrant workers: 40% compared to 2% for the urban natives, 24% for the rural migrants, and 35% for the rural natives.

Table 4.4 Community-level summary statistics for LBC.

Variable	N	Mean (s.d.)	Proportion
Region			
East	82		8%
North	63		6%
Northeast	36		4%
Central	204		20%
South	166		16%
Southwest	157		16%
Northwest	303		30%
Number of households	1065	495 (328)	
Total population	1077	2255 (1728)	
Agricultural labor	1059		50%
Access to tap water	1077		34%
Population with hukou	1077		97%
Population eligible for welfare	1058		16%
Population working as migrants	1072		40%

4.5 Summary of findings

The overall pattern across the four groups of children, as shown by the rich set of variables available in the CFPS, is quite clear: The LBC is the most disadvantaged group among the four, though in some aspects they fare quite comparable to the rural natives. The rural migrants, though of the same origin as the LBC and the rural natives, fare better than the two groups that still reside in rural China. The urban natives, in all aspects, outperform the other three groups by a large margin. This confirms the findings of Xu & Xie (2015) and Yeung & Gu (2016): the main difference in outcomes does not exist among the different types of rural children but continues to persist between children of rural origins and children of urban origins.

Chapter 5

Impact of parental migration

We use propensity score matching to estimate the average treatment effect of parental migration on LBC's academic development and mental health accounting for confounding by the matching variables. Here we present results on the selection of the matching specification, balance assessment, and the estimation of the treatment effect. Using the analytical sample for school grade as an example, Table 5.1 shows there exist some differences in the means and proportions of the matching variables before matching, although the differences are not very big; there are also appreciable pre-matching differences in the outcome variables (last four columns).

5.1 Selecting matching specification

Because we have four analytical samples, the ideal matching specification would achieve a good balance in all four analytical samples while preserving an adequate sample size.

We start with the matching specification adopted from Xu & Xie (2015): 1:1 nearest neighbor without replacement + exact matching on gender, using propensity score estimated via logistic regression as the distance measure. Although all treatment units find control matches within the region of common support and all SMDs except for one in the analytical sample for cognitive ability fall outside of the threshold of 0.10, we think the covariate balance could be improved more. Because we have significantly more control units than treatment units, next we try the same matching specification but with a 1:5 matching ratio. Instead of improvement, we see that covariate balance has greatly worsened in all analytical samples and many matched control units fall outside of the region of common support. We modify the matching

Table 5.1 Pre-matching descriptive statistics.

Variable	LBC	Rural natives
Sample size	498	3127
Age	12.55	12.53
Gender		
Boys	52%	53%
Girls	48%	47%
Birth location		
Home	57%	53%
Hospital	43%	47%
Preschool attendance	50%	52%
Age starting to talk (month)	21.91	22.13
Family size	5.41	5.04
Community agricultural labor	51%	51%
Population working as migrants	41%	35%
Father's educational stage		
Below elementary	23%	28%
Elementary school	33%	34%
Junior high school	38%	30%
Senior high school	5%	6%
2-year college	0%	1%
4-year college	0%	0%
Mother's educational stage		
Below elementary	46%	45%
Elementary school	31%	31%
Junior high school	20%	21%
Senior high school	1%	2%
2-year college	1%	0%
Region		
East	7%	12%
North	6%	12%
Northeast	4%	8%
Central	21%	15%
South	14%	13%
Southwest	18%	19%
Northwest	29%	22%
School grade	2.55	2.57
Cognitive ability	-0.18	-0.13
Subjective well-being	-0.22	-0.02
Psychological distress	-0.15	-0.00

specification to allow a replacement to avoid quickly depleting the control pool of good matches. The resulting covariate balance shows a big improvement from the first specification using 1:1 matching without replacement: in all four analytical samples, all SMDs are well below the threshold of 0.10. We check one more matching specification by dropping the exact matching on gender. Results are very similar to the one with exact matching on gender. Given the similar performance, we choose the simpler option and decide on 1:5 nearest neighbor with replacement.

5.2 Matching results

Matching results using 1:5 nearest neighbor with replacement are shown in Tables 5.2-5.5 and Figure 5.1. All treatment units have found five matching control units so that no treatment units are discarded during the matching process (Table 5.2). Because this specification allows for the replacement of matched control units, some control units are used multiple times (Table 5.3). The jitter plots, which visualize the distribution of propensity scores of those who are matched and who are unmatched, show very good overlap for the distribution of propensity scores in the matched treatment and control groups for each of the four analytical samples, minimizing the potential for extrapolation (Figure 5.1). Importantly, all SMDs for the matching variables after matching not only fall below the threshold of 0.10, but most are below 0.05 (Table 5.4). Over 98% of the SMDs for squares and two-way interactions between the matching variables are below 0.15 (due to space limitation, these SMDs are not shown in Table 5.4). Additionally, variance ratios are all close to one and eCDF statistics are all close to zero (Table 5.5). All the metrics for balance assessment have shown good results.

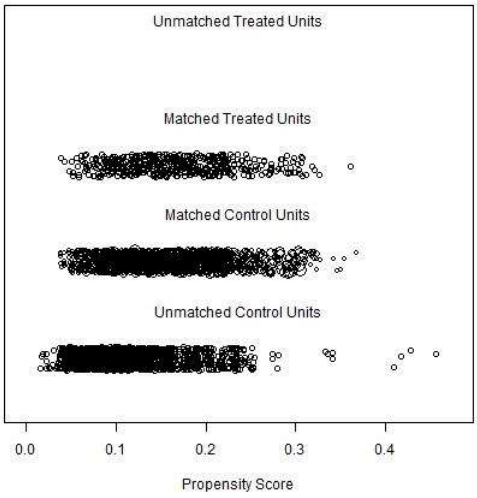
Table 5.2 Sample size before and after matching.

	School grade	Cognitive ability	Subjective well-being	Psychological distress
Treatment group				
Matched	498	460	393	423
Unmatched	0	0	0	0
Control group				
Matched	1540	1470	1255	1350
Unmatched	1587	1499	1444	1482

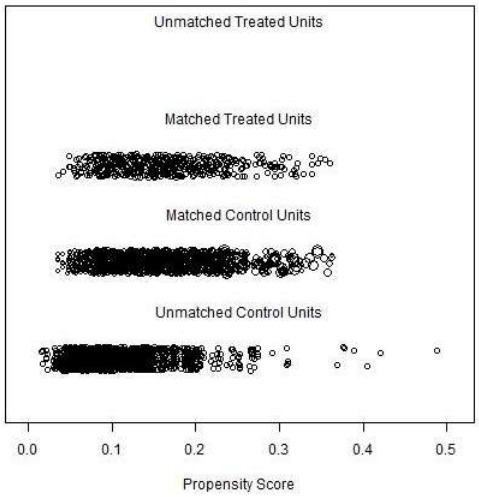
Table 5.3 The number of times control units are used.

Analytical sample	1	2	3	4	5	6	7	8	9	10	11	12	13
School grade	617	317	164	66	40	19	11	5	2	1	1	0	1
Cognitive ability	631	318	142	65	34	15	4	6	0	0	1	0	0
Subjective well-being	551	275	126	59	29	10	4	1	1	0	0	0	0
Psychological distress	571	271	131	65	34	19	7	2	0	0	0	0	0

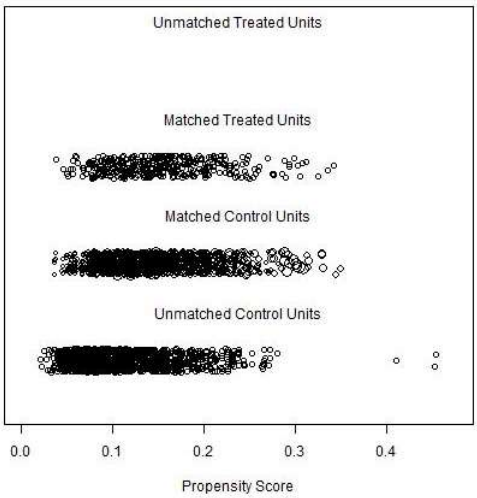
Figure 5.1 The distribution of propensity scores.



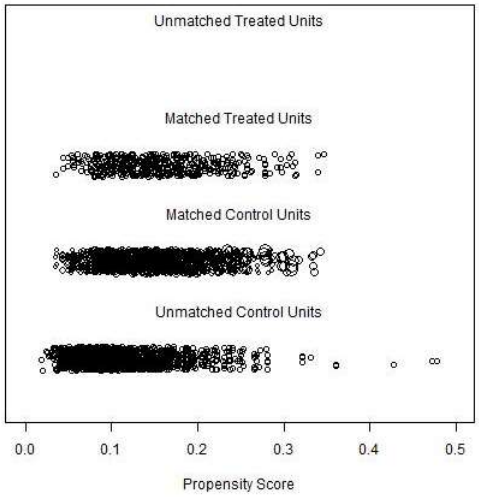
a) School grade



b) Cognitive ability



c) Subjective well-being



d) Psychological distress

Table 5.4 Standardized mean differences before and after matching.

Matching variable	School grade		Cognitive ability		Subjective well-being		Psychological distress	
	Before	After	Before	After	Before	After	Before	After
Age	0.02	0.01	0.04	0.03	0.07	0.01	0.06	0.03
Gender	-0.01	0.04	-0.04	0.03	-0.01	0.04	0.00	-0.04
Birth location	-0.08	-0.01	-0.09	0.04	-0.03	-0.01	-0.04	0.02
Preschool attendance	-0.06	0.01	-0.05	0.02	0.02	-0.04	0.01	0.04
Age starting to talk (month)	-0.02	-0.04	-0.03	-0.02	0.00	-0.01	-0.02	0.01
Family size	0.21	0.03	0.19	0.02	0.21	0.01	0.22	0.01
Community agricultural labor	-0.01	0.00	-0.02	-0.03	-0.01	0.01	-0.01	-0.02
Population working as migrants	0.27	-0.04	0.32	0.01	0.26	0.01	0.26	0.00
Father's educational stage								
Below elementary	-0.11	-0.04	-0.12	-0.02	-0.15	0.02	-0.14	-0.04
Elementary school	-0.02	-0.02	-0.05	-0.02	-0.01	-0.06	-0.03	0.00
Junior high school	0.16	0.06	0.19	0.04	0.19	0.03	0.20	0.04
Senior high school	-0.06	-0.02	-0.06	-0.01	-0.08	0.01	-0.08	0.00
2-year college	-0.14	0.03	-0.14	0.02	-0.11	0.00	-0.11	-0.01
4-year college	0.03	-0.01	0.04	0.00	0.01	0.02	0.01	0.01
Mother's educational stage								
Below elementary	0.03	-0.03	0.02	-0.04	0.05	0.01	0.05	-0.02
Elementary school	0.00	0.01	0.03	0.02	-0.01	-0.01	-0.02	0.04
Junior high school	-0.02	0.02	-0.03	0.02	-0.03	-0.01	-0.02	0.00
Senior high school	-0.09	0.04	-0.06	0.01	-0.08	0.03	-0.10	0.00
2-year college	0.02	-0.05	-0.01	0.03	0.01	0.00	0.01	-0.04
Region								
East	-0.20	-0.02	-0.18	0.03	-0.12	-0.04	-0.13	0.02
North	-0.22	0.04	-0.23	0.02	-0.22	0.00	-0.25	0.06
Northeast	-0.21	0.02	-0.19	0.04	-0.18	0.01	-0.20	-0.01
Central	0.15	0.01	0.18	0.02	0.20	0.02	0.19	0.00
South	0.04	-0.03	-0.01	-0.03	0.06	-0.01	0.06	0.03
Southwest	-0.03	0.00	0.00	0.01	-0.11	0.03	-0.09	-0.02
Northwest	0.17	0.00	0.14	-0.05	0.13	-0.01	0.14	-0.04

Table 5.5 Variance ratio and the maximum eCDF difference after matching.

