I Z A Institute of Labor Economics

Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 16596

The Long-Term Impact of Parental Migration on the Health of Young Left-behind Children

Jinkai Li
Erga Luo
Bart Cockx

NOVEMBER 2023

I Z A Institute
of Labor Economics
Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 16596

The Long-Term Impact of Parental Migration on the Health of Young Left-behind Children

Jinkai Li
Ghent University

Erga Luo
Zhejiang University

Bart Cockx
Ghent University, CESifo, IRES, IZA and Maastricht University

NOVEMBER 2023

ISSN: 2365-9793

IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

The Long-Term Impact of Parental Migration on the Health of Young Left-behind Children*

In 2015, 15% of all children in China were left behind in the countryside because at least one of their parents migrated to a city. We implement an event study analysis between 2010 and 2018 on five waves of the China Family Panel Studies (CFPS) to investigate the dynamic effects of parental migration on the health of left behind young children (LBC). While we find a gradual increase in medical expenditures, we do not detect any significant impact on the incidence of sickness. Furthermore, the analysis shows that the incidence of overweight declines gradually since their parents' first migration and reports suggestive evidence for mental health improvement. We argue that these long-term positive effects on health and health consumption can be explained by the transitory nature of migration, the high-quality substitution of the caregiver role by grandparents, and by a reorientation in family expenditures, partly induced by government policy.

JEL Classification: I15, J10, J61

Keywords: young left-behind children, parental migration, Hukou system, long-term impact on health, event study analysis, mechanisms analysis

Corresponding author:
Erga Luo
Department of Agricultural Economics and Management
Zhejiang University
866 Yuhangtang Rd
310027
China
E-mail: leg@zju.edu.cn

* The authors declare no competing interests. The authors are grateful for valuable comments from Ilse Ruyssen and William Parienté. Jinkai Li gratefully acknowledges support from the China Scholarship Council (CSC202003250063).

1 Introduction

Internal migration refers to a movement within a country, usually from rural areas to urban areas. Most migrants aim at finding better job opportunities, earning a higher income, and improving family living conditions. However, due to restrictive migration policies, high or uncertain living costs in destinations, many children are separated from their parents. These are the so-called "left-behind children" (LBC). A major concern is that these LBC suffer from the absence of their parents. In this article we provide causal evidence on the long-term effects of parents' migration on the health conditions of young LBC in rural China.

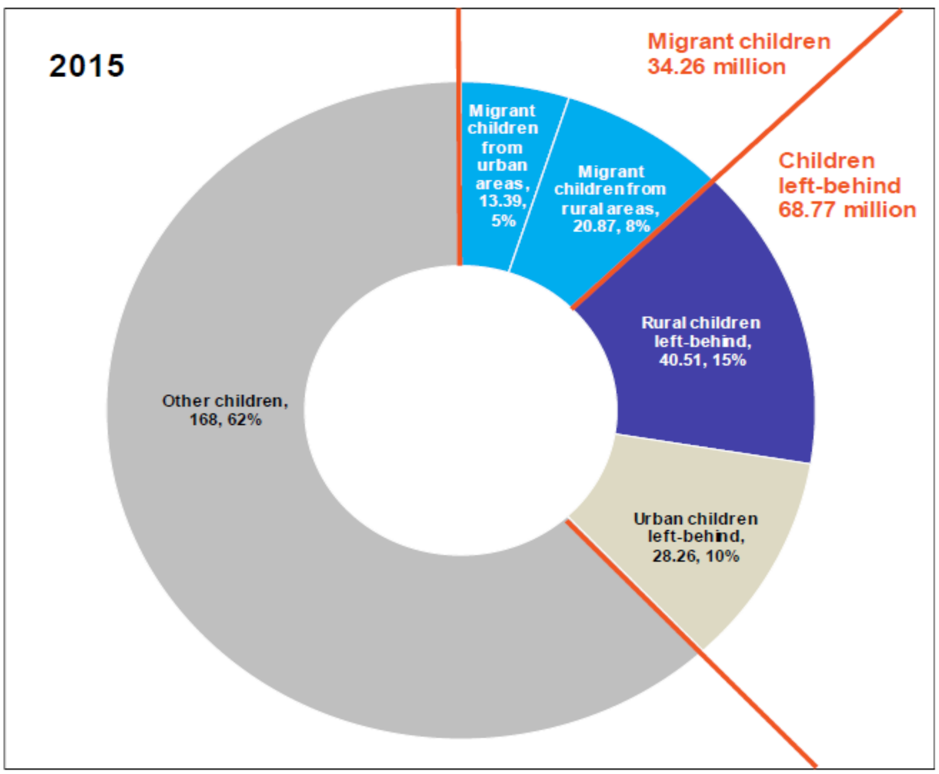
The urban-rural income gap is one of main causes of internal migration. Although government's support for rural areas has narrowed the urban-rural income gap in the recent decades, the ratio of disposable income per capita between urban and rural residents remained at a prominent level for a long term. In 2021, it was still 2.50 reported by National Bureau of Statistics of China. As a result, the internal migration has grown continuously at a high rate, from 6.6 million in 1982 to a maximum of 253 million migrants in 2014. After 2014, this number only slightly decreased.[2] This corresponds to close to 20% of the total population. This massive migration has to led to a huge number of migrant children and children left behind, especially in the rural areas.[3] Figure 1 shows that in 2015 there were

[2] Internal migration peaked in 2020 to 376 million, but this relates to the COVID-19 pandemic which inhibited many migrants to return home. Source: National census reports of China 1982, 1990, 2000, and 2020.

[3] Children are defined to be persons under the age of 18.

in China approximately 34 million migrant children, and 69 million LBC, of which 41 million were living in rural areas. This accounts respectively for 13%, 25%, and 15% of all children in China (UNICEF, 2018). About 40% of the LBC are left behind by both parents.[4] Considering the widespread internal migration in China, knowledge about its impact on LBC's health is of vital importance from a societal perspective.

Figure 1. The Children Distribution in China in 2015



Note: Unit: million. The data is retrieved from UNICEF (2018).

[4] Our own calculations based on the 2010-2018 panel of the China Family Panel Studies (CFPS) described in more detail below in Section 4.

While there is a societal concern that the migration of parents adversely affects the health of LBC, theoretically the impact could go either way. On the one hand, the absence of parental companionship and care may enhance heavy farm or household work, and insufficient nutrition intake may be detrimental for LBC's health (Chang et al., 2011; Min et al., 2019; Zheng et al., 2022). On the other hand, migration from the countryside to the city may promote the health of LBC as it may increase earnings and, hence, allow families to buy more and higher quality food as well as spend more on healthcare and other healing goods and services (Ambler et al., 2015; Antman, 2012; Yang, 2011). Furthermore, depending on the quality of substitute caregivers, family environment and external support the LBC's health may improve or deteriorate (Dolbin-MacNab and Yancura, 2018; Robila, 2011).

There is growing empirical evidence on the effect of parental migration on LBC's health from multiple perspectives, such as weight/height/BMI (Mu and de Brauw, 2015; Viet Nguyen, 2016; Zhou et al., 2015), illness and chronic disease (Li et al., 2015; Schmeer, 2009; Schmeer, 2013), dietary behavior (Arcan, 2021; Ye and Pan, 2011), and self-reported health (Wen et al., 2015). However, the conclusions from these studies are mixed. Some scholars find the positive effects on LBC's health, as measured by weight, self-rated health, lowered stunting or anemia (Mu and de Brauw, 2015; Shi et al., 2020; Sun and Liang, 2021; Wen et al., 2015), while others report detrimental impacts on LBC's blood pressure, weight or height growth, and chronic disease (Li et al., 2015; Lu, 2020; Meng and Yamauchi, 2017; Wen and Li, 2016). Furthermore, some studies mentioned no statistically significant impact on LBC's physical health (Tian et al., 2017; Xu and Xie, 2015; Zhou et al., 2015). This may result from the relative importance of the aforementioned opposing forces but may also partly be the consequence of not correctly capturing the dynamics of migration and its effect on the health of LBC. The correct identification of these dynamics will be the focus of this study.

This study leverages longitudinal survey data on parents and children that were bi-annually collected by the China Family Panel Studies (CFPS) between 2010 and 2018. The panel structure of the data enables us to determine the timing of the parents' migration and study how this affects the young LBC's health over time, up to eight years later. We limit our analysis to a subsample of rural children between zero and six years old in 2010, and who before that moment were never left behind by their parents. In the benchmark, we analyze children left behind by both parents. In a sensitivity analysis, we consider one-parent migration.

While we do not find a significant impact of migration on young LBC's subjectively reported health in the short- and long-run, we do detect a clear and steady *increase* of medical expenditures (*doctor visits* and *hospitalizations*) and *reduction* of *overweight* over time. We also document a steady long-run improvement in some proxies of mental health. In line with the existing literature (Lei et al., 2018; Wu and Zhang, 2017; Zhang et al., 2014), we also detect weaker effects if just one of the parents migrates rather than both. All these results are shown to be robust to a variety of sensitivity analyses.

We then try to get a better understanding of the mechanisms that drive these findings. A first explanation of why we do not find adverse effects on health is that parents do not migrate persistently. Two years after the migration of both parents, in more than 50% of the families already one parent, usually the mother, returned home. Furthermore, when both parents are absent, the grandparents take over the care of the children. There is no reason that this would reduce the quality of care, quite on the contrary (Chen et al., 2011; Yang and Liu, 2020; Zeng and Xie, 2014). Third, we find that migration has only a transient positive impact on family income and expenditures. This does therefore *not* support the commonly stated hypothesis that migration durably sustains the purchasing power affording families to consistently spend more on higher quality food and other health-promoting goods and services. We therefore assert that a more plausible explanation is that migration has reoriented spending in a direction that favors the long-term health of LBC. We argue that this change in behavior is triggered by various factors, such as (i) the need felt by migrating parents to compensate for their absence, (ii) the greater exposure in the city to information about what matters for the child development, and (iii) new regulations and policies from the local and central governments that provide more support to LBC.

This study makes several contributions to the literature. First, this study fills a data gap by tracking parents' migration and children's health since early childhood. This is required to study the dynamics of the impact of migration, because this allows to identify the first migration event that took place in a child's live and thereby avoids that the treatment status is contaminated by migration that took place earlier. By restricting our sample in the first wave of the CFPS to young children whose parents did not migrate since their birth, we are the first to provide a clean identification of the dynamic effects of the first migration on the health of these LBC up to eight years later.[5] Existing studies on LBC's development mainly use two types of data: cross-sectional data (Shi et al., 2020; Su et al., 2013; Wu et al., 2015; Zhao et al., 2014), and short-period panel data (Bai et al., 2018; Li et al., 2017; Wang et al., 2019; Yue et al., 2020; Zhou et al., 2021). To the best of our knowledge, this is the first study to track children's health indicators for a so extended period since early childhood.

Second, we are the first to study the long-term effect of parental migration on LBC with an event study analysis. Existing studies mostly used linear or logit regression (Lu, 2020; Shi et al., 2020; Wen et al., 2015), propensity score matching (Liu et al., 2021; Xu and Xie, 2015), fixed effects (Chang et al., 2019; Wang et al., 2019; Xu et al., 2019), or instrumental variables (Li et al., 2015; Meng and Yamauchi, 2017; Mu and de Brauw, 2015), concentrating on the short-term effect of parental migration. Some studies based on their analysis on the difference-in-differences methodology (Bai, Yang, et al., 2022; A. Yue et al., 2020; Zhang et al., 2014).This is very close to our approach except that we could take the recent insights into account that avoid possibly seriously biased treatment effects in the standard two-way fixed effect model if event times are not fixed and treatment effects are heterogeneous across different migration cohorts (de Chaisemartin and D'Haultfœuille, 2020; Goodman-Bacon, 2021; Sun and Abraham, 2021).

Third, by focusing on the dynamic effects of migration, we question some of the

[5] If the first migration takes place right after the survey date in 2010, the impact can be measured up to eight years later in the available survey of the CFPS in 2018.

mechanisms that the existing literature has proposed as drivers of the causal effects of migration on the health of LBC, and advance some new ones. A main novel finding revealed by our dynamic approach is that migration is not permanent, but temporary. Consequently, remittances cannot explain a *sustainable* improvement of LBC's health as has been asserted in the literature (Alcaraz et al., 2012; Amuedo-Dorantes and Pozo, 2010). Aside from the more commonly discussed role of grand-parents as high-quality alternative caregivers, we therefore propose some new channels, such as the arrival of new information and targeted regulations and policies that could explain the reorientation of spending and other behavioral reactions that lead to a steady improvement of the health and the medical expenditures for LBC. As to the latter, the provision of affordable social health insurance in rural China seems to have been key.[6] These new explanations that we propose are, however, exploratory as they require more detailed information on attitudes and behavioral reactions of parents, and on more detailed spending patterns of migrating households.

The rest of this study is organized as follows. Section 2 provides some information about the relevant institutional background in China. Section 3 explains the identification strategy. Section 4 presents the data, the sample selection, the definition of migration status, and some descriptive statistics. Section 5 reports the main results and some robustness analyses.

---

[6] This is consistent with the recent study of Lagakos et al. (2023) studying seasonal migration in Bangladesh. These authors find that subsidies targeted to migrants are not beneficial because they relax credit constraints, but rather because they provide better insurance to poor rural households. In China, the government directly provides health insurance targeted at poor rural households instead of migration subsidies. Hence, it coincidently supports "needy households willing to undergo the ordeal of migration" (Ibid, p. 805).

Section 6 discusses potential mechanisms. Section 7 concludes.

2 Institutional Environment

China established the Hukou system in 1958. This is a household registration system that restricts migration from rural areas to cities to prevent overcrowding and social disruption in the cities. A rural or urban Hukou is assigned to individuals born in a rural or urban area, respectively. An individual is exclusively entitled to public services and social welfare if he/she resides in a region that corresponds to his/her Hukou. This means that a rural Hukou holder who resides in the city is not entitled to, e.g., social housing, medical treatment, education, and social pensions. Children inherit the Hukou status from their parents (Gao et al., 2023). Hence, the Hukou system imposes important barriers to internal migration and adversely affects the living conditions of those who do migrate.

Despite these restrictions imposed by the Hukou system, economic growth and rapid urbanization resulted in a continuous expansion of labor demand and, consequently, in massive rural-urban labor migration. Many rural adults migrate out to work in large or medium cities where they are mostly engaged in low-skilled heavy work (Wang et al., 2015). Furthermore, since 1984, the government has gradually eased the restrictions of the Hukou identity with the aim of filling the gap between labor demand and supply. This facilitated the migration from the countryside to the city. As mentioned in the Introduction, together with the high urban wage premium, this has spurred a rapid growth of internal migration involving about 20% of the Chinese population since 2010.

Nevertheless, it remains difficult for migrants to fully obtain the local legal Hukou identity and a permanent residence in the city. Consequently, their children are left behind due to the lack of access to schooling and medical services in cities. In 2015, there were 41 million LBC in rural areas in China as shown in Figure 1 (UNICEF, 2018).

There is a common belief that LBC suffer from this migration because it reduces the parent-child interaction (Mu and Hu, 2016; UNICEF, 2018). Under the pressure of heavy work and high transportation costs, migrating parents mostly only return home once a year, usually during the spring festival. Some researchers have indeed found evidence that this absence can negatively affect the health and emotional development of children (Li et al., 2015; Meng and Yamauchi, 2017; Zhao and Chen, 2022). However, other studies find no or even positive effects (Shi et al., 2020; Sun and Liang, 2021; Tian et al., 2017; Wen et al., 2015; Xu and Xie, 2015; Zhou et al., 2015).There are a number of factors that can mitigate, or even reverse these negative effects, and therefore explain the mixed findings of migration on health outcomes of LBC.

First, often only one of the two parents migrates out to work (Su et al., 2013). This is usually the father while the mother stays at home to care for the children. Among LBC aged 0 to 15 with rural Hukou and living in a rural area around 60% were left behind by only one of the parents between 2010 and 2018.[7]

Second, even if both parents are absent, grandparents often care for the LBC. Descriptive

[7] Own calculations based on the CFPS 2010-2018.

statistics of the CFPS reveal that grandparents care for 78% of the children younger than 12 left behind by both parents while this share drops to 31% and 25%, respectively if only one or none of the parents migrated. This matters because the quality of the care by grandparents need not be inferior to that by parents (Chen et al., 2011; Lou et al., 2013; Yang and Liu, 2020; Zeng and Xie, 2014).

Note that in China children below the age of 12 are very rarely sent to a boarding school. In the CFPS only 4% of the LBC under 12 go to a boarding school. This share is even slightly lower than for children not left behind, i.e., 5%. For children under the age of 6 these shares even drop below 0.5%.

