FACULTY OF LAW, ECONOMICS AND FINANCE

CREA
Discussion
Paper
2017-06

Economics

Center for Research in Economics and Management
University of Luxembourg

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April, 2017

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To Migrate With or Without Ones' Children in China - That is the Question *

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Abstract

Where should Chinese internal migrant parents locate their school-aged children: migrate with them or leave them behind? And should they invest in private education of their children? Empirical evidence based on the 2009 wave of the Rural-Urban Migration Survey in China (RUMiC) data is inconclusive. We use an overlapping generations model to find a theoretical optimum that maximizes parents' utility which includes the children's educational performance. Depending on the educational investment parents make and the relocation cost of children, we provide necessary and sufficient conditions for migrant parents to take their children to migrate and whether they should provide their children with private education. As the choices of migrant parents affect not only their children's human capital accumulation, but also on the economic potential of their descendants, we present both short- and long-term consequences of the parents decision.

Keywords: Migrant children; left-behind children; hukou; China; educational performance.
JEL classification: O15, I31, J13, R23

*We thank Raouf Boucekkine, David de la Croix and Luisito Bertinelli for helpful suggestions. We also acknowledge Tao Kong for clarifications regarding the data collection. All remaining errors are ours.

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1 Introduction

The gradual economic opening initiated by China in 1978 has led to a tremendous number of rural-to-urban migrants. China's National Bureau of Statistics estimates that in 2015 there were about 277.5 million internal Chinese migrant workers, equivalent to 36% of the total workforce[1]. Of these, 169 million were long distance migrants. Nearly every other long distance migrant has moved to a different province for work. High labor demand in China's urban manufacturing sector together with poverty in many rural areas are the main drivers of these massive migratory flows.

While the economic benefits to workers' mobility are certain, the associated social challenges are daunting. Policy makers have attempted to reign migration in by perpetuating a 1950s policy of restricting each individuals' access to free public education and health care to his locality of official residence, typically that of his birth. Notwithstanding this obstacle, as well as serious psychological costs, many Chinese families have chosen to split, leaving children and old parents behind in rural villages. Other families preferred to migrate together with their children, risking to squander the potential of their offspring, as in the destination cities educational opportunities for rural children are limited.

Migrant children inherit their parents' official (rural) registration place and face barriers in accessing public services, notably education. Their chances of obtaining official city residency are slim, even later in their adult life, except if they earn a university degree, because high skilled workers are still much demanded in China's urban labor markets. Because of its pivotal role in families' long run wellbeing, the children's educational achievement is a crucial concern for parents. Consequently, we first assess in this paper whether migrant children's educational performance differs of that of left behind children. Subsequently, assuming migrant workers utility depends on their own, their children's and their parents' consumption, as well as the educational performance of their children, we investigate what are Chinese migrant workers' optimal choices regarding the location of their school-aged children: leave them behind in the

[1]The estimates are based on an annual survey of migrant workers conducted by China's National Bureau of Statistics. Results are published at http://www.clb.org.hk/content/migrant-workers-and-their-children.

rural home village or take them to the city?

Existing empirical literature suggests that children of migrating parents are hurt no matter if they join their parents or if they are left behind. Parental absence may cause left behind children to suffer from mental health issues such as mood swings, stress, depression or anxiety disorders (Qin and Albin, 2010; Lee, 2011; Ye and Lu, 2011; Hu et al., 2014; Zhao and Yu, 2016). However, according to a *All-China Women's Federation* report, in 2013 about 61 million Chinese children - one of every five in China - are left behind[2]. They live in rural areas and haven't seen one or both parents for at least three months in a year. They are cared for either by one parent, by relatives (usually grandparents, who tend to be illiterate), by friends or they are enrolled in boarding schools. Nearly 3.4 percent of them live alone. Parental absence leaves these children at risk of abuse or suicide and makes them easy targets for human traffickers. Statistics on the prevalence of such tragedies are lacking, but anecdotal evidence abounds [3]. Left-behind children in other developing countries have been found to be at a greater risk of living on the edge of society, suffering from drug abuse, teenage pregnancy, psychosocial problems, and violent behavior (Cortes, 2008).

If brought to the city, migrant children cannot benefit from the same educational opportunities as local urban children (Wang, 2008; Li et al., 2010; Liu et al., 2016) and public health care (Milcent, 2010; Mou et al., 2013; Lu et al., 2016; Sun et al., 2016) [4]. This disadvantage is generated by the national policy of household official registra-

[2]A much lower estimate of 9.02 million children left behind in rural areas has been reported in November 2016 by China's Ministry of Civil Affairs. Only 360,000 of them were not under anyone's direct care. Nearly two out of three were aged between 6 and 13 years old, i.e. of compulsory school age. This discrepancy stems from the use of different definitions: whereas the All-China Women's Federation considers a child left behind if it is aged under 18 and either parent has migrated, the Ministry of Civil Affairs only includes children aged 0 to 16 left by both parents. It is the former definition that complies with the guidelines of the United Nations Children's Fund (UNICEF) and is more widely accepted (see for example The Economist, October 17th 2015, page 29-30)

[3]For example, The Economist, October 17th 2015, page 32: "In May a teacher in one such [boarding] school in Gansu province in the north-west was executed for abusing 26 primary-school students. In Ningxia province in June, a teacher got life in prison for raping 12 of his pupils, 11 of whom had been left behind".

[4]A 2012 survey in the city of Cixi, Zhejiang province, found for example that 57 percent of migrant children did not have any medical insurance, see China Labor Bulletin at http://www.clb.org.hk.

tion (*hukou*) system, which will be briefly explained in the next section [5]. According to All-China Women's Federation (2013) in 2010 one out of every four children in China's urban areas was a migrant child who came to the city together with one or both parents. By 2013 that proportion had risen to one out of three, amounting to a staggering 35.81 million migrant children.

These migrant children must either attend makeshift private schools, which often lack adequate teachers and aim only for profit, or pay higher fees in order to be admitted to public schools (Lu and Zhang, 2004; Wong et al., 2007; Wang and Holland, 2011; Liu et al., 2015). Public schools prefer admitting urban children because the government subsidies they receive are solely based on the number of local children enrolled. Schools may boost their revenue by charging extra fees and require donations from parents, with amounts proportional to the schools' academic reputation. This strong incentive to maintain high academic standards, together with the often-held view of migrant children as being academically inferior, leads public schools to set up obstacles to admitting migrant children (Chan and Crothall, 2009). Migrant children thus often attend mediocre or low quality schools, even if they have been living in their host cities for many years. Recognising these negative effects, a few provinces such as Beijing and Shanghai have recently begun reforms of the hukou system, but the overwhelming majority of migrant children still suffer under the policy.

Findings regarding the impact of parental migration on the educational performance of left behind children are mixed. Chen et al. (2009) reports that there is no clear effect on educational performance from parents' out-migration, though some father out-migration improves the performance of left-behind children. Using data from north-eastern provinces of Hebei and Liaoning, Meyerhoefer and Chen (2011) find that parental migration is associated with a lag in grade-level attainment for left-behind children, especially for girls. Lu (2012), Zhang et al. (2014), Zhao et al. (2014), Meng and Yamauchi (2015) and Lu et al. (2016) conclude that parental migration significantly lowers the grades of left-behind children compared to children whose parents have not migrated.

[5] This policy sets Chinese migrant workers apart. A different framework than that used in previous studies of rural-urban migration such as Lucas (2004) needs to be used because in China rural migrants cannot become urbanized.

The empirical studies as to migrant children's educational performance are twofold: On the one hand, the educational outcomes of migrant children are worse than those of local urban children (Kong and Meng, 2010) and on the other hands, Chen and Feng (2013), Lu et al. (2016) and Sun et al. (2016), among others, report that a significant proportion of migrant children in China are not able to attend public schools for the lack of local hukou and turn to privately operated migrant schools. These studies also suggest that access to public schools is the key factor determining the quality of education that migrant children receive.

While previous empirical work indicates that both leaving children behind and migrating with them may prevent them from fully realizing their educational and earning potential, no study has, to the best of our knowledge, compared the outcomes of migrant and left-behind children. International migration literature, especially UNICEF's systematic studies about left-behind and migrant children, focuses either on children migrating to developed economies, for example UK (Crawley, 2009), France (Kirszbaum et al., 2009), Germany (Clauss and Nauck, 2009), Australia (Katz and Redmond, 2009), the Netherlands (De Valk et al., 2009), Switzerland (Fibbi and Wanner, 2009), or on left-behind children in developing countries such as Indonesia, Thailand and Philippines (Bryant, 2005), Argentina, Chile and South Africa (Yaqub, 2009) or Mexico and Salvador (De La Garza, 2010). This paper aims to fill this gap by studying what is the optimal choice of migrating parents on where to locate their children and what are the long-run consequences of the choices made for the children's own offspring.

We first compare empirically the educational performance of left-behind and migrant children using the 2009 Rural Urban Migration survey in China data. While no overall difference among the two groups is observed, we find interestingly that the effect of migration depends on the age of the children: young children being schooled in cities show better results than their left behind peers, yet no such advantage exists at the level of junior high school. These results need to be interpreted with caution however. Selection of children into a migrating or left-behind group is endogenous, it may depend on their ability and motivation to study, both of which are unobserved and associated with educational performance. Unavailability of more suitable data prevents us from overcoming these limitations in our empirical analysis.

Consequently we resort to a theoretical model to provide more conclusive results. In the framework of an overlapping generations model (OLG), we consider migrant workers decide jointly on whether to migrate with their children or leave them behind and on how much to invest in their private, remedial education. The migrant workers' decision depends on two key parameters: the relocation cost of children and the educational investment parents are able and willing to make. The relocation cost encompasses the fees paid for enroling children in urban schools, the extra health care costs and generally any living costs associated with children living in the city. The educational investment is the share of migrant workers' lifetime income that is invested in children's education. This share is the ratio between the importance of children's education and the whole family's consumption. Our model provides relocation cost thresholds for different income levels, which represent the necessary and sufficient conditions for migrant parents' decision to take their children to the city as opposed to leaving them behind. These thresholds increase not only with migrants' life-time income, but also with the gap in public education quality between the migrants' home rural village and their host city. In other words, the discrepancy in quality between public urban and rural education implicitly hinders migrant workers to migrate with their children.

The private education decision of migrant parents depends on the relationship between educational investment and the public education input. Not surprisingly, sufficiently high public education input discourages parents' from investing in private education. Regarding private education, the standard result in the literature is that high income parents provide more private education to their children than low incomes ones (de La Croix and Doepke, 2003). Our finding is that private educational input depends on relative income, which relies on how much parents value education and lifetime income. Thus, if all parents care about their children's education equally, the standard result in the literature holds in our setting as well. Nonetheless, since in China achieving university education in the only way for rural children to improve their lives, low income parents may value education higher than parents who are better off. Low income parents would thus be willing to pay a higher share of their income for the private education of their children. The data of Rural Urban Migration in China confirms this finding.

The rest of paper is structured as follows. Section 2 briefly explains the policies applying to internal migration and public education in China. Section 3 describes the data and the empirical methodology. In Section 4, we use an overlapping generations model to obtain the optimal choice of consumption and private educational investment. Section 5 provides the answers to our original question of when migrant workers should take their children to migrate and when they should leave their children behind. Also in this section, we revisit the RUMiC data which confirms our thereotical findings. Section 6 presents the dynamics and long-run outcomes and Section 7 concludes.

2 The Chinese Context: Hukou, Gaokao and Access to Public Schools

This section describes the circumstances which constrain migrant parents' choices in China so that their decisions can be better understood and assessed. Policy rules named *hukou* limit internal population movement. They interact with regulations regarding the National College Entrance Examination called *Gaokao*. Policies concerning migrant children's access to rural or urban public schools also exist, but they are hard to enforce. The combination of these rules make it challenging for migrant parents to decide on how to maximize their children's chances of receiving good quality education, as we will describe below.