Matching variable	School grade		Cognitive ability		Subjective well-being		Psychological distress	
	Var. Ratio	eCDF	Var. Ratio	eCDF	Var. Ratio	eCDF	Var. Ratio	eCDF
Age	1.06	0.01	1.07	0.01	1.02	0.01	1.02	0.01
Gender	-	0.02	-	0.03	-	0.01	-	0.02
Birth location	-	0.02	-	0.02	-	0.02	-	0.02
Preschool attendance	-	0.02	-	0.01	-	0.01	-	0.02
Age starting to talk (month)	1.02	0.01	1.01	0.01	1.07	0.03	1.15	0.00
Family size	1.09	0.03	1.03	0.02	0.87	0.01	0.95	0.02
Community agricultural labor	1.00	0.00	1.05	0.00	1.09	0.00	1.08	0.00
Population working as migrants	0.88	0.00	0.99	0.00	0.89	0.00	0.93	0.00
Father's educational stage								
Below elementary	-	0.00	-	0.00	-	0.00	-	0.00
Elementary school	-	0.01	-	0.02	-	0.00	-	0.01
Junior high school	-	0.01	-	0.01	-	0.00	-	0.02
Senior high school	-	0.01	-	0.01	-	0.00	-	0.00
2-year college	-	0.00	-	0.00	-	0.00	-	0.00
4-year college	-	0.00	-	0.00	-	0.00	-	0.00
Mother's educational stage								
Below elementary	-	0.03	-	0.03	-	0.05	-	0.04
Elementary school	-	0.00	-	0.02	-	0.00	-	0.01
Junior high school	-	0.00	-	0.01	-	0.02	-	0.02
Senior high school	-	0.04	-	0.04	-	0.05	-	0.05
2-year college	-	0.05	-	0.03	-	0.04	-	0.03
Region		0.00		0.01		0.01		0.01
East	-	0.01	-	0.00	-	0.00	-	0.01
North	-	0.00	-	0.01	-	0.00	-	0.00
Northeast	-	0.01	-	0.01	-	0.01	-	0.00
Central	-	0.01	-	0.01	-	0.01	-	0.01
South	-	0.00	-	0.00	-	0.01	-	0.01
Southwest	-	0.00	-	0.02	-	0.01	-	0.02
Northwest	-	0.04	-	0.04	-	0.03	-	0.03

5.3 Treatment effect estimation

To estimate the average treatment effect of parental migration on LBC, we fit a multiple regression model for each of the four outcomes on the treatment indicator while controlling for the matching variables to adjust for any slight residual imbalances after matching. Matching weights are included in the estimation to account for the 1:5 matching. A cluster-robust standard error is implemented to account for control unit multiplicity and clustering. The coefficient on the treatment indicator is taken to be the estimate of the treatment effect.

Table 5.6 lists the treatment effect together with its standard error, p-value, 95% confidence interval, and the effect size for each outcome. Despite the parental absence, our results show that LBC are not worse off than their rural counterparts in terms of school grade and cognitive ability. They do, however, report significantly lower subjective well-being and show more symptoms of psychological distress than the rural natives, though the effect size for both coefficients is small.

Table 5.6 Treatment effect estimation.

Outcome	Coefficient	Std. Error	p-value	95% CI	Effect Size
School grade	0.01	0.05	0.76	(-0.08, 0.10)	0.02
Cognitive ability	-0.04	0.05	0.43	(-0.14, 0.06)	-0.04
Subjective well-being	-0.16	0.06	0.01	(-0.27, -0.05)	-0.18
Psychological distress	-0.12	0.06	0.05	(-0.24, 0.00)	-0.12

Chapter 6

Treatment effect variation by gender

When dividing LBC into gender groups, we see appreciable differences in the means of the outcome variables between the genders (Table 6.1), prompting us to further examine whether the effect of parental migration differs by gender. Similar to Chapter 5, now within each gender group, we use propensity score matching to estimate the average treatment effect of parental migration on LBC's academic development and mental health accounting for confounding by the matching variables. The control group for LBC in each subgroup is rural natives of the same gender. Here we present results on the selection of the matching specification, balance assessment, and the estimation of the treatment effect. Using the analytical sample for school grade as an example, Table 6.2 shows there exist some differences in the means and proportions of the matching variables before matching in both gender groups; there are also appreciable pre-matching differences in the outcome variables (last four columns), especially for the boys.

Table 6.1 Mean and standard deviation comparison by gender.

Outcome	Rural natives	LBC: Boys	LBC: Girls
School grade	2.53 (0.86)	2.43 (0.86)	2.67 (0.87)
Cognitive ability	-0.17 (1.04)	-0.29 (1.03)	-0.08 (1.04)
Subjective well-being	-0.06 (0.87)	-0.33 (1.01)	-0.12 (0.99)
Psychological distress	-0.05 (0.96)	-0.21 (1.17)	-0.10 (1.10)

Table 6.2 Pre-matching descriptive statistics by gender.

Variables	Boys		Girls	
	LBC	Rural natives	LBC	Rural natives
Sample size	260	1642	238	1485
Age	12.41	12.49	12.71	12.56
Gender				
Boys	100%	100%	0%	0%
Girls	0%	0%	100%	100%
Birth location				
Home	58%	50%	56%	56%
Hospital	42%	50%	44%	44%
Preschool attendance	47%	52%	53%	53%
Age starting to talk (month)	22.42	22.29	21.35	21.96
Family size	5.35	4.88	5.47	5.23
Community agricultural labor	49%	51%	53%	51%
Population working as migrants	43%	35%	40%	36%
Father's educational stage				
Below elementary	23%	27%	23%	29%
Elementary school	33%	33%	34%	36%
Junior high school	36%	32%	39%	28%
Senior high school	7%	7%	3%	6%
2-year college	0%	2%	0%	1%
4-year college	1%	0%	0%	0%
Mother's educational stage				
Below elementary	45%	45%	48%	44%
Elementary school	35%	31%	27%	31%
Junior high school	18%	21%	22%	21%
Senior high school	1%	2%	2%	3%
2-year college	0%	0%	1%	1%
Region				
East	6%	12%	7%	12%
North	5%	12%	8%	11%
Northeast	2%	7%	6%	9%
Central	20%	16%	24%	15%
South	14%	12%	14%	14%
Southwest	20%	20%	16%	18%
Northwest	33%	21%	25%	22%
School grade	2.43	2.49	2.67	2.65
Cognitive ability	-0.28	-0.15	-0.07	-0.11
Subjective well-being	-0.33	-0.07	-0.12	-0.03
Psychological distress	-0.22	-0.00	-0.08	-0.00

6.1 Selecting matching specification

Because we have two gender groups in each analytical sample, the ideal matching specification would achieve good balance while preserving adequate sample size in both gender groups and all four analytical samples.

We start with the matching specification used for the impact analysis: the 1:5 nearest neighbor with replacement, using propensity score estimated via logistic regression as the distance measure. It achieves good balance in girls with all SMDs smaller than 0.10. Balance is generally good for boys, but there are three instances in which the SMDs are at the borderline of 0.10. Since there is an even greater number of control units than treatment units, in the next matching specification we bump up the treatment-to-control ratio to 1:7 while still allowing for replacement. Now there is a slight improvement in balance for both gender groups. A further examination of the jitter plots under this matching specification reveals the presence of several units with outlying propensity scores, which prompts us to try one more matching specification: the 1:7 nearest neighbor with replacement plus common region restriction. The result is an improvement in overall balance and all SMDs now fall under the 0.10 threshold. The common region restriction also identifies two left-behind girls from the analytical samples for subjective well-being and distress and two left-behind boys from the analytical samples for school grade and cognitive ability. Because this matching specification achieves satisfactory balance and keeps matched units within the region of common support, we settle on it. Because treatment units are being discarded, treatment effects estimated subsequently will no longer correspond to the average treatment for the treated (ATT). Since the purpose of this moderation analysis is more for treatment effect discovery, it is not as important to keep the target population 100% intact.

6.2 Matching results

Matching results using 1:7 nearest neighbor with replacement plus common region restriction for each gender group are shown in Tables 6.3-6.8 and Figures 6.1-6.2. Two treatment units were discarded from each of the four analytical samples due to common region restriction (Table 6.3). All remaining treatment units found seven matching control units each. Because this matching specification allows the replacement of matched control units, many control units are used multiple times (Table 6.4). The jitter plots show very good overlap for the distribution of propensity scores in matched treatment and control groups after the common region restriction for each gender group in each analytical sample (Figures 6.1-6.2). All SMDs are below the threshold of 0.10 and most are below 0.05 (Tables 6.5 and 6.7). Over 97% of the SMDs for squares and two-way interactions between the matching variables are below 0.15 (due to space limitation, these SMDs are not shown presented). Additionally, variance ratios are all in the recommended range of 0.5 to 2.0 and eCDF statistics are all close to zero (Tables 6.6 and 6.8). The balance achieved with 1:7 nearest neighbor with replacement plus common region restriction is quite satisfactory.

Table 6.3 Sample size before and after matching by gender.

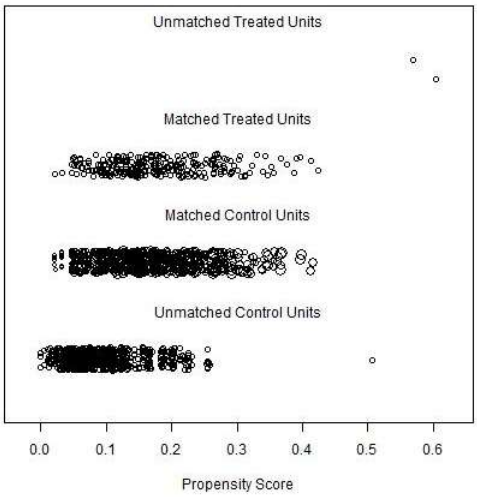
	School grade	Cognitive ability	Subjective well-being	Psychological distress
Boys				
Treatment: unmatched*	2	2	0	0
Treatment: matched	258	231	202	221
Control: matched	934	863	759	834
Control: unmatched*	708	693	640	647
Girls				
Treatment: unmatched*	0	0	2	2
Treatment: matched	238	227	189	200
Control: matched	907	890	749	757
Control: unmatched*	578	523	551	594

* Unmatched includes those excluded due to the common region restriction and those in The common region but did not find matches.

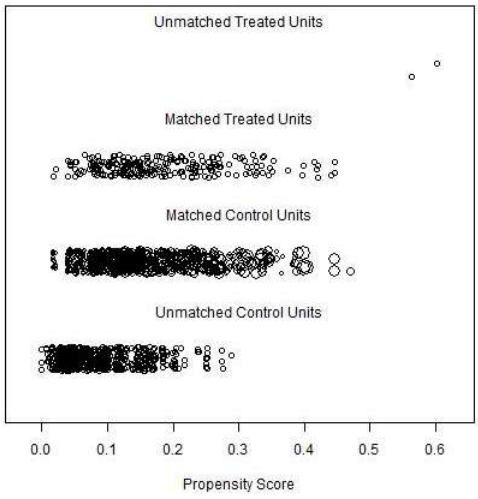
Table 6.4 The number of times control units are used by gender.

Analytical sample	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
School grade															
Boys	263	180	100	72	42	23	11	7	9	1	1	1	-	-	-
Girls	256	203	92	66	38	15	8	7	1	4	1	1	-	-	-
Cognitive ability															
Boys	305	155	88	57	30	21	8	5	5	1	4	2	0	0	1
Girls	290	201	87	63	23	20	6	3	8	0	1	-	-	-	-
Subjective well-being															
Boys	270	151	105	67	18	9	5	3	4	2	-	-	-	-	-
Girls	271	158	95	47	23	14	3	3	1	1	-	-	-	-	-
Psychological distress															
Boys	267	165	97	53	40	16	9	7	0	2	0	1	-	-	-
Girls	247	165	97	50	20	18	10	2	2	2	-	-	-	-	-

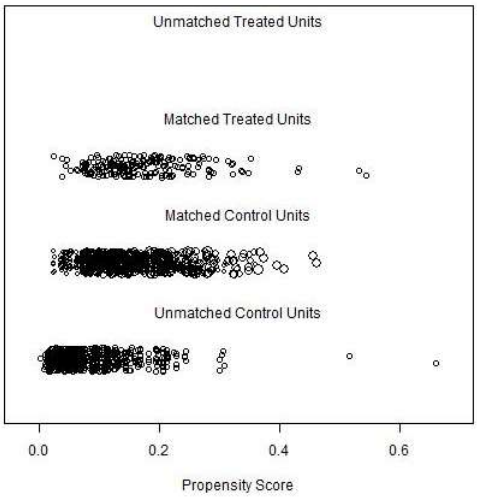
Figure 6.1 The distribution of propensity scores for left-behind boys.