A third mitigating factor of migration on the health of LBC is that migrants remit money. This may allow parents to improve the material living conditions of their children as compared to the counterfactual in which they would not have migrated. While the CFPS does not contain complete information about remittances, Akay et al. (2014) report that in 2008 nearly 60% of migrant household heads with a rural Hukou remit per month 350 Chinese Yuan back home.[8] This represents 19% of their income. However, we will argue in Section 6.2 that remittances are unlikely to be driving our findings because migration is found to be transitory.

Finally, the Chinese government implemented between 2013 and 2016 a few regulations

[8] The information comes from the first wave of Migrant Household Survey, a component of the Rural Urban Migration in China dataset which is collected since 2008.

and policies that provide support to LBC in rural areas.[9] Local governments and schools were called on to provide necessary assistance and guidance to LBC to support LBC's physical health, mental health, and education. Especially in school, teachers are motivated to pay attention to LBC's nutrition and mental health. Furthermore, the Chinese government set up a national social health insurance starting from 2002, called as the New Rural Cooperative Medical Scheme (NRCMS), which aims especially at providing accessible health insurance for residents (including children) with a rural Hukou (Meng and Xu, 2014). Residents holding a rural Hukou pay yearly a reduced premium to be insured by the NRCMS. The local and central government cover the remaining major proportion of the premium. Through NRCMS, rural residents must only pay a fixed copayment for specified primary healthcare, basic hospital services, specialist consultations, surgeries, and other medical treatments. The copayment rate varies by location, household income, and region. Between 2012 and 2016, the coverage rate of the social health insurance for children in rural areas increased from 50% to 85% and might therefore have had a positive impact on the health of LBC. Residents with higher medical needs can complement the social insurance by commercial insurance at a higher premium. However, since most rural residents cannot afford this higher premium, the take-up rate has been always relatively low, fluctuating between 15% and 20% between 2010 and 2018.[10]

---

[9] For more information see: https://www.gov.cn/zwgk/2013-01/10/content_2309058.htm and https://www.gov.cn/zhengce/content/2016-02/14/content_5041066.htm.

[10] The statistics in this paragraph are own calculations based on the surveys in the CFPS (2010-2018).

3 Identification strategy

We aim at estimating the causal relationship between parental migration and young LBC's health outcomes. To identify this causal relationship, we must solve two main *endogeneity* issues: selectivity and reverse causality. First, the choice of parents to migrate can be selective if it relates to family characteristics that are correlated with LBC's health. For example, low-income parents or parents who face a temporary income loss may be more likely to migrate to compensate for this lower income. However, if low or unstable income is correlated with bad health conditions of the children, then a crude comparison of health outcomes between the children of parents with a different migration status is biased downwards. A second potential source of endogeneity is the potential reverse causality in which the health condition of children drives the migration decision of the parents. For instance, parents may be more reluctant to migrate if their child has a bad health condition and decide to migrate once the bad health condition of their children has improved. This would result in a spurious positive relation between the health of LBC and the migration of their parents. We did not find a valid instrumental variable that could tackle this threat. However, when we discuss the results we will argue why reverse causality is not plausible.

Another issue is that the impact of migration on health is *dynamic*. It is unlikely that the absence of parents triggers an immediate effect on children's health. Its relationship with children's health is gradual as the lack of parental care only slowly causes psychological and emotional imbalance which in turn might have repercussions on the physical health condition (McCabe and Ricciardelli, 2003; Vaillant, 1979). Furthermore, also factors that mitigate or even reverse these negative effects of parents' migration, such as grandparents' care, or remittances reinforcing the budget for education and care, will manifest only slowly in LBC's health condition (Acharya and Leon-Gonzalez, 2014; Chen et al., 2011; Møllegaard and Jæger, 2015). This points to the need of longitudinal data in which the timing of the migration decision is well recorded, and the health condition of LBC is measured several years after the parents have migrated to the city. With longitudinal data we can contrast in an event-study approach the health condition of children at particular moments after the parental migration to the condition before. This contrast controls for the aforementioned endogeneity factors to the extent that they are time constant. Furthermore, by measuring how the effects evolve over time, we can accurately capture effects that only manifest gradually (Bindler and Ketel, 2022; Dobkin et al., 2018; Kleven et al., 2019).

Sun and Abraham (2021) have recently shown that the traditional event-study approach can result in biased estimates of the average causal effects if treatment effects are heterogeneous across units. This echoes the general conclusion of the recent literature that shows that two-way fixed effect (TWFE) models do not identify causal parameters if treatment effects are heterogenous across time and units (Callaway and Sant'Anna, 2021; de Chaisemartin and D'Haultfœuille, 2020; Goodman-Bacon, 2021; Sun and Abraham, 2021). For the benchmark regressions, we therefore implement the estimator that was proposed by Sun and Abraham (2021). We will present this estimator in the next paragraph. This approach considers the children of never migrated parents as control units. In a robustness analysis we also consider the estimator proposed by de Chaisemartin and D'Haultfeuille (2020), which differs in that it additionally includes the children of parents that did not-yet-migrate among the control units. By including more control units this makes the estimator more precise, but also less robust in case the no anticipation assumption is not satisfied.[11]

The estimator of Sun and Abraham (2021) is implemented on a national representative sample of children whose parents did not migrate before the time at which they were sampled, i.e., not before 2010. In the panel data described in more detail in the next section, the health outcomes of children and migration decisions of parents are measured in 2010 ($t = 0$) and four subsequent waves, i.e., time periods of two years, from 2012 to 2018 ($t \in \{1,2,3,4\}$). This defines four cohorts depending on the *event time* E_i, i.e., the timing of the migration of the parents of child i. E.g., $E_i = 1$ for children, whose parents migrated between 2010 and 2012. To avoid biases, recent literature shows that it is key to allow for treatment effect heterogeneity across these cohorts. Migration is considered as *an absorbing treatment*. This means that the treatment status does not revert to zero once the parents return home. This is the so-called *staggered treatment adoption.*[12]

The estimator of Sun and Abraham (2021) is then estimated in three steps.[13] First, the next two-way fixed effect model is estimated in which treatment effects are allowed to vary across cohorts:

---

[11] We use the Stata code downloaded from https://asjadnaqvi.github.io/DiD/docs/code/06_did_multiplegt/.

[12] We treat migration as an absorbing state because if parents return home the impact of migration is unlikely to reverse immediately. This complicates the analysis significantly (see de Chaisemartin and D'Haultfeuille 2020) and is therefore not considered.

[13] We use the Stata code written by Sun and Abraham which can be downloaded from https://github.com/lsun20/eventstudyinteract.

$$Y_{i,t} = \sum_{e=1}^{4} \sum_{l=-4, l \neq -1}^{3} \beta_{e,l}\, 1\{E_i = e\} 1\{t - E_i = l\} + \theta_i + \emptyset_t + \varepsilon_{i,t} \quad (1)$$

where Y_{it} is the outcome of interest of child i in wave t, θ_i and $\emptyset_t$ are child and time fixed effects, and ε_{it} is the idiosyncratic term. $1\{.\}$ is the indicator function which is equal to one if its argument is true and zero otherwise, and $l \in \{-4, \ldots 0, \ldots 3\}$ denotes the relative time, before and after parental migration for negative and positive values of l; $l = 0$ refers to the first relative time observed after migration; $l = -1$ is chosen as the reference period which cannot be separately identified from the child fixed effects θ_i. We therefore set $\beta_{e,-1} = 0$. For children whose parents do not migrate during the observation period, i.e., the *never treated,* the event time is missing. They therefore function as the counterfactual relative to which the impact of migration is measured. The $\beta_{e,l}$ measure the dynamic effects at relative times $l \in \{-4, \ldots 0, \ldots 3\}$ for each cohort $e \in \{1,2,3,4\}$. Since we observe each child only during maximum five waves, we cannot identify all $\beta_{e,l}$ for all cohorts. For *e*=1, we can only identify $\beta_{1,0}$, $\beta_{1,1}$, $\beta_{1,2}$, $\beta_{1,4}$ (and $\beta_{1,-1} \equiv 0$); for *e*=2, only $\beta_{1,-2}$, $\beta_{1,0}$, $\beta_{1,1}$, $\beta_{1,3}$ (and $\beta_{1,-1} \equiv 0$); for *e*=3, only $\beta_{1,-3}$, $\beta_{1,-1}$, $\beta_{1,0}$, β_{12} (and $\beta_{1,-1} \equiv 0$); and for *e*=4, only $\beta_{1,-4}$, $\beta_{1,-3}$, $\beta_{1,-2}$, $\beta_{1,0}$ (and $\beta_{1,-1} \equiv 0$).

In a second step, we estimate each cohort shares underlying each relative time. In a last step, we take the weighted average of the estimates in the first step with weights set to the estimated cohort shares. We denote these average treatment effects by β_l for $l \in \{-4, \ldots 0, \ldots 3\}$. Note that only $\beta_{e,0}$ is estimated for all four cohorts, so that only the average treatment effect of the first period after migration, i.e., β_0, is a weighted average over all four cohorts. At the other extreme, the average treatment effects at l=-4 and l =3 involve, respectively, only cohorts e=4 and e=1: β_{-4}=$\beta_{1,-4}$ and $\beta_3 = \beta_{1,3}$.

β_l (for $l < 1$) captures the extent to which treated children experience different health outcomes than the control group – the children of whom the parents never migrate – prior to the migration of their parents. If these parameters are significantly different from zero, this suggests a violation of the parallel trends assumption required for the identification of the causal effect of migration by this approach. To allow for correlation of outcomes between siblings, we cluster the standard errors at the family level (Stock and Watson, 2008).

4. Data

The China Family Panel Studies (CFPS) is a nationally representative, biennial longitudinal survey launched in 2010 by the Institute of Social Science Survey (ISSS) of Peking University (Xie et al., 2016). The CFPS is designed to collect individual- and family-level longitudinal data to record the true condition of Chinese families (Xie and Hu, 2014). In 2010, 14,960 households from 635 communities were interviewed, including 33,600 adults and 8,990 children, in 25 of 31 provinces. Focusing on core respondents in wave 2010, the follow-up response rate of CFPS is approximately 80%. CFPS focuses on the economic, non-economic, and wellbeing of the Chinese population, such as economic activities, migration, healthy and educational outcomes, employment, income, and consumption. CFPS claims to provide the most comprehensive and highest-quality survey data of contemporary China. Xie et al (2017) have proved the data representatives of CFPS in demographic and socio-economic variables, which is like other national-scale sampling surveys. In this study, we conduct an 8-year follow-up analysis on early childhood children, covering the 5 waves of CFPS that were rolled out between 2010 and 2018.

We now first describe the sample selection criteria. Subsequently, we discuss how we define migration using the CFPS. We distinguish between the migration history in 2010 and the migration status in subsequent waves of the panel. We then describe the main outcomes of interest and provide some descriptive statistics of the sample retained for the analysis.

4.1 Sample Selection

Since the aim of this study is to measure the impact of parents migration to the city on the health of young LBC, we impose the next three selection criteria on the children in the 2010 CFPS sample:

(i) We select only children of parents who live in a rural area and have a rural Hukou;

(ii) We retain only children who are six years old, or younger, at the interview in 2010;

(iii) We exclude children left behind by their parents before the interview in 2010.

Restriction (iii) is imposed because the event study approach that we will follow can only be implemented on a sample of children that were not left behind prior to the period of analysis. This is because we consider a staggered design in which we treat migration as an *absorbing state.* This selection criterion is important because we will see that there is a very delayed response of migration on children's health. Failure to capture the migration history of the parents at selection may therefore bias our estimates. Selection criterion (ii) is imposed for a similar reason. We will explain below that the CFPS can only identify the migration history for young children. We impose condition (i) because we want to focus on the impact of parents' migration induced by the Hukou regulation, and because most migration is from rural areas to cities.

By imposing these selection criteria, the sample of 8,990 children reduces to 1,505. Another 136 children are dropped from the analysis either because they were only interviewed in 2010 survey, or because they did not respond to the 2012 survey.[14] The final sample contains therefore 1,369 children of whom 226 were left behind by both parents at some point between 2012 and 2018. Among these 1,369 children, 986 live in families with one child, 151 in families with two children, 23 in families with three children, and 3 in families with four children. As we discuss in more detail below, we will implement sensitivity analyses where (i) we retain only children aged three or younger in 2010, and (ii) the treatment is redefined as being left behind by at least one parent instead of two. The data flowchart for the sample selection considering the two retained migration definitions are reported in Figure A1 and Figure A2 in the Appendix.

4.2 Definition of Migration Status

(i) Migration History

In the benchmark analysis, migration refers to a state in which *both* parents have left their

[14] We retain children in the analysis if they did not respond to any survey after 2012. In that case we retain all responses before the first non-response, irrespectively of whether they respond in a later survey date. This makes the panel unbalanced, but not selective to the extent that this non-response is random conditional on the individual fixed effects.

children behind. In the CFPS data we operationalize the condition (iii) in Section 4.1 that children should not be left behind at any moment before 2010 by the simultaneous fulfillment of next three conditions:

(i) At least one of the parents reports to have permanently lived at home (with the children) during the last 12 months before the interview in 2010;

(ii) At least one of the parents reported to have lived permanently with their children from birth up to the age of two years (or the age they have in 2010, if younger);

(iii) At least one of the parents reported to be living at home at the survey date in 2010.

The first two conditions ensure that, before the survey date in 2010, parents did not migrate simultaneously while their children were younger than three. For children older than three in 2010, it is possible that both parents left their children behind after the age of three, but then only temporarily, since condition (iii) ensures that at least one of the parents was living at home at the survey date. By restricting the sample to children aged six or below, this can only have happened for a small number of children and, if it did, only over a brief time span. Nevertheless, because of this potential violation, we implement a robustness analysis in which we retain in the analysis only children aged three, or younger.

We also implement a sensitivity analysis in which we alter the definition of migration to a state in which at least *one* of the parents left their children behind. This definition implies that in conditions (i) and (ii) we should impose that that *both* parents should have been living at home before the survey in 2010 instead of just one. However, due to data restrictions, we cannot modify these conditions.[15] We can only change the corresponding condition in (iii). Because this is a stricter condition on control groups than in the benchmark analysis, requiring that both parents reported to be living at home in 2010, the sample size is reduced in this case from 1,369 to 1,136. On the other hand, this more lenient definition of migration (only one parent) increases the number of children left behind from 226 to 394.

(ii) Migration Status in Subsequent Waves

In the CFPS two types of variables help identifying parental migration: (1) Whether father/mother is living at home at the survey date; (2) If a parent is not living at home, the reason is reported. In the benchmark analysis, the migration status is set to one from the moment that (1) neither mother, nor father lives at home, because (2) they are both working outside the place of residence.

By measuring the migration status only at the two-yearly intervals at which the families are interviewed, this definition of the migration status does not capture short migration episodes which start and end between two waves. However, this is the best we can do

[15] We do not change conditions (i) and (ii) because CFPS survey in 2010 only records the longest continuous period (unit: months) that both parents did not live with children during the last 12 months before the interview or from birth up to the age of two years. So, we do not have separate information about the periods that father or mother lives with their children.

because the CFPS does not report when these migration periods start and end. On the other hand, since migration is defined to be an *absorbing* state, their migration status is not reverted if one of the parents returns home after a while.

Figure 2 counts the number of children left behind by migration cohort. Cohort 0 refers to the group of children of whom both parents migrate never simultaneously. This is reflected by the horizontal line at zero throughout the observation period. However, as the blue line illustrates, this does not exclude that one of the two parents might be migrating. Indeed, in 2010, 1,143 out of the 1,306 children were never simultaneously left behind by both father and mother during the period 2010-2018. 260 children were living in a household where both parents had migrated at some point in time. Cohort 2 refers to the group of children of whom both parents were migrating in the second wave, i.e., in 2012. This is reflected by the red curve that starts from zero in 2010 and then peaks to 103 children in 2012. Thereafter the curve steadily declines, meaning that at least one of the two parents, mostly the mother (green curve), gradually returns home over time. Six years later, in 2018, virtually, there are 22 children whose father is still migrating and 10 children whose mother is still migrating. For the subsequent cohorts, a similar evolution is observed, although both parents migrate less when children are older. For the interpretation of the findings below it is important to keep in mind that the simultaneous migration of two parents is for most of the children not lasting more than two years and that usually the father is absent for a longer period. In Figure A3 we provide similar charts for the sensitivity analysis in which we consider the migration of at least one parent as the treatment. This presents similar migration patterns.