The hukou system [6] is a household registration system established about six decades ago that determines individuals' official place of residence and submits the right to migrate inside China to the approval of local government. Each person is ascribed a household registration status (or hukou status) classified either as "rural" or as "urban" which ties the person to a single administrative unit. An individual must be registered in one and only one place and can only draw on welfare benefits in the place of registration. Families were originally registered where they permanently resided when the policy was first enforced, in the late 1950s. Subsequently children have automatically inherited the hukou status of one of their parents [7]. Children of urban migrants

[6] This description of the hukou system draws on Chan (2010) and Hao and Yu (2015).

[7] Until 1998 a newborn's hukou status followed that of his mother (Chan and Buckingham, 2008)

holding rural hukou are thus still deemed rural, even if they are born in the city. In the rest of the paper we will use the term "migrant children" to refer to the children holding a rural hukou but living in a city.

Until the late 1970s the rural population was barred from moving to urban areas through the hukou system. Since the 1980s, along with economic development, the government has allowed some limited rural-urban mobility, but de facto migration to cities overwhelmingly surpassed official registered moves. Despite the gradual hukou reform, converting a rural hukou to a city one remains difficult for adult migrants even at present, and close to impossible for school-aged children of migrants. While the hukou policy has contributed to maintaining social stability in the face of geographically highly unequal economic growth and living conditions, it has confined the rural Chinese to being second-class citizens, deprived of rights to access public services and welfare programs available in more developed urban areas.

The central government has attempted to regulate migrant children's access to public education, most notably in the *Provisional Regulations on Schooling for Children of Migrant Populations in Cities and Townships of 1996 and 1998*. Under this policy, local governments in the rural areas were instructed to strictly limit the emigration of school-aged children. Children who have custodians in their hukou registration place are to receive the compulsory education [8] in the (rural) registration place. Only if they lack village custodians are they allowed to register in an urban public school, often incurring extra admission fees.

Central policy makers have attempted to relax rural-urban emigration limitations by Article 12 of the *Compulsory Education Act of the People's Republic of China* in 2006: "For school-aged children or adolescents, who have parents or other legal custodians working or living in places other than the hukou-registration places, who receive compulsory education in places other than the hukou-registration places, local government should provide them with equal conditions in receiving compulsory education. Specific policy is determined by province, autonomous region and municipality." How-

[8] According to the *Compulsory Education Act of the People's Republic of China* enacted in 1986, compulsory education lasts for nine years and consists of six years of elementary school and three years of junior high school.

ever, local governments do not always follow the centrally defined rules, especially since the law provides them with some local autonomy. For example, in Beijing and Zhejiang provinces some schools continue to ask proof that no custodians exist in the home village and schools still impose special fees for migrant children (Chen et al., 2016). These constraints have spurred the creation of privately run low quality profit-driven schools, where the migrant children excluded from public education are registered as a last resort.

The hukou system influences not only migrant children's enrolment in public schools, but also their results in the National College Entrance Examination, called Gaokao in Chinese. The National College Entrance Examination is a prerequisite for enrolment into almost any undergraduate study program in a Chinese university. Children take this test in June of their last year of senior high school. Chinese and Math are mandatory subjects in all provinces, English is also commonly tested, but provinces may also add other subjects. As children are supposed to take this exam in the their hukou registration place, migrant children might find themselves tested in subjects they have not studied in the cities where they migrated. This means that even if migrant children successfully enrolled in better quality public urban schools, they may be disadvantaged in the Gaokao exam.

Considering these interactions between the hukou system and the Gaokao policy, it is not obvious whether a rural or an urban compulsory schooling is preferable for children of migrant parents. Though the quality of education in urban areas is supposed to be higher than in rural villages, migrant workers' children may not be better off even if they are taken to the city. Therefore, in next section, we use the Rural Urban Migration in China (RUMiC) survey data to investigate whether there are educational performance differences between migrant children and left-behind children.

3 Empirical Comparison of the Educational Performances of Left-behind and Migrant Children

We attempt to analyse empirically how the educational performances of left-behind children compare to those of rural migrant children. This section describes the unique large-scale survey of internal migrants in China, it discusses methodology and its limitations, and reports the results.

3.1 Data

Nationwide data collection regarding internal migrants in China is made very challenging by the geographical scale and temporary nature of the migration, the sheer number of persons concerned as well as the usual difficulties in defining and tracking migrants, especially unregistered migrants. However, the recent large-scale Migrant Household Survey (MHS), drawing on a random sample of rural-to-urban migrant households from the five provinces which are the largest source of migrants in China and the four most common destination provinces [9] allows some interesting insights on the outcomes of Chinese internal migration. The survey design and implementation are described in detail by (Kong, 2010).

The MHS is one of the three independent surveys forming the Rural Urban Migration in China (RUMiC) survey [10]. It has been initiated in 2006 by a group of universities comprising the Australian National University, the University of Queensland and Beijing Normal University as a longitudinal survey following migrant households for a

[9]The sample covers 15 cities in nine provinces: Shanghai, Guangdong, Jiangsu, Zhejiang, Anhui, Hubei, Sichuan, Chongqing and Henan. According to the 2000 Census, two-thirds of migrant workers in China have chosen as destination cities in the provinces of Shanghai, Guangdong, Jiangsu and Zhejiang. 47% of migrant workers stem from the Sichuan, Chongqing, Anhui, Hubei and Henan provinces (Akgüç et al., 2014).

[10]The financial support for RUMiC was obtained from the Australian Research Council, the Australian Agency for International Development (AusAID), the Ford Foundation, IZA and the Chinese Foundation of Social Sciences. The two other surveys in the RUMiC project are the Urban Household Survey (UHS) and the Rural Household Survey (RHS).

period of five years. The MHS targeted the population of migrants who were registered in a rural area but lived in an urban area at the time when the survey started in 2008 (Kong, 2010). Considering these workers usually live in factory dormitories or makeshift accommodations, a sampling frame was not readily available. Instead, the survey first randomly selected workplaces within defined city boundaries and subsequently migrant workers in each workplace were randomly chosen based on their birth months. Face-to-face interviews with the selected workers and the members of their households[11] living in the city were performed.

The MHS questionnaires collect rich information on demographic and socio-economic characteristics of migrant workers, their household members in the city as well as their spouses and children who stayed behind in the home village. Parents or custodians provided answers concerning many types of expenditures, including those for education, as well as test scores obtained in school by children who were younger than 16 years old and children who were older than 16 but still in school. Parents can be assumed to have good knowledge of their children's scores because at the end of each semester they attend a parents meeting and the final test scores are also sent to parents in writing (see Meng and Yamauchi (2015) for more detail).

Despite considerable efforts of the surveying team, 64% of households could no longer be tracked after the first wave (Akgüç et al., 2014). This substantial attrition rate prevents us from relying on the panel dimension of the MHS. We exploit only the second wave of the MHS because at present it is the only publicly available wave in which scores obtained by children in school have been collected. In early 2009 5243 households were interviewed. They had a total of 3116 children, of which 1219 children were too young to attend school and 1897 were aged between 6 and 16 or were older than 16 but still in school. 148 school-aged children who already obtained a local urban hukou were excluded from the analysis, as were the 394 children for whom Math or Chinese scores were not recorded (46 had dropped out of school altogether).

In explaining test scores earned by the children in school, selection bias may occur if children earning high scores continue education beyond the nine years of compul-

[11] A household was defined as anyone who was living with the respondent at the time of the survey, sharing income and expenditure.

sory education whereas lower achieving students leave school to seek jobs. We thus restricted our analysis to children enrolled in compulsory education, i.e. enrolled in elementary and junior high school. Our sample thus consists of 789 children with complete information[12], of which 415 are migrant children and 374 are left-behind children. Children whose primary residence the year before the survey was a rural village are considered left-behind children and those living in the city in the same period are defined as migrant children.

We measure educational performance by the test scores earned by children both in Math and in Chinese language because these two are main subjects taught and tested in every grade of the 9-year compulsory education in accordance with the National Curriculum Standard designed by the Ministry of Education. The contents of the tests in each region must follow the National Curriculum Standard (Meng and Yamauchi, 2015), allowing comparability across provinces of China. It is widely accepted they provide a good measure of overall educational performance of children (Chen et al., 2009; Zhao et al., 2014). As schools in China may use different scales in grading children's performance, we ensure comparability across schools by analysing not the raw Math and Chinese scores but standardized scores, determined as the ratio of the actual scores obtained to the maximum test score possible in the school for Math and Chinese respectively. The maximum scores were reported by the parents in the RUMiC data.

3.2 Descriptive Statistics

The descriptive statistics are reported in Table 1. The proportion of 58% boys in the sample is slightly high, but one should keep in mind in the Chinese population the sex-ratio also tends to be high (in 2005 it was estimated by China's National Bureau of Statistics at 54.25% (UNICEF, 2014)) and that in the rural population from which the migrants emerge the share of boys is known to be even higher (it was at 54.89% at the time of the 2000 census (Wang et al., 2006)). We find no evidence of a preference for migrating with sons, as had been reported in previous literature (for example, (Chen and Feng, 2013)).

[12]Observations with missing information on explanatory variables are excluded.

Migrant and left behind children are similar in age and are equally likely to be only children. Almost half of the children in our sample are not the only child in the household. While this might seem inconsistent with the one-child policy China has long implemented, it is not surprising since the one-child policy has always allowed households holding a rural hukou to have a second child if their first child was a girl. In certain regions a family could also pay a so-called "social compensation fee" in order to have a second child.

Household income is the total income earned by family members living in the destination city. The income of families migrating with children are 19% higher than the families where children are left behind. Consistent with our hypotheses, migrant parents remit almost 40% more on average if their children are left behind. Parents who migrated with their children are more likely to spend on private education and spend on average three times more on private education than those who left their children behind. These *private educational cost* (or *private educational investment* is the cost parents can choose to pay or not) were collected under the heading "remedial costs outside of school" in the questionnaire of MHS and they correspond to cram school expenses. Cram schools provide extra classes for children in the evenings, weekends or school holidays with the stated aim of improving their school test scores. *Relocation cost* (which is the cost parents must pay in order to enrol their children in school) in Table 1 is defined as the sum of "regular living and school fees" and "sponsorship fees" from the questionnaire of MHS. Regular living and school fees, consisting of expenses for food, accommodation and remedial classes taken in school, are similar for families who left children behind and those who migrate with children. We name *educational expenditure* as the sum of the private educational cost and relocation cost, that is the educational related cost.

Although China passed a law in 2008 that barred schools from charging parents with extra fees for simply accepting to enrol their children, many schools continued to demand such fees in the form of donations, called "sponsorship fees" in the MHS questionnaire. Because children with rural hukou do not have a right to enroll in urban schools, parents who have migrated with their children are more likely to incur such fees. Indeed, 28% of migrant parents reported having paid such sponsorship fees compared to only 5% of migrants who have left children behind. In spite of these dif-

ferences in sponsorship fees paid, the parents' perception of the quality of the school their children attend is the same whether the children are left-behind or migrant. Almost two thirds of parents consider their children attend "average" quality schools and slightly more than one quarter think their children are enrolled in "better than average" schools. Only 4% of parents report their migrant children attend schools of "the best" quality, which confirms the difficulties migrant children have in accessing good quality education in their destination cities. Yet among parents who left children behind the proportion who think their children are enrolled in "the best" quality schools is only slightly higher, at 6%.

As expected, migrant parents themselves have only gained limited or no formal education: 67% of fathers and 78% of mothers only have elementary school education or no education at all. For left-behind children it is most often the mother that raises the child, so her education level is particularly important for the children's learning. In families migrating with children, the proportions of middle and higher educated fathers are slightly higher (20% and 16% respectively) than among families where children are left-behind, where only 16% of fathers have finished junior high school and 14% have graduated at least from senior high school.