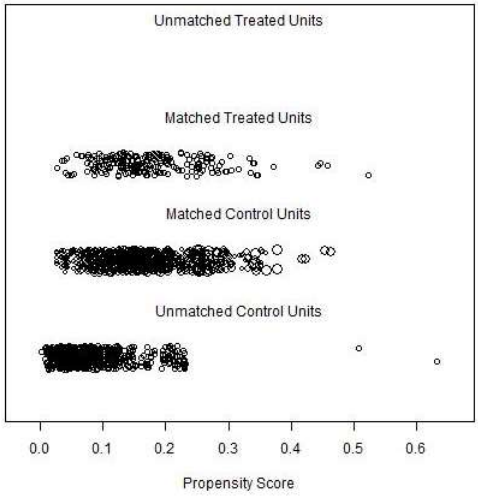
a) School grade



b) Cognitive ability

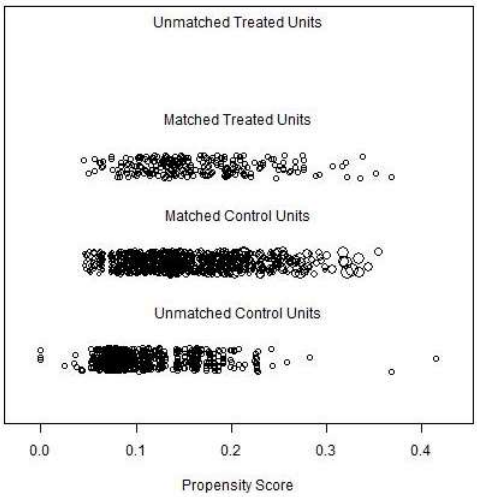


c) Subjective well-being

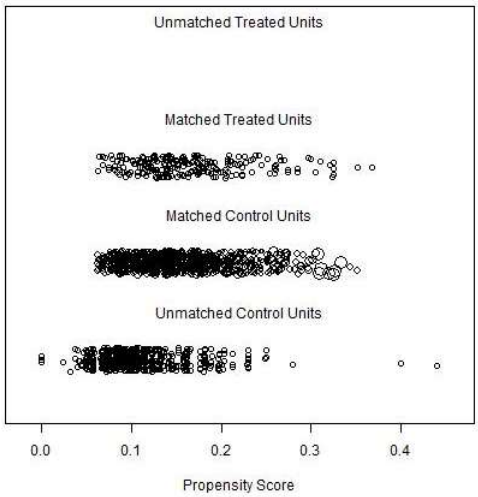


d) Psychological distress

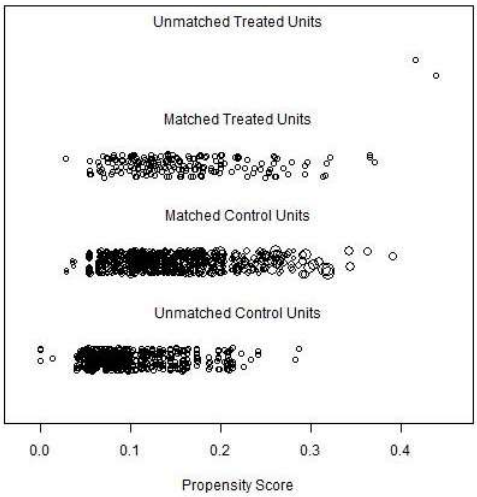
Figure 6.2 The distribution of propensity scores for left-behind girls.



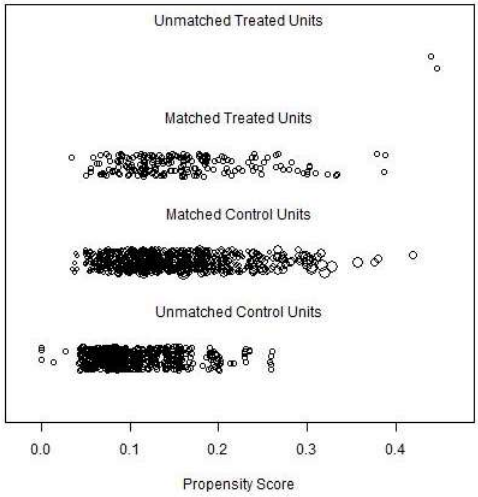
a) School grade



b) Cognitive ability



c) Subjective well-being



d) Psychological distress

Table 6.5 Standardized mean differences before and after matching for left-behind boys.

Matching variable	School grade		Cognitive ability		Subjective well-being		Psychological distress	
	Before	After	Before	After	Before	After	Before	After
Age	-0.05	-0.02	-0.02	0.01	-0.05	0.02	-0.06	0.01
Gender	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Birth location	-0.16	0.00	-0.13	-0.04	-0.13	-0.02	-0.13	0.03
Preschool attendance	-0.11	-0.05	-0.10	0.01	-0.05	0.05	-0.04	0.08
Age starting to talk (month)	0.02	-0.02	-0.02	-0.02	0.02	-0.04	-0.01	-0.01
Family size	0.27	0.06	0.27	0.01	0.34	0.02	0.32	-0.03
Community agricultural labor	-0.06	-0.06	-0.11	0.02	-0.06	-0.03	-0.10	0.01
Population working as migrants	0.35	0.00	0.42	0.01	0.37	0.02	0.34	0.03
Father's educational stage								
Below elementary	-0.07	0.03	-0.08	0.00	-0.15	-0.06	-0.14	-0.01
Elementary school	-0.01	-0.08	-0.10	-0.05	0.04	0.02	0.03	-0.04
Junior high school	0.09	0.03	0.18	0.05	0.13	0.05	0.13	0.05
Senior high school	-0.01	0.02	-0.03	0.00	-0.05	-0.02	-0.05	-0.03
2-year college	-0.19	0.04	-0.19	0.03	-0.14	-0.07	-0.15	0.03
4-year college	0.07	0.00	0.07	0.00	0.04	0.04	0.04	0.02
Mother's educational stage								
Below elementary	-0.01	0.00	-0.04	0.01	0.00	-0.03	0.00	-0.02
Elementary school	0.09	-0.02	0.12	-0.03	0.09	0.03	0.07	0.04
Junior high school	-0.06	0.01	-0.08	0.04	-0.08	0.00	-0.06	-0.03
Senior high school	-0.16	0.05	-0.08	-0.01	-0.17	0.04	-0.19	-0.02
2-year college	-0.01	0.02	0.00	-0.04	0.02	-0.07	0.02	-0.01
Region								
East	-0.22	-0.01	-0.18	0.03	-0.09	0.00	-0.11	0.02
North	-0.34	0.03	-0.41	-0.01	-0.36	0.07	-0.44	0.02
Northeast	-0.39	0.01	-0.45	0.03	-0.53	0.04	-0.55	0.02
Central	0.10	-0.02	0.13	0.02	0.13	0.00	0.13	0.04
South	0.07	-0.02	0.01	-0.01	0.14	0.01	0.13	-0.03
Southwest	0.01	-0.03	0.05	0.00	-0.08	-0.01	-0.07	-0.03
Northwest	0.25	0.04	0.23	-0.03	0.19	-0.04	0.22	-0.01

Table 6.6 Variance ratio and the maximum eCDF difference for left-behind boys.

Matching variable	School grade		Cognitive ability		Subjective well-being		Psychological distress	
	Var. Ratio	eCDF	Var. Ratio	eCDF	Var. Ratio	eCDF	Var. Ratio	eCDF
Age	1.17	0.03	1.24	0.04	1.06	0.05	1.02	0.06
Gender	-	0.00	-	0.00	-	0.00	-	0.00
Birth location	-	0.00	-	0.02	-	0.01	-	0.01
Preschool attendance	-	0.02	-	0.00	-	0.03	-	0.04
Age starting to talk (month)	1.03	0.05	0.95	0.04	0.97	0.05	1.01	0.05
Family size	0.99	0.06	0.78	0.08	1.01	0.04	0.99	0.04
Community agricultural labor	1.05	0.06	1.02	0.04	1.08	0.06	1.13	0.07
Population working as migrants	0.94	0.04	0.97	0.04	0.89	0.05	0.96	0.04
Father's educational stage								
Below elementary	-	0.01	-	0.00	-	0.02	-	0.00
Elementary school	-	0.04	-	0.02	-	0.01	-	0.02
Junior high school	-	0.02	-	0.02	-	0.02	-	0.03
Senior high school	-	0.00	-	0.00	-	0.00	-	0.01
2-year college	-	0.00	-	0.00	-	0.00	-	0.00
4-year college	-	0.00	-	0.00	-	0.00	-	0.00
Mother's educational stage								
Below elementary	-	0.00	-	0.00	-	0.01	-	0.01
Elementary school	-	0.01	-	0.01	-	0.02	-	0.02
Junior high school	-	0.00	-	0.01	-	0.00	-	0.01
Senior high school	-	0.00	-	0.00	-	0.00	-	0.00
2-year college	-	0.00	-	0.00	-	0.00	-	0.00
Region								
East	-	0.00	-	0.01	-	0.00	-	0.01
North	-	0.01	-	0.00	-	0.01	-	0.00
Northeast	-	0.00	-	0.00	-	0.00	-	0.00
Central	-	0.01	-	0.01	-	0.00	-	0.01
South	-	0.01	-	0.00	-	0.00	-	0.01
Southwest	-	0.01	-	0.00	-	0.00	-	0.01
Northwest	-	0.02	-	0.01	-	0.02	-	0.01

Table 6.7 Standardized mean differences before and after matching for left-behind girls.

Matching variable	School grade		Cognitive ability		Subjective well-being		Psychological distress	
	Before	After	Before	After	Before	After	Before	After
Age	0.09	-0.05	0.11	-0.01	0.20	-0.02	0.19	0.02
Gender	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Birth location	0.01	0.02	-0.04	0.01	0.09	0.07	0.07	-0.04
Preschool attendance	0.01	0.02	0.01	0.02	0.09	0.00	0.06	-0.03
Age starting to talk (month)	-0.07	-0.04	-0.04	-0.02	-0.03	0.03	-0.03	0.01
Family size	0.14	-0.02	0.12	-0.02	0.08	-0.04	0.12	0.01
Community agricultural labor	0.06	0.01	0.07	0.04	0.05	-0.02	0.09	-0.03
Population working as migrants	0.18	-0.01	0.21	-0.03	0.15	0.02	0.17	-0.04
Father's educational stage								
Below elementary	-0.14	-0.03	-0.17	-0.05	-0.15	-0.01	-0.14	0.02
Elementary school	-0.04	0.01	0.00	0.01	-0.07	0.02	-0.08	-0.02
Junior high school	0.23	0.01	0.20	0.03	0.26	-0.02	0.27	0.00
Senior high school	-0.14	-0.01	-0.11	-0.01	-0.11	0.01	-0.13	0.02
2-year college	-0.08	0.03	-0.08	0.01	-0.07	0.05	-0.07	0.01
4-year college	-0.05	0.00	-0.05	0.00	-0.05	0.00	-0.05	0.00
Mother's educational stage								
Below elementary	0.07	0.02	0.07	-0.04	0.10	-0.01	0.11	0.01
Elementary school	-0.10	0.02	-0.08	0.01	-0.12	0.01	-0.12	0.00
Junior high school	0.03	-0.02	0.02	0.02	0.03	0.02	0.01	-0.01
Senior high school	-0.05	-0.05	-0.05	0.03	-0.05	-0.03	-0.05	-0.02
2-year college	0.03	-0.01	-0.02	0.05	0.01	0.00	0.01	0.00
Region								
East	-0.18	0.03	-0.18	0.03	-0.17	0.00	-0.16	-0.06
North	-0.11	0.01	-0.10	0.02	-0.12	-0.02	-0.11	-0.03
Northeast	-0.11	-0.01	-0.08	0.01	-0.05	-0.03	-0.06	0.01
Central	0.21	0.02	0.23	0.04	0.26	0.05	0.25	0.03
South	0.01	-0.02	-0.03	-0.03	-0.04	0.00	-0.03	0.02
Southwest	-0.07	0.00	-0.05	0.02	-0.13	0.01	-0.11	0.02
Northwest	0.08	-0.03	0.04	-0.06	0.07	-0.03	0.06	-0.01

Table 6.8 Variance ratio and the maximum eCDF difference for left-behind girls.

