Human Capital and China's Left-Behind Migrant Children: Policy Analysis with Endogenous Migration Decisions

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Abstract

Background: There are over 260 million people migrating for work within China, and over 61 million children of migrants live apart from one or both parents (termed "left-behind" migrant children). Due to the unique *hukou* system (residential permit system) in China, access to government services for children varies by location and migration status. This has direct effects on human capital of children as well as indirect effects via endogenous parental reactions.

Analysis: I present an economic model to analyze how parents make decisions related to migration and investments in child human capital under various policy regimes. I then apply the model to analyze parental reactions after two recent and proposed changes to Chinese government policy. I also empirically test for changes in the number of left-behind migrant children after a recent policy change using panel data on Chinese families; a regression model with child-level fixed effects enables a within-child analysis.

Results: Based on a within-child empirical analysis, I find that a recent increase in generosity of services in rural areas was associated with 5% increase in a child's chance of being left-behind by one or more parents. In my theoretical analysis, I find that when increasing government support for children in rural areas increases the number of left-behind migrant children, the human capital of children who become newly left-behind is reduced, whereas increasing government support for migrant children may decrease the number of left-behind migrant children and thereby increase the human capital of a larger range of children.

Conclusion: The number of Chinese parents near the margin of leaving children behind may be non-negligible. Therefore, when we take endogenous migration effects into account, raising governmental support for rural non-migrant children would likely benefit children less than was previously apparent. In contrast, raising governmental support for rural migrant children would benefit children more than was previously apparent. [1]

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1 Introduction and overview

Inequalities of opportunity between rural and urban China have spurred large waves of rural-urban migration since the 1980s, in what has been called the largest rural-urban labor migration in human history [66]. The 2010 census shows the number of migrants to be over 260 million. However, due to the Chinese residential registration permit system (the *hukou* system), access to health and education services is more difficult for individuals not living in their official place of residence, especially for family members of migrant workers [15, 40, 76, 80, 84, 85]. That is, Chinese social policy typically involves targeting government dollars to citizens according to their place of residence and *hukou*. For example, migrant children face difficulties enrolling in urban schools and cannot participate in urban-specific health care schemes [16, 39, 40, 74]. As a result, there is an increasing phenomenon of leaving children behind in their place of official residence while one or both parents migrate. In 2010, there were 61 million such 'left-behind' children in rural China, including 50 million under the age of 14 [2]. This represents an increase of over 2 million in comparison to 2005 and would comprise 38% of all rural *hukou* children [1, 2, 18].

The healthy development of rural *hukou* children is of concern in the context of the large and growing income inequality in China [70, 82]. If some children have decreased earning capacity because of poverty, detrimental effects of parental migration, or their lack of access to services in urban areas, this would reinforce income inequality across China in the future [11, 13, 26, 27, 46, 61, 64].[2] The concern for these children is evidenced by the extensive body of empirical research in China focusing on whether being left behind by migrant parents is detrimental to children's well-being [4, 23, 24, 28, 33, 35, 38, 49, 53, 54, 55, 85, 88, 91].

I argue that policies designed to help rural children should be modeled in a framework where benefits vary by migration status and place of residence, as they do in China. To this purpose, I build an economic model of geographically targeted government investments, parental reactions, and children's human capital development [6, 72]. Parents are the sole decision makers and they care about their own current consumption and their child's human capital development. Parents can choose between multiple

[2]The model adapted in this paper resembles others that have been used to examine inter-generational mobility, and therefore direct consideration of implications for future income inequality could be an extension to this work [5, 9, 72].

migration scenarios (migrating and bringing their child, migrating and leaving their child behind, or staying in the rural area), and they can choose their levels of time and monetary investments in their child. In the model, as in the Chinese *hukou* system, the amount of money the government spends on children is lower when they leave their area of official residence.

I use the framework to analyze the implications of two government policies designed to improve the human capital of children with rural *hukou,* which broadly reflect one recent policy change and one proposed policy change in China. The first policy change involves increasing government services for rural non-migrants, as in the New Cooperative Medical Scheme, a health insurance scheme for rural residents introduced in 2003 [42, 74]. The second policy change involves increasing government services for some rural migrants*,* as in ongoing *hukou* reforms [29, 73, 75, 81].

When the government changes its support of rural non-migrant children or rural migrant children, there are both direct and indirect impacts on children's human capital. A location-specific increase in government support of children directly helps children, but the beneficial effect can be reduced or amplified by parental endogenous responses. For example, policies that target government dollars to rural non-migrant children could increase the number of left-behind children and reduce the human capital of children newly left-behind. In contrast, a policy that targets government dollars to rural *migrant* children could decrease the number of left-behind children and increase the human capital of children no longer left-behind. These results are based in part on the observation that if parents are indifferent between two migration scenarios, an increase in rural-only or urban-only government investment could sway their decision one way or another as to where their child should live.