In order to control for possible regional differences in children's educational performance, we introduce a set of dummies indicating the origin of migrant children and the area where left behind children live. Ideally province-level dummies would have been used, but insufficient observations have led us to distinguish just three regions: a Central region, a Coastal region and the region of Western China. Half of the children in our sample come from the Central provinces of China, which is not surprising, because central China is at the same time less developed than the east-coast and not too far removed from the urban east-coastal areas to allow migration. Western areas are poorer than central ones, but migration from those areas is hindered by the vast distances migrants would have to travel away from home. Close to 30% of the children stem from Western areas.

Chinese and Math test scores are higher than expected, with migrant children scoring on average 86% of the maximum score and left-behind children scoring on average 84% of the full score. One possible explanation would be that parents have refused to

provide children' scores especially when these scores were low. But it is also the case that at the elementary school level it is generally easier for children to obtain higher test scores. Differences in the average standardized Chinese and Math scores of migrant and left-behind children are small and not significantly different from zero.

3.3 Empirical Strategy and Results

The empirical model is written as:

$$S_{ih} = \alpha + \beta_1 M_h + \beta_2 Age_{ih} + \beta_3 M_h * Age_{ih} + \beta_k X_{kih} + \epsilon_{ih}, \quad (1)$$

where S_{ih} stands for the standardized Chinese or Math test scores of child i in household h. M_h is equal to 1 if children in household h are migrant and 0 if they are left behind. X_{kih} is a vector of k control variables refering to characteristics of children, parents, households and region of origin, such as gender and age of the children, the perceived quality of the school schildren attend, yearly household expenditures on education, amount remitted per year etc.. ϵ_{ih} is the error term.

The migration status of the children in the sample varies across households[13]. We report standard errors clustered at the household level to correct for the fact that children within the same household are expected to have more similar educational performances than children chosen at random from the population. The error term ϵ_{ih} is assumed to be independent across households.

Based on existing experimental and empirical studies, parental effects on children's educational performance are likely to be stronger when children are in elementary school and to weaken as children grow older (Entwisle and Hayduk, 1982, 1988; Topor et al., 2010). We therefore introduce the interaction term between the age of children and the migration status $M_h * Age_{ih}$.

[13]Only 4 households in our sample report having migrated with some children and left others behind.

Table 1: Summary statistics

	Migrant children	Left-behind children	All children		
	Mean	Mean	Mean	Min	Max
Standardized test scores					
Chinese	0.860	0.836	0.849	0.24	1.00
	(0.106)	(0.121)	(0.114)		
Mathematics	0.868	0.855	0.862	0.20	1.00
	(0.118)	(0.120)	(0.119)		
Age of children	10.877	11.345	11.099	6	18
	(2.868)	(2.909)	(2.895)		
Grade of children	4.523	5.005	4.752	1	9
	(2.500)	(2.543)	(2.533)		
Proportion of boys	0.576	0.588	0.582		
Proportion of households with an only child	0.470	0.409	0.441		
Household income	3.248	2.647	2.963	0.60	10.00
	(1.692)	(1.419)	(1.596)		
Remittance	3.825	5.312	4.530	0.00	50.00
	(6.162)	(6.492)	(6.360)		
Private education cost	0.112	0.037	0.077	0.00	4.50
	(0.438)	(0.223)	(0.357)		
Relocation cost	1.924	1.413	1.682	0.00	18.30
	(2.349)	(2.192)	(2.289)		
Regular living and school fees	1.437	1.327	1.385	0.00	15.00
	(1.869)	(2.002)	(1.933)		
Proportion having paid a sponsorship fee	0.282	0.045	0.170		
Perceived quality of school					
Worse than average	0.029	0.029	0.029		
Average	0.651	0.647	0.649		
Better than average	0.282	0.259	0.271		
The best	0.039	0.064	0.051		
Father's highest level of education					
No education	0.123	0.086	0.105		
Elementary school	0.521	0.612	0.564		
Junior high school	0.198	0.163	0.181		
Senior high school or above	0.159	0.139	0.150		
Mother's highest level of education					
No education	0.178	0.214	0.195		
Elementary school	0.610	0.575	0.593		
Junior high school	0.108	0.123	0.115		
Senior high school or above	0.104	0.088	0.096		
Region of origin					
Central	0.523	0.484	0.504		
Coastal	0.198	0.222	0.209		
Western	0.280	0.294	0.286		
Observations	415	374	789		

Source of data: RUMiC data. MHS wave 2009. Notes: Standard deviations are reported in parenthesis. Remittance, Private education cost, Relocation cost and Regular living and school fees are measured in thounsands of RMB per year. The measure of Household income is thousands of RMB per month. The Coastal region includes the provinces of Fujian, Guangdong, Jiangsu, Liaoning, Shandong, Zhejiang and Shanghai. The Central region inlcudes migrants from the provinces of Anhui, Hebei, Heilongjiang, Henan, Hubei, Hunan, Jiangxi and Shanxi. The Western region regroups Chongqing, Gansu, Guangxi, Guizhou, Ningxia, Qinghai, Shaanxi, Sichan, Xinjiang and Yunan.

Table 2: OLS results for educational performance in Chinese and Math

	Standardised Chinese scores	Standardised Math scores
	(1)	(2)
Migrant children	0.118 (0.034)***	0.114 (0.035)***
Age	−0.003 (0.002)	−0.004 (0.002)
Migrant child * age	−0.009 (0.003)***	−0.010 (0.003)***
Boys(d)	−0.020 (0.008)***	−0.006 (0.008)
Only child	−0.002 (0.008)	−0.001 (0.009)
Private education cost	0.010 (0.008)	0.015 (0.007)**
Relocation cost	−0.001 (0.002)	−0.002 (0.002)
Household income	0.003 (0.003)	0.005 (0.003)
Remittance	−0.001 (0.001)	0.000 (0.001)
Perceived quality of School (ref:Average)		
Worth than average	−0.095 (0.041)**	−0.068 (0.031)**
Better than average	0.026 (0.009)***	0.038 (0.009)***
Best	0.056 (0.015)***	0.056 (0.017)***
Fathers' Level of Education (ref: Elementary school)		
No education	−0.040 (0.016)**	−0.029 (0.019)
Junior high school	0.015 (0.010)	0.030 (0.010)***
Senior high school or above	−0.001 (0.012)	0.001 (0.012)
Mothers' Level of Education (ref: Elementary school)		
No education	−0.017 (0.012)	−0.012 (0.014)
Junior high school	0.002 (0.012)	0.011 (0.012)
Senior high school or above	0.010 (0.011)	0.005 (0.012)
Region dummies	yes	yes
Number of household clusters	609	609
Observations	789	789

Source of data: RUMiC data. MHS wave 2009. Notes: Relocation cost are the sum of regular living and school fees and sponsorship fees. Standard errors in parentheses correct for clustering at the household level. All regressions include the constants.*p<0.1; **p<0.05; ***p<0.01.

Table 2 reports OLS parameter estimates. We find that, ceteris paribus, migration has a significant impact both on the Chinese score and the Math score that children obtain: at young ages migrant children outperform left-behind children, but around at the end of the compulsory education this trend is reversed. Migrant children aged 6 have Chinese test scores on average 6.4 percentage points higher than the left-behind children of the same age, whereas among migrants of age 16 the left-behind earn Chinese test scores on average 2.6 percentage points higher than their migrant counterparts. Math scores are on average 5.4 percentage points higher among migrants of age 6 than among left-behind children of the same age. Among 16 year-old, the left behind score 4.6 percentage points higher in Math than the migrant children. For children of age

13 the Chinese test score is the same whether children migrate to the city or are left behind. These results are by no means to be interpreted as causal effects however for the reasons we discuss below.

Regarding the effects of control variables, the perceived quality of the school substantially improves both Chinese and Math scores. Girls' scores in Chinese are 2.0 percetage points higher on average than those of boys, but no differences exist regarding Math scores.

Only the father's education level influences the children's Chinese test scores, with children of uneducated fathers performing significantly worse than those of fathers who have at least primary education. A father's middle or higher education does not improve the Chinese scores of his children. This might be the consequence of Chinese migrant workers having to work very long hours [14], leaving them too little time for helping their children study.

Table 3: Results for children in elementary school and in junior high school

	Dependent variable:			
	Elementary School		Junior high School	
	Chinese	Math	Chinese	Math
	(1)	(2)	(3)	(4)
Migrant children	0.030***	0.025**	−0.015	−0.041**
	(0.010)	(0.010)	(0.016)	(0.018)
Observations	552	552	237	237
Number of household clusters:	504	504	221	221

Source of data: RUMiC data. MHS wave 2009. Notes: Standard errors in parentheses correct for clustering at the household level. *p<0.1; **p<0.05; ***p<0.01. Each regression includes a constant and children's, parents', households' and regions' characteristics variables.

To gauge robustness of our result that the differences in educational performance between migrant children and left-behind children are age related, we divide children into two groups on the basis of their grade, i.e. children in elementary school and children in junior high school, we then repeat our analysis in each group. The results in Table 3 indicate that, in the group of elementary school, migrant children are outper-

[14]Migrants worked on average 25.2 days a month an 8.7 hours a day in 2015. 85 percent of them worked in excess of 44 hours per week. See China Labour Bulletin at `http://www.clb.org.hk/content/migrant-workers-and-their-children`.

forming left-behind children in both Chinese and Math subject. After controlling for all other variables, Chinese and Math test scores of migrant children are 3.0 percentage points and 2.5 percentage point, respectively, higher than left-behind counterparts. Concerning children in the junior high school, there is no statistically significant discrepancy in Chinese test scores, Math scores of left-behind however are 4.1 percentage point higher than migrant children. This is consistent with the findings drawn on in Table 2, at young ages of children, migrant children get the advantage of educational performance over left-behind children while this advantage is weaken among children in the junior high school.

Nevertheless, much caution is needed in interpreting the estimated effects of children's migration on test scores for several reasons. The parents decision to migrate with a child or to leave him or her in the home village may depend on the educational performance of the child, creating a problem of reverse causality. Important determinants of the educational performance such as the general ability of children or their study effort are unobserved, yet they may be correlated with the migration status of the children and causing our estimates to be both biased and inconsistent. Selection bias may also affect our results, as for a non-negligible share of children in the sample the Math and Chinese scores are not reported. In the Chinese context it can be assumed that some parents might feel ashamed to report a low educational performance for their children and might prefer to simply not answer the survey question. If such a pattern was indeed followed in reporting test scores, the average of test scores would be overestimated and the variance of the test scores reduced. Finally, test scores as well as educational expenditure and household income are likely plagued by measurement error. Minimum values of these variables are surprisingly low. Disentangling the effects of measurement error in our context is difficult.

An instrumental variable strategy would have allowed us to solve some of the aforementioned problems, but at present we were unable to find a satisfactory instrument. Availability of panel data would have allowed us to control for at least the time-constant unobserved heterogeneity among children, but difficulties in tracking migrants across the waves of the MHS survey has precluded us from performing such analysis. For these reasons we consider the empirical results reported in Table 2 to be provisional.

In next section, we rely on a theoretical model to provide more conclusive information on the optimal choices of migrant workers regarding whether to take children to migrate to the city or not.