Matching variable	School grade		Cognitive ability		Subjective well-being		Psychological distress	
	Var. Ratio	eCDF	Var. Ratio	eCDF	Var. Ratio	eCDF	Var. Ratio	eCDF
Age	1.00	0.03	1.00	0.02	1.01	0.03	0.97	0.03
Gender	-	0.00	-	0.00	-	0.00	-	0.00
Birth location	-	0.01	-	0.01	-	0.03	-	0.02
Preschool attendance	-	0.01	-	0.01	-	0.00	-	0.01
Age starting to talk (month)	1.16	0.08	1.24	0.07	1.32	0.07	1.33	0.06
Family size	1.00	0.04	1.02	0.04	0.98	0.03	0.91	0.04
Community agricultural labor	1.09	0.05	1.05	0.05	0.99	0.05	0.97	0.04
Population working as migrants	0.97	0.03	0.97	0.03	0.84	0.07	0.80	0.06
Father's educational stage								
Below elementary	-	0.01	-	0.02	-	0.01	-	0.01
Elementary school	-	0.00	-	0.01	-	0.01	-	0.01
Junior high school	-	0.01	-	0.01	-	0.01	-	0.00
Senior high school	-	0.00	-	0.00	-	0.00	-	0.00
2-year college	-	0.00	-	0.00	-	0.00	-	0.00
4-year college	-	0.00	-	0.00	-	0.00	-	0.00
Mother's educational stage								
Below elementary	-	0.01	-	0.02	-	0.01	-	0.00
Elementary school	-	0.01	-	0.00	-	0.00	-	0.00
Junior high school	-	0.01	-	0.01	-	0.01	-	0.00
Senior high school	-	0.01	-	0.00	-	0.00	-	0.00
2-year college	-	0.00	-	0.00	-	0.00	-	0.00
Region								
East	-	0.01	-	0.01	-	0.00	-	0.01
North	-	0.00	-	0.01	-	0.01	-	0.01
Northeast	-	0.00	-	0.00	-	0.01	-	0.00
Central	-	0.01	-	0.02	-	0.02	-	0.01
South	-	0.01	-	0.01	-	0.00	-	0.01
Southwest	-	0.00	-	0.01	-	0.00	-	0.01
Northwest	-	0.01	-	0.03	-	0.01	-	0.00

6.3 Treatment effect estimation

To estimate the average treatment effect of parental migration on LBC for each gender, we fit a multiple regression model for each of the four outcomes on the treatment indicator in the gender groups, including the matching variables as covariates to adjust for any slight residual imbalances after matching. Matching weights are included in the estimation to account for the 1:7 matching. A cluster-robust standard error is implemented to account for control unit multiplicity and clustering. The coefficient on the treatment indicator is taken to be the estimate of the treatment effect in the gender subgroups.

Table 6.9 lists the treatment effect together with its standard error, p-value, 95% confidence interval, and the effect size for each outcome. Left-behind girls do not fare worse in all outcomes compared to rural native girls. Left-behind boys, however, are more vulnerable. They seem to fare worse than rural native boys in cognitive ability, subjective well-being, as well as psychological distress; the negative impact in psychological distress, in particular, has a p-value less than 0.05 and an appreciable effect size of -0.24.

Table 6.9 Treatment effect estimation by gender.

	Coefficient	Std. Error	p-value	95% CI	Effect Size
School grade					
Boys	-0.05	0.06	0.45	(-0.17, 0.07)	-0.05
Girls	0.02	0.06	0.80	(-0.11, 0.14)	0.02
Cognitive ability					
Boys	-0.13	0.07	0.07	(-0.28, 0.01)	-0.13
Girls	-0.01	0.07	0.93	(-0.15, 0.13)	-0.01
Subjective well-being					
Boys	-0.21	0.08	0.01	(-0.37, -0.06)	-0.24
Girls	-0.13	0.08	0.08	(-0.28, 0.02)	-0.15
Psychological distress					
Boys	-0.16	0.08	0.06	(-0.33, 0.01)	-0.17
Girls	-0.07	0.09	0.39	(-0.25, 0.10)	-0.08

Chapter 7

Treatment effect variation by parental migration mode

When dividing LBC into subgroups based on parental migration mode, we see appreciable differences in the means of the outcome variables among the subgroups (Table 7.1), prompting us to further examine whether the effect of parental migration differs by parental migration mode. Similar to Chapter 5, now within subgroups by parental migration mode, we use propensity score matching to estimate the average treatment effect of parental migration on LBC's academic development and mental health accounting for confounding by the matching variables. The control group for LBC in each subgroup is all rural natives, as parental migration mode does not apply to rural natives. Here we present results on the selection of the matching specification, balance assessment, and the estimation of the treatment effect.

Table 7.1 Mean and standard deviation comparison by parental migration mode.

Outcome	Rural natives	LBC: Father-absent	LBC: Mother-absent	LBC: Both-absent
School grade	2.53 (0.86)	2.53 (0.88)	2.33 (0.84)	2.69 (0.86)
Cognitive ability	-0.17 (1.04)	-0.11 (1.08)	-0.24 (0.98)	-0.30 (0.97)
Subjective well-being	-0.06 (0.87)	-0.17 (1.00)	-0.22 (0.94)	-0.34 (1.03)
Psychological distress	-0.05 (0.96)	-0.05 (1.06)	-0.43 (1.23)	-0.21 (1.20)

Using the analytical sample for school grade as an example, Table 7.2 shows there exist some differences in the means and proportions of the matching variables before matching among the three subgroups, as well as the pre-matching outcome variables (last four columns). To be noted is the large family size for the both-absent LBC: 6.52 compared to 5.04 for rural natives, 4.84 for the father-absent LBC, and 5.17 for the mother-absent LBC. This large family size

confirms our theory that the availability of additional family members, usually the grandparents, makes it possible for two parents to migrate.

Table 7.2 Pre-matching descriptive statistics by parental migration mode.

Variable	Rural natives	LBC: Father-absent	LBC: Mother-absent	LBC: Both-absent
Sample size	3127	266	81	151
Age	12.53	12.63	12.80	12.29
Gender				
Boys	53%	51%	51%	56%
Girls	47%	49%	49%	44%
Birth location				
Home	53%	55%	60%	59%
Hospital	47%	45%	40%	41%
Preschool attendance	52%	52%	43%	48%
Age starting to talk (month)	22.13	22.49	22.43	20.61
Family size	5.04	4.84	5.17	6.52
Community agricultural labor	51%	51%	48%	52%
Population working as migrants	35%	40%	42%	43%
Father's educational stage				
Below elementary	28%	21%	33%	21%
Elementary school	34%	38%	28%	28%
Junior high school	30%	35%	31%	46%
Senior high school	6%	5%	6%	5%
2-year college	1%	0%	1%	0%
4-year college	0%	0%	0%	1%
Mother's educational stage				
Below elementary	45%	52%	43%	39%
Elementary school	31%	30%	28%	36%
Junior high school	21%	17%	28%	22%
Senior high school	2%	2%	0%	2%
2-year college	0%	0%	0%	1%
Region				
East	12%	6%	2%	10%
North	12%	8%	9%	3%
Northeast	8%	5%	5%	3%
Central	15%	23%	15%	23%
South	13%	13%	15%	15%
Southwest	19%	14%	19%	25%
Northwest	22%	32%	36%	21%
School grade	2.57	2.53	2.33	2.69
Cognitive ability	-0.13	-0.09	-0.23	-0.31
Subjective well-being	-0.02	-0.17	-0.21	-0.32
Psychological distress	-0.00	-0.04	-0.42	-0.21

7.1 Selecting matching specification

Because we have three subgroups in each analytical sample, the ideal matching specification would achieve good balance while preserving adequate sample size in all subgroups and all four analytical samples.

We start with the matching specification used for the impact analysis: the 1:5 nearest neighbor with replacement, using propensity score estimated via logistic regression as the distance measure. This matching specification works well in achieving balance in the father-absent subgroup for all four outcomes; however, for the mother-absent and both-absent subgroups, the SMDs for a small number of covariates are still a little larger than 0.10 in the analytical samples for subjective well-being and psychological distress. Since there is an even greater number of control units than treatment units, in the next matching specification we bump up the treatment-to-control ratio to 1:7 while still allowing for replacement. There is a slight improvement in balance for all subgroups in all analytical samples, which is enough to bring all the SMDs within the 0.10 threshold save for one, which is also getting very close. A further examination of the jitter plots under this matching specification reveals the presence of several units with outlying propensity scores in the father-absent subgroup, which prompts us to try one more matching specification: 1:7 nearest neighbor with replacement plus common region restriction. This matching specification yields a comparable balance as the previous specification but from the father-absent subgroup, it discards one treatment unit from the analytical sample for school grade, two from the analytical sample for subjective well-being, and two from the analytical sample for psychological distress. Because treatment units are being discarded, treatment effects estimated subsequently will no longer correspond to the average treatment for

the treated (ATT). Again, since the purpose of this moderation analysis is more for treatment effect discovery, it is not as important to keep the target population 100% intact.

7.2 Matching results

Matching results using 1:7 nearest neighbor with replacement plus common region restriction for each subgroup in each analytical sample are shown in Tables 7.3-7.10 and Figures 7.1-7.3. Due to the common region restriction, one treatment unit from the analytical sample for grade and two treatment units from the analytical samples for subjective well-being and psychological distress are discarded; these units all come from the father-absent subgroup (Table 7.3). All remaining treatment units found seven matching control units each. Because this specification allows the replacement of matched control units, many control units are used multiple times (Table 7.4). The jitter plots show very good overlap for the distribution of propensity scores in matched treatment and control groups after the common region restriction for each subgroup in each analytical sample (Figures 7.1-7.3). Except for two instances, all SMDs are below the threshold of 0.10 and most are below 0.05 (Tables 7.5, 7.7, and 7.9). The two exceptions are a 0.10 for the percentage of agricultural labor in the community for mother-only LBC in the analytical sample for cognitive ability (Table 7.7) and a 0.16 for mother's highest educational level for both-absent LBC in the analytical sample for subjective well-being (Table 7.9). These remaining residual differences will be adjusted for when we include the matching variables in the outcome models as covariates. Additionally, variance ratios are all in the recommended range of 0.5 to 2.0 and eCDF statistics are all close to zero (Tables 7.6, 7.8, and 7.10). One aspect that is less ideal for this matching specification is the SMDs for the squares and two-way interactions between the matching variables: while over 97% in the four analytical samples for the father-

absent LBC are over 0.15, only over 94% and 90% are over 0.15 in the four analytical samples for the both-absent and mother-absent LBC. Although not as ideal as the balance metrics from the previous sections, the balance we have achieved with 1:7 nearest neighbor with replacement plus common region restriction is acceptable.

Table 7.3 Sample size before and after matching by parental migration mode.

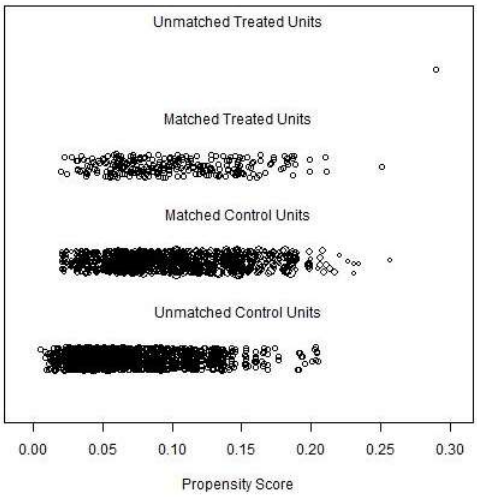
	School grade	Cognitive ability	Subjective well-being	Psychological distress
Subgroup 1: Father-absent				
Treatment: unmatched*	1	0	2	2
Treatment: matched	265	248	218	230
Control: matched	1267	1168	1066	1128
Control: unmatched*	1860	1801	1633	1704
Subgroup 2: Mother-absent				
Treatment: unmatched*	0	0	0	0
Treatment: matched	81	75	64	68
Control: matched	497	463	402	439
Control: unmatched*	2630	2506	2297	2393
Subgroup 3: Both-absent				
Treatment: unmatched*	0	0	0	0
Treatment: matched	151	137	109	123
Control: matched	711	642	519	591
Control: unmatched*	2416	2327	2180	2241

* Unmatched includes those excluded due to the common region restriction and those in The common region but did not find matches.

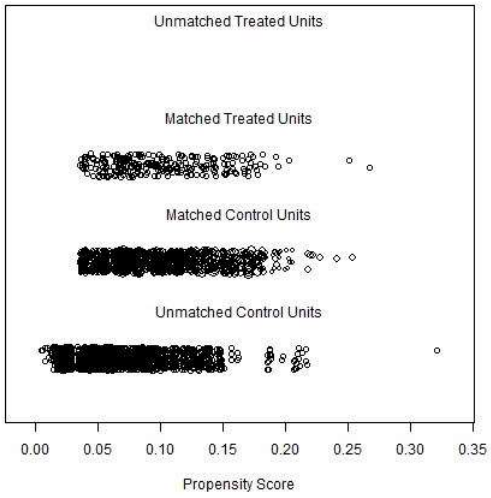
Table 7.4 The number of times control units are used by parental migration mode.