Figure 2. The Frequency of Children Left Behind by Two Parents

Note: The cohorts refer to the timing of the migration of both parents. Cohort 0 refers to the group of children whose parents have not jointly migrated. Cohort 2 refers to the group of children whose parents are for the first time observed to be jointly migrating at the second survey in 2012. For cohort 3 this happens in 2014, and so on. *father* refers to children of whom the father migrates; *mother* refers to children of whom the mother migrates; *two* refers to the children of whom both parents migrate simultaneously. Y-axis indicates the migration frequency as measured by the number of children.

4.3 Main Outcomes and Descriptive Statistics

In this research we aim at identifying the effect of migration on the health of LBC. We consider three types of indicators of health: (i) general self-reported indicators of physical health; (ii) long-term indicators of physical health; (iii) proxies of mental health. The definitions of main outcomes and predetermined variables can be seen in Panel (a) and (b) of Table A1 in the Appendix. Furthermore, we briefly describe these main outcomes and predetermined variables, and provide in Table 1 descriptive statistics of them as measured in 2010 *before* the parental migration. We report the means by of these variables by treatment status, i.e., by distinguishing the children of whom the parents eventually both migrate (the treated group) and those who do not during the observation period between 2012 and 2018 (the never treated group) and indicate whether their difference is significantly different from zero. Table 1 does not report for all outcomes the same number of observations. This is a consequence of non-response to specific questions in 2010. Additionally, we also provide similar description by these two groups from 2012 to 2018 in Table A2.

(i) General Indicators of Physical Health

In the benchmark analysis, we consider three general indicators of physical health. A first indicator is *sickness* which is a variable that measures whether a child has been ill in the last month. *Doctor visits* indicates the frequency of child's visiting doctors in the last year. *Hospitalization* is an indicator that measures whether a child was hospitalized in the last year and signals more severe or acute problems of health. The latter two indicators are different from the first in which they reflect both the severeness of the illness, but also the extent to which the family can afford the medical treatment.

Table 1 indicates that the children of migrating parents do not experience more *sickness* and do not visit doctors or hospitals more frequently than children whose parents stay at home before parental migration, suggesting that these general health indicators were balanced between treatment conditions in 2010, prior to migration.

(ii) Long-Term Indicators of Health

Researchers have shown that in the long-term the health condition of children is reflected in their body growth, such as weight and height (WHO, 2006; Vesel et al., 2010). More specifically, children's *underheight*, *underweight*, and *overweight*, which in turn may be reflected in an excessive body mass index (*BMI*), are signals of bad health. We use the study of Li et al. (2009) that has established the age and gender specific thresholds to determine excessive height and weight based on a national children growth survey in China. The implied thresholds of height and weight are presented in Table A3 in the Appendix. In a sensitivity analysis, we also consider excessive *BMI* as an alternative outcome. The definitions of the alternative outcomes that we consider in the sensitivity analyses are reported in Panel (c) of Table A1.

Table 1 shows that the measures of *underheight* and *underweight* do not display any statistical difference between the two groups in 2010. By contrast, the LBC display on average more *overweight* in 2010, prior to the migration of their parents. This imbalance points to a selection bias that will be controlled by the individual fixed effects in the event study analysis.

(iii) Proxies of Mental Health

The CFPS data do not contain direct indicators of the mental health of children for the ages that we consider. However, physical health, such as sickness and medical behaviors, weight gains or losses, as measured in (i) and (ii), can be closely related to mental health issues

(Bell et al., 2019; Talen and Mann, 2009).

Although CFPS does not provide the complete longitudinal mental status survey since from child's birth up to now, we collect some proxies of mental records of children from CFPS. We consider four items on the behavioral performance of children as evaluated by parents or other caregivers, i.e., *focus, compliance* (or, equivalently*, conscientiousness*)*, persistence,* and *neatness* (or, equivalently*, punctuality*). A low performance on these items can reflect a behavioral disorder of children. There is literature suggesting that children's behavioral disorders have a close relationship with children's mental health problems (Bandura et al., 2003; Feng et al., 2022; Krueger et al., 1996; Li et al., 2022; Shoshani and Steinmetz, 2014; Zheng, 2015).

(iv) Sample Description by Predetermined Covariates in 2010

Table 1 also compares LBC and non-LBC based on several predetermined variables as measured in the 2010 survey. It is striking that the two samples are not significantly different in most of these predetermined variables. Four variables seem to matter. Both the LBC and their parents are younger. Parents therefore seem to prefer migration when their children are still young. Furthermore, mother's health of LBC is significantly lower prior to migration, but this is potentially induced by the higher non-response for this question. The two groups can differ in other dimensions that are not reflected by the predetermined variables that are reported in the table. If so, note that in the causal analysis these differences will be controlled for by the individual fixed effects.

Table 1. Summary Statistics in 2010 of Outcomes and Predetermined Variables

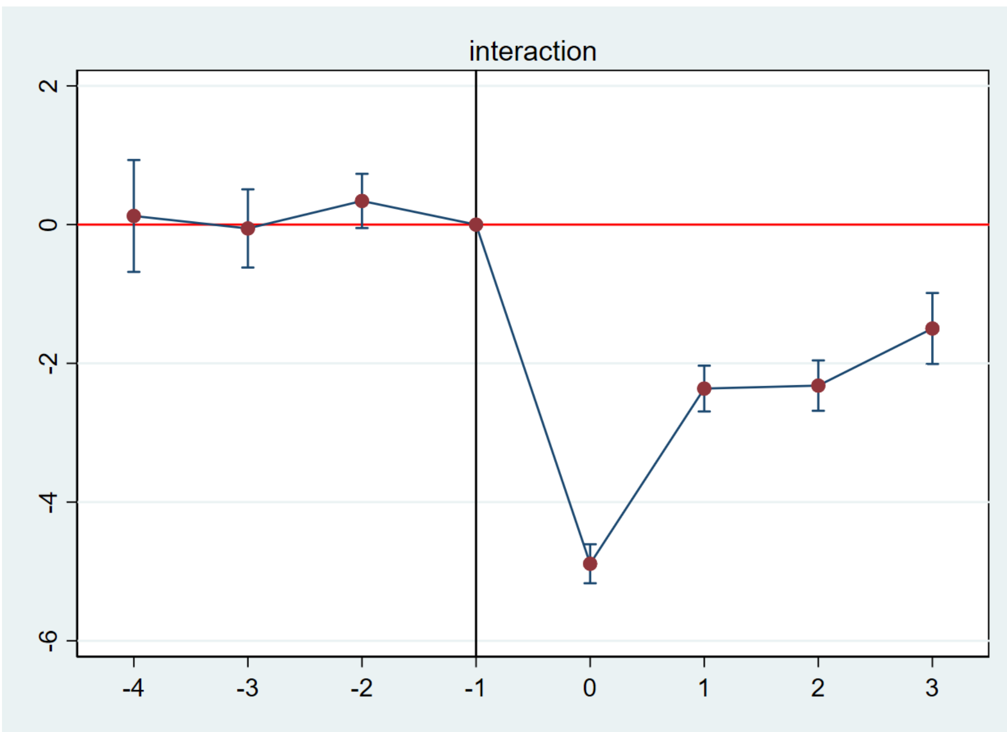
Variables	LBC mean	non-LBC mean	Mean Difference	p-Value
Outcomes				
General indicators of physical health				
sickness	0.425	0.439	-0.0140	0.694
doctor visits	1.995	2.244	-0.248	0.312
hospitalization	0.0920	0.120	-0.0280	0.239
Long-term indicators of health				
underheight	0.694	0.643	0.0510	0.174
underweight	0.309	0.319	-0.0100	0.775
overweight	0.272	0.173	0.0990	0.001***
Proxies of mental health				
focus	3.409	3.489	-0.0800	0.705
compliance	3.591	3.760	-0.169	0.310
persistence	3.182	3.453	-0.271	0.187
neatness	3.045	3.219	-0.174	0.443
Predetermined variables				
age	2.429	3.147	-0.718	0.000***
gender	0.571	0.536	0.0340	0.342
father age	29.34	32.80	-3.459	0.000***
mother age	27.25	30.68	-3.429	0.000***
father health	5.371	5.425	-0.0540	0.630
mother health	5.031	5.236	-0.204	0.032**
father education	2.491	2.519	-0.0280	0.695
mother education	2.142	2.205	-0.0640	0.354
Child number	1.911	1.884	0.0270	0.660
real income in CNY (Base：2010)	23445.55	23315.09	130.46	0.922
real expenditure in CNY (Base：2010)	20711.89	19652.13	1059.76	0.365
Number of children	226	1143		

Notes: The definitions of main outcomes and predetermined variables are reported in panels (a) and (b) of Table A1 in the Appendix.

5 Main Results

In this section we report the findings of the event-study analysis described in Section 3. As a starting point, we aim at convincing the reader that the CFPS data can capture well the migration decision of the parents. To do so, we implement the event study analysis on the number of days in a typical week that parents and children interact. In Figure 3, the negative impact on *interaction* (4.9 days on average) is particularly high in the first year of migration (*time 0*). This must be compared to 6.5 days, the average number of interactions one period prior to parents' migration. In the following waves it gradually goes up close to the original level, consistent with the migration patterns described in Figure 2.

Figure 3. The Effect of Parental Migration on the Number of Days in a Typical Week that Parents and Children Interact



Note: This figure plots the dynamic effect after the exposure to parental migration on the number of days in a typical week that parents and children interact. The detailed definition of the variable *interaction* is presented in Panel (d) of **Error! Reference source not found.** in the Appendix. Time (-1), one wave prior to parental migration, is defined as the reference event time. The average base level of *interaction* one period prior to migration is 6.5. Vertical lines present 95% confidence intervals with family-level clustered standard errors.

We now first present the effects of migration on children's outcomes on the three sets of health outcomes listed in Section 4.3: general indicators of health, long-term indicators, and proxies for mental health. In a subsequent section, we then show that these findings are robust to sensitivity analyses in various directions. In Section 6, we then aim at uncovering the mechanisms that explain our findings.

5.1 Impact of Parent's Migration on the Health of LBC

(i) General Indicators of Health

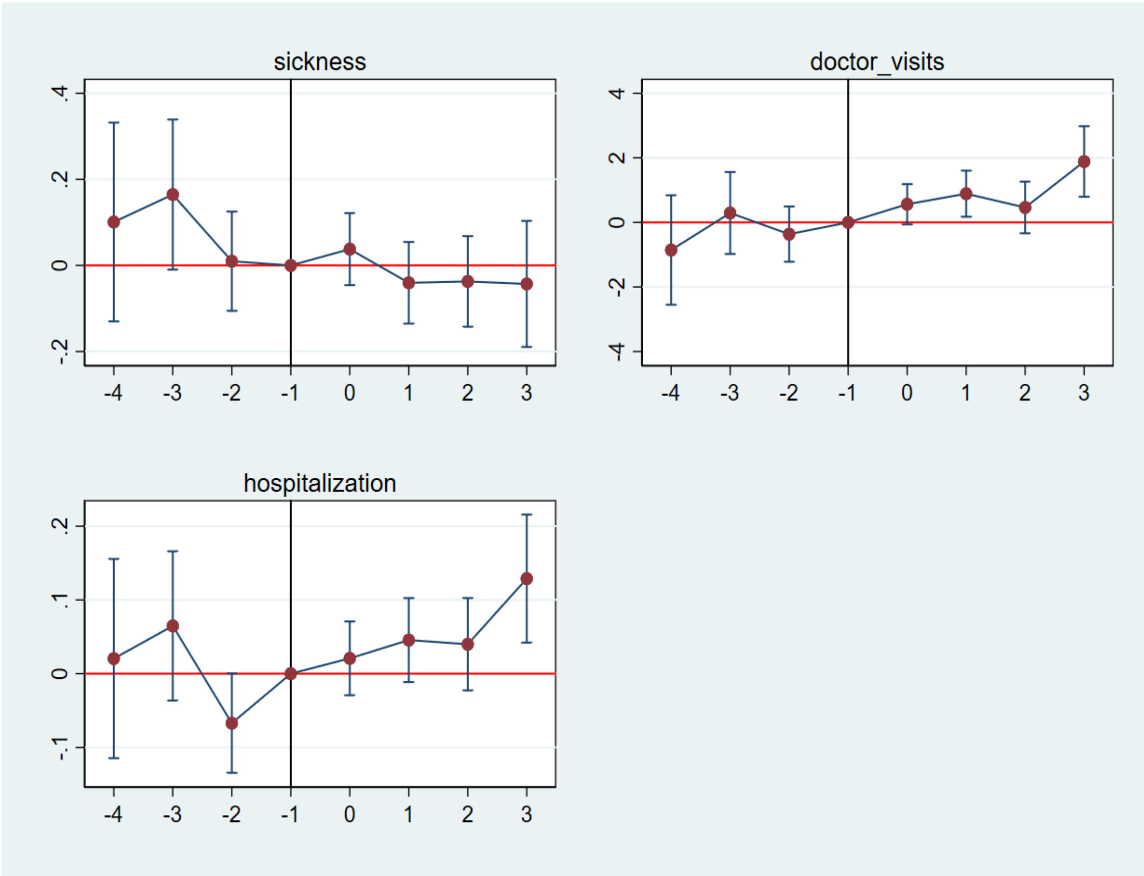
Figure 4 graphically plots the parameters of interest on the three general indicators of health. First, observe that in the pre-treatment period the LBC neither were reported to have experienced more sickness than non-LBC, nor did they make more *doctor visits* in the last year. By contrast, LBC were significantly less hospitalized two periods (i.e., four years) prior to migration.[16] This latter finding is a potential threat to the parallel trends assumption, and therefore to a causal interpretation of the event study estimates on *hospitalization.* We argue, however, that is likely to be related to a multiple testing problem, i.e., an unlucky draw. The reason is that we do not observe issues in periods -3 and -4. We cannot find a plausible explanation of why children of migrating parents would be less likely hospitalized four years prior to migration, but not so six and eight years before.

In the post-treatment period, the effect of migration on *sickness* is close to zero throughout

[16] The joint tests of significance for these outcome variables are reported in Table A.4 in the Appendix.

the observation period. By contrast, the effects on *doctor visits* and *hospitalization* are steadily increasing throughout and become statistically significant in the third wave (6 years) after the migration was first observed. Table A4 in the Appendix shows that the positive effects on these two outcomes are jointly significant. These contrasting findings need not be contradictory. We will argue in Section 6.3 that the gradual increases in *doctor visits* and *hospitalization* are caused by a higher take-up of social health insurance and by a reorientation of spending by migrating parents. Furthermore, we demonstrate in the next subsection that other long-term indicators of health rather improve than deteriorate. The findings that the health of LBC is not affected by parental migration is in line with the findings of Xie et al. (2022) who analyzed the first three waves of the CFPS data based on hierarchical linear models.

Figure 4. Effects of Parental Migration on General Indicators of Health



Note: This figure plots the dynamic effect after the exposure to parental migration on *sickness* (indicator of reported sickness in the last month), *doctor visits* (number of doctor visits in the last year) and *hospitalization* (number of hospitalizations in the last year). Time (-1), one wave prior to parental migration, is defined as the reference event time. The average values of *sickness*, *doctor visits* and *hospitalization* at time -1 are 0.35, 1.77, and 0.08, respectively. Vertical lines present 95% confidence intervals with family-level clustered standard errors.