4 The theoretical model

4.1 The model

We consider an overlapping generations model of migrants who have rural hukou but work in a urban area. Suppose each individual is one household and will live for two periods: young and old. The lifetime utility of generation t is

$$U_t = u(c_t) + \beta u(d_{t+1}) + \gamma U_t^f, \tag{2}$$

where c_t and d_{t+1} represent consumption in young and old age respectively, with parameter $\beta(\in (0,1))$ denoting time preference. Following the concept of altruism introduced by Lucas and Stark (1985) and the Chinese tradition of children providing support for old parents, [15] we assume that individuals also take care the other family members (parents, children, siblings etc.), which is denoted by U_t^f, with $\gamma(\in (0,1))$ being the altruism parameter. For simplicity, we take

$$U_t^f = a_P u_P\left(\frac{c_{P,t}}{N}\right) + a_K \sum_{k=1}^{K} u_k(c_{k,t}, h_{k,t+1}), \tag{3}$$

where c_p measures parents' consumption (if there are young siblings in the family, we consider that as part of parents' consumption), N is number of siblings who share the cost of old age parents, K is the number of children in each household[16], c_k and $h_{k,t+1}$

[15]The left-behinds are not only children, but also parents. The Economist August 29th 2015 reported that: *In 2009-11 people over 65 accounted for just under half of all suicides, and more in rural area: living alone in old age can be harsh anywhere, but in China it may be particularly isolating, given that so many young Chinese have left their villages, and parents, in search of work. The government has tried to enforce filial piety, passing a law in 2013 that threaten fines or jail if people fail to visit parents and feed their 'spiritual needs'.*

[16]China long held a one child policy. However, many exceptions were allowed, especially in the rural regions, so quite some families had more than one child. This is also confirmed by the RUMiC data.

are children's consumption and human capital accumulation, i.e. schooling. We assume an individual cares equally for all her children, but may care less for her parents than her children, that is, a_P could be less than or equal to a_K. [17]

Denote human capital of migrant workers as h_t which checks $h_t \geq h_0$ with h_0 measuring pure physical capital and excluding any education, training, skills or experience. Suppose unit human capital wage is w_t, which is exogenously given, so an individual with human capital h_t earns income $w_t h_t$. This income is divided among four additive components: her own (and family's) consumption when young (c_t), savings s_t for old age, consumption related remittances m_t and private education related costs $g(e_t)$. Consumption related remittances are sent home to support parents' old age and the standard costs of raising non-adult children left behind (including school books and other costs for school supplies). However, in the Chinese context, distinct private education costs may be incurred both if children are left-behind and if they are migrating with the parents. If children do not migrate, families may need to pay a fee to a boarding school (often held by some local teachers) or to relatives to ensure basic care for the children. For example, in mountainous regions schools may be hours away from home. If young adults migrate to work and leave children behind, grandmothers often rent a room near the school where their grandchildren are registered. This way grandchildren can attend school safely, avoiding daily lengthy and dangerous home-to-school travels, and are spared the burden of cooking and cleaning their clothes themselves. Very often, after their grandchildren leave for school, those grandmothers walk back to their home villages to take care their farm (and husbands) and return to their rented rooms before their grandchildren do. If migrant parents do take children with them, they have to pay extra fees for enrolling their children in the local urban schools, as was already explained in the introduction. Thus the young migrant worker faces the following financial budget constraint:

$$c_t + s_t + g(e_t) + m_t = w_t h_t. \tag{4}$$

When the migrant is old, her consumption consists of savings from young age with interest rate r_{t+1}, possible old age working income but with some discounted human capital ϕh_t (parameter $0 \leq \phi \leq 1$) and maybe some exogenous transfer from her adult

[17] This implications of this assumption will be clarified in Section 4.2.

children or/and public pension, which we denote by $\widetilde{T_{t+1}} = \widetilde{m_{t+1}} + \widetilde{p_{t+1}}$. Thus the old-age budget constraint is

$$d_{t+1} = s_t(1 + r_{t+1}) + w_{t+1}\phi h_t + \widetilde{T_{t+1}}. \tag{5}$$

In equation (3), parents utility depends not only on children's consumption, but also on their children's human capital accumulation. For the special case of Chinese rural migrant workers, we modify the suggested formulation of de Brauw and Giles (2012, 2016) and de La Croix and Doepke (2003) about human capital accumulation in the following way:

$$h_{t+1}^j = h_0 + B_t^j(\theta_j + e_t^j)^\eta h_t^{\alpha^j}(\overline{h_t^j})^\kappa, \quad j = m, l. \tag{6}$$

We use j to denote the location of the children's education: $j = m$ captures the case where the children study in the city where they migrante with their parents, while $j = l$ indicates the children are left-behind and attend school in their rural village.

In this equation, h_0 is basic physical labor without any extra education or training, parameter $\eta \in (0, 1)$ denotes the share of public and parents' contribution to the childrens' education outcome, α^j is parents' human capital impact, $\kappa(\in [0, 1-\eta])$ can be interpreted as effect of the quality of the school, and $\overline{h_t^j}$ is the average human capital of teachers. The positive parameter θ_j measures free public education, indicating that even if the parents chose not to invest anything, children will still get some education if they make some efforts, that is, if $B_t^j > 0$.

Here B_t^j represents a learning productivity parameter, indicating children's ability, their motivation and effort to study at time t. To account for the circumstances of the *lost generation of left-behind children*[18], we consider B_t^j can be equal to zero. A positive and large value for B_t^l would suggest that the left-behind children are very much motivated and work hard in school, which is confirmed by some anectodal evidence reported in the media. However, it may be more reasonable to expect B^l to be just slightly larger than zero since the left-behind children lack parental affection, supervision and discipline, they often need to undertake household chores such as cooking

[18]See for example, the BBC news, on Sep1. 2011 at: http://www.bbc.com/news/ world-asia-pacific-14743222 and 2 Oct. 2012 at http://www.bbc.com/news/magazine-19787240. The Wall Street Journal article at: http://www.wsj.com/articles/SB10001424052702304173704579260900849637692.

their own meals and washing their own clothes, and may even need to take care of younger siblings or work in the field to produce their own food. B_t may vary according to characteristics of the children, such as their age, gender etc., reflecting that boys may suffer more from being left behind than girls, or that young children may be affected more by the separation from their parents than older ones. The empirical analysis presented in Section 3 using RUMiC data suggests the age of children affects B_t.

By no means can B_t^m either be expected to be high. Migrant children may not like their new school and may not be liked by their urban peers. They too may lack study time if they need to cook or clean while migrant parents work very long hours. Moreover, depending on the differences between the curricula of their origin and destination school, migrant children may lack previous knowledge and face difficulties in following lectures.

In equation (6) above, the term $h_t^{\alpha^j}$ captures the intergenerational human capital transfer. $\alpha^j = 1$ means that the new generation inherits the same human capital as their parents. However, given the left-behind children do not grow up with their parents, they cannot learn directly the skills needed for rural life, such as how to grow crops or how to repair tools, leading to the assumption that $\alpha^l = 0$. Even if the children migrate with parents, their human capital accumulation may be hindered by the unavailability of parents to supervise homework or their inability to pay for remedial classes (as local urban parents do). Thus, we impose $0 \leq \alpha^j \leq 1$.

Having presented each term in equation (6), we now turn to the assumptions needed to study the differences in human capital accumulation of the left behind and the migrant children.

Assumption 1

- *Urban schools have better education infrastructure and better teachers than those in rural regions:* $\theta_m > \theta_l$, $\overline{h_t^m} > \overline{h_t^l}$.
- *The inter-generational parameter checks:* $0 \leq \alpha^j \leq 1$, $j = m, l$.
- *The productivity parameter satisfies:* $B_t^j \geq 0$, $j = m, l$.

Assumption 2 *The private education costs follow:*

$$g(e_t) = g^j(e_t^j) = \begin{cases} K(e_t^l + k_l), & \text{for left behind children } j = l, \\ K(e_t^m + k_m), & \text{for migrant children } j = m \end{cases}$$

with per child relocation cost $k_m > 0$, while staying at the original location it is normalized to $k_l = 0$ and e_t^j indicating whether migrant parents chose to offer private education to their children or not.

Under Assumption 1 and 2, the migrant worker's optimization problem is:

$$\max_{c_t,\, s_t,\, m_t,\, e_t} U_t = u(c_t) + \beta u(d_{t+1}) + \gamma \left[a_P u_P \left(\frac{c_{P,\,t}}{N} \right) + a_K \sum_{k=1}^{K} u_k(c_{k,\,t}, h_{k,\,t+1}) \right],$$

subject to the two period budget constraints (4) and (5), the children's human capital accumulation (6) and the remittance constraint which will be presented later.

To get explicit solutions we take the logarithm of the utility function yielding,

$$U_t = \ln(c_t) + \beta \ln(d_{t+1}) + \gamma a_P \ln \left(\frac{c_{P,\,t}}{N} \right) + \gamma a_K K[\ln(c_{k,\,t}) + \widetilde{\beta}_k \ln(h_{k,\,t+1} - h_0)].$$

We assume here that parents care equally for all of their children and denote $\widetilde{\beta}_k \in [0, 1]$ a parameter that measures how much parents value children's education compared to their children's consumption. $h_{k,\,t+1} - h_0$ measures educational performance, given that the physical capital parents gave to their children is included in the c_k term, showing that parents value both their children's consumption and education.

It is clear from the above functional form that if $B_t^j = 0$, the last term $\ln(h_{k,\,t+1} - h_0) = -\infty$, so the parents do not have an optimal interior choice. Therefore we distinguish two different cases in what follows: (1) the normal case where $B_t^j > 0$ and (2) the case of the "lost generation" where $B_t^j = 0$.

4.2 Theoretical results – the normal case

Since the children in our study may migrate with their parents or be left-behind we must treat children's and parents' consumption separately. This distinguishes our

work from the classical overlapping generations literature, such as de La Croix and Doepke (2003).

As most of the left-behind children are living with their grandparents, we make no difference between the children and their grandparents' consumption, that is, we assume and normalize to family consumption c_f:

$$c_k^l = c_P := c_f. \tag{7}$$

Then the migrant's remittance checks

$$\frac{c_{P,t}}{N} + K c_{k,t}^l \leq m_t^l + \widetilde{y}, \tag{8}$$

which states that the consumption of left-behind children and their grandparents depends on remittances and other exogenous income, $\widetilde{y}$, most likely income from agriculture or leasing farmland. Here the cost of aged parents is shared by total N siblings of the migrant adults. Thus, the migrants' utility can be rewritten as:

$$U_t = \ln(c_t^l) + \beta \ln(d_{t+1}^l) + (\gamma a_P + \Gamma_K) \ln(c_{f,t}) + \Gamma_K \widetilde{\beta}_k \ln(h_{k,t+1}^l - h_0), \tag{9}$$

with $\Gamma_K = \gamma a_K K$ being the altruism factor for children.

If children migrate, the remittances will be purely supporting left-behind aged parents and verify

$$\frac{c_P}{N} \leq m_t^m + \widetilde{y}. \tag{10}$$

The migrants' utility is

$$U_t = (1 + \Gamma_K) \ln(c_t^m) + \beta \ln(d_{t+1}^m) + \gamma a_P \ln(c_{p,t}) + \Gamma_K \widetilde{\beta}_k \ln(h_{k,t+1}^m - h_0). \tag{11}$$

Definition 1 *We call* $\{c_t^j, s_t^j, e_t^j, m_t^j\}$ *(* $j = l, m$*)* an optimal choice *if it maximizes utility (9) (or (11)) under budget constraints (4), (5), (8) (or(10)) and the children's human capital accumulation (6) with Assumptions 1 and 2.*

The standard first order condition shows that

$$d_{t+1}^j = \begin{cases} \beta(1+r) c_t^l, & j = l, \\ \dfrac{\beta(1+r)}{1+\Gamma_K} c_t^m, & j = m. \end{cases} \tag{12}$$

Equation 12 shows the relationship between the two periods' marginal utility. Taking into account the old-age consumption constraint, we obtain that the migrant's savings follow

$$s_t^j = \begin{cases} \beta c_t^l - \dfrac{\widetilde{T_{t+1}} + \phi h_t w_{t+1}}{1+r}, & j = l, \\ \dfrac{\beta}{1+\Gamma_K} c_t^m - \dfrac{\widetilde{T_{t+1}} + \phi h_t w_{t+1}}{1+r}, & j = m. \end{cases} \tag{13}$$

The same calculation as above yields that

$$c_f \left(\frac{1}{N} + K \right) = m_t^l + \widetilde{y} = (\gamma a_p + \Gamma_K) c_t^l \text{ or } \frac{c_P^m}{N} = m_t^m + \widetilde{y} = \frac{\gamma a_p}{1+\Gamma_K} c_t^m. \tag{14}$$

The intuition behind equation (14) is straightforward: the left-hand side is the cumulative consumption of all left-behind children and old parents, which will be covered by the remittances and the potential income of the left behind $\widetilde{y}$. At the same time this consumption is determined based on the migrant's own consumption corrected by the altruism factors of children and parents, γa_p and Γ_K.