Analytical sample	1	2	3	4	5	6	7	8	9	10	11
School grade											
Subgroup 1: father-absent	564	268	101	52	27	12	3	2	-	-	-
Subgroup 2: mother-absent	371	81	7	2	1	-	-	-	-	-	-
Subgroup 3: both-absent	395	110	53	24	14	4	8	2	-	1	1
Cognitive ability											
Subgroup 1: father-absent	545	272	91	50	20	5	4	2	-	-	-
Subgroup 2: mother-absent	358	51	9	7	2	-	-	-	-	-	-
Subgroup 3: both-absent	337	115	55	22	10	8	2	1	1	1	-
Subjective well-being											
Subgroup 1: father-absent	527	256	93	34	8	3	2	-	-	-	-
Subgroup 2: mother-absent	310	60	6	-	-	-	-	-	-	-	-
Subgroup 3: both-absent	305	95	34	22	4	2	4	1	-	1	-
Psychological distress											
Subgroup 1: father-absent	534	255	98	30	20	5	2	1	-	-	-
Subgroup 2: mother-absent	355	53	5	-	-	-	-	-	-	-	-
Subgroup 3: both-absent	366	89	35	20	9	5	3	1	2	1	-

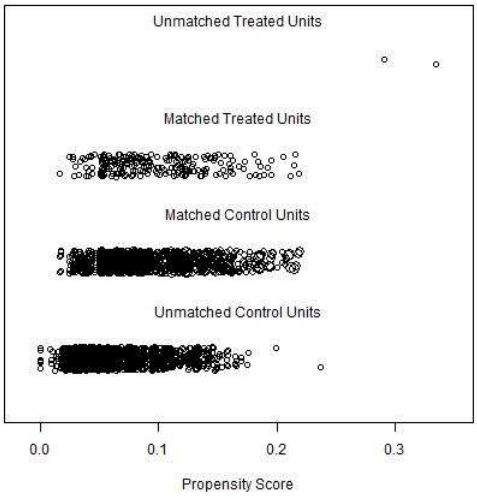
Figure 7.1 The distribution of propensity scores for father-absent LBC.



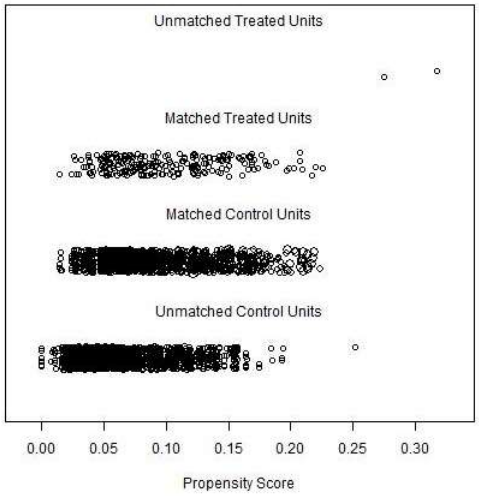
a) School grade



b) Cognitive ability

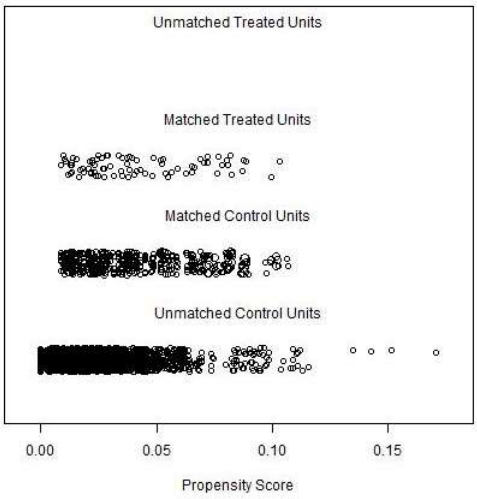


c) Subjective well-being

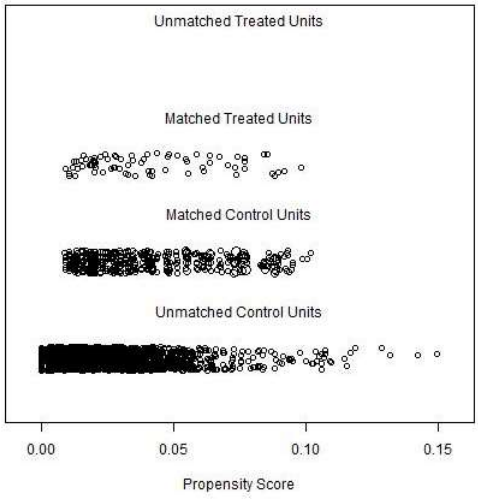


d) Psychological distress

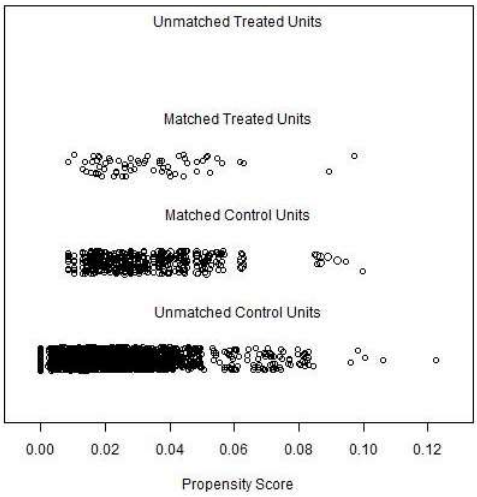
Figure 7.2 The distribution of propensity scores for mother-absent LBC.



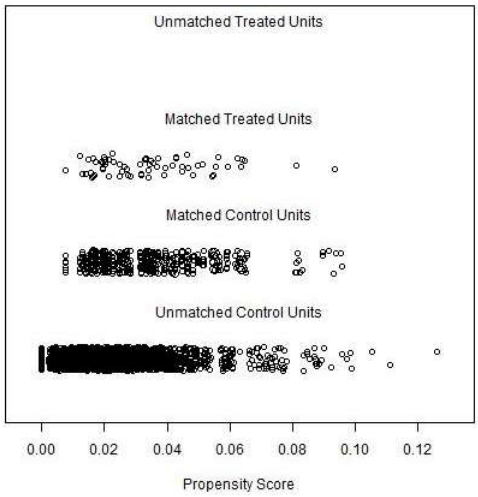
a) School grade



b) Cognitive ability

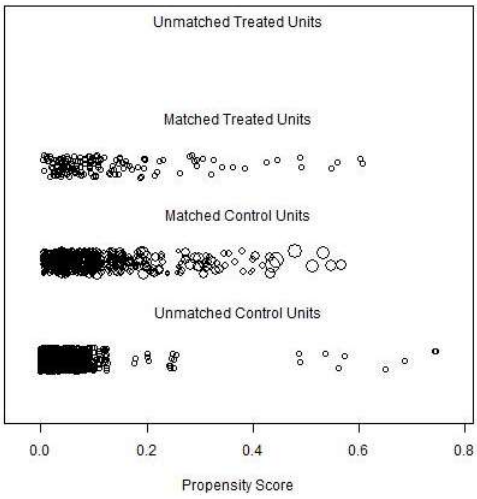


c) Subjective well-being

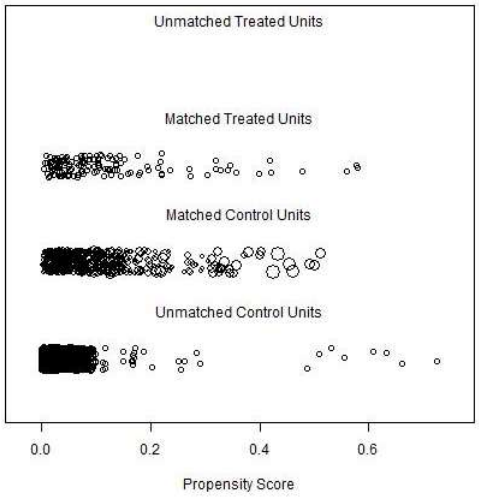


d) Psychological distress

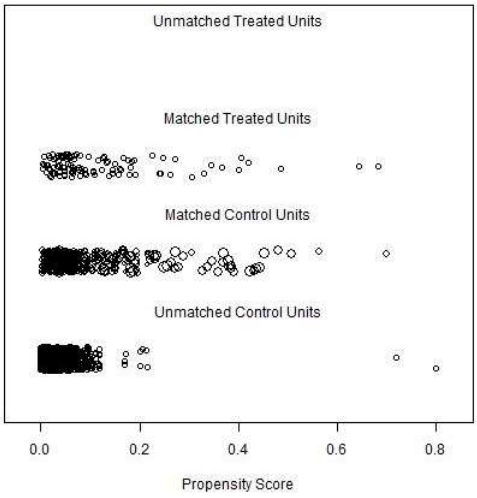
Figure 7.3 The distribution of propensity scores for both-absent LBC.



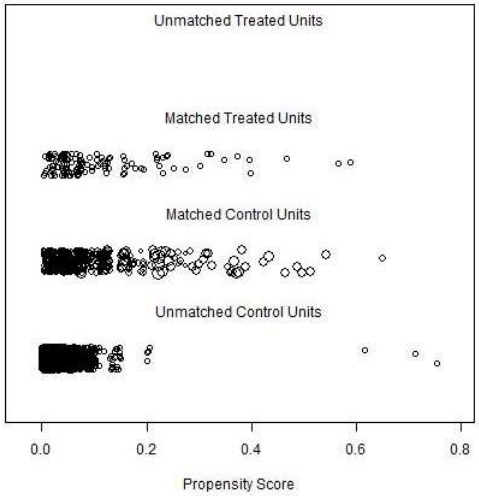
a) School grade



b) Cognitive ability



c) Subjective well-being



d) Psychological distress

Table 7.5 Standardized mean differences before and after matching for father-absent LBC.

Matching variable	School grade		Cognitive ability		Subjective well-being		Psychological distress	
	Before	After	Before	After	Before	After	Before	After
Age	0.05	-0.01	0.09	-0.03	0.06	-0.01	0.07	0.03
Gender	-0.04	0.06	-0.04	0.02	-0.08	0.01	-0.05	0.02
Birth location	-0.03	0.01	-0.07	0.00	0.00	-0.02	-0.01	0.04
Preschool attendance	0.00	-0.01	0.02	-0.02	0.03	-0.01	0.04	0.02
Age starting to talk (month)	0.04	0.02	0.04	0.01	0.05	-0.01	0.05	0.00
Family size	-0.14	-0.04	-0.13	0.00	-0.10	-0.01	-0.09	0.03
Community agricultural labor	0.00	0.01	-0.01	0.04	-0.01	0.00	-0.03	-0.01
Population working as migrants	0.23	-0.02	0.27	-0.02	0.26	-0.03	0.25	0.02
Father's educational stage								
Below elementary	-0.15	0.02	-0.19	-0.01	-0.14	0.06	-0.17	0.00
Elementary school	0.08	-0.05	0.06	0.00	0.06	-0.04	0.07	-0.03
Junior high school	0.11	0.02	0.15	0.01	0.13	-0.02	0.14	0.05
Senior high school	-0.09	0.02	-0.09	-0.02	-0.11	0.00	-0.12	-0.03
2-year college	-0.15	0.03	-0.15	-0.01	-0.12	0.02	-0.12	0.01
4-year college	0.03	-0.04	0.03	-0.01	-0.05	0.00	-0.05	0.00
Mother's educational stage								
Below elementary	0.13	0.01	0.10	0.02	0.19	0.02	0.17	-0.04
Elementary school	-0.03	0.01	0.00	-0.01	-0.09	0.01	-0.07	-0.01
Junior high school	-0.11	-0.03	-0.12	-0.04	-0.12	-0.04	-0.12	0.05
Senior high school	-0.08	-0.01	-0.04	0.05	-0.07	-0.01	-0.08	0.03
2-year college	-0.02	0.02	-0.02	0.03	0.01	0.03	0.01	0.06
Region								
East	-0.23	-0.02	-0.20	-0.04	-0.16	-0.01	-0.19	0.02
North	-0.16	0.00	-0.18	0.02	-0.21	-0.01	-0.22	-0.03
Northeast	-0.17	0.04	-0.13	0.04	-0.13	-0.06	-0.14	0.01
Central	0.17	0.02	0.22	0.02	0.20	0.01	0.21	0.05
South	0.01	-0.04	-0.10	-0.02	0.03	0.00	0.04	-0.01
Southwest	-0.15	-0.02	-0.10	-0.02	-0.23	0.01	-0.25	-0.01
Northwest	0.23	0.02	0.20	0.00	0.22	0.02	0.23	-0.03

Table 7.6 Variance ratio and the maximum eCDF difference for father-absent LBC.