(ii) Long-Term Indicators of Health

Figure 5 shows that parental migration induces a significant steady decrease in *overweight*, while there is no detectable influence on *underweight* and *underheight*. Even if the point estimate on *underheight* at time 3, i.e. 6 years after the migration, is close to the 5%

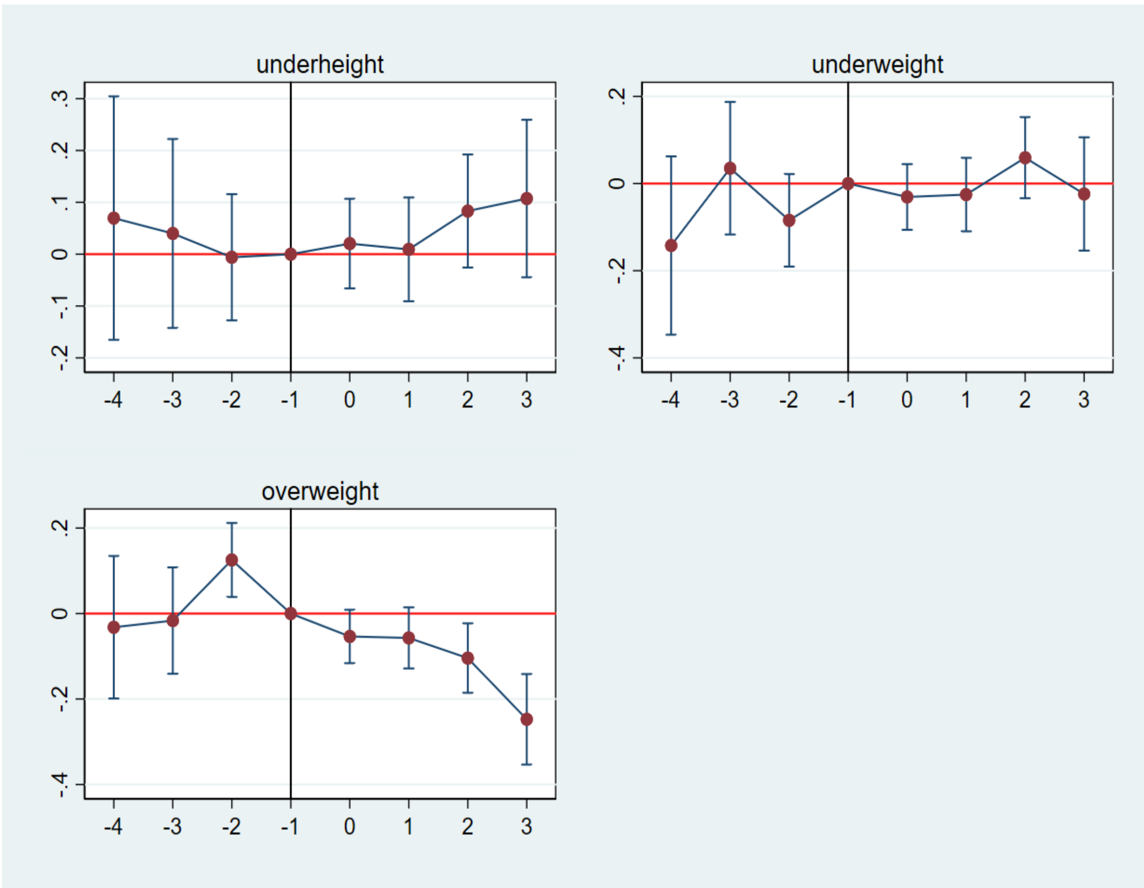
significance level, the effects in all other years are close to zero, so that there is no convincing evidence that LBC grow more slowly. By contrast, even if initially there is no notable effect of migration on overweight (-0.05 at time 0), in the long term, the incidence of *overweight* steadily decreases since migration, becoming significant from four years after the first migration was recorded.

The significant positive effect on *overweight* in the second wave prior to migration introduces a concern that the parallel trends assumption is violated. As for *hospitalization,* we assert that this is a consequence of a multiple testing issue, or a measurement error. This interpretation is reinforced by the fact that we do not observe any violation of the parallel trends assumption when we consider in the robustness analyses in Section 5.2 similar alternative outcomes, such as *weight*, *BMI* and *overBMI*.

These findings document that LBC's health condition has actually gradually improved since their parents' migration. This finding contrasts with most of the existing literature (Lei et al., 2018; Li et al., 2015; Lu, 2020; Meng and Yamauchi, 2017; Wen and Li, 2016; Wu and Guo, 2020). One of reasons why previous researchers might not have found comparable results before is that they did not consider such a long time perspective as we do. Furthermore, the results of some of these studies might have been confounded by ignoring the migration history prior to the survey date at which the data was collected. We can avoid this *initial condition problem* by having access to exceptionally long and rich panel data.

Nevertheless, the reader may not be convinced, because we only clearly observe these significant effects for one outcome variable. We therefore present some further evidence that supports the hypothesis that the parents' migration is favorable for the health condition of the LBC. First, in Section 5.2 (ii) we will show that our findings are robust when we use some alternative indicators of health. Second, since the incidence of *overweight* is known to be related to mental health problems (BeLue et al., 2009; Sawyer et al., 2006), we will consider the impact on a few proxies of mental health in the next subsection. Furthermore, in Section 6 we will discuss of potential mechanisms and show that these all are consistent with the finding that migration has a positive influence on the health of LBC in the long run.

Figure 5. Effects of Parental Migration on Long-term Health Indicators

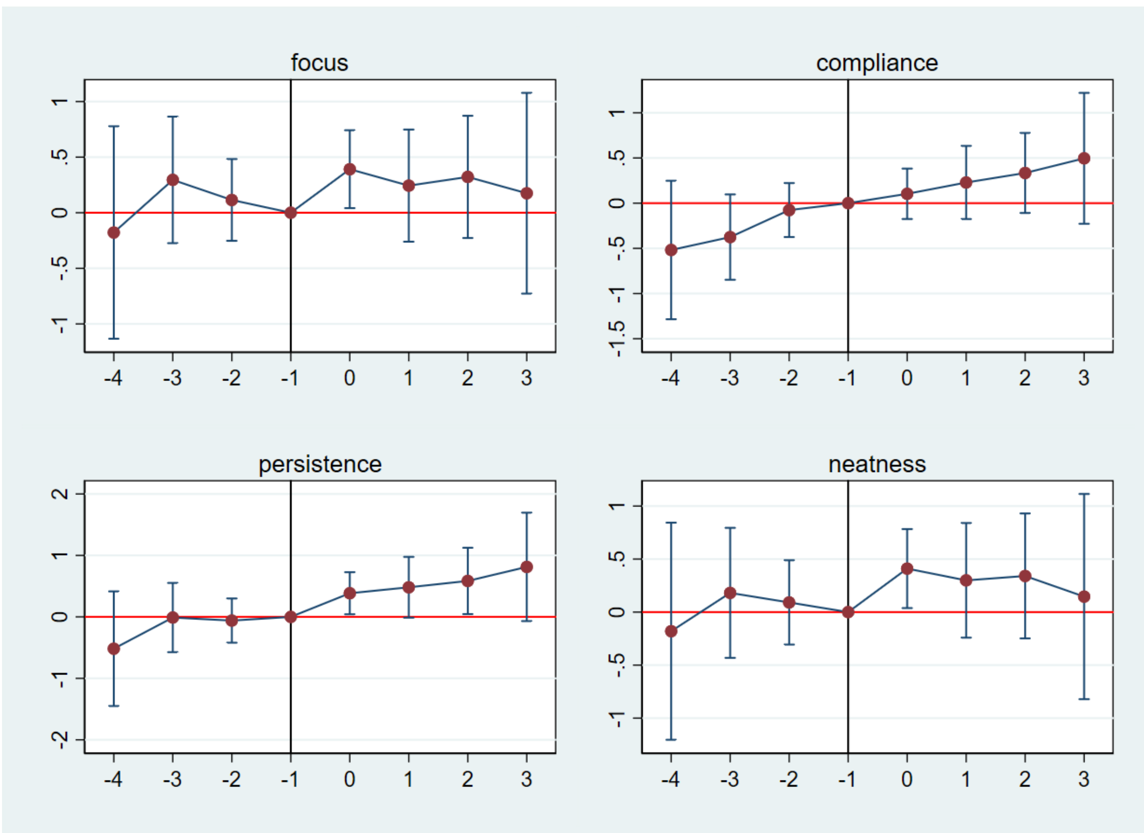


Note: This figure plots the dynamic effect after the exposure to parental migration on *underheight, underweight and overweight*. Time (-1), one wave prior to parental migration, is defined as the reference event time. The average values of *underheight*, *underweight* and *overweight* at time -1 are 0.63, 0.33, and 0.20, respectively. Vertical lines present 95% confidence intervals with family-level clustered standard errors.

(iii) Proxies for Mental Health

The CFPS did not measure mental health directly. However, the panel does contain some proxy variables in which mental health issues should be reflected. Figure 6 shows that parental migration did not have any negative influence on these outcomes. The impact of *persistence* is continuously increasing, and these effects are all (close to) significant. The post-migration effects on *focus* and *neatness* display some significant positive effects which pass the joint significance tests at the 5% level (see Table A4). These findings suggest an improvement of the behavioral performances of LBC. This contrasts with the findings of some previous studies (Chang et al., 2019; Lu, 2020; Yue et al., 2020; Zhao and Chen, 2022). However, in Section 6 we provide evidence of some mechanisms that provide further support for these findings.

Figure 6. Effects of Parental Migration on Mental Health Proxies



Note: This figure plots the dynamic effect after the exposure to parental migration on *focus, compliance, persistence,* and *neatness*. Time (-1), one wave prior to parental migration, is defined as the reference event time. The average values of *focus*, *compliance*, *persistence,* and *neatness* at time -1 are 3.38, 3.92, 3.54, and 3.23, respectively. Vertical lines present 95% confidence intervals with family-level clustered standard errors.

5.2 Robustness Analyses

We have conducted four robustness tests in various directions and conclude that our findings are robust.

(i) Robust to an Alternative Estimator to Treatment Effect Heterogeneity

The implemented estimator of Sun and Abraham (2021) takes the parents that never migrate as a control group. de Chaisemartin and D'Haultfœuille (2020) proposed an alternative estimator that takes the *not-yet-migrated* parents as control group (see Section 3). The findings for the benchmark outcomes obtained by this alternative estimator are reported in Figure A4 of the Appendix. The findings are clearly like the benchmark results.

(ii) Robust to Alternative Health Outcomes

Due to the lack of other indicators of mental health, we limit the robustness tests to other indicators of children's *sickness*, *doctor visits* and body growth: the frequency of doctor visits in last month (*sickness1*)*,* an indicator of doctor visits in the last month (*doctor1*)*, weight, height, BMI, underBMI*, and *overBMI.* The reader can find their definitions of these variables in panel C of Table A1 and the results of in Figure A5, both in the Appendix. This analysis confirms that parental migration does not have any statistically significant effect on the alternative caregiver-reported indicators of health, i.e., on *sickness1* and *doctor1*. Furthermore, the finding that parental migration induces a gradual decrease in *weight, BMI* and *overBMI* is consistent with the benchmark findings regarding *overweight*.

(iii) Robust to the Age Definition of Children

In Section 4.2 (i) we mentioned that for children aged older than three we cannot capture the full migration history and therefore might have incorrectly assigned some children to *the not-yet-treated group.* We therefore check whether dropping children older than three affects our findings. Figure A6 in the Appendix confirms that the findings are robust.

(iv) Robust to the Definition of Migration

Some studies find stronger (negative) effects on cognitive and non-cognitive performances when both parents migrate as compared to only one parent. (Lei et al., 2018; Wu and Zhang, 2017; Zhang et al., 2014). Consistent with this literature, we also find less strong effects in the same direction: See Figure A7 in the Appendix.

6. Mechanisms

Why are LBC's health outcomes improved after the exposure to parental migration? Intuitively, parental companionship and supervision matter a lot for child's growth (Britto et al., 2017), so that the parental absence is expected to have an adverse effect on the health of LBC. However, there are alternative mechanisms that may reverse this negative impact (Lagakos et al., 2023). In this section we investigate three plausible channels through which the exposure to parental migration may improve LBC's health: substitution of parental care by alternative caregivers, enhanced purchasing power, and reorientation of spending.[17]

[17] The definitions of the intermediate outcomes analyzed in this section are presented in panel (d) of Table A.1.

6.1 Substitution of Parental Care by that of Alternative Caregivers

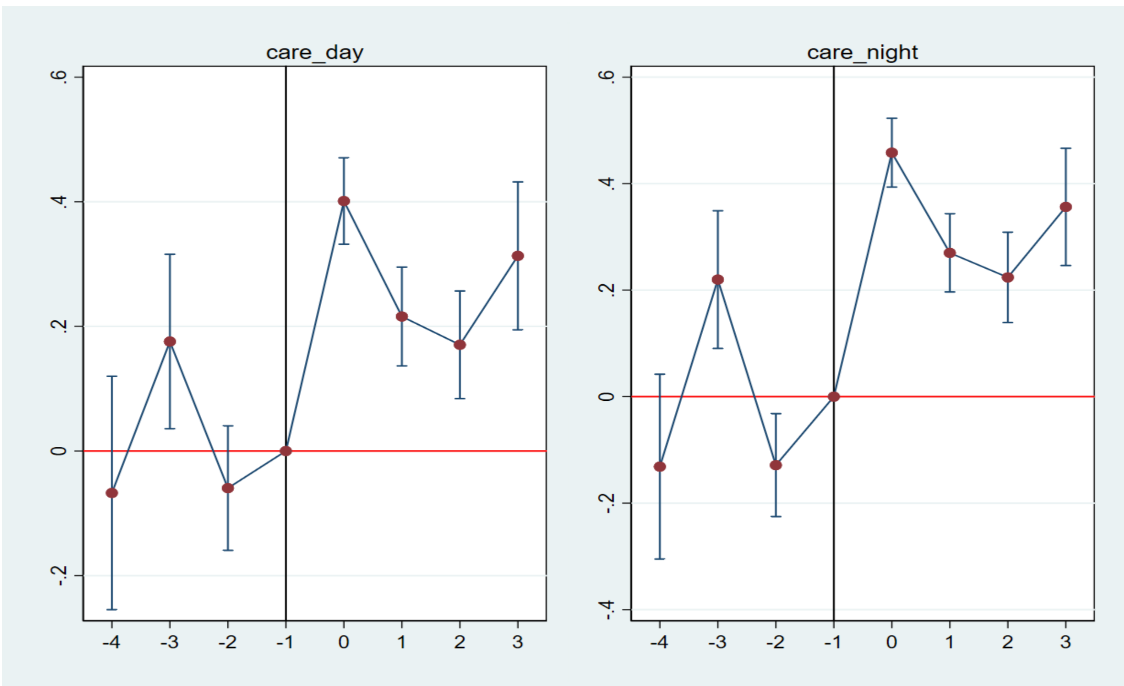
When parents migrate out for work, other caregivers substitute for parental care. To the extent that these alternative caregivers may have more time and equal affection, they may provide care of similar, or even higher quality than that provided by parents that stay at home. In Section 2 we already reported descriptive evidence that grandparents are likely to take over this role from the migrating parents, especially within the age range that we are considering here. We have also seen that later, when children enter middle school, this caring role is progressively taken over by boarding schools, but this is less relevant to our study as most children will still be in primary school within the period of analysis. Only the older children aged 4 to 6 in 2010 will have started middle school at the end of the observation period 8 years later.

Figure 7 reports the findings of the event-study analysis. It shows a sharp rise in grandparents as primary caregivers at time zero, when parents are first reported to be both away from home. This does not rise by 100% partly because grandparents are already the primary caregivers in the counterfactual of no migration (see Section 2). Furthermore, in the subsequent years this caring role by grandparents decreases because we have seen that one of the parents, usually the mother, returns home after a while (see Figure 2. The Frequency of Children Left Behind by Two Parents in Section 4.2).

These findings are consistent with the fact that grandparents are important caregivers in rural China (Lou et al., 2013). In traditional Chinese culture, grandparents have a close family bond with their grandchildren and attach the significant importance to their wellbeing and development (Chen et al., 2011; Yang and Liu, 2020; Zeng and Xie, 2014).

Grandparents usually have extensive experience of raising children. More importantly, they are willing to express their preference love for children by investing time and energy into the care of children, and by protecting them from diseases and dangerous circumstances (Ao et al., 2022; Bai et al., 2022; Crosnoe and Elder, 2002).

Figure 7. Effects of Parental Migration on the Propensity that Grandparents Care for Children during the Day and at Night



Note: This figure plots the dynamic effect after the exposure to parental migration on the propensity that grandparents care for the child during the day (*care_day*) and at night (*care_night*). Time (-1), one wave prior to parental migration, is defined as the reference event time. The average value of *care_day* and *care_night* at time -1 are both 0.31. Vertical lines present 95% confidence intervals with family-level clustered standard errors.

6.2 Enhanced Purchasing Power

The family's purchasing power is an essential factor shaping children's nutrition intake which in turn has a positive influence on their health condition (Goode et al., 2014). Furthermore, the growth of financial resources makes it possible to acquire goods and services, such as higher quality housing and other amenities that can improve the physical and mental functioning of children. We therefore analyzed the effect of parents' migration on wage, family income, and expenditures. However, even if migration enhances purchasing power, this is no guarantee that the family spends more on items positively affecting the physical and mental health of children. While we do not have detailed information on the type of expenditures, we will argue that some forces may have reoriented spending in this direction. This will be discussed in Section 6.3.

China agricultural production is usually the source of income in rural areas wage income is the typical income source in urban areas (Zhao, 1999). We will consider total family income, which includes both sources, as the indicators of purchasing power. We supplement the analysis by also considering wage income and expenditures as outcome variables.[18] The results are presented in Figure 8.