The optimal choice of private education e_t^j must satisfy

$$\frac{1}{c_t^l} \left(\text{or } \frac{(1+\Gamma_K)}{c_t^m} \right) \; K = \frac{\Gamma_K \widetilde{\beta}_k}{h_{k,\,t+1}^j - h_0} B_t^j h_t^{\alpha^j} (\overline{h^j})^{\kappa} (\theta_j + e_t^j)^{\eta - 1} \eta,$$

where the left-hand side is the marginal loss of consumption due to the educational investment and the right-hand side presents the marginal gain for children's human capital accumulation. Rearranging terms in the above equation, the optimal education per child is given by:

$$e_t^j = \begin{cases} \dfrac{\Gamma_K \widetilde{\beta}_k \eta}{K} c_t^l - \theta_l, & j = l, \\ \dfrac{\Gamma_K \widetilde{\beta}_k \eta}{(1+\Gamma_K) K} c_t^m - \theta_m, & j = m. \end{cases} \tag{15}$$

Substituting the above savings, remittances and private education costs into the budget constraint, it follows that for $j = l, m$,

$$c_t^l \left(or \frac{c_t^m}{1+\Gamma_K} \right) \; (1 + \beta + \gamma a_P + \Gamma_K + \Gamma_K \widetilde{\beta}_k \eta) = w_t h_t + \widetilde{y} + \frac{\widetilde{T_{t+1}} + \phi h_t w_{t+1}}{1+r} - K k_j + K \theta_j,$$

with $k_l = 0$ and $k_m > 0$. We denote $W_t = w_t h_t + \widetilde{y} + \frac{\widetilde{T_{t+1}} + \phi h_t w_{t+1}}{1+r}$ the lifetime earnings composed of the labor incomes from the two periods, the potential income in the home village, the discounted old-age social transfers and the children's remittances. Thus the left-hand side is the aggregate lifetime cost, which includes consumption by taking into account young and discounted old age, parents and children's consumptions, plus the educational costs of children. The right-hand side is lifetime potential income, which includes lifetime earnings and public social transfers for education net of relocation costs of children's schooling.

From the above analysis we conclude that:

Proposition 1 *Given Assumption 1 and 2 and assuming that $B^j > 0$ and $\widetilde{\beta}_k > 0$, for migrant workers, there exists one and only one optimal choice, $c_t^{in,j}$ which is given by*

$$c_t^{in,j} = \begin{cases} \dfrac{(W_t + K\theta_l)}{\Lambda}, & j = l, \\ \dfrac{[W_t + K(\theta_m - k_m)](1+\Gamma_K)}{\Lambda}, & j = m, \end{cases} \tag{16}$$

$s_t^{in,j}, e_t^{in,j}$ are given by (13) and (15) respectively and remittances are

$$m_t^{in,l} = (\gamma a_P + \Gamma_K) c_t^{in,l} - \widetilde{y}, \quad m_t^{in,m} = \frac{\gamma a_P}{1+\Gamma_K} c_t^{in,m} - \widetilde{y}, \tag{17}$$

where

$$\Lambda = 1 + \beta + \gamma a_p + \Gamma_K (1 + \widetilde{\beta}_k \eta).$$

Finally, old-age consumption $d_{t+1}^{in,j}$ is given by (12).

Noticing that migrant's consumption, hence everyone's consumption, increases in term of public education input, while private education cost decreases: $\frac{\partial e_t^{in,j}}{\partial \theta_j} = \frac{\Gamma_K \widetilde{\beta_k} \eta}{\Lambda} - 1 < 0$. High public education input induces parents to decrease their private educational investment. Thus, instead of providing private education to their children, parents consume that part of income. This argument may lead to the case that no private investment in education is an optimal choice. Therefore, to guarantee that in Proposition 1, $e_t^{in,j} > 0$, the following are needed.

Proposition 2 *Given Assumption 1 and 2. Assume that* $B^j > 0$ *and* $\widetilde{\beta}_k > 0$*. The optimal education investment* $e_t^{in,j} > 0$ *if and only if*

$$\frac{\Gamma_K \widetilde{\beta}_k \eta}{\lambda}(W_t - Kk_j) > K\theta_j \tag{18}$$

with $\lambda = 1 + \beta + \gamma a_P + \Gamma_K$.

Condition (18) plays the role of Tobin's-q in investment of education, whose intuition is straightforward. The right-hand side is the total public education input of all children, while the left-hand side measures the importance (or desired level) from education in term of consumption and income. Ratio $\frac{\Gamma_K \widetilde{\beta}_k}{\lambda}$ measures the relative importance of education compared to the net of relocation income, $(W_t - Kk_j)$. Multiplied by the share, η, of educational input, the left-hand side is indeed total importance of education, or the optimal desired level of educational input. Proposition 2 states that there is private investment in children's education if and only if the public input in education is lower than parents' desired level of educational input for their children.

In the following, for simplicity, we shall call $\frac{\Gamma_K \widetilde{\beta}_k \eta}{\lambda} W_t$ as *relative educational investment*.

Additionally, given all other terms, education is relative more expensive for low-income parents than for high-income ones, which is a standard results. However, for migrant workers, the extra information we obtain is that children's relocation cost plays an important role in the decision making of children's education. In the case of $j = l$, leaving the children back home, there is no relocation cost, that is, $k_l = 0$, it may happen that

$$\frac{\Gamma_K \widetilde{\beta}_k \eta}{\lambda} W_t > K\theta_l \quad \text{while} \quad \frac{\Gamma_K \widetilde{\beta}_k \eta}{\lambda}(W_t - Kk_m) < K\theta_m. \tag{19}$$

If that is the case, the following results hold:

Proposition 3 *Suppose that the assumptions of Proposition 2 hold, especially,* $B^j > 0$*. If furthermore, condition (19) holds, it is optimal to invest in children's private education back home,* $e_t^{in,l} > 0$*.*

This proposition does not state that the migrant parents should take their children to migrate or leave them behind. It only states that if the parents leave their children

behind and if condition (19) holds, then it is optimal to invest in their children's private education. Obviously, if they bring their children along, it is not optimal to invest in education from the point of view of migrant workers' utility maximization.

Regardless of the relocation cost, k_m, given the differences in regional development, θ_m could be largely above θ_l, such that, condition (19) holds. In other words, changing hukou system itself to reduce the relocation cost of children's migration may not be enough to solve the left-behind children problem. From this point of view, left-behind children may continue to exist for a long time. Of course, condition (18) may fail in any case, which we call as a corner solution, denoted as $e_t^{co} = 0$. We conclude this case in the next proposition.

Proposition 4 *Suppose Assumption 1 and 2 hold and $B^j > 0$. If no private educational investment, $e_t^{co,j} = 0$, the optimal consumption is*

$$c_t^{co,l} = \frac{W_t}{\lambda} \text{ and } c_t^{co,m} = \frac{(W_t - Kk_m)(1+\Gamma_K)}{\lambda}. \tag{20}$$

$S_t^{co,j}$, $m_t^{co,j}$ and $d_t^{co,j}$ with $j = l, m$ are given by (13), (14) and (12), respectively. Moreover, $e_t^{co,j} = 0$ is an optimal choice if and only if

$$\frac{\Gamma_K \widetilde{\beta}_k \eta}{\lambda}(W_t - Kk_j) \leq K\theta_j, \ j = l, m. \tag{21}$$

4.3 Lost generation

To close this section, we briefly show the results of migrant parents' choices if their children are not motivated to school study. In other words, in the human capital accumulation equation, $B_t^j = 0$, and we have $h_{k,t+1} = h_0$. There is no education affect and the children are left only with their physical capital, thus, this generation of children are often called *the lost generation* in the newspaper. In this case, the migrant parents do not have an optimal educational choice for their children. Thus, $e_t^j = 0, j = l, m$ and the following results can be obtained:

Proposition 5 *Given Assumption 1 and 2. Assume that* $B^j = 0$ *and* $\widetilde{\beta}_k = 0$*, the unique optimal choice of migrant workers is* $e_t^{L,j} = 0$*,*

$$c_t^{L,j} = \begin{cases} \frac{W_t}{\lambda}, & j = l, \\ \frac{(W_t - Kk_m)(1+\Gamma_K)}{\lambda}, & j = m, \end{cases} \qquad m_t^{L,j} = \begin{cases} (\gamma a_P + \Gamma_K)c_t^{L,l} - \widetilde{y}, & j = l, \\ \frac{\gamma a_P}{1+\Gamma_K} c_t^{L,m} - \widetilde{y}, & j = m. \end{cases}$$

The utility is

$$U_t^{L,j} = \lambda \ln(c_t^{L,j}) + \beta \ln(\beta(1+r)) + (\gamma a_P + \Gamma_K) \ln\left(\frac{\gamma a_P + \Gamma_K}{K+1}\right).$$

Obviously, both private and public educational investment are no longer migrant parents' concern, though the relocation cost of children, k_m still decreases migrant parents' consumption.

The difference between the corner solution of last subsection and the current situation is the following. In the former, the children will make an effort to study, $B_t^j > 0$, though parents may optimally choose not to pay extra after school intuition fee, $e^{co,j} = 0$. While in the later case, parents does not have a choice for children's education.

It is straightforward that in both cases without private educational investment, $c_t^{L,j} = c_t^{co,j}$, but the children's human capital accumulation differs: $h_{t+1}^{L,j} = h_0$ due to $B_t^j = 0$; while $h_{t+1}^{co,j} > h_0$ given $B_t^j > 0$.

5 Answers to the original questions

After migrant parents making their optimal choices of consumption, saving and investment in their children's private education, now we are ready to answer the fundamental question: Should these migrant parents take their children with them? When should they, or what are the conditions for them to, take their children? In this section, we will give precise answers to these questions based on educational investment and relocation cost threshold which will be defined later on.

From migrant parents' optimal choices, four possible combinations appear: (I) invest in private education wherever their children are: $e_t^j > 0$, for both $j = l$ and $j = m$; (II)

no private education in any case: $e_t^j = 0$, for $j = l, m$; (III) left-behind children have private education while not the migrant ones: $e_t^l > 0$, $e_t^m = 0$ and (IV) migrant children have private education, but not the left-behind ones: $e_t^l = 0$, $e_t^m > 0$.

Actually, case (IV) can not happen. Intuitively, migrant parents may notice that their migrant children have difficulties to follow city school or the original good students back to rural hometown is no longer that good. In order not to discourage their migrant children, parents may pay extra intuition fee for their children to attend after school courses to catch-up with the city students. If these children are left-behind, this cost is unnecessary. Mathematically, it means:

$$e_t^l = 0, \quad e_t^m > 0.$$

However, under current setting and from Proposition 2, that implies $\theta_l > \theta_m$, which contradicts to Assumption 1. Hence, this case can not happen[19]. In other words, it is never optimal for Chinese internal migrant parents to take their children to migrate and provide them with private education in the city, but not in the rural hometown.

Thus, in the following, we only need to study the other three cases.