Matching variable	School grade		Cognitive ability		Subjective well-being		Psychological distress	
	Var. Ratio	eCDF	Var. Ratio	eCDF	Var. Ratio	eCDF	Var. Ratio	eCDF
Age	1.17	0.04	1.24	0.04	1.18	0.02	1.09	0.02
Gender	-	0.03	-	0.01	-	0.01	-	0.01
Birth location	-	0.01	-	0.00	-	0.01	-	0.02
Preschool attendance	-	0.00	-	0.01	-	0.00	-	0.01
Age starting to talk (month)	1.13	0.04	1.03	0.03	1.03	0.04	1.11	0.05
Family size	1.09	0.05	1.14	0.04	0.94	0.06	1.06	0.05
Community agricultural labor	1.06	0.05	1.00	0.03	1.05	0.04	1.00	0.04
Population working as migrants	0.83	0.06	0.88	0.04	0.80	0.06	0.80	0.07
Father's educational stage								
Below elementary	-	0.01	-	0.00	-	0.03	-	0.00
Elementary school	-	0.02	-	0.00	-	0.02	-	0.01
Junior high school	-	0.01	-	0.01	-	0.01	-	0.02
Senior high school	-	0.00	-	0.00	-	0.00	-	0.01
2-year college	-	0.00	-	0.00	-	0.00	-	0.00
4-year college	-	0.00	-	0.00	-	0.00	-	0.00
Mother's educational stage								
Below elementary	-	0.00	-	0.01	-	0.01	-	0.02
Elementary school	-	0.00	-	0.00	-	0.00	-	0.00
Junior high school	-	0.01	-	0.01	-	0.01	-	0.02
Senior high school	-	0.00	-	0.01	-	0.00	-	0.00
2-year college	-	0.00	-	0.00	-	0.00	-	0.00
Region								
East	-	0.00	-	0.01	-	0.00	-	0.00
North	-	0.00	-	0.00	-	0.00	-	0.01
Northeast	-	0.01	-	0.01	-	0.01	-	0.00
Central	-	0.01	-	0.01	-	0.00	-	0.02
South	-	0.01	-	0.01	-	0.00	-	0.00
Southwest	-	0.01	-	0.01	-	0.00	-	0.00
Northwest	-	0.01	-	0.00	-	0.01	-	0.01

Table 7.7 Standardized mean differences before and after matching for mother-absent LBC.

Matching variable	School grade		Cognitive ability		Subjective well-being		Psychological distress	
	Before	After	Before	After	Before	After	Before	After
Age	0.17	0.00	0.15	-0.02	0.22	-0.06	0.21	-0.02
Gender	-0.04	0.00	-0.09	-0.04	-0.10	0.04	-0.10	-0.04
Birth location	-0.16	0.00	-0.12	-0.03	-0.16	0.01	-0.19	-0.03
Preschool attendance	-0.19	0.04	-0.15	0.04	-0.02	0.04	-0.05	-0.02
Age starting to talk (month)	0.03	-0.08	0.04	0.08	0.04	-0.04	-0.01	0.02
Family size	0.09	0.05	0.06	-0.05	0.08	-0.07	0.14	0.05
Community agricultural labor	-0.11	-0.02	-0.11	0.10	-0.08	-0.07	-0.08	-0.02
Population working as migrants	0.28	0.04	0.33	-0.01	0.28	0.03	0.26	0.04
Father's educational stage								
Below elementary	0.12	0.09	0.13	0.07	0.13	0.02	0.11	-0.04
Elementary school	-0.13	-0.02	-0.17	-0.02	-0.08	-0.06	-0.11	0.08
Junior high school	0.02	-0.03	0.03	-0.02	-0.03	0.04	0.03	-0.01
Senior high school	-0.01	-0.06	0.01	-0.05	-0.07	-0.05	-0.09	-0.05
2-year college	0.00	-0.06	0.00	-0.02	0.02	0.05	0.02	-0.02
4-year college	-0.04	0.00	-0.05	0.00	-0.05	0.00	-0.05	0.00
Mother's educational stage								
Below elementary	-0.03	0.05	-0.07	0.09	-0.02	-0.04	-0.01	-0.02
Elementary school	-0.06	0.00	-0.03	-0.05	-0.05	0.06	-0.09	0.04
Junior high school	0.16	-0.05	0.18	-0.05	0.13	-0.01	0.16	-0.02
Senior high school	-0.16	0.00	-0.16	0.00	-0.15	0.00	-0.15	0.00
2-year college	-0.07	0.00	-0.07	0.00	-0.06	0.00	-0.06	0.00
Region								
East	-0.59	0.06	-0.57	0.00	-0.45	0.03	-0.48	0.04
North	-0.11	0.03	-0.09	0.01	-0.07	0.04	-0.09	0.04
Northeast	-0.14	-0.07	-0.13	0.03	-0.18	0.07	-0.19	0.01
Central	-0.01	0.00	0.02	-0.08	-0.02	-0.07	0.00	-0.04
South	0.06	-0.03	0.07	-0.05	0.12	0.04	0.09	-0.05
Southwest	-0.01	0.01	0.04	0.00	-0.06	-0.05	-0.02	-0.01
Northwest	0.30	0.01	0.21	0.08	0.25	0.00	0.25	0.04

Table 7.8 Variance ratio and the maximum eCDF difference for mother-absent LBC.

Matching variable	School grade		Cognitive ability		Subjective well-being		Psychological distress	
	Var. Ratio	eCDF	Var. Ratio	eCDF	Var. Ratio	eCDF	Var. Ratio	eCDF
Age	0.90	0.11	0.92	0.10	0.91	0.10	0.90	0.08
Gender	-	0.00	-	0.02	-	0.02	-	0.02
Birth location	-	0.00	-	0.02	-	0.01	-	0.01
Preschool attendance	-	0.02	-	0.02	-	0.02	-	0.01
Age starting to talk (month)	0.85	0.08	1.18	0.06	1.10	0.06	1.09	0.05
Family size	1.13	0.09	0.99	0.05	0.58	0.07	0.83	0.11
Community agricultural labor	1.04	0.06	1.14	0.08	1.06	0.10	1.09	0.08
Population working as migrants	1.12	0.08	1.17	0.09	1.26	0.10	1.05	0.09
Father's educational stage								
Below elementary	-	0.04	-	0.03	-	0.01	-	0.02
Elementary school	-	0.01	-	0.01	-	0.03	-	0.04
Junior high school	-	0.02	-	0.01	-	0.02	-	0.00
Senior high school	-	0.01	-	0.01	-	0.01	-	0.01
2-year college	-	0.01	-	0.00	-	0.01	-	0.00
4-year college	-	0.00	-	0.00	-	0.00	-	0.00
Mother's educational stage								
Below elementary	-	0.02	-	0.04	-	0.02	-	0.01
Elementary school	-	0.00	-	0.02	-	0.03	-	0.02
Junior high school	-	0.02	-	0.02	-	0.00	-	0.01
Senior high school	-	0.00	-	0.00	-	0.00	-	0.00
2-year college	-	0.00	-	0.00	-	0.00	-	0.00
Region								
East	-	0.01	-	0.00	-	0.00	-	0.01
North	-	0.01	-	0.00	-	0.01	-	0.01
Northeast	-	0.02	-	0.01	-	0.02	-	0.00
Central	-	0.00	-	0.03	-	0.02	-	0.01
South	-	0.01	-	0.02	-	0.02	-	0.02
Southwest	-	0.00	-	0.00	-	0.02	-	0.00
Northwest	-	0.01	-	0.04	-	0.00	-	0.02

Table 7.9 Standardized mean differences before and after matching for both-absent LBC.

Matching variable	School grade		Cognitive ability		Subjective well-being		Psychological distress	
	Before	After	Before	After	Before	After	Before	After
Age	-0.14	0.02	-0.11	0.02	-0.02	-0.01	-0.06	0.02
Gender	0.06	0.02	0.00	-0.01	0.20	-0.06	0.14	0.00
Birth location	-0.12	-0.02	-0.10	-0.02	0.00	0.02	-0.01	0.01
Preschool attendance	-0.08	-0.04	-0.12	-0.03	0.01	0.07	-0.03	0.07
Age starting to talk (month)	-0.17	0.01	-0.24	-0.03	-0.14	-0.01	-0.16	-0.02
Family size	0.77	0.01	0.75	0.00	0.79	0.03	0.75	0.02
Community agricultural labor	0.03	0.05	0.00	0.06	0.03	-0.06	0.07	0.00
Population working as migrants	0.34	-0.03	0.38	-0.06	0.26	0.07	0.28	-0.05
Father's educational stage								
Below elementary	-0.18	-0.01	-0.15	0.01	-0.42	-0.05	-0.27	0.02
Elementary school	-0.15	0.03	-0.20	0.03	-0.14	0.02	-0.17	0.00
Junior high school	0.31	-0.02	0.34	-0.02	0.44	0.00	0.39	-0.02
Senior high school	-0.05	-0.01	-0.06	-0.02	-0.03	0.06	-0.02	-0.01
2-year college	-0.12	0.00	-0.12	0.00	-0.12	0.00	-0.11	0.00
4-year college	0.06	0.03	0.06	0.00	0.07	-0.04	0.07	0.01
Mother's educational stage								
Below elementary	-0.12	0.00	-0.10	-0.01	-0.20	-0.06	-0.13	-0.04
Elementary school	0.09	0.03	0.10	0.02	0.15	0.08	0.11	0.01
Junior high school	0.02	-0.03	0.00	-0.02	0.05	0.02	0.03	0.03
Senior high school	-0.03	0.02	-0.02	0.01	-0.03	0.00	-0.05	0.03
2-year college	0.07	-0.02	0.03	0.04	0.05	-0.16	0.05	-0.03
Region								
East	-0.05	0.01	-0.05	0.03	0.03	0.00	0.03	0.05
North	-0.47	-0.02	-0.53	-0.02	-0.41	0.00	-0.46	0.01
Northeast	-0.34	0.05	-0.41	0.03	-0.35	0.03	-0.38	0.04
Central	0.19	-0.01	0.19	0.00	0.29	-0.01	0.25	-0.06
South	0.07	-0.01	0.09	-0.07	0.08	0.07	0.07	-0.04
Southwest	0.14	0.00	0.14	0.01	0.06	-0.04	0.11	0.06
Northwest	-0.03	0.00	-0.02	0.03	-0.16	-0.02	-0.14	-0.03

Table 7.10 Variance ratio and the maximum eCDF difference for both-absent LBC.

Matching variable	School grade		Cognitive ability		Subjective well-being		Psychological distress	
	Var. Ratio	eCDF	Var. Ratio	eCDF	Var. Ratio	eCDF	Var. Ratio	eCDF
Age	0.96	0.07	1.08	0.03	0.87	0.05	0.83	0.05
Gender	-	0.01	-	0.01	-	0.03	-	0.00
Birth location	-	0.01	-	0.01	-	0.01	-	0.00
Preschool attendance	-	0.02	-	0.02	-	0.03	-	0.04
Age starting to talk (month)	1.27	0.08	1.03	0.06	1.31	0.12	1.19	0.11
Family size	0.89	0.09	0.83	0.08	0.74	0.10	0.73	0.10
Community agricultural labor	1.06	0.06	1.00	0.06	1.00	0.07	1.03	0.07
Population working as migrants	0.94	0.05	0.95	0.06	0.84	0.11	0.89	0.05
Father's educational stage								
Below elementary	-	0.00	-	0.00	-	0.02	-	0.01
Elementary school	-	0.01	-	0.01	-	0.01	-	0.00
Junior high school	-	0.01	-	0.01	-	0.00	-	0.01
Senior high school	-	0.00	-	0.00	-	0.01	-	0.00
2-year college	-	0.00	-	0.00	-	0.00	-	0.00
4-year college	-	0.00	-	0.00	-	0.00	-	0.00
Mother's educational stage								
Below elementary	-	0.00	-	0.00	-	0.03	-	0.02
Elementary school	-	0.02	-	0.01	-	0.04	-	0.00
Junior high school	-	0.01	-	0.01	-	0.01	-	0.01
Senior high school	-	0.00	-	0.00	-	0.00	-	0.00
2-year college	-	0.00	-	0.00	-	0.02	-	0.00
Region								
East	-	0.00	-	0.01	-	0.00	-	0.02
North	-	0.00	-	0.00	-	0.00	-	0.00
Northeast	-	0.01	-	0.00	-	0.01	-	0.01
Central	-	0.01	-	0.00	-	0.01	-	0.03
South	-	0.00	-	0.02	-	0.02	-	0.02
Southwest	-	0.00	-	0.00	-	0.02	-	0.03
Northwest	-	0.00	-	0.01	-	0.01	-	0.01

7.3 Treatment effect estimation

To estimate the average treatment effect of parental migration on LBC for each subgroup, we fit a multiple regression model for each of the four outcomes on the treatment indicator in the subgroup samples, including the matching variables as covariates to adjust for any slight residual imbalances after matching. Matching weights are included in the estimation to account for the 1:7 matching. A cluster-robust standard error is implemented to account for control unit multiplicity and clustering. The coefficient on the treatment indicator is taken to be the estimate of the treatment effect within the subgroups.