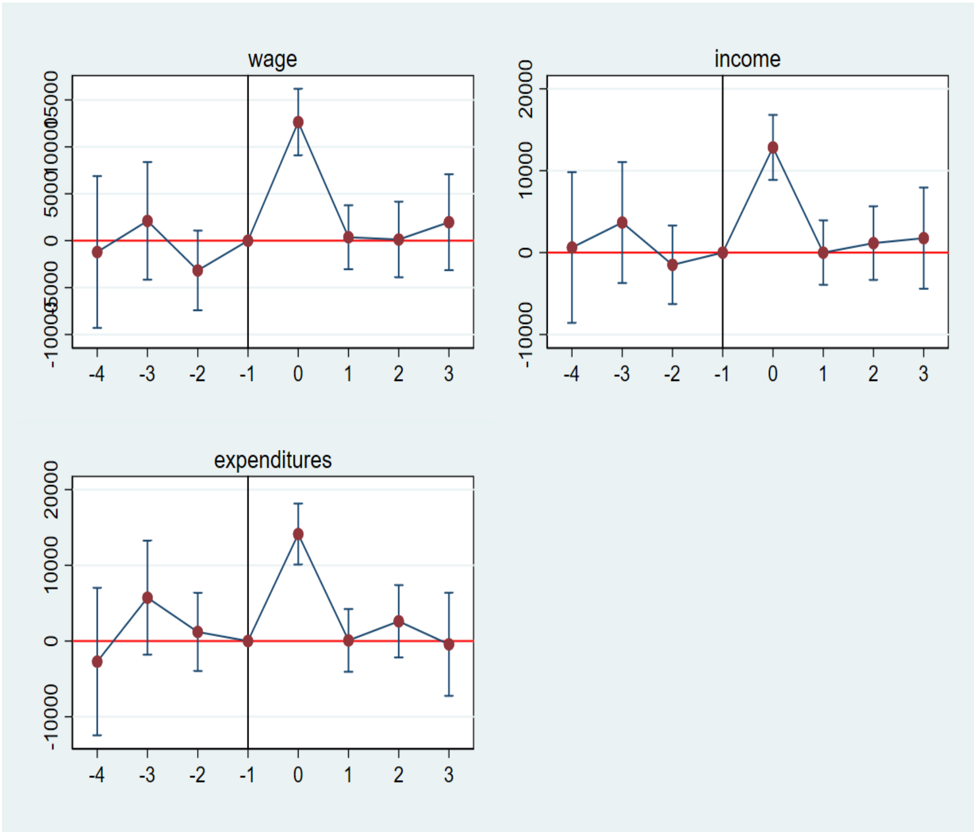
The migration status does not have any statistically significant impact on income prior to the moment that the first migration takes place. This is important, because it rejects a common conjecture that parents migrate to compensate for a negative income shock that they have experienced just before. As discussed in Section 3, such a finding would have

[18] All these financial indicators are deflated by the official consumption price index (CPI) in China with 2010 as reference year.

pointed to a problem of reverse causality, which results in an upward bias of the impact of migration on income.

From Figure 8 we may therefore conclude that migration has a significantly positive effect on income, but also that this effect is transient. Two years later, the effect on income is zero and it remains zero thereafter. This is consistent with the descriptive evidence reported in Figure 2 that in most families at least one of the migrating parents has already returned home two years later. This can be explained by the restrictions imposed by the Hukou registration system which make it hard for rural migrants to integrate more persistently in cities (Song, 2014).

Figure 8. Effects of Parental Migration on the Family's Purchasing Power



Note: This figure plots the dynamic effect after the exposure to parental migration on *wage* income, family *income* and *expenditures*. Monetary values are expressed in real CNY (with 2010as reference year). The official Chinese CPI is used as deflator. Time (-1), one wave prior to parental migration, is defined as the reference event time. The average values of *wage* income, family *income* and *expenditures* at time -1 are 20886.12, 27596.48, and 20759.57, respectively. Vertical lines present 95% confidence intervals with family-level clustered standard errors.

The patterns of the effect of migration on wages and on expenditures follow quite closely the one that we find for income. The fact that wage and income are affected is expected because it confirms that parents migrate to the city where they earn wage income. The finding that the effect on expenditures follows closely the pattern of that on income means that all additional income is spent and not saved for later. This means that this transient positive effect on earnings cannot have persistently enhanced the purchasing power of these families. This channel *cannot* therefore explain why the health of LBC improves in the long run.

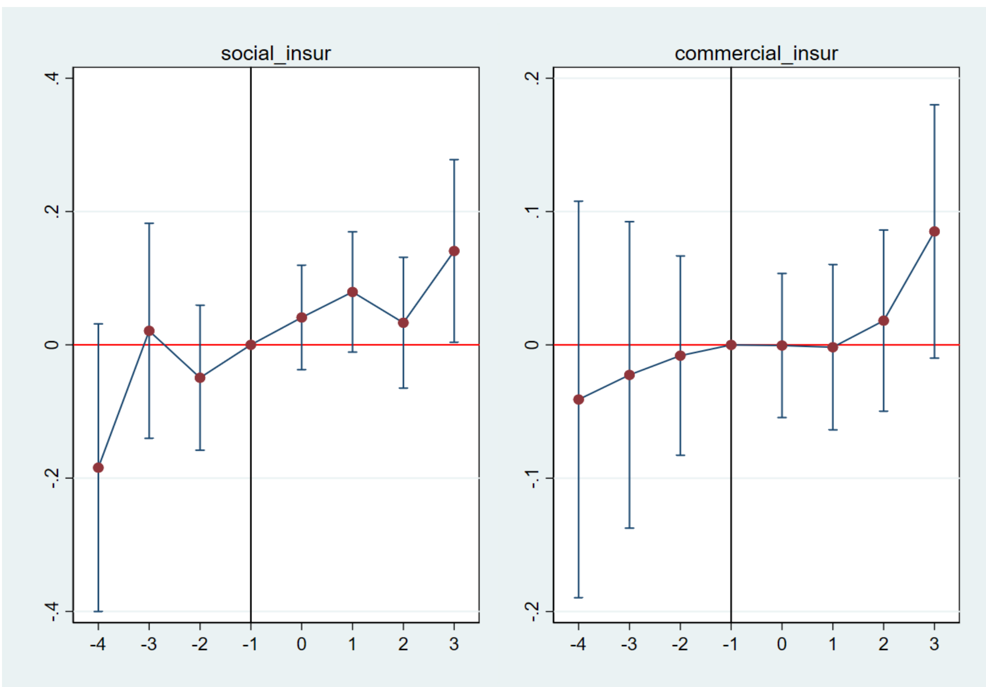
6.3 Reorientation of Spending

Even if a higher purchasing power cannot be the main driver of the improved health outcomes of LBC in the long run, a reorientation of spending might be an alternative explanation. First, by migrating from rural areas to the city parents may have become more aware about the importance of good child nutrition and healthcare. Compared to parents in rural areas, migrant parents in cities have more opportunities to attend public lectures about the importance of parenting children, food nutrition and disease prevention (Hu et al., 2008; Qin et al., 2014). Moreover, migrating parents may have a feeling of guilt towards their left behind children and therefore may compensate for their absence by investing more into high-protein and low-calorie food, as well as by paying more attention to creating a trustworthy environment for the growing-up of their children, which both can be beneficial to mental health and to reducing overweight (Amuedo-Dorantes and Pozo, 2010; Pan et al., 2020; Yang, 2011). Besides, the new regulations and reforms that induced local governments and schools to provide more assistance to LBC with a specific attention to adequate nutritional intake and to mental health reinforce these factors (see Section 2).

Figure 9 provides some suggestive evidence that the migration did reorient the spending of patterns. The results show that the migration led to more access to social health insurance, i.e., the NRCMS-scheme described in Section 2. This may also explain the upward trend of *doctor visits* and *hospitalization* since migration that could be observed in Figure 4. For commercial insurance (the right-hand panel) the evidence of an upward trend is less clear, but this can be explained by the high price that is associated with it.

The available data are not sufficiently detailed to provide further evidence in support of the hypothesis that migration affects the spending pattern in favor of expenditures that improve the long-term health condition of LBC. We call for further research to collect the necessary data to investigate this.

Figure 9. Effects of Parental Migration on the Take-Up of Health Insurance



Note: This figure plots the dynamic effect after the exposure to parental migration on the take-up of *health insurance*: *social insurance* (left panel) and *commercial insurance* (right panel). Time (-1), one wave prior to parental migration, is defined as the reference event time. The average values of *social insurance* and *commercial insurance* are 0.56 and 0.08, respectively. Vertical lines present 95% confidence intervals with family-level clustered standard errors.

7 Conclusion

This study innovates by revealing the dynamics of the impact of first parental migration on the health of young LBC in rural China. Despite finding no impact on the incidence of sickness of LBC, we detect a significant increase in medical expenditures for *doctor visits* and *hospitalization* in the long-run, six to eight years after the first migration took place. Since we show that migration is temporary and income gains are transient, these higher medical expenditures in the long run *cannot* be explained by a sustained higher purchasing power induced by migration. We argue that these higher expenditures are rather caused by a higher take-up of social health insurance that the Chinese government promoted in the period of analysis and that was targeted at poor rural households whose members are more prone to migrate.

Another major finding is that migration gradually reduces the incidence of *overweight*. We argued that this suggests a gradual improvement in the mental health of LBC. While our data do not contain direct indicators of mental health, our analysis does reveal that LBC experience less behavioral disorders which is suggestive evidence for a better mental health condition. We show that grandparents take over the caregiver's role of parents. Their close blood bonds may explain their intense devotion to the children's education care, which may mitigate the parental absence, or even result in higher quality care (Chen et al., 2011; Crosnoe and Elder, 2002; Lou et al., 2013). But as migration is temporary, parents return home and revert to their parenting role. The sustained improvement of (mental) health cannot therefore be fully explained by the caring role of grandparents. We suggest that the migration may have acquainted parents with a new social environment and information that may have led to acquire better knowledge about health education and adequate parenting which may have changed their attitude towards their children as well as reoriented their spending patterns. There is indeed evidence that migrating parents' access to better quality health care services and attendance to public lectures about health care and education in cities may foster an improvement in the raising of their children and in how to keep their health up (Hu et al., 2008; Qin et al., 2014). Besides, the specific assistance provided by local governments and schools to LBC with a specific attention to adequate nutritional intake and to mental health may also partly explain the long-term health improvements of LBC.

We acknowledge that there are still several shortcomings in our study, in particular resulting from data limitations. First, the data are still very imperfect in tracing back the migration history of parents. We could only track the migration history of the parents of young children before the first survey date and could not detect temporary migrations between two survey dates. By this limitation we could only study the impact of migration on children six years old or less at the first survey date. To get a better understanding of the dynamics of the effects of parents migration on health and other outcomes of LBC, we therefore recommend collecting data in which the migration history of parents is more accurately recorded. Second, we could measure the impact on only a very restricted set of health indicators. We lack in particular good indicators of mental health but would also recommend collecting more extensive information on nutrition intake and physical health. To get a correct picture of the dynamics, it is key to systematically collect this information at fixed moments over the life course of children age, but also, more generally, on cognitive and non-cognitive ability, and on educational investments. Finally, we currently could only put forward some exploratory mechanisms that explain the long-term (mental) health improvement of LBC because we lack longitudinal information on parents' attitudes towards parenting, actual parenting behavior, and more detailed spending patterns on child goods and services.

This study could also be improved from a methodological perspective. First, we used an event study approach in which the treatment adoption was assumed to be staggered, which means that migration is an irreversible absorbing state. A consequence is that we could only evaluate the dynamic effects of the first observed migration. We found evidence, however, that migration is temporary. This also means that parents most likely migrate multiple times in the life course of their children. This would require analysis in which the migration status can switch on and off. de Chaisemartin and D'Haultfoeuille (2020) propose such a generalization, but this requires strong assumptions, notably that the migration cannot have a delayed impact on the health outcomes of children. This assumption seems overly restrictive in our context. A second methodological shortcoming is that we had to assume the absence of reverse causality, i.e., that the child's health condition could not have caused the migration decision of the parents. We argued that this issue was unlikely to be important, but we could not formally assess for this possibility because we did not find a sufficiently strong instrumental variable that could cope with this issue.

References

Acharya, C. P., and Leon-Gonzalez, R. (2014). How do Migration and Remittances Affect Human Capital Investment? The Effects of Relaxing Information and Liquidity Constraints. *Journal of Development Studies*, *50*(3), 444–460. https://doi.org/10.1080/00220388.2013.866224/SUPPL_FILE/FJDS_A_866224_SM4845.PDF

Akay, A., Giulietti, C., Robalino, J. D., and Zimmermann, K. F. (2014). Remittances and well-being among rural-to-urban migrants in China. *Review of Economics of the Household*, *12*, 517–546.

Alcaraz, C., Chiquiar, D., and Salcedo, A. (2012). Remittances, schooling, and child labor in Mexico. *Journal of Development Economics*, *97*(1), 156–165. https://doi.org/10.1016/J.JDEVECO.2010.11.004

Ambler, K., Aycinena, D., and Yang, D. (2015). Channeling Remittances to Education: A Field Experiment among Migrants from El Salvador. *American Economic Journal: Applied Economics*, *7*(2), 207–232. https://doi.org/10.1257/APP.20140010

Amuedo-Dorantes, C., and Pozo, S. (2010). Accounting for Remittance and Migration Effects on Children's Schooling. *World Development*, *38*(12), 1747–1759. https://doi.org/10.1016/J.WORLDDEV.2010.05.008

Antman, F. M. (2012). Gender, educational attainment, and the impact of parental migration on children left behind. *Journal of Population Economics*, *25*(4), 1187–1214. https://doi.org/10.1007/S00148-012-0423-Y/TABLES/9

Ao, X., Chen, X., and Zhao, Z. (2022). Is care by grandparents or parents better for children's non-cognitive skills? Evidence on locus of control from China. *China Economic Review*, *71*, 101734. https://doi.org/10.1016/J.CHIECO.2021.101734

Arcan, C. (2021). Dietary Intake and Weight Status Between Left-behind and Nonleft-behind Children in Rural China. *Obesity*, *29*, 82.

Bai, Y., Emmers, D., Li, Y., and Tang, L. (2022). Parental locus of control and early childhood development: Evidence on parent and grandparent caregivers in rural China. *China Economic Review*, *74*, 101814. https://doi.org/10.1016/J.CHIECO.2022.101814

Bai, Y., Yang, N., Wang, L., and Zhang, S. (2022). The impacts of maternal migration on the cognitive development of preschool-aged children left behind in rural China. *World Development*, *158*, 106007. https://doi.org/10.1016/J.WORLDDEV.2022.106007

Bai, Y., Zhang, L., Liu, C., Shi, Y., Mo, D., and Rozelle, S. (2018). Effect of Parental Migration on the Academic Performance of Left Behind Children in North Western China. *Journal of Development Studies*, *54*(7), 1154–1170. https://doi.org/10.1080/00220388.2017.1333108/SUPPL_FILE/FJDS_A_1333108_SM4180.PDF

Bandura, A., Caprara, G. V., Barbaranelli, C., Gerbino, M., and Pastorelli, C. (2003). Role of affective self-regulatory efficacy in diverse spheres of psychosocial functioning. *Child Development*, *74*(3), 769–782.

Bell, S. L., Audrey, S., Gunnell, D., Cooper, A., and Campbell, R. (2019). The relationship between physical activity, mental wellbeing, and symptoms of mental health disorder in adolescents: A cohort study. *International Journal of Behavioral Nutrition and Physical Activity*, *16*(1), 1–12. https://doi.org/10.1186/S12966-019-0901-7/TABLES/3

BeLue, R., Francis, L. A., and Colaco, B. (2009). Mental health problems and overweight in a nationally representative sample of adolescents: effects of race and ethnicity. *Pediatrics*, *123*(2), 697–702.