In order to eliminate the effects from siblings left-behind who may be able to help to take care the left-behind children, which is the case sometimes, in the following, we take $N = 1$. In addition, the human capital of migrants transferring to their children's human capital accumulation may be very limited regardless their children are left-behind or migrant, thus, we also assume in the rest of this paper that

$$h_t^{\alpha^m} = h_t^{\alpha^l}.$$

5.1 Case (I): $e_t^j > 0$, for $j = l, m$

Parents would like to offer their children optimal private education no matter where their children are living. By Proposition 2, parents' willingness to invest in their children's private education implies that migrant parents' desired level of educational in-

[19]Obviously, that may not be the case for some international migrants.

put should satisfies condition (18), which can be rewritten as (recall $k_l = 0$)

$$0 < k_m < \widehat{K_m^{(I)}} \triangleq \frac{W_t}{K} - \frac{\lambda}{\Gamma_K \widetilde{\beta}_k \eta} \theta_m. \tag{22}$$

This condition states that migrants' educational investment must check

$$\frac{\Gamma_K \widetilde{\beta}_k \eta}{\lambda} W_t > K\theta_m. \tag{23}$$

If so, the utility of migrant parents are:

$$U_t^j = \Lambda \ln(c_t^{in,j}) + \Gamma_K \widetilde{\beta}_k \ln\left[B_t^j h_t^{\alpha^j} (\overline{h_t^j})^\kappa\right] + \varepsilon^j + \delta^j, \quad j = l, m \tag{24}$$

with

$$\varepsilon^l = \beta \ln(\beta(1+r)) + (\gamma a_f + \Gamma_K) \ln\left(\frac{\gamma a_f + \Gamma_K}{1+K}\right),$$

$$\varepsilon^m = \beta \ln\left(\frac{\beta(1+r)}{1+\Gamma_K}\right) + \gamma a_f \ln\left(\frac{\gamma a_f}{1+\Gamma_K}\right),$$

$$\delta^l = \Gamma_K \widetilde{\beta}_k \eta \ln\left(\frac{\Gamma_K \widetilde{\beta}_k \eta}{K}\right)$$

and

$$\delta^m = \Gamma_K \widetilde{\beta}_k \eta \ln\left(\frac{\Gamma_K \widetilde{\beta}_k \eta}{(1+\Gamma_K)K}\right).$$

To see what would be the difference between leaving their children behind and migrating, we can easily check that:

$$\begin{aligned} U^{in,m} - U^{in,l} &= \Lambda \ln\left[\tfrac{W_t + K(\theta_m - k_m)}{W_t + K\theta_l}\right] + I(a_k) \\ &\quad + \Gamma_K \widetilde{\beta}_k \left[\ln\left(\tfrac{B_t^m}{B_t^l}\right) + \kappa \ln\left(\tfrac{\overline{h^m}}{\overline{h^l}}\right) + \ln\left(\tfrac{h_t^{\alpha^m}}{h_t^{\alpha^l}}\right)\right], \end{aligned} \tag{25}$$

where $I(a_k)$ stands for the gains from whole family being together which is deduced from the difference in the altruistic terms:

$$I(a_k) = (1+\Gamma_K)\ln(1+\Gamma_K) + \gamma a_f \ln(\gamma a_f) + (\gamma a_f + \Gamma_K)\ln\left(\frac{1+K}{\gamma a_f + \Gamma_K}\right).$$

Given $0 < \gamma a_f < 1$, it can be shown that as long as parents caring for their children no less than caring for their own aged parents, that is, as long as $a_k \geq a_p$, taking their children to migrate is beneficial for migrnats:

$$I(a_k) > 0. \tag{26}$$

It is trivial to see that if the relocation cost is sufficiently high, such as using up migrants' lifetime income: $Kk_m > W_t + K\theta_m$, we have $U^{in,m} - U^{in,l} = -\infty$. Obviously, the only choice for migrants is leaving their children behind. At the same time, it is also easy to check that if there is no relocation cost, that is, $k_m = 0$, we have $U^{in,m} - U^{in,l} > 0$ provided B^m is not much smaller than B^l. Thus, the whole family migrating are better off than leaving the children behind. By continuity, there exists positive constant

$$K_m^{(I)} = K_m^{(I)}\left(W_t, \theta_m, \theta_l, \frac{B^m}{B^l}, \frac{\overline{h^m}}{\overline{h^l}}\right) \triangleq \frac{1}{K}\left[W_t + K\theta_m - \frac{W_t + K\theta_l}{e^{I(a_k)/\Lambda}}\left(\frac{B^l \overline{h^l}^{\kappa} h^{\alpha^l}}{B^m \overline{h^m}^{\kappa} h^{\alpha^m}}\right)^{\Gamma_K \widetilde{\beta_k}/\Lambda}\right], \tag{27}$$

such that,

$$U^{in,m} - U^{in,l} \begin{cases} > 0 & \text{if } \ 0 \leq k_m < K_m^{(I)}, \\ < 0 & \text{if } \ k_m > K_m^{(I)}. \end{cases} \tag{28}$$

In other words, the threshold of relocation cost, $K_m^{(I)}$, determines the gains from migrating children. This threshold depends on the differences in educational level in different regions: θ_j and $\overline{h^j}$, and the children's motivation B^j for $j = l, m$, given parents' human capital, number of children in the family and other altruistic parameters.

Additionally, the relocation cost threshold increase with the destination's public input in education, $\frac{\partial K_m^{(I)}}{\partial \theta_m} > 0$, and decrease with the rural's public eductional input, $\frac{\partial K_m^{(I)}}{\partial \theta_l} < 0$. Similarly, we can have that $\frac{\partial K_m^{(I)}}{\partial\left(\frac{\overline{h^m}}{\overline{h^l}}\right)} > 0$. In other words, the smaller the educational gap between the original rural region and the destination city, the lower is the relocation cost threshold; thus, it is easier and more beneficial for parents to bring their children to migrate together. The larger the gap is, the higher is the relocation cost threshold and the more difficult for parents to take their children along. This last statement is some counterintuitive. The reason lies on the fact that given it is more beneficial to bring the children to the destination to enjoy better education, there is higher price to pay and the price here is the relocation cost.

Therefore, for the policy maker in order to reduce the left-behind children problem, it is essential to increase the educational input in the poor rural regions, such that, the educational gap between the rural and city is reduced.

Remark. We are not talking about decreasing the development gap between different

rural and urban regions, which is a much harder task. Instead, we focus only on public educational input and training of qualified teachers, which the policy maker in China are quite possible to pursue.

We conclude the above analysis in the following:

Proposition 6 *Suppose migrant parents are able to, that is, condition (23) is true, invest in their children's private education regardless where their children are living. There exits a relocation cost threshold which is given by (27), which is decreasing in terms of educational gap between urban and rural regions. Moreover,*

- *it is optimal for migrant parents to take their children with them and pay private education in the destination (additional to the public education) city, if and only if,*

$$k_m < \min\{\widehat{K_m^{(I)}}, \ \ K_m^{(I)}\};$$

- *otherwise, it is optimal for parents to leave their children behind and offer them with private education (additional to public education) in the rural hometown.*

The first part of this proposition is what we demonstrated above. And it is easy to check that the migrant parents leave their children behind with private education if and only if

$$k_m > \max\{\widehat{K_m^{(I)}}, \ \ K_m^{(I)}\}.$$

Between the above two polar cases, given both $\widehat{K_m^{(I)}} \lesseqgtr K_m^{(I)}$ are possible, the conclusion is not straightforward. Nonetheless, if relocation cost checks $\widehat{K_m^{(I)}} < k_m < K_m^{(I)}$, though parents are better off by taking their children to migrate, the private investment in education can not reach to its optimal level. While if relocation cost checks $K_m^{(I)} < k_m < \widehat{K_m^{(I)}}$, migrant parents offer optimal private education to their children in the city, but they are worse off in utility than leaving their children behind at least in the short-run. Therefore, the last two cases both should belong to the second statement in the Proposition 6.

For relatively high income parents (or parents who care more for their children's education than consumption), this proposition provides necessary and sufficient condition

on which parents should take their children to migrate and provide them with private education in the destination city. Violating this condition means either parents will be worse off by taking their children to migrate than leaving their children behind, or it is not an optimal educational choice. Thus, leaving them behind with private education is the optimal choice.

5.2 Case (II): $e_t^j = 0$, for $j = l, m$

The other symmetric case is that regardless where their children are living, private education is too costly for migrant parents considering their income. By Proposition 2, that means the migrants' relative educational investment checks

$$\frac{\Gamma_K \widetilde{\beta}_k \eta}{\lambda} W_t < K\theta_l \, (< K\theta_m) \, . \tag{29}$$

In other words, either parents' educational investment are too low compared with public educational input or the public educational input is sufficiently high and no need for extra investment in education. Either way, with no private education cost, the migrant workers' utility can be easily rewritten as

$$U_t^j = \lambda \ln(c_t^{co,j}) + \Gamma_K \widetilde{\beta}_k \ \ln \left[B_t^j \theta_j^{\eta} h_t^{\alpha^j} (\overline{h_t^j})^{\kappa} \right] + \varepsilon^j, \quad j = l, m. \tag{30}$$

Thus, higher utility essentially depends on higher consumption, higher human capital accumulation of children or both. Direct calculation yields that the difference in consumption between taking children to migrate and leaving them behind is:

$$c_t^{co,m} - c_t^{co,l} = \frac{W_t \Gamma_K - K k_m (1 + \Gamma_K)}{\lambda} \quad \left(\gtreqless 0 \right) . \tag{31}$$

Obviously, taking the children to migrate does not automatically increase the consumption and utility. The difference in consumptions essentially lies on the relationship between altruistic gain, $W_t \Gamma_K$, and relation cost of children, $K k_m (1 + \Gamma_K)$. If the gain is more than covering the relocation cost, everyone in the family would have higher consumption with children migration than leaving them behind. However, when the gain is less than the cost, all consumptions, including the migrant workers, their children and parents, are less than the ones leaving the children behind. In this

scenario, the only possible improvement in migrant worker's utility is children's human capital accumulation, measured by educational performance, $h_{t+1}^m - h_0$. Notwithstanding, there is no guarantee that the migrant children's educational performance is better than those of being left-behind, as we mentioned in the empirical test in Section 3.

More precisely, similar to the previous case, direct calculation yields

$$\begin{aligned} U^{co,m} - U^{co,l} &= \lambda \ln\left[\tfrac{W_t - K k_m}{W_t}\right] + I(a_k) \\ &\quad + \Gamma_K \widetilde{\beta}_k \left[\ln\left(\tfrac{B_t^m}{B_t^l}\right) + \kappa \ln\left(\tfrac{\overline{h^m}}{\overline{h^l}}\right) + \ln\left(\tfrac{h_t^{\alpha^m}}{h_t^{\alpha^l}}\right) + \eta \ln\left(\tfrac{\theta_m}{\theta_l}\right)\right], \end{aligned} \tag{32}$$

in which the first term is always negative given $k_m > 0$ and the second and last terms are always nonnegative, provided migrant children do not decrease too much their motivation and efforts compared to being left-behind.