Table 7.11 lists the treatment effect together with its standard error, p-value, 95% confidence interval, and the effect size for each of the four outcomes. Parental migration mode does not have a moderating effect on cognitive ability: all subgroups of LBC do not score lower on the cognitive tests than their rural native counterparts. Parental migration mode does have a moderation impact on the other three outcomes. LBC whose mothers are absent receive 0.20 points lower in school grade than the rural natives; with an effect size of -0.23, this is a meaningful negative impact. Subjective well-being is significantly lower for father-absent LBC and both-absent LBC: father-absent LBC score 0.15 points lower than the rural natives while the both-absent LBC score 0.27 points lower. The negative impact on the both-absent subgroup is particularly pronounced with an effect size of -0.31. In terms of psychological distress, LBC with an absent mother is affected the worst: scoring 0.37 points lower than the rural natives, the effect size of which is -0.38. It seems the absence of a mother leads to more symptoms of psychological distress and a decrease in school performance, while the absence of a father leads to lower subjective well-being.

Table 7.11 Treatment effect estimation by parental migration mode.

	Coefficient	Std. Error	p-value	95% CI	Effect Size
School grade					
Subgroup 1: father-absent	-0.02	0.06	0.76	(-0.13, 0.10)	-0.02
Subgroup 2: mother-absent	-0.20	0.10	0.04	(-0.40, 0.00)	-0.23
Subgroup 3: both-absent	0.09	0.08	0.22	(-0.06, 0.25)	0.11
Cognitive ability					
Subgroup 1: father-absent	-0.01	0.07	0.87	(-0.15, 0.13)	-0.01
Subgroup 2: mother-absent	-0.14	0.11	0.20	(-0.35, 0.08)	-0.14
Subgroup 3: both-absent	-0.05	0.08	0.55	(-0.22, 0.12)	-0.05
Subjective well-being					
Subgroup 1: father-absent	-0.15	0.07	0.03	(-0.28, -0.01)	-0.17
Subgroup 2: mother-absent	-0.11	0.13	0.38	(-0.37, 0.14)	-0.13
Subgroup 3: both-absent	-0.27	0.10	0.01	(-0.48, -0.07)	-0.31
Psychological distress					
Subgroup 1: father-absent	-0.02	0.08	0.77	(-0.17, 0.13)	-0.02
Subgroup 2: mother-absent	-0.37	0.14	0.01	(-0.64, -0.09)	-0.38
Subgroup 3: both-absent	-0.17	0.11	0.15	(-0.39, 0.06)	-0.17

Chapter 8

Discussions

We have thus far examined the impact of parental migration in four outcomes on LBC as a whole, on left-behind boys and girls, and on LBC whose father, mother, and both parents are migrant workers. Table 8.1 summarizes all the treatment effects.

Table 8.1 Summary of treatment effects.

	Coefficient	Std. Error	p-value	95% CI	Effect Size
School grade					
All LBC	0.01	0.05	0.76	(-0.08, 0.10)	0.02
Boys	-0.05	0.06	0.45	(-0.17, 0.07)	-0.05
Girls	0.02	0.06	0.80	(-0.11, 0.14)	0.02
Father-absent	-0.02	0.06	0.76	(-0.13, 0.10)	-0.02
Mother-absent	-0.20	0.10	0.04*	(-0.40, 0.00)	-0.23
Both-absent	0.09	0.08	0.22	(-0.06, 0.25)	0.11
Cognitive ability					
All LBC	-0.04	0.05	0.43	(-0.14, 0.06)	-0.04
Boys	-0.13	0.07	0.07	(-0.28, 0.01)	-0.13
Girls	-0.01	0.07	0.93	(-0.15, 0.13)	-0.01
Father-absent	-0.01	0.07	0.87	(-0.15, 0.13)	-0.01
Mother-absent	-0.14	0.11	0.20	(-0.35, 0.08)	-0.14
Both-absent	-0.05	0.08	0.55	(-0.22, 0.12)	-0.05
Subjective well-being					
All LBC	-0.16	0.06	0.01*	(-0.27, -0.05)	-0.18
Boys	-0.21	0.08	0.01*	(-0.37, -0.06)	-0.24
Girls	-0.13	0.08	0.08	(-0.28, 0.02)	-0.15
Father-absent	-0.15	0.07	0.03*	(-0.28, -0.01)	-0.17
Mother-absent	-0.11	0.13	0.38	(-0.37, 0.14)	-0.13
Both-absent	-0.27	0.10	0.01*	(-0.48, -0.07)	-0.31
Psychological distress					
All LBC	-0.12	0.06	0.05*	(-0.24, 0.00)	-0.12
Boys	-0.16	0.08	0.06	(-0.33, 0.01)	-0.17
Girls	-0.07	0.09	0.39	(-0.25, 0.10)	-0.08
Father-absent	-0.02	0.08	0.77	(-0.17, 0.13)	-0.02
Mother-absent	-0.37	0.14	0.01*	(-0.64, -0.09)	-0.38
Both-absent	-0.17	0.11	0.15	(-0.39, 0.06)	-0.17

We find that LBC as a whole do not fare worse when compared to the rural natives in terms of cognitive ability and school grade. They do, however, fare worse in the mental health domain, reporting significantly lower subjective well-being (coefficient = -0.16, p = 0.01, effect size = -0.18) and higher levels of psychological distress (coefficient = -0.12, p = 0.05, effect size = -0.12), though the effect size for both is minimal. In terms of gender, boys seem to be more vulnerable to the negative impacts of parental migration, especially in subjective well-being (coefficient = -0.21, p = 0.01, effect size = -0.24). In terms of parental migration mode, the role of both parents is shown to be important in different domains. While children left behind by fathers and by both parents report significantly lower subjective well-being (coefficient = -0.13, p = 0.03, effect size = -0.17 for the father-absent; coefficient = -0.27, p = 0.01, effect size = -0.31 for the both-absent), children left behind by mothers show significantly higher symptoms of psychological distress (coefficient = -0.37, p = 0.01, effect size = -0.38).

The following sections attempt to offer some plausible explanations for the findings based on theories and data from the matched samples.

8.1 School grade and cognitive ability

Despite the parental separation, LBC seem to function quite normally in academic and cognitive domains. This neutral outcome may be the result of the two contrasting theories working concurrently and canceling out each other's effect.

According to child development theories (McLanahan & Sanderfur, 1994), when one or both parents live away from home for long periods, children left behind would be deprived of parental supervision and care, including parental time and help in academic-related work, resulting in low school performance and delayed cognitive development. We do observe this

theory at work to some extent in the data: in the matched data from Chapter 5, consistently across all four analytical samples, LBC receive fewer hours in homework help than the rural natives: between 1.24-1.48 hours per week for the LBC and 1.84-1.98 hours for the rural natives; parental education engagement factor score is also noticeably lower: around -0.15 for the LBC and -0.02 for the rural natives. However, the reduced parental engagement did not result in a final drop in outcomes, indicating another force at work.

The increased household income may be the other force at work. As predicted by the household strategy theory (Stark & Bloom, 1985), when family members leave home for migrant work, they earn higher wages than they would at home and send back a portion in the form of remittance. This improvement in the household's immediate socioeconomic condition effectively neutralizes the negative impact on academic outcomes coming from the reduction in parental education engagement. Our data clearly shows this increase in income: across all four analytical samples, per capita household income for LBC is around 8,000 RMB while that for the matched rural natives is 5,800 RMB. Furthermore, LBC's households not only receive a higher income but also spend more on their child's education: around 1,850 RMB for LBC's households vs. 1,600 RMB for the rural native households. These numbers confirm the household strategy theory at work and show that in academic domains, money has the power to reverse some of the negative effects due to parental separation.

The moderation analysis for gender confirms this proposed mechanism. When we examine the gender-specific matched dataset from Chapter 6, we observe in both left-behind boys and girls the same reduction in parental education engagement (for boys, around -0.07 for the left-behind and -0.01 for the rural natives; for girls, around -0.18 for the left-behind and -0.08 for the rural natives) on one hand, and the same increase in household income (for boys, around

8,200 RMB for the left-behind and 5,750 RMB for the rural natives; for girls, around 7,750 RMB for the left-behind and 5,750 RMB for the rural natives) as well as in education expenditure (for boys, around 1,700 RMB for the left-behind and 1,500 RMB for the rural natives; for girls, around 2,000 RMB for the left-behind and 1,700 RMB for the rural natives) on the other hand. Per our proposed mechanism, the final results show that both left-behind boys and girls do not fare worse in school grade and cognitive ability than their matched rural natives. Gender does not play a moderation effect on academic outcomes.

In the moderation analysis for parental migration mode, unlike what we have observed for LBC as a whole and LBC in the other two parental migration modes, we find children left behind by mothers achieve lower school grade (coefficient = -0.20, p = 0.04, effect size = -0.23), though not lower cognitive scores. Why might this be the case? A closer look at the matched data reveals some interesting patterns. First off, among the three parental migration modes, the increase in income is the least for households with a migrating mother: an average of 1,100 RMB in comparison to 1,750 RMB for households with a migrating father and 2,500 RMB for households with two migrating parents. This makes sense as two workers make more than one worker and the male workers generally make more than the female workers, especially in low-skill sectors that require physical strength. Secondly, in the matched analytical sample for school grade, the average family education expenditure for the mother-absent households is actually lower than that for the rural native households (1,692 RMB vs 1,852 RMB), a pattern unique to the analytical sample for school grade. This unique pattern may well be the result of data unreliability as sample sizes, especially in the mother-absent subgroup, drop down quickly when we divide LBC into the three subgroups based on parental migration mode. Even if this pattern is the result of data unreliability, it nevertheless lends support to our proposed mechanism: children

left behind by mothers achieve lower grade in school because in the analytical sample for school grade, their family spends less on education than the control families; they do not score lower in cognitive ability because in that analytical sample, the families of children left behind by mothers do spend more on education. This observation also leads us to revise our proposed mechanism: what matters the most for neutralized academic outcomes is not a mere increase in household income but an increase in education spending.

In summary, LBC are not harmed by parental migration in academic domains because the increased household income and education spending buffer the negative consequences of parental separation. Gender does not play a moderation role because both genders experience the same increase in household income and education spending. Parental migration mode may play a moderation role insofar as households with a migrating mother receive the least amount of income gain and may not have the means to boost their education expenditure much.

8.2 Subjective well-being

According to child developmental theories, adequate parental care and healthy bonding are essential for a child's psychological health; when parents are absent for long periods, children are more likely to develop unhealthy psychological symptoms due to the deprivation of such care and bonding. This is indeed what we find for the LBC: they report lower subjective well-being than the rural natives, though the effect size for LBC as a whole is not very large (-0.18). A closer look at our matched data from Chapter 5 shows that the parental bonding factor score is slightly lower for the LBC than for the rural natives (-0.13 vs. -0.12), mildly hinting at an association between parental bonding and subjective well-being.

The evidence is stronger when we examine the moderation effect for gender. Left-behind boys, more so than left-behind girls, report lower subjective well-being when compared to matched rural native kids of the same gender. Why might that be the case? Matched data from Chapter 6 reveals that left-behind boys report significantly lower parental bonding scores than rural native boys (-0.30 vs. -0.13), while left-behind girls report higher parental bonding scores than rural native girls (0.06 vs. 0.00). The data seems to indicate that it is harder for parents to form strong and positive bonding with left-behind boys than it is with left-behind girls. It could very well be gender differences in the way child-parent bonds are formed: boys usually bond via physical contact and rough plays, which are hard to maintain with physical absence, while frequent conversations and caring words are sufficient for girls to develop attachment, which can still be managed via technology these days. It could also be the result of girls being more understanding of the parents' decisions and therefore make an effect to cooperate with the parents in maintaining close bonding, hence the popular Chinese expression that "daughters are the parents' warm layering coat", indicating a strong intimate relationship between the parents and their sweet and understanding daughters, as opposed to sons, who tend to be more ignorant of the parents' needs and expectations.

The moderation analysis for parental migration mode somewhat supports the association between parental bonding and subjective well-being. While all three subgroups report lower subjective well-being than the rural natives, the only coefficient that is both statistically significant and of meaningful effect size is the one for the both-absent LBC. Intuitively this makes a lot of sense: parental bonding will be weakened the most when both parents are absent from the child. A closer look at the matched data from Chapter 7 shows that the parental bonding score for the both-absent LBC is indeed lower than that for the rural natives (-0.24 vs. -0.17).