Bindler, A., and Ketel, N. (2022). Scaring or Scarring? Labor Market Effects of Criminal Victimization. *Journal of Labor Economics*, *40*(4), 939–970.

https://doi.org/10.1086/718515/SUPPL_FILE/20459DATA.ZIP

Britto, P. R., Lye, S. J., Proulx, K., Yousafzai, A. K., Matthews, S. G., Vaivada, T., Perez-Escamilla, R., Rao, N., Ip, P., Fernald, L. C. H., MacMillan, H., Hanson, M., Wachs, T. D., Yao, H., Yoshikawa, H., Cerezo, A., Leckman, J. F., and Bhutta, Z. A. (2017). Nurturing care: promoting early childhood development. *The Lancet*, *389*(10064), 91–102. https://doi.org/10.1016/S0140-6736(16)31390-3

Callaway, B., and Sant'Anna, P. H. C. (2021). Difference-in-Differences with multiple time periods. *Journal of Econometrics*, *225*(2), 200–230. https://doi.org/10.1016/J.JECONOM.2020.12.001

Chang, F., Jiang, Y., Loyalka, P., Chu, J., Shi, Y., Osborn, A., and Rozelle, S. (2019). Parental migration, educational achievement, and mental health of junior high school students in rural China. *China Economic Review*, *54*, 337–349. https://doi.org/10.1016/J.CHIECO.2019.01.007

Chang, H., Dong, X. yuan, and MacPhail, F. (2011). Labor Migration and Time Use Patterns of the Left-behind Children and Elderly in Rural China. *World Development*, *39*(12), 2199–2210. https://doi.org/10.1016/J.WORLDDEV.2011.05.021

Chen, F., Liu, G., and Mair, C. A. (2011). Intergenerational ties in context: Grandparents caring for grandchildren in China. *Social Forces*, *90*(2), 571–594.

Crosnoe, R., and Elder, G. H. (2002). Life Course Transitions, the Generational Stake, and Grandparent-Grandchild Relationships. *Journal of Marriage and Family*, *64*(4), 1089–1096. https://doi.org/10.1111/J.1741-3737.2002.01089.X

de Chaisemartin, C., and D'Haultfœuille, X. (2020). Two-Way Fixed Effects Estimators with Heterogeneous Treatment Effects. *American Economic Review*, *110*(9), 2964–2996. https://doi.org/10.1257/AER.20181169

Dobkin, C., Finkelstein, A., Kluender, R., and Notowidigdo, M. J. (2018). The Economic Consequences of Hospital Admissions. *American Economic Review*, *108*(2), 308–352. https://doi.org/10.1257/AER.20161038

Dolbin-MacNab, M. L., and Yancura, L. A. (2018). International Perspectives on Grandparents Raising Grandchildren: Contextual Considerations for Advancing Global Discourse. *International Journal of Aging and Human Development*, *86*(1), 3–33. https://doi.org/10.1177/0091415016689565

Feng, X., Astell-Burt, T., Standl, M., Flexeder, C., Heinrich, J., and Markevych, I. (2022). Green space quality and adolescent mental health: do personality traits matter? *Environmental Research*, *206*, 112591. https://doi.org/10.1016/J.ENVRES.2021.112591

Gao, X., Liang, W., Mobarak, A. M., and Song, R. (2023). *Migration Restrictions Can Create Gender Inequality: The Story of China's Left-Behind Children*. https://doi.org/10.3386/W30990

Goode, A., Mavromaras, K., and Zhu, R. (2014). Family income and child health in China. *China Economic Review*, *29*, 152–165. https://doi.org/10.1016/J.CHIECO.2014.04.007

Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing. *Journal of Econometrics*, *225*(2), 254–277. https://doi.org/10.1016/J.JECONOM.2021.03.014

Hu, X., Cook, S., and Salazar, M. A. (2008). Internal migration and health in China. *The Lancet*, *372*(9651), 1717–1719. https://doi.org/10.1016/S0140-6736(08)61360-4

Kleven, H., Landais, C., Søgaard, J. E., Bandiera, O., Besley, T., Chetty, R., Goldin, C., Hoynes, H., Katz, L., Levy, G., Mcelroy, M., Naidu, S., and Persson, T. (2019). Children and Gender Inequality: Evidence from Denmark. *American Economic Journal: Applied Economics*, *11*(4), 181–209. https://doi.org/10.1257/APP.20180010

Krueger, R. F., Caspi, A., Moffitt, T. E., Silva, P. A., and McGee, R. (1996).

Personality traits are differentially linked to mental disorders: A multitrait-multidiagnosis study of an adolescent birth cohort. *Journal of Abnormal Psychology*, *105*(3), 299–312. https://doi.org/10.1037/0021-843X.105.3.299

Lagakos, D., Mobarak, A. M., and Waugh, M. E. (2023). The welfare effects of encouraging rural–urban migration. *Econometrica*, *91*(3), 803–837.

Lei, L., Liu, F., and Hill, E. (2018). Labour Migration and Health of Left-Behind Children in China. *Journal of Development Studies*, *54*(1), 93–110. https://doi.org/10.1080/00220388.2017.1283015/SUPPL_FILE/FJDS_A_1283015_SM9773.DOCX

Li, D., and Wen, Y. (2009). Educational well-being of rural children left behind. *Educational Measurement and Evaluation*, *4*, 32–35.

Li, F., Cui, Y., Li, Y., Guo, L., Ke, X., Liu, J., Luo, X., Zheng, Y., and Leckman, J. F. (2022). Prevalence of mental disorders in school children and adolescents in China: diagnostic data from detailed clinical assessments of 17,524 individuals. *Journal of Child Psychology and Psychiatry*, *63*(1), 34–46.

Li, H., Ji, C., Zong, X., and Zhang, Y.-Q. (2009). Height and weight standardized growth charts for Chinese children and adolescents aged 0 to 18 years. *Zhonghua Er Ke Za Zhi= Chinese Journal of Pediatrics*, *47*(7), 487–492.

Li, L., Wang, L., and Nie, J. (2017). Effect of Parental Migration on the Academic Performance of Left-behind Middle School Students in Rural China. *China and World Economy*, *25*(2), 45–59. https://doi.org/10.1111/CWE.12193

Li, Q., Liu, G., and Zang, W. (2015). The health of left-behind children in rural China. *China Economic Review*, *36*, 367–376. https://doi.org/https://doi.org/10.1016/j.chieco.2015.04.004

Liu, H., Chang, F., Corn, H., Zhang, Y., and Shi, Y. (2021). The impact of parental migration on non-cognitive abilities of left behind children in northwestern China. *Journal of Asian Economics*, *72*, 101261.

https://doi.org/10.1016/J.ASIECO.2020.101261

Lou, V. W. Q., Lu, N., Xu, L., and Chi, I. (2013). Grandparent–Grandchild Family Capital and Self-Rated Health of Older Rural Chinese Adults: The Role of the Grandparent–Parent Relationship. *The Journals of Gerontology: Series B*, *68*(4), 599–608. https://doi.org/10.1093/GERONB/GBT040

Lu, S. (2020). Family migration and youth psychosocial development: An ecological perspective. *Children and Youth Services Review*, *113*, 104953. https://doi.org/https://doi.org/10.1016/j.childyouth.2020.104953

McCabe, M. P., and Ricciardelli, L. A. (2003). Body image and strategies to lose weight and increase muscle among boys and girls. *Health Psychology*, *22*(1), 39–46. https://doi.org/10.1037/0278-6133.22.1.39

Meng, Q., and Xu, K. (2014). Progress and challenges of the rural cooperative medical scheme in China. *Bulletin of the World Health Organization*, *92*, 447–451.

Meng, X., and Yamauchi, C. (2017). Children of Migrants: The Cumulative Impact of Parental Migration on Children's Education and Health Outcomes in China. *Demography*, *54*(5), 1677–1714. https://doi.org/10.1007/S13524-017-0613-Z

MIN, S., HOU, L. ling, Hermann, W., HUANG, J. kun, and MU, Y. ying. (2019). The impact of migration on the food consumption and nutrition of left-behind family members: Evidence from a minority mountainous region of southwestern China. *Journal of Integrative Agriculture*, *18*(8), 1780–1792. https://doi.org/10.1016/S2095-3119(19)62588-8

Møllegaard, S., and Jæger, M. M. (2015). The effect of grandparents' economic, cultural, and social capital on grandchildren's educational success. *Research in Social Stratification and Mobility*, *42*, 11–19. https://doi.org/10.1016/J.RSSM.2015.06.004

Mu, G. M., and Hu, Y. (2016). *Living with vulnerabilities and opportunities in a migration context: Floating children and left-behind children in China*. Springer.

Mu, R., and de Brauw, A. (2015). Migration and young child nutrition: evidence from rural China. *Journal of Population Economics*, *28*(3), 631–657. https://doi.org/10.1007/S00148-015-0550-3/TABLES/8

Pan, Z., Xu, W., Wang, G., Li, S., and Yang, C. (2020). Will remittances suppress or increase household income in the migrant-sending areas? Modeling the effects of remittances in rural China. *China Economic Review*, *61*, 101452. https://doi.org/10.1016/j.chieco.2020.101452

Qin, X., Pan, J., and Liu, G. G. (2014). Does participating in health insurance benefit the migrant workers in China? An empirical investigation. *China Economic Review*, *30*, 263–278. https://doi.org/10.1016/J.CHIECO.2014.07.009

Robila, M. (2011). Parental migration and children's outcomes in Romania. *Journal of Child and Family Studies*, *20*(3), 326–333.

Sawyer, M. G., Miller-Lewis, L., Guy, S., Wake, M., Canterford, L., and Carlin, J. B. (2006). Is there a relationship between overweight and obesity and mental health problems in 4-to 5-year-old Australian children? *Ambulatory Pediatrics*, *6*(6), 306–311.

Schmeer, K. (2009). Father absence due to migration and child illness in rural Mexico. *Social Science and Medicine*, *69*(8), 1281–1286. https://doi.org/10.1016/J.SOCSCIMED.2009.07.030

Schmeer, K. K. (2013). Family structure and child anemia in Mexico. *Social Science and Medicine*, *95*, 16–23. https://doi.org/10.1016/J.SOCSCIMED.2012.10.028

Shi, H., Zhang, J., Du, Y., Zhao, C., Huang, X., and Wang, X. (2020). The association between parental migration and early childhood nutrition of left-behind children in rural China. *BMC Public Health*, *20*(1), 1–11. https://doi.org/10.1186/S12889-020-8350-4/FIGURES/1

Shoshani, A., and Steinmetz, S. (2014). Positive Psychology at School: A School-Based Intervention to Promote Adolescents' Mental Health and Well-Being.

Journal of Happiness Studies, *15*(6), 1289–1311. https://doi.org/10.1007/S10902-013-9476-1/FIGURES/3

Song, Y. (2014). What should economists know about the current Chinese hukou system? *China Economic Review*, *29*, 200–212. https://doi.org/https://doi.org/10.1016/j.chieco.2014.04.012

Stock, J. H., and Watson, M. W. (2008). Heteroskedasticity-Robust Standard Errors for Fixed Effects Panel Data Regression. *Econometrica*, *76*(1), 155–174. https://doi.org/10.1111/J.0012-9682.2008.00821.X

Su, S., Li, X., Lin, D., Xu, X., and Zhu, M. (2013). Psychological adjustment among left-behind children in rural China: the role of parental migration and parent–child communication. *Child: Care, Health, and Development*, *39*(2), 162–170. https://doi.org/10.1111/J.1365-2214.2012.01400.X

Sun, F., and Liang, Z. (2021). Parental migration and anemia status of children in China. *Social Science and Medicine*, *270*, 113680. https://doi.org/10.1016/J.SOCSCIMED.2021.113680

Sun, L., and Abraham, S. (2021). Estimating dynamic treatment effects in event studies with heterogeneous treatment effects. *Journal of Econometrics*, *225*(2), 175–199. https://doi.org/https://doi.org/10.1016/j.jeconom.2020.09.006

Talen, M. R., and Mann, M. M. (2009). Obesity and Mental Health. *Primary Care: Clinics in Office Practice*, *36*(2), 287–305. https://doi.org/10.1016/J.POP.2009.01.012

Tian, X., Ding, C., Shen, C., and Wang, H. (2017). Does Parental Migration Have Negative Impact on the Growth of Left-Behind Children?—New Evidence from Longitudinal Data in Rural China. *International Journal of Environmental Research and Public Health*, *14*(11), 1308. https://doi.org/10.3390/IJERPH14111308

UNICEF. (2018). *CHAPTER 10 CHILDREN AFFECTED BY MIGRATION. Children* *in China: An Atlas of Social Indicators 2018*. UNICEF Chinese website. https://www. unicef. cn/sites/unicef. org. china ….

Vaillant, G. E. (1979). Natural history of male psychologic health: Effects of mental health on physical health. *New England Journal of Medicine*, *301*(23), 1249–1254.

Vesel, L., Bahl, R., Martines, J., Penny, M., Bhandari, N., and Kirkwood, B. R. (2010). Use of new World Health Organization child growth standards to assess how infant malnutrition relates to breastfeeding and mortality. *Bulletin of the World Health Organization*, *88*(1), 39–48.

Viet Nguyen, C. (2016). Does parental migration really benefit left-behind children? Comparative evidence from Ethiopia, India, Peru, and Vietnam. *Social Science and Medicine*, *153*, 230–239. https://doi.org/10.1016/J.SOCSCIMED.2016.02.021

Wang, L., Zheng, Y., Li, G., Li, Y., Fang, Z., Abbey, C., and Rozelle, S. (2019). Academic achievement and mental health of left-behind children in rural China: A causal study on parental migration. *China Agricultural Economic Review*, *11*(4), 569–582. https://doi.org/10.1108/CAER-09-2018-0194/FULL/XML

Wang, X. R., Hui, E. C. M., Choguill, C., and Jia, S. H. (2015). The new urbanization policy in China: Which way forward? *Habitat International*, *47*, 279–284. https://doi.org/10.1016/J.HABITATINT.2015.02.001

WEN, M., and LI, K. (2016). PARENTAL AND SIBLING MIGRATION AND HIGH BLOOD PRESSURE AMONG RURAL CHILDREN IN CHINA. *Journal of Biosocial Science*, *48*(1), 129–142. https://doi.org/10.1017/S002193201500005X

Wen, M., Su, S., Li, X., and Lin, D. (2015). Positive youth development in rural China: The role of parental migration. *Social Science and Medicine*, *132*, 261–269. https://doi.org/10.1016/J.SOCSCIMED.2014.07.051

World Health Organization. (2006). *WHO child growth standards: length/height-for-age, weight-for-age, weight-for-length, weight-for-height, and body mass index-for-age: methods and development*. World Health Organization.

Wu, J., and Zhang, J. (2017). The Effect of Parental Absence on Child Development in Rural China. *Asian Economic Policy Review*, *12*(1), 117–134. https://doi.org/10.1111/AEPR.12166

Wu, Q., Lu, D., and Kang, M. (2015). Social capital and the mental health of children in rural China with different experiences of parental migration. *Social Science and Medicine*, *132*, 270–277. https://doi.org/10.1016/J.SOCSCIMED.2014.10.050

Wu, Y., and Guo, Z. (2020). An analysis of the nutritional status of left-behind children in rural China and the impact mechanisms of child malnutrition. *Children and Youth Services Review*, *119*, 105598. https://doi.org/10.1016/J.CHILDYOUTH.2020.105598

Xie, W., Sandberg, J., Uretsky, E., Hao, Y., and Huang, C. (2022). Parental Migration and Children's Early Childhood Development: A Prospective Cohort Study of Chinese Children. *Population Research and Policy Review*, *41*(1), 29–58. https://doi.org/10.1007/S11113-020-09626-3

Xie, Y., and Hu, J. (2014). An introduction to the China family panel studies (CFPS). *Chinese Sociological Review*, *47*(1), 3–29.

Xie, Y., Zhang, X., Tu, P., and Ren, Q. (2016). *China Family Panel Studies (CFPS). Ann Arbor, Mich: Inter-university Consortium for Political and Social Research [distributor]*. https://doi.org/http://doi.org/10.3886/ICPSR36524.v2.

Xie, Y., Zhang, X., Tu, P., Ren, Q., Sun, Y., Lv, P., Ding, H., Hu, J., and Wu, Q. (2017). China family panel studies user's manual. *Peking University: Beijing, China*.

Xu, H., and Xie, Y. (2015). The Causal Effects of Rural-to-Urban Migration on Children's Well-being in China. *European Sociological Review*, *31*(4), 502–519.

https://doi.org/10.1093/ESR/JCV009

Xu, Y., Xu, D., Simpkins, S., and Warschauer, M. (2019). Does It Matter Which Parent is Absent? Labor Migration, Parenting, and Adolescent Development in China. *Journal of Child and Family Studies, 28*(6), 1635–1649. https://doi.org/10.1007/S10826-019-01382-Z

Yang, D. (2011). Migrant Remittances. *Journal of Economic Perspectives*, *25*(3), 129–152. https://doi.org/10.1257/JEP.25.3.129

Yang, F., and Liu, X. (2020). Grandparenting styles, childhood food insecurity, and depression among Chinese rural left-behind children: A structural equation model. *Children and Youth Services Review*, *119*, 105648.