Similar to Case (I), there exists positive relocation cost threshold

$$K_m^{(II)} = \frac{W_t}{K}\left[1 - \left(\frac{B^l \overline{h^l}^{\kappa} h^{\alpha^l} \theta_l^{\eta}}{B^m \overline{h^m}^{\kappa} h^{\alpha^m} \theta_m^{\eta}}\right)^{\Gamma_K \widetilde{\beta_k}/\lambda} e^{-\frac{I(a_k)}{\lambda}}\right], \tag{33}$$

such that,

$$U^{co,m} - U^{co,l} \begin{cases} > 0 & \text{if } \ 0 \le k_m < K_m^{(II)}, \\ < 0 & \text{if } \ k_m > K_m^{(II)}. \end{cases} \tag{34}$$

Thus, for this group of migrants, the following conclusion can be drawn:

Proposition 7 *Suppose migrant's income checks (29), that is, parents can not (or no need to) afford any private education to their children regardless where their children are living. Then, there is relocation cost threshold, which is defined by (33), such that,*

- *if $k_m < K_m^{(II)}$, parents would be better off by taking their children to migrate;*
- *if $k_m > K_m^{(II)}$, it is optimal for parents to leave their children behind.*

5.3 Case (III): $e_t^l > 0, \quad e_t^m = 0$

Parents may realize that the education level in the city is higher than back home rural area and education is essentially important for their children's future. In order to give their children a better chance to get better education, the migrant parents may invest in private education for their children when they leave them behind, while no needs when these children migrate to the city. That is, via Proposition 2, migrant parents' educational investment checks

$$K\theta_l < \frac{\Gamma_K \widetilde{\beta}_k \eta}{\lambda} W_t < K\theta_m. \tag{35}$$

In this case, parents' utilities are:

$$U_t^{in,l} = \Lambda \ln(c_t^{in,l}) + \Gamma_K \widetilde{\beta}_k \ln\left[B_t^l h_t^{\alpha^l} (\overline{h_t^l})^\kappa\right] + \varepsilon^l + \delta^l$$

and

$$U_t^{co,m} = \lambda \ln(c_t^{co,m}) + \Gamma_K \widetilde{\beta}_k \ \ln\left[B_t^m \theta_m^\eta h_t^{\alpha^m} (\overline{h_t^m})^\kappa\right] + \varepsilon^m.$$

Thus, the difference is:

$$\begin{aligned} U^{co,m} - U^{in,l} \ &= \lambda \ln\left[\tfrac{W_t - K k_m}{W_t + K\theta_l}\right] + \Gamma_K \widetilde{\beta}_k \eta \ln\left(\tfrac{\theta_m}{e^{in,l}+\theta_l}\right) \\ &\quad + J(a_k) + \Gamma_K \widetilde{\beta}_k \left[\ln\left(\tfrac{B_t^m}{B_t^l}\right) + \kappa \ln\left(\tfrac{\overline{h^m}}{\overline{h^l}}\right) + \ln\left(\tfrac{h_t^{\alpha^m}}{h_t^{\alpha^l}}\right)\right], \end{aligned} \tag{36}$$

where $J(a_k) = \lambda \ln\left(\frac{\Lambda}{\lambda}\right) + (1+\Gamma_K)\ln(1+\Gamma_K) > 0$ and $e^{in,l} + \theta_l = \dfrac{\Gamma_K \widetilde{\beta}_k \eta (W_t + K\theta_l)}{K\Lambda}$ by (15). It is easy to see that the terms in the second line are nonnegative given the assumptions and if the migrant children's motivation do not decrease too much compared to being left-behind. The second term on the right-hand side could be positive or negative depending on the educational input ratio, $\frac{\theta_m}{e^{in,l}+\theta_l}$. If the destination's educational input is sufficiently high, such that, $\theta_m > e^{in,l} + \theta_l$, then children migration should benefit from the public school in the destination. Nevertheless, the first term on the right-hand side is always negative due to the relocation cost. More precisely, the relocation cost threshold in this case is given by

$$K_m^{(III)} = \frac{1}{K}\left[W_t - \frac{W_t + K\theta_l}{e^{J(a_k)/\lambda}} \left(\frac{B^l \overline{h^l}^\kappa h^{\alpha^l}}{B^m \overline{h^m}^\kappa h^{\alpha^m}} \left(\frac{e^{in,l} + \theta_l}{\theta_m}\right)^\eta\right)^{\Gamma_K \widetilde{\beta_k}/\lambda}\right], \tag{37}$$

which can be positive or negative. The following conclusion can be made in this case:

Proposition 8 *Suppose condition (35) holds and relocation cost threshold $K_m^{(III)}$ is defined by (37),*

- *if $K_m^{(III)} > 0$ and if $0 < k_m < K_m^{(III)}$, migrant parents are better off by taking their children to migrate, though without private education in the destination;*
- *otherwise, if $k_m > K_m^{(III)}$, it is optimal for migrant parents to leave their children behind but invest in their private education.*

The information from the second part of this proposition is two-fold: (1) $k_m > K_m^{(III)} > 0$ and (2) $k_m \geq 0 > K_m^{(III)}$. In the first case, it is still possible that reducing the real relocation cost, k_m, to such an extend that parents are better off by taking the children to migrate, for example, hukou reforming such that registration in the destination school is free. However, the second case makes that impossible. If $K_m^{(III)} < 0$, the optimal choice for parents is leaving their children behind and invest in their private education - too costly to take their children to migrate.

5.4 Summary of theoretical findings and data revisit

Combining the above three cases, we summarize the findings in the following Figure 1, which gives precise idea where Chinese internal migrant parents should locate their children depending on their income, concerns of human capital accumulation and relocation cost threshold.

In Figure 1, the horizontal axis is the relocation cost for children migration and the vertical axis presents the private educational investment of migrant parents. Recall the educational investment is determined by mainly two parts: the lifetime income, W_t, and how parents value children's education in term of consumption, $\frac{\Gamma_K \widetilde{\beta_k} \eta}{\lambda}$. If all parents value their children's education equally, that is, $\frac{\Gamma_K \widetilde{\beta_k} \eta}{\lambda}$ is the same for everyone, then parents' decision of taking their children to migrate or leave them behind, and how to invest in their education, will only depend on income. Nonetheless, parents may value their children's education differently. It could happen that some high income parents do not care about their children's education due to the fact education is

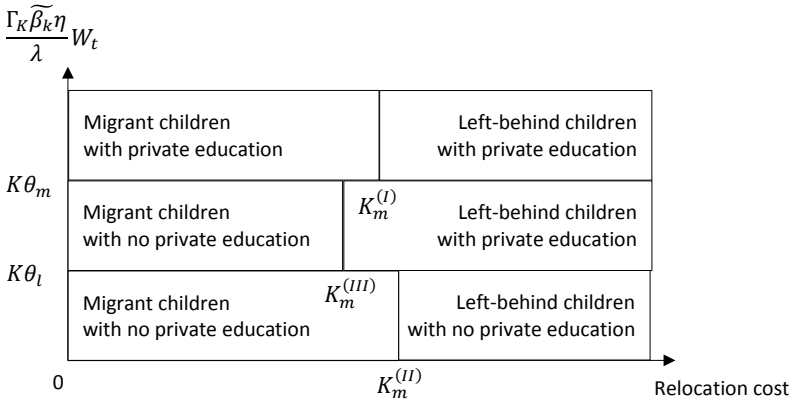


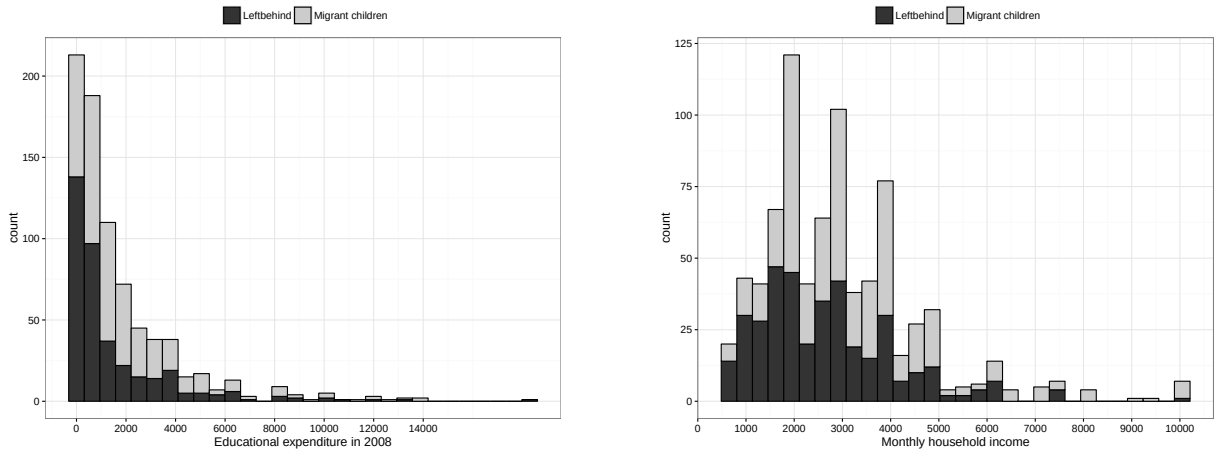
Figure 1: Choice of migrant parents.

not rewarded as it should be or they are just too busy to care about their children's schooling. If so, their private educational investment , $\frac{\Gamma_K\widetilde{\beta_k}\eta}{\lambda}W_t$, is low compared to public educational input. On the other side, it may be the case that low income parents realize how important education is to their children and consider it as the only way to change their children's lives. And thus they value $\frac{\Gamma_K\widetilde{\beta_k}\eta}{\lambda}$ highly, such that, $\frac{\Gamma_K\widetilde{\beta_k}\eta}{\lambda}W_t$ is high related to public educational input, though their income, W_t, is low. In other words, these parents sacrifice their consumption, and the whole family's consumption, in order to provide good education to their children.

In the rest of this section, we revisit the RUMiC data in order to show how Chinese internal migrants value their children's education and how that reflects in their decision making.

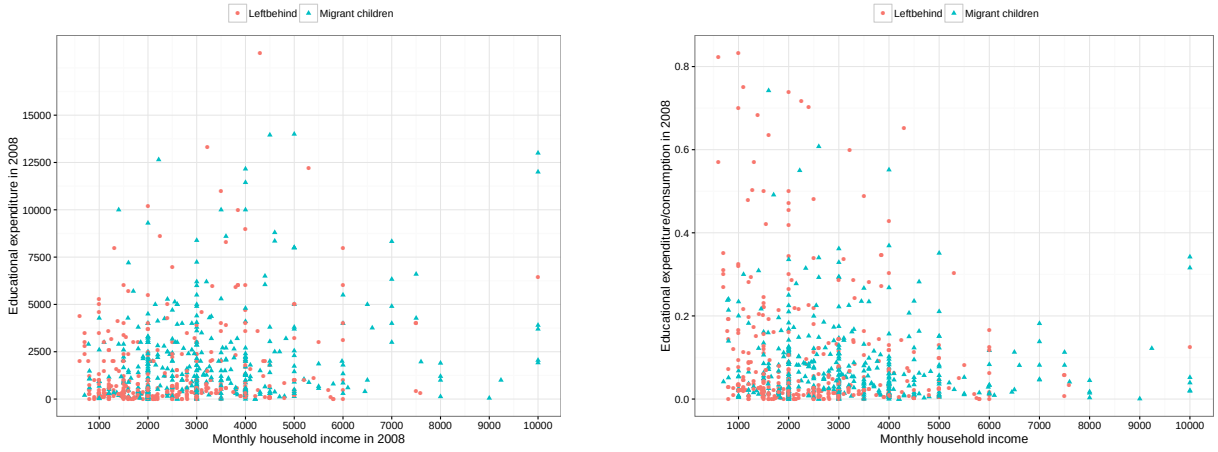
From the RUMiC data, in Figure 2(a), we plot the households' educational expenditure in 2008 (horizontal axis) and number of children benefits from it (vertical axis). It is obvious that regardless of their children being left-behind or migrant and regardless of the household income, Figure 2(b), parents invest in their children's education.

From the raw data, it is hard to see the theoretical patterns shown in Figure 1. Thus, in order to obtain clearer information, in Figure 3(a), we plot the yearly (2008) educational expenditure in term of monthly household income. Given the students' registration is usually semestral and yearly, so for educational expenditure we choose the total year



(a) (b)

Figure 2: (a) number of left-behind and migrant children and educational expenditure. (b) number of children and household income.



(a) (b)

Figure 3: (a) Household income and educational expenditure. (b) Household income and relocation cost.

of 2008. In order to make the plots readable, the horizontal line is monthly income instead of yearly income. It is clear that on the far right of Figure 3(a), most of the high income parents take their children to migrate, but their investment in their children's education may be high (upper-right corner) or low (lower-right corner), which depend on how the parents value their children's education (that is, $\frac{\Gamma_K \widetilde{\beta_k} \eta}{\lambda}$ in the theoretical part) compared to other consumption. As well, on the lower-left corner, where parents' income are low (monthly income is between 1000-2000 yuan), parents invest about 2500-5000 yuan per year on their left-behind children's education, which are no less than the higher incomes parents who earn 6000-8000 yuan per month.

Figure 3(b) presents the relative education-consumption expenditure to income relationship. The vertical axis is the education-consumption ratio and the horizontal axis is migrants' monthly income. In Figure 3(b), the upper-left corner presents the left-behind children from low income family but with relatively (to consumption) high investment in education, while the lower-right corner are migrant children from high income family but with relatively low educational expenditure. However, both (a) and (b) in Figure 2 clearly state that in absolute term, the high income parents do not invest less in their children's education than the low incomes ones. Both high and low income parents invest in their children's private education and the difference mainly lies on taking their children to migrate or leaving them behind. Figure 3(b) on the one hand shows that the education is relatively more expensive for low income parents, and on the other hand confirms the results in Figure 1 that low income parents optimally choose to leave their children behind but invest in their education, while it is optimal for high income parents to take their children and invest in their education as well.