The parental bonding scores for the father-absent and mother-absent LBC are also lower than the rural natives (-0.09 vs. 0.06 for the father-absent LBC and -0.12 vs. -0.04 for the mother-absent LBC), but with one parent remaining, the magnitude of the decrease may not be large enough to bring a significant reduction in a child's subjective well-being.

As opposed to what we have observed for academic outcomes, the negative impact on subjective well-being does not seem to be neutralized by increased household income. This should not come as surprising because strong parenting bonding cannot be purchased. As the adage would say, "Money can't buy happiness", so in the case of LBC, increased household income cannot be exchanged for a sense of well-being.

In summary, we speculate that LBC's lower subjective well-being is associated with weakened parenting bonding, and an increase in household income does not alleviate this negative impact. Gender plays a moderating role as it is harder for boys than for girls to form bonding. Parental migration mode also plays a moderating role because children left behind by both parents are most deprived in terms of parental bonding, hence, experience the lowest subjective well-being.

8.3 Psychological distress

Similar to subjective well-being, we observe the harmful impact of parental separation on LBC's elevated levels of psychological distress, which also does not seem to be neutralized by the increased household income. This confirms what Zhou et al. find in their 2018 paper that the negative impact due to decreased parental care is stronger than the positive impact due to increased income on depressive symptoms. Our results lead us to conclude that money only has neutralizing effects on academic-related outcomes but not mental health outcomes.

Although both are in the domain of mental health, subjective well-being and psychological distress are two different constructs. In our data, the correlation between the two variables is only 0.21. While we find the strength of parenting bonding to be a potential mediator for subjective well-being, the mechanism for psychological distress appears to be different. As we have observed earlier for subjective well-being, all three subgroups by parental migration mode experience weakened parental bonding, especially the both-absent LBC; however, psychological distress is not the worst for both-absent LBC but the mother-absent LBC with a meaningful effect size of -0.38. Why might that be the case?

From our matched data, we speculate that a child's level of psychological distress is related to the level of tension within the family. Parental migration not only interferes with interpersonal relationships among the family members but also disrupts the routines and task assignments in the family. This disruption raises the level of overall tension within the family, perhaps in the form of frequent quarrels or the parents' elevated levels of distress, ultimately leading to a child experiencing higher levels of distress. Although we don't have a direct measure of family tension in the dataset, we do have four related variables: 1) the number of quarrels between parents in the last month, 2) the number of quarrels between the child and the parents in the last month, 3) father's level of psychological distress, and 4) mother's level of psychological distress.

For LBC as a whole, the number of quarrels between parents is a little less than that in the control families (0.38 vs. 0.54), perhaps because physical distance acts as a natural barrier to quarreling, and the number of quarrels between the parent and the child is comparable with that in the control families (0.78 vs. 0.76). The level of psychological distress, however, is higher for the parents of LBC, especially for the mothers (-0.06 vs. -0.02 for fathers of LBC and control,

and -0.31 vs. -0.14 for mothers of LBC and control, with a lower score indicating more symptoms of psychological distress). The elevated levels of parental distress probably contribute to the elevated level of distress for the left-behind child, though the effect size for LBC as a whole is rather minimal (-0.12). Between left-behind boys and left-behind girls, the level of tension within the family does not seem to differ much, hence, we do not see gender playing a moderating role in the impact on psychological distress, which is what Ding & Buhs (2017) finds also.

Parental migration mode, however, does play a significant moderating role. We see in families with a migrant mother, the father that remains at home is highly distressed with a psychological distress score of -0.38, compared to -0.03 for the rural native fathers, so distressed that his level of distress, for the first time, surpasses that of the mother (the general trend we have seen throughout is that the mothers, regardless whether she is in the treatment or the control group, are appreciably more distressed than the fathers). The father is very distressed probably because he now has to take over the role of the major caretaker at home. The migrating mother, on the other hand, experiences less distress than the rural native mothers (-0.14, compared to -0.28 for the rural native mothers), most likely because she is now free of the heavy childrearing and homemaking load she used to carry. Another interesting pattern in families with a migrant mother is that the number of between-parent quarrels is higher than that in the control families. This number is consistently smaller in migrant families whether we examine LBC as a whole or by gender because physical distance usually acts as a natural barrier to quarreling. For the number of quarrels between the parents to increase, the tension between the spouses must be intense enough to be able to overcome that barrier. Perhaps the father's high level of distress contributes to that end. So with a highly distressed father and an increased number of between-

parent quarrels, children left behind by a migrant mother, per our speculation, exhibit significantly higher levels of distress.

In summary, we speculate that LBC's higher levels of psychological distress are associated with a heightened level of tension within a disrupted family, and an increase in household income does not alleviate this negative impact. Gender does not play a moderating role as the level of tension does not differ between families of left-behind boys and girls. Parental migration mode plays an important moderating role because families with a migrant mother experience a high level of family tension as manifested in the remaining father's high level of distress and the increased number of between-parent quarrels.

8.4 Policy recommendations

Policy changes from the central government have the biggest potential to change China's migration scene and the lives of the LBC. Additionally, bottom-up approaches initiated at the community and local government levels may also be meaningful places to introduce changes. Below we give some policy recommendations in light of our findings.

First, in our descriptive analysis, we see that rural migrant children, though of the same origin as LBC, fare much better than LBC in all the aspects being compared. Rural migrant children are those rural children who are brought into urban cities with their migrant parents. Although they also face many challenges while assimilating into urban life, they have the privilege of living with and being cared for by their parents. Living in a city in many ways also exposes them to new learning opportunities, ideas, and life events, all of which help them develop better than those left behind in their rural homes. Hence, we recommend the local government of the destination cities continue alleviating the institutional barriers hindering

migrants from bringing their children so that more migrant workers will choose to migrate as a family. For example, the local government can work with the local public schools to lower the enrollment criteria for migrant children; the local government can also designate hospitals to offer discounted healthcare to migrant workers and their family members; the local government may also offer incentives to real estate developers to build and sell affordable apartments in neighborhoods with a large migrant population. To fund these efforts, we would recommend that the central government allocate extra funding for localities with large proportions of migrant workers.

Second, because parental migration harms the mental health of LBC, we recommend that local schools pay more attention to the mental states of LBC, especially left-behind boys. The local schools can offer a class on mental health to educate all children, start a club for LBC so they can share feelings and support one another, and provide mental health training to head teachers so they can identify at-risk students and offer timely help and support.

Third, we see that children left behind by both parents show the most worrisome signs of mental distress. Therefore, if the parents have to migrate for work and have no way of bringing along their children, we think only one parent should migrate while the other remains behind to care for the child. Between the two parents, we think it is better to have the mother stay behind because stay-behind fathers usually do not handle the stress of childcaring very well, and also because migrant fathers usually make more money. Hence, we would recommend the local government of the rural villages to offer incentives for households with children to not send out two migrating parents. We also recommend the local government provide mental support to left-behind spouses, especially if the spouse is a father.

8.5 Limitations and future work

One major limitation of the study is not having a precise time on when a rural child first becomes a LBC. With data in a wave all collected at the same time, it can be difficult to tell whether some of the variables are pre- or post-treatment. We have taken great care in ensuring that the matching variables selected are all pre-treatment measures or are otherwise unrelated to the treatment itself. For the outcomes, however, it is harder to ensure that they are in fact post-treatment or have been post-treatment long enough for an effect to show up (i.e., it is entirely possible to have a LBC whose parents decided to migrate a day before the survey is to be administered. This child would be counted as a LBC in the data; however, the outcome such as school grade and psychological distress for this child is effectively pre-treatment because they describe the conditions of the past semester or month.) At the same time, this limitation also works to strengthen our findings: even with the potential presence of children who contributes little or no to final outcome differences, we still found several large differences that are of meaningful sizes.

Another limitation of the study is having to form composite outcome variables by combining scores from different instruments to retain sufficient sample size (the cognitive composite formed from the Chinese word test/math test in 2010 and 2014 and the Chinese character recall/numerical series in 2012 and 2016 and the psychological distress composite formed from the K-6 factor score in 2010 and 2014 and the CES-D subscale factor score in 2012 and 2016). Especially for the psychological distress composite, there is no established evidence showing that the latent construct measured by the K-6 is the same as the latent construct measured by the 11-item CES-D subscale, though some of the items on both appear quite similar

and separate analyses have shown the direction of the final results would not have changed had we used the individual instruments.

Lastly, it is a pity that we are not able to carry out longitudinal analyses in this study due to insufficient sample sizes for the relevant migration patterns within the age range of children we are interested in.

Now with the availability of CFPS 2018 and 2020, two directions of future work are possible. The first direction is to refine the current study. Now with two more waves of data available, we could redo the analyses by examining the impact on distress as measured by the K-6 using waves 2010, 2014, and 2018 and on depression as measured by the CES-D using waves 2012, 2016, and 2020. With more data, we can also examine more outcomes of substantive interest that are not included in the current study due to insufficient sample size. Two such outcomes are self-esteem as measured by the Rosenberg Self-Esteem Scale (Rosenberg, 1965) and positive behavior as measured by a positive behavior scale.

The second and more interesting direction is to do a longitudinal analysis. With four waves of data, we have 33 kids with the migration pattern of "rural native to left-behind", whose time of being left behind could be inferred. With the addition of two more waves, we may get a sufficient sample size for this migration pattern and be able to examine how the impact of parental migration on adolescent LBC changes in a span of up to four years. Additionally, now with six waves of data, we may be able to follow some adolescents into adulthood and examine how their outcomes (cognitive ability and depressive symptoms, for example, as these instruments are also administered to adults) progress over longer periods.

Appendix

Psychological scales

Kessler Distress Scale

Please rate how often you had the following feelings in the past 30 days. (1 = all the time; 2 = most of the time; 3 = some of the time; 4 = a little of the time; 5 = none of the time)

1. Feeling nervous
2. Feeling hopeless
3. Feeling restless or fidgety
4. Feeling so depressed that nothing could cheer you up.
5. Feeling that everything was an effort
6. Feeling worthless

Center for Epidemiological Studies Depression Scale

Please rate how often you had the following feelings in the past week. (1 = most or all of the time; 2 = occasionally or a moderate amount of time; 3 = some or a little of the time; 4 = rarely or none of the time). Items with (*) are included in the 11-item subscale.

1. I was bothered by things that usually don't bother me. (*)
2. I did not feel like eating; my appetite was poor. (*)
3. I felt that I could not shake off the blues even with help from my family or friends. (*)
4. I felt I was just as good as other people.
5. I had trouble keeping my mind on what I was doing. (*)
6. I felt depressed. (*)

7. I felt that everything I did was an effort. (*)
8. I felt hopeful about the future.
9. I thought my life had been a failure. (*)
10. I felt fearful. (*)
11. My sleep was restless. (*)
12. I was happy.
13. I talked less than usual.
14. I felt lonely. (*)
15. People were unfriendly.
16. I enjoyed life.
17. I had crying spells.
18. I felt sad. (*)
19. I felt that people dislike me.
20. I could not get "going."

Subjective Well-being Scale

Please give the following statement a score from 0 to 10, 0 being the lowest score and 10 being the highest score.

1. How popular are you?
2. How happy do you feel?
3. How confident do you feel about the future?
4. How well do you get along with people?

Self-efficacy Scale

Please rate the following statement from 1 to 4. (1 = strongly disagree; 2 = disagree; 3 = agree; 4 = strongly agree)

1. I am always prepared.
2. I pay attention to details.
3. I am organized.
4. I follow schedules.
5. I am attentive when studying.
6. I am methodical.
7. I do homework before playing.
8. I finish my homework right away.
9. I clean things up promptly.

Parenting Bonding Instrument

Please rate the following statement from 1 to 5. (1 = never; 2 = rarely; 3 = sometimes; 4 = often; 5 = always)

1. When I have done wrong things, my parents will ask me for the reason and discuss it with me solutions.
2. My parents encourage me to work hard.
3. My parents talk to me in a calm way.
4. My parents encourage me to think independently.
5. When my parents want me to do something, they will tell me clearly.
6. My parents enjoy talking with me.

7. My parents ask me about my school.
8. My parents praise me.

Parental Education Engagement Scale

Please rate the following statement from 1 to 5. (1 = never; 2 = rarely; 3 = sometimes; 4 = often; 5 = always)

1. My parents ask me about my school.
2. My parents check my homework.
3. My parents help me with my homework.
4. My parents read to me.
5. My parents attend teacher-parent conferences.

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