Ye, J., and Pan, L. (2011). Differentiated childhoods: impacts of rural labor migration on left-behind children in China. *Https://Doi.Org/10.1080/03066150.2011.559012*, *38*(2), 355–377. https://doi.org/10.1080/03066150.2011.559012

Yue, A., Bai, Y., Shi, Y., Luo, R., Rozelle, S., Medina, A., and Sylvia, S. (2020). Parental Migration and Early Childhood Development in Rural China. *Demography*, *57*(2), 403–422. https://doi.org/10.1007/S13524-019-00849-4

Yue, Z., Liang, Z., Wang, Q., and Chen, X. (2020). The impact of parental migration on depression of children: new evidence from rural China. *Chinese Sociological Review*, *52*(4), 364–388. https://doi.org/10.1080/21620555.2020.1776601

Zeng, Z., and Xie, Y. (2014). The effects of grandparents on children's schooling: Evidence from rural China. *Demography*, *51*(2), 599–617.

Zhang, H., Behrman, J. R., Fan, C. S., Wei, X., and Zhang, J. (2014). Does parental absence reduce cognitive achievements? Evidence from rural China. *Journal of Development Economics*, *111*, 181–195. https://doi.org/10.1016/J.JDEVECO.2014.09.004

Zhao, C., and Chen, B. (2022). Parental migration and non-cognitive abilities of left-behind children in rural China: Causal effects by an instrumental variable approach. *Child Abuse and Neglect*, *123*, 105389. https://doi.org/10.1016/J.CHIABU.2021.105389

Zhao, Q., Yu, X., Wang, X., and Glauben, T. (2014). The impact of parental migration on children's school performance in rural China. *China Economic Review*, *31*, 43–54. https://doi.org/10.1016/J.CHIECO.2014.07.013

Zhao, Y. (1999). Leaving the Countryside: Rural-to-Urban Migration Decisions in China. *American Economic Review*, *89*(2), 281–286. https://doi.org/10.1257/AER.89.2.281

Zheng, X., Fang, Z., Wang, Y., and Fang, X. (2022). When left-behind children become adults and parents: The long-term human capital consequences of parental absence in China. *China Economic Review*, *74*, 101821. https://doi.org/10.1016/J.CHIECO.2022.101821

Zheng, Y., and Zheng, X. (2015). Current state and recent developments of child psychiatry in China. *Child and Adolescent Psychiatry and Mental Health*, *9*, 1–10.

Zhou, C., Sylvia, S., Zhang, L., Luo, R., Yi, H., Liu, C., Shi, Y., Loyalka, P., Chu, J., Medina, A., and Rozelle, S. (2015). China's left-behind children: Impact of parental migration on health, nutrition, and educational outcomes. *Health Affairs*, *34*(11), 1964–1971. https://doi.org/10.1377/hlthaff.2015.0150

Zhou, Q., Guo, S., and Lu, H. J. (2021). Well-Being and Health of Children in Rural China: The Roles of Parental Absence, Economic Status, and Neighborhood Environment. *Applied Research in Quality of Life*, *16*(5), 2023–2037. https://doi.org/10.1007/S11482-020-09859-6

Appendix

Table A1. Variable Definitions

Variable list	Variable type	Definition
Panel (a): Main outcomes		
sickness	Discrete variable	Equal to 1 if a child has been ill in the last month
doctor visits	Count variable	The frequency of child's visits a doctor in the last year.
hospitalization	Discrete variable	Equal to 1 if a child was hospitalized in the last year.
underheight	Discrete variable	Equal to 1 if a child’s height is below the 10th percentile of the height distribution by age and gender.
underweight	Discrete variable	Equal to 1 if a child’s weight is below the 10th percentile of the weight distribution by age and gender.
overweight	Discrete variable	Equal to 1 if a child’s weight is above the 90th percentile of the weight distribution by age and gender.
focus	Count variable	Parents or other caregivers evaluate a child's focuses. Likert scale: 1-5. Large value means better valuation. This variable is available among CFPS 2010-2018 for children aged 3-15.
compliance	Count variable	Parents or other caregivers evaluate a child's compliance. Likert scale: 1-5. Large value means better valuation. This variable is available among CFPS 2010-2018 for children aged 3-15.
persistence	Count variable	Parents or other caregivers evaluate a child's persistence. Likert scale: 1-5. Large value means better valuation. This variable is available among CFPS 2010-2018 for children aged 3-15.
neatness	Count variable	Parents or other caregivers evaluate a child's neatness. Likert scale: 1-5. Large value means better valuation. This variable is available among CFPS 2010-2018 for children aged 3-15.
Panel (b): Predetermined variables		
age	Count variable	A child's age, ranging from 0 to 14
gender	Discrete variable	1 for male and 0 for female
father age	Count variable	Father's age
mother age	Count variable	Mother's age
father health	Count variable	Self-evaluation of health, ranging from 1 to 7. Larger value means better health performance.
mother health	Count variable	Self-evaluation of health, ranging from 1 to 7. Larger value means better health performance.
father education	Count variable	1 for male and 0 for female
mother education	Count variable	1 for illiteracy, 2 for primary school, 3 for middle school, 4 for high school, 5 for technical college and 6 for bachelor from university.

child number	Count variable	1 for illiteracy, 2 for primary school, 3 for middle school, 4 for high school, 5 for technical college and 6 for bachelor from university.
income[19]	Continuous variable	Family net income, which is equal to total family income minus production costs.
expenditures	Continuous variable	Family total expenditures
Panel (c): Alternative outcomes for robustness tests		
sickness1	Count variable	The frequency of child's sickness in the last month.
doctor1	Discrete variable	Equal to 1 if a child visited a doctor in the last year.
height	Continuous variable	The original value of a child's height (unit: cm)
weight	Continuous variable	The original value of a child's weight (unit: kg)
BMI	Continuous variable	BMI is a child's body mass index by dividing a child's weight by the square form of a child's height.
underBMI	Discrete variable	Equal to 1 if a child's BMI is below the 10th percentile of the BMI distribution by age and gender.
overBMI	Discrete variable	Equal to 1 if a child's BMI is above the 90th percentile of the BMI distribution by age and gender.
Panel (d): Intermediate outcomes		
interaction	Count variable	Number of days with parents per week during a recent non-holiday month, ranging from 0 to 7
care_day	Discrete variable	Equal to 1 if grandparents care for the child during the day
care_night	Discrete variable	Equal to 1 if grandparents care for the child during the night
wage	Continuous variable	Family-level wage income
social_insur	Discrete variable	Equal to 1 if a child has social health insurance. The information is not available in CFPS 2016 and 2018.
commercial_insur	Discrete variable	Equal to 1 if a child has a commercial health insurance.

[19] We have deflated income, savings, and expenditure by PCI to eliminate the influence of macro-economic fluctuation.

Table A2. Description of Outcomes and Predetermined Variables from 2012 to 2018

Variables	LBC mean	non-LBC mean	Mean Difference	p-Value
Outcomes				
General indicators of physical health				
sickness	0.255	0.265	-0.00900	0.594
doctor	2.109	1.735	0.373	0.008***
hospitalization	0.0820	0.0610	0.0220	0.025**
Long-term indicators of health				
underheight	0.533	0.452	0.0810	0.000***
underweight	0.283	0.251	0.0320	0.068*
overweight	0.110	0.139	-0.0290	0.034**
Proxies of mental health				
focus	3.604	3.497	0.107	0.012**
compliance	3.978	3.885	0.0930	0.004***
persistence	3.727	3.567	0.160	0.000***
neatness	3.439	3.345	0.0930	0.043**
Predetermined variables				
age	7.057	7.896	-0.839	0.000***
gender	0.547	0.525	0.0230	0.252
father age	33.75	37.62	-3.874	0.000***
mother age	31.78	35.50	-3.721	0.000***
father health	5.400	5.448	-0.0480	0.434
mother health	5.076	5.234	-0.158	0.002***
father education	2.481	2.528	-0.0470	0.214
mother education	2.133	2.215	-0.0820	0.025**
Child number	2.150	2.133	0.0170	0.622
real income in CNY (Base：2010)	36658.81	30438.28	6220.53	0.000***
real expenditure in CNY (Base：2010)	25896.29	18261.02	7635.27	0.000***

Notes: The number of LBC and non-LBC are separately 226 and 1143. The number of observations varies by year because of non-response. The definitions of main outcomes and predetermined variables are reported can be seen in Panels (a) and (b) of Table A1 in the Appendix.

Table A3. The Deciles of Heigh and Weight for Chinese Children by Age and Gender

	Boy				Girl			
	height	weight	height	weight	height	weight	height	weight
Age	10th	10th	90th	90th	10th	10th	90th	90th
0	48,1	2,83	52,7	3,85	47,5	2,76	51,9	3,75
1	73,1	8,72	80,1	11,58	71,6	8,2	78,5	10,82
2	84,1	10,9	93,1	14,46	82,9	10,39	91,7	13,74
3	91,9	12,74	101,8	16,92	90,8	12,27	100,5	16,36
4	99,1	14,43	109,3	19,29	98,1	13,99	108,2	18,81
5	105,8	16,33	116,9	22,23	104,8	15,68	115,7	21,41
6	111,8	18,06	123,7	25,29	110,8	17,32	122,5	24,19
7	117,6	20,04	130,5	29,35	116,2	19,01	129	27,28
8	123,1	22,24	137,1	34,31	121,6	20,89	135,4	30,95
9	128	24,31	142,9	39,08	126,7	22,93	141,6	35,26
10	132,3	26,55	148,2	43,85	132,1	25,36	148,2	40,63
11	136,8	29,33	154	49,2	138,2	28,53	155,2	46,78
12	142,5	32,77	161,5	55,5	144,1	32,42	160,7	52,49
13	149,6	37,04	169,5	62,57	148,6	36,29	164	56,46
14	156,7	41,8	175,1	68,53	151,3	39,55	165,9	58,88

Note: Cutoff values of deciles of weight and height are expressed in kg and cm, respectively. (Li et al., 2009).

Table A4. Joint Significance Tests

	Pre-treatment periods		Post-treatment periods	
Outcomes	F-stat:	P-value:	F-stat:	P-value:
sickness	3.62	0.3057	3.34	0.5023
doctor visits	2.48	0.4798	13.97	0.0074
hospitalization	8.05	0.0450	9.47	0.0504
underheight	0.48	0.9222	3.74	0.4423
underweight	5.49	0.1395	4.62	0.3286
overweight	10.09	0.0178	22.22	0.0002
focus	1.69	0.6382	10.60	0.0314
compliance	3.42	0.3308	2.95	0.5663
persistence	1.32	0.7246	5.32	0.2557
neatness	0.75	0.8619	10.06	0.0395

Figure A1. Sample Selection Considering Two-Parent Migration

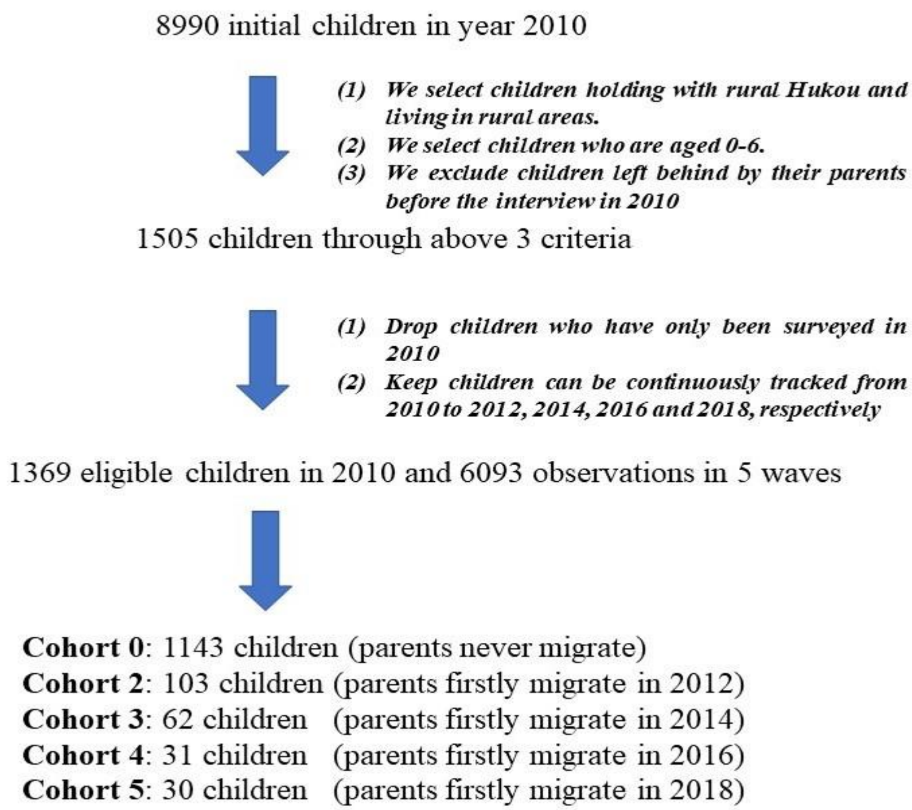


Figure A2. Sample Selection Considering One-Parent Migration

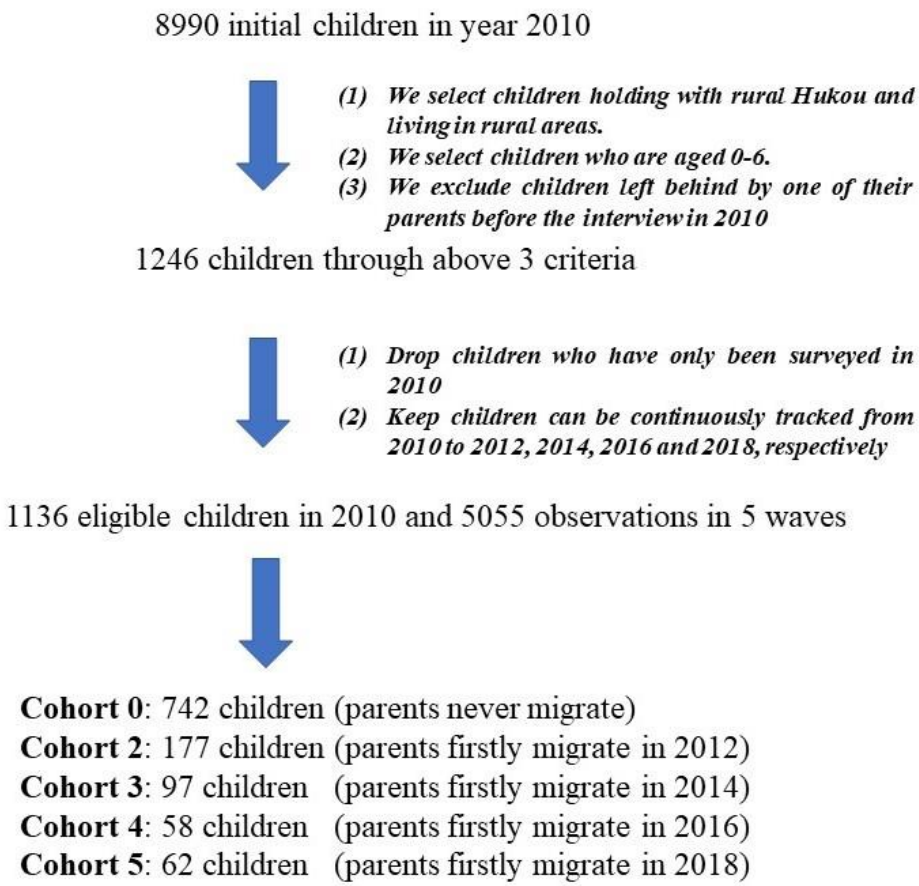
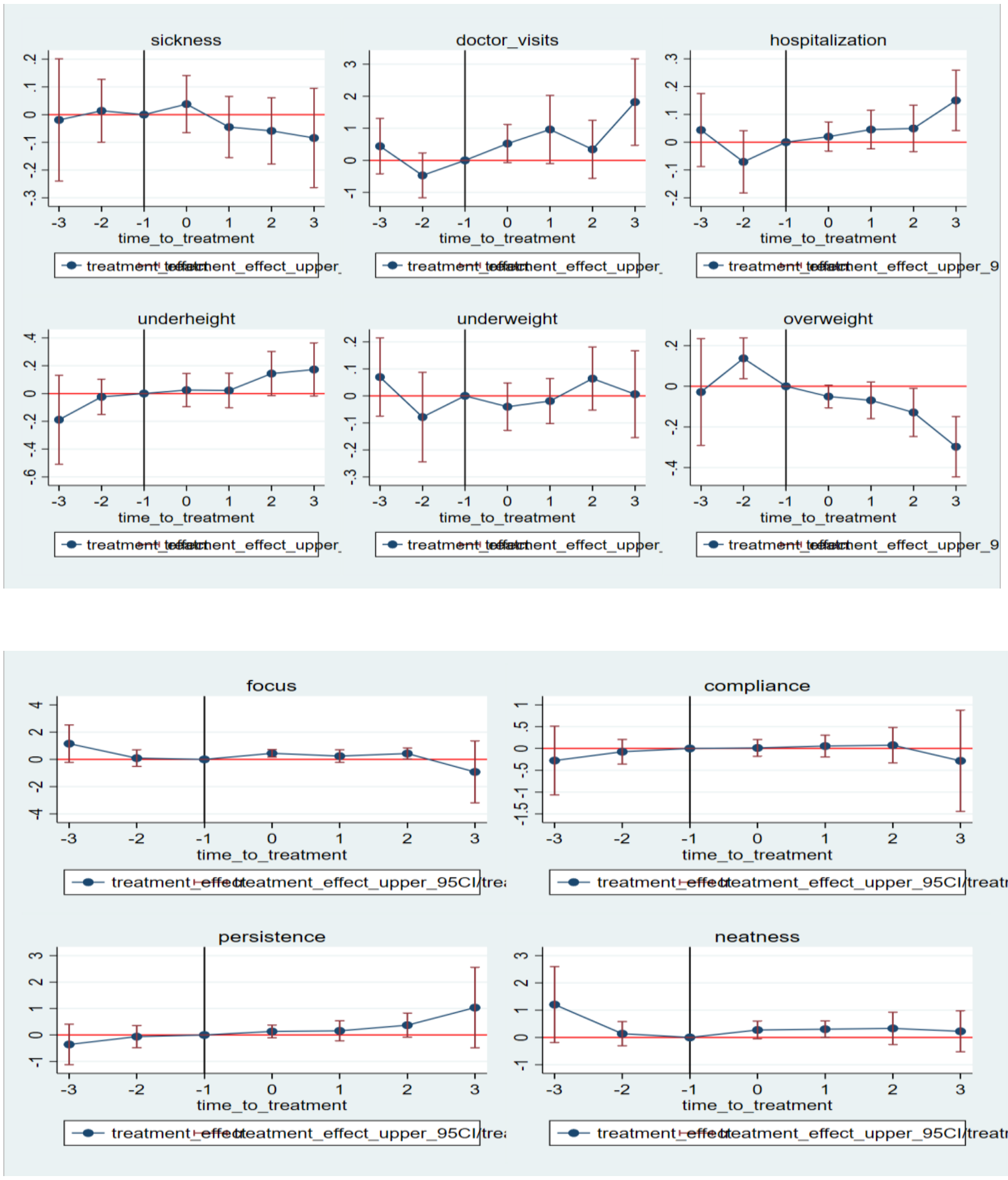