Given the work most of Chinese internal migrant undertake,[20] the relative low income and high relocation cost may be the reason that there are so many Chinese young children being left-behind. Though the decision of leaving their children behind is difficult for migrant parents, that may be the rational choice.

[20]China's National Bureau of Statistics estimates that in 2015, 31% migrant workers were employed in manufacturing sector, 21% in construction sectors, 12% in sales, 11% in household services, 6% in transport and logistics, another 6% in hotel and catering services and the rest 13% took others sector jobs.

6 The dynamics and the long-run outcomes

In this section, we will investigate what would be the long-run consequences from the decision of migrant parents as to where to locate their children and how to educate their children.

For rural Chinese children, except working as farmers or as migrant workers just like their parents, due to the hukou constraint, they have only two ways to change their lives: (1) individual efforts to succeed in the National College Entrance Examination and become skilled labor after graduation and; (2) to be lucky falling into the urbanization process.

If the Chinese rural children succeeding to enter and finish university study, their high education will enable them to find a better paid job and live in the city, so will their future children and descendants. Thus, succeeding in Gaokao is essential for the familys short- and long-run welfare.

Besides the chance of entering university, due to the current urbanization process in China, there are some opportunities to obtain urban hukou (so do their descendants in the future) and earn city income without university degree, which is still better than being migrant workers.

Therefore, migrant parents' decisions are not only important for their own welfare, but also essential for their children's future (the short-run effects) as well as their future descendent's economic potential (the long-run effects).

Before the detail study of the long-run consequence from the migrant decision, it is worth to notice that the current setting of human capital and wealth accumulation dynamics of Chinese internal migrants are similar to the seminal contribution of Galor and Zaira (1993) and Galor and Moav (2004), where parents' wealth and bequest play one of the central rules in determining the long-run equilibrium of the economy. In their studies, the parents' bequest may limit children's ability to borrow from the credit market and hence constraint their chances of educational investment. The current study differs from their contribution in the following two aspects: (1) Chinese internal migrants usually do not rely on the financial credit market because of the limi-

tation and imperfection of Chinese credit market, rather they rely on their own income to invest in their children's education; (2) in the current study, we do not investigate the macroeconomy, rather we focus only on the offsprings of the current migrant workers by assuming that the Chinese macroeconomic environment, especially the hukou system, will not change in the short- and long-run. Of course, that does not mean the long-run Chinese macroeconomic study is not interesting, rather, it is a very important topic and deserve some separated and more serious study. We will discuss this in the conclusion again.

We start with the children who are motivated to study, that is, $B^j > 0, j = l, m$. Following the theoretical finding in Figure 1, there are four possible outcomes from parents' decisions on where to locate their children and how to educate them: children are living in (a) city with private education, (b) city with no private education, (c) rural with private education, or (d) rural with no private education.

We denote that children with private education have probabilities $p^j \in (0, 1)$ $(j = l, m)$ to enter university. Without private education, the probabilities of entering university are $q^j \in (0, 1), j = l, m$, depending on they are left-behind or migrant children. Mathematically, for $j = l, m$, the university-entry probability, which is measured only on final entry exam, checks

$$P\left(h_{t+1}^j - h_0 = B_t^j(\theta_j + e_t^j)^\eta h_t^{\alpha^j}(\overline{h_t^j})^\kappa \geq h^*\right) = \begin{cases} p^j, & \text{if } e_t^j > 0, \\ q^j, & \text{if } e_t^j = 0, \end{cases}$$

where h^* is the lowest level to enter university.[21]

By assumption that in the city the public schools are better than the rural ones, then with private complementary investment in education, we can easily impose that

$$p^m > p^l, q^m > q^l.$$

However, it is harder to justify the relationship between p^l and q^m, given the children need to go back to their hometown to take the exam. If the migrant destination is in a different province than their home town, the exam may not be the same, thus the

[21] Different universities have different entry requirements. Even in the same university, the entry levels may differ among the original regions of the students.

migrant children may face some disadvantage in comparison to the left-behind ones. Of course, for the migrant students with private education, the private classes may compensate this difference.

With the urbanization process, migrant children have probability $\tau \in (0, 1)$ to get city hukou during their childhood, regardless their education situation.

Combining the above mentioned two channels of changing lives together, migrant children with private education have probability $\tau + p^m$ to get urban hukou or become high skilled workers. And the rest $1 - \tau - p^m$ migrant children will stay with rural hukou. While for migrant children without private education, the chances to remain rural hukou is $1 - \tau - q^m$. Given these children grow up in the city instead of their original rural villages, they do not know the farm work and will remain as migrant just like their parents.

For the left-behind children, private eduction increases their chances ($p^l - q^l > 0$) to enter the university. And the rest will remain rural hukou and grow up in the rural hometown. So they will face exactly the same decision as their parents: migrate to the city to look for better paid jobs or stay in the country side and work as farmers. And if they decide to migrate, they will face the same dilemma as their parents: Where will they locate their children - leave them behind or take them, provide them with private education or not?

For those children who lost motivation to study, that is $B^j = 0 (j = l, m)$, as shown in Section 4.3, the parents do not have much choices on their education and entering university is impossible. Nevertheless, if they migrate with their parents to the city, they have the same chances obtain urban hukou as the other migrant children via urbanization. The rest of them will remain rural hukou and work as their migrant parents. For the left-behind non-motivated children, they hold always rural hukou and repeat their parents' decisions and choices.

We use the tree in Figure 4 to illustrates the above dynamics of hukou/skills changing over generations.

The above analysis demonstrates that the migrant children with private education

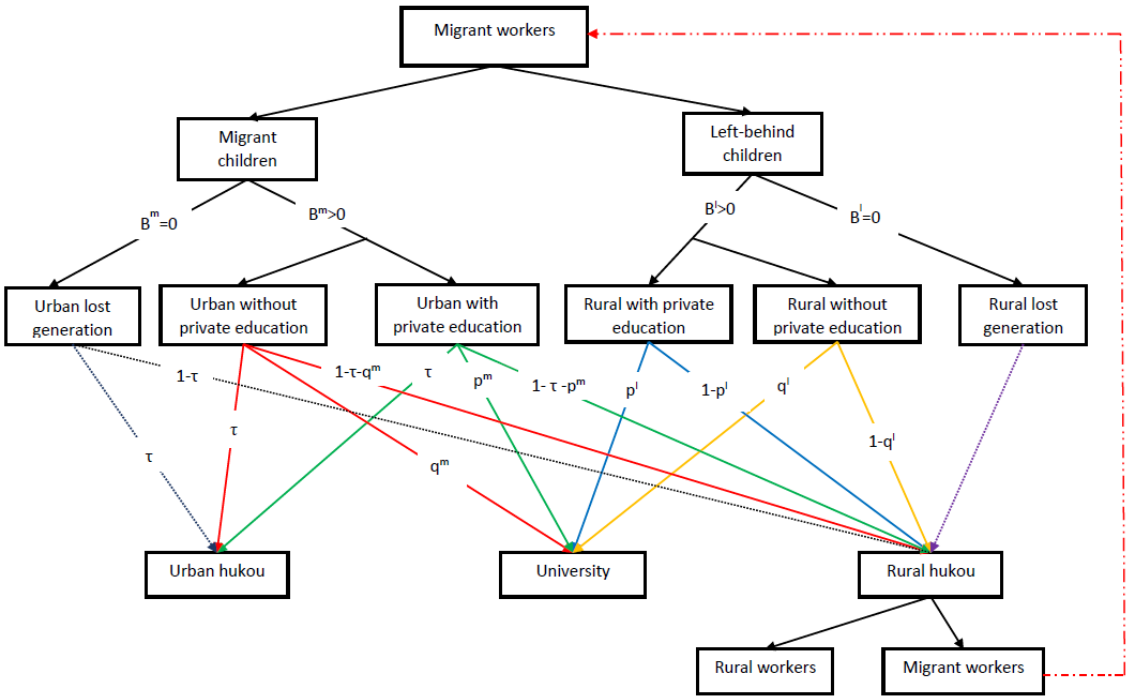


Figure 4: Dynamics of Migrants' hukou change

have much bigger chances to obtain urban hukou or higher paid jobs than the rest of the children. Therefore, if current migrant parents take into account not only their children's human capital accumulation (short-run), but also their future descendants' economic potential (long-run), the optimal choice should take the children to migrate and provide them with private education. Alter all, Figure 1 shows that the decision making depends on the relatively income. The ones, at the upper-left-corner of Figure 1, who have relatively high educational investment and can afford to take their children to migrate and offer them with private education, their children will be better off than the rest. Thus, the inequality among different migrant families increases over a few generations. But of course, if low income parents care very much for their children's education, the inequality situation may reverse over time.

Nevertheless, to study the macroeconomic environment and the long-run distribution of the Chinese economy is beyond the current study.

7 Concluding Remarks

The aim of this paper is to provide answers to the following questions: Where should Chinese internal migrant parents locate their children - leave them behind or take them to migrate? And how should they invest in their children's education?

"Take your child with you" (to migrate) is one of the suggestions from scholars to the migrant job seeking parents. However, the reality is far more complicated than this simple slogan. Emotionally, most, if not all, Chinese internal and international, migrant parents, would like to take their children with them. But financially, among some other difficulties, sometime this good wish become impossible. Thus, leaving their children behind in their home town becomes a rational choice.

To give precise answers, we rely not only on empirical studies but also on theoretical analysis. The originality of our study is that we compare the differences of educational performance between the migrant and left-behind children of different ages. However, the empirical test based on RUMiC data is inconclusive, though it indeed suggests that younger children may benefit more (in their educational performance) from living with their migrant parents than teenagers. Theoretical OLG model demonstrates that taking their children to migrate or not rely on the relocation cost of children migration. The relocation costs include extra school registration fee and possible extra health insurance due to the constraint of hukou and depends on the educational development gaps between rural regions and cities. The larger the educational gap is, the higher is the relocation cost threshold. Thus, to make it possible for children to migrate with their parents, some basic child-related policies and infrastructure are needed. These policy includes reducing the educational gap between differential regions, diminishing school registration fee, providing public health care for migrants children and so on to remove the barriers of children migration and decrease the children relocation cost.

Furthermore, providing children with extra private education to complement the public school not only affects children's human capital accumulation but also influences the economic potential of their descendants in the future. The provision of private education relies on the comparison between educational investment of migrant parents

and the public educational input.

The educational investment is defined as lifetime income multiplied by the education-consumption ratio, and the lifetime income includes also potential remittances from children in the future. Thus, with the promise from their children of old age support, the inequality can be decreased if the low income migrant parents cares more for their children's education than the high income ones. Nonetheless, if all parents care equally for their children's education, inequality increases over generations.

It is worth noting that our theoretical results are based on a tractable OLG model that ignores many economic and non-economic effects of Chinese internal migration. Nevertheless, omitting these features allows us to focus on the main concerns of the migrants workers. Nevertheless, the RUMiC data revisit confirms the theoretical finding as to the choices of migrant parents. Future work should account for the extensions which include the macroeconomic impacts of migrant workers. Especially, we should forecast and estimate the gain and lost in GDP when these left-behind and migrant children enter the job market. One possible further study is in line with the framework of Galor and Zeira (1993), but including migrant worker and original city residents together, to study the long-run distribution of wealth and inequality among all population, not only among the migrant workers as this current study. Furthermore, with more panel data available, tracing down the development differences of those left-behind and migrant children would provide new insight into the understanding of the wellbeing of these children.

To conclude, the present paper demonstrates conditions under which Chinese internal migrant parents should take their children with them and how to provide them with private education. This insight can contribute to explaining the enormous left-behind children in China and may be helpful in designing immigration policies.

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