Figure A3. The Frequency of Children Left Behind by at least One Parent

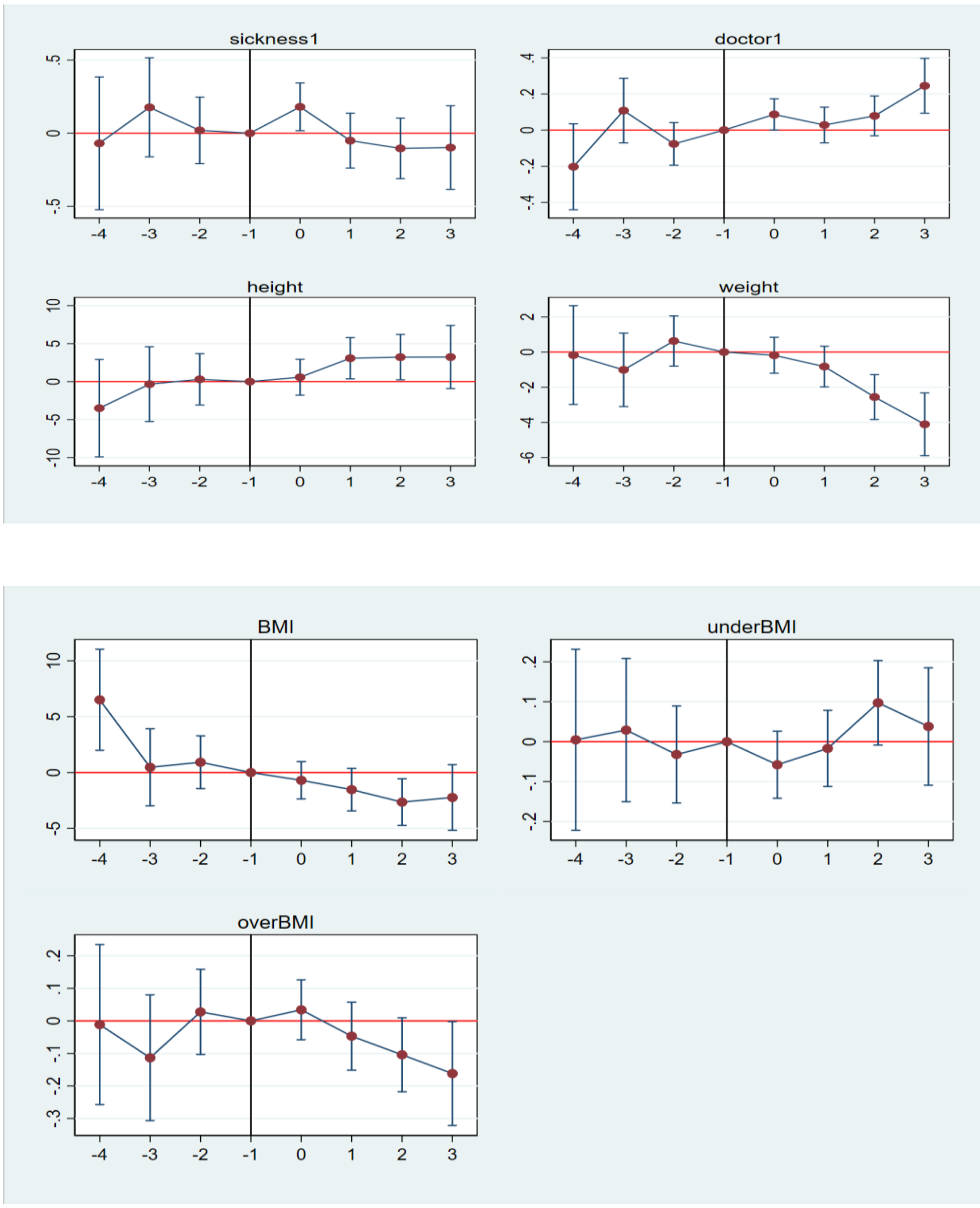
Note: The cohorts refer to the timing of the migration of at least one parent. Cohort 0 refers to the group of children whose parents never migrated. Cohort 2 refers to the group of children whose at least one parent is for the first time observed to be migrating at the second survey in 2012. For cohort 3 this happens in 2014, and so on. *one* refers to children of whom at least one parent migrates; *father* refers to children of whom the father migrates; *mother* refers to children of whom the mother migrates. Y-axis indicates the migration frequency as measured by the number of children.

Figure A4. Robustness Tests for the Main Outcomes with de Chaisemartin and D'Haultfœuille Estimator



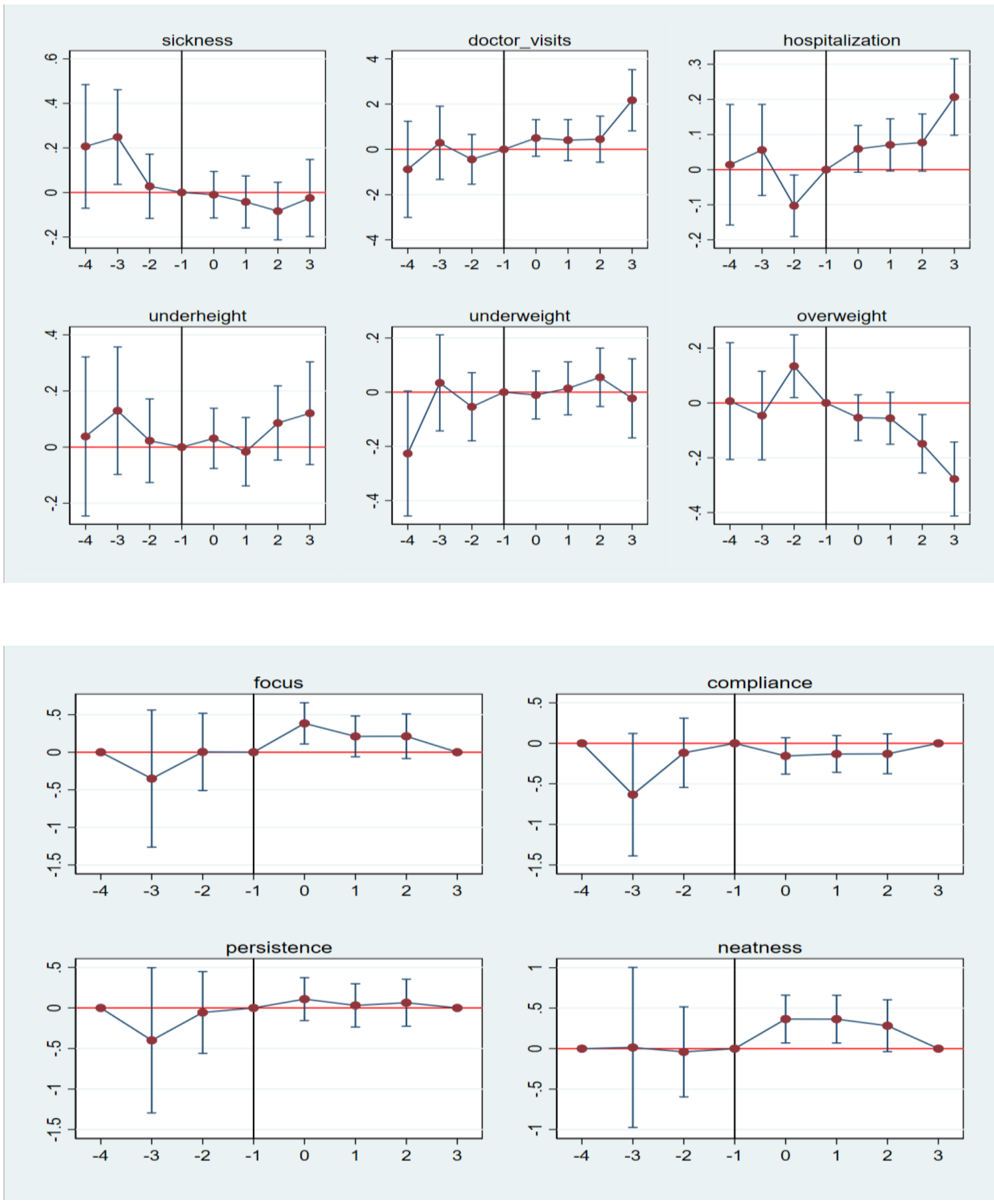
Note: This figure plots the dynamic effect after the exposure to parental migration. Time (-1), one wave prior to parental migration, is defined as the reference event time. The average values of *sickness*, *doctor visits*, *hospitalization*, *underheight*, *underweight*, *overweight*, *focus*, *compliance*, *persistence,* and *neatness* at time -1 are 0.35, 1.77, 0.08, 0.63, 0.33, 0.20, 3.38, 3.92, 3.54, and 3.23, respectively. Vertical lines present 95% confidence intervals with family-level clustered standard errors.

Figure A5. Robustness Tests Using Alternative Outcomes



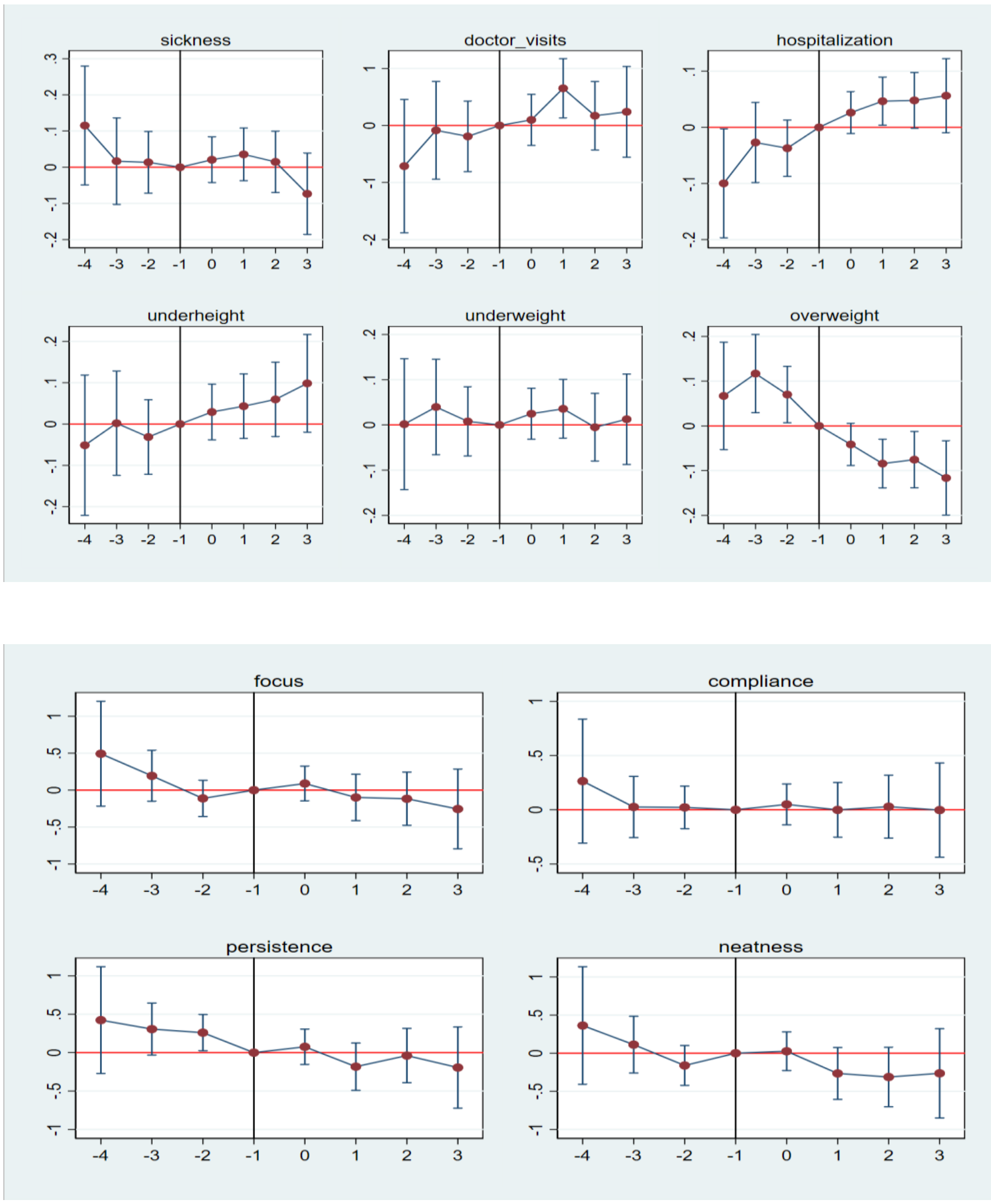
Note: This figure plots the dynamic effect after the exposure to parental migration. Time (-1), one wave prior to parental migration, is defined as the reference event time. The average values of *sickness1*, *doctor1*, *height*, *weight*, *BMI*, *underBMI*, and *overBMI* at time -1 are 0.58, 0.48, 89.90, 16.39, 21.19, 0.23 and 0.64, respectively. Vertical lines present 95% confidence intervals with family-level clustered standard errors.

Figure A6. Robustness Tests Restricting the Sample to Children Aged 0-3 in 2010



Note: This figure plots the dynamic effect after the exposure to parental migration. Time (-1), one wave prior to parental migration, is defined as the reference event time. The average values of sickness, doctor visits, hospitalization, underheight, underweight, overweight, focus, compliance, persistence, and neatness at time -1 are 0.38, 1.81, 0.09, 0.59, 0.27, 0.24, 3.42, 4.00, 3.62, and 3.22, respectively. Vertical lines present 95% confidence intervals with family-level clustered standard errors.

Figure A7. Robustness Tests Considering One Parent Migration



Note: This figure plots the dynamic effect after the exposure to parental migration. Time (-1), one wave prior to parental migration, is defined as the reference event time. The average values of sickness, doctor visits, hospitalization, underheight, underweight, overweight, focus, compliance, persistence, and neatness at time -1 are 0.34, 1.99, 0.10, 0.58, 0.28, 0.17, 3.47, 3.79, 3.43, and 3.42, respectively. Vertical lines present 95% confidence intervals with family-level clustered standard errors.