After identifying these results in the theoretical model, I conduct an empirical analysis based on the roll-out of the New Cooperative Medical Scheme, a policy that provided government-sponsored health insurance only for rural non-migrants. Results show that the probability of a child being left-behind increased after this increase in government spending on rural non-migrant children, indicating that migration effects may indeed have undermined the benefits of the policy for rural children.

The rest of the paper proceeds as follows. In section 2, I discuss some relevant literature on migration and children's human capital development in China. In section 3, I outline the justification for the theoretical framework. In section 4, I present the theoretical framework. In section 5, I derive comparative

statics related to how children's human capital changes when policy changes, and how the effect depends on endogenous migration effects. In section 6, I present the empirical test for migration effects. Section 7 concludes.

2 Literature review

2.1 Migration and children's human capital development in China

In examining the literature on migration and children's human capital development in China, several points stand out. First, tracking migrant families in China is difficult, and panel data projects focused specifically on migrant workers sometimes run into difficulties. As a result, the published evidence typically focuses on two types of comparisons: comparisons of left behind migrant children with rural children whose parents did not migrate, and comparisons of migrant children in cities with non-migrant urban children.

In addition, selection issues make it difficult to correctly identify causal effects of the impact of parental migration on children [25]. As in other countries, there is evidence of a healthy migrant effect in China [37, 56]; likewise, those who migrate may have more human capital or better social networks than non-migrants [90]. Children of migrants may therefore appear to be different from children of non-migrants simply because their parents are different. To correct for selection, studies that compare left behind migrant children with children whose parents did not migrate often employ instrumental variables approaches or propensity score methods, and sometimes incorporate panel data to control for unobserved factors.[3] However, even after accounting for selection and narrowing to empirically tractable comparisons, I find that the results about the impacts of migration on child development in China are mixed.

In the literature review that follows, I mostly focus on the studies that compare left behind migrant children with rural children whose parents did not migrate and explicitly adjust for selection. In reviewing psychology related studies, I also include some research that does not adjust for selection but show effects that are *opposite* of what we would expect from healthy migrant bias or shows a dose-response to parental

[3] In contrast, I found that studies that compare migrant children with urban children in China are often descriptive, not based on panel data, and do not deal with selection.

absence, thereby enhancing validity of the results. I show that in these studies, the mixed results appear to line up with the argument summarized by many previous researchers: namely, because left-behind children experience both positive factors (parental remittances) and negative factors (parental absence), the impact of being left behind could be negative or positive, depending on the balance of these two factors [4, 63, 91]. I conclude that in addition to taking migration effects into account, it is important to account for these two positive and negative factors - parental spending on children and parental time with children - when analyzing the direct and indirect impacts of policies on child development.

2.1.1 Educational outcomes among China's left-behind migrant children

Studies have found mixed results as to whether being left behind by migrant parents supports or harms children's educational attainment. For example, some studies find no net effect of parental migration on school performance [92], while others find an improvement but only when the father migrates [14], opposite results by child gender [41], or even a negative impact [77, 91].

As noted by previous researchers, two opposing effects of parental migration on left-behind children may explain why results are mixed [4, 63, 91]. First, remittances from migrant parents (typically representing an increase in household income by 8.5-13.1 percent) stimulate investment in education for left behind migrant children, especially because credit constraints are important determinants of educational investment in rural China [12, 21]. Second, parental monitoring and involvement are also predictors of child academic achievement [44], so that we might expect left-behind children to show lower academic performance than peers living with both parents.[4] Taking a closer look at the Chinese literature, we see evidence of both of effects. First, using an instrumental variable approach and data from the China Generic Social Survey, a large nationally representative survey, Hu finds that the absence of adult household members is negatively related to high school attendance, but that remittances reduce the negative effect [34].[5] Similarly, Lu finds a positive relationship between rural children's educational attainment and migration of siblings, but not between educational attainment and migration of parents: migration of

[4] Surveys have indicated that over 80% of migrant children whose mothers have migrated are raised by grandparents, who often have lower educational achievement than the parents and provide less stimulation [22, 50, 57, 85].

[5] Hu finds that the effects are stronger for girls than for boys, although other papers on educational aspirations of left behind migrant children in China using this identification strategy show mixed results as to which gender is more strongly impacted [55, 78].

older siblings increases family income remittances without diminishing parental attention [54]. Meanwhile, performance in school seems to be more straightforwardly related to parental migration, such that lack of parental attention is associated with lower school performance. Using survey data collected from Qinghai and Ningxia provinces, Zhao and colleagues found that after adjustment using instrumental variables parental migration was associated with a 1.7% decline in percentile rank of mathematics score among rural children [87].

Unsurprisingly given the limited options for quality schooling for migrants in urban areas, comparison of children who migrated with their parents to their urban counterparts finds a stark contrast between the two groups in schooling and achievement [8]. On average, migrant children show higher drop-out rates, lower daily attendance and lower graduation rates than comparison children [46, 47, 68]. Although attendance rates for migrant children in Beijing climbed from 12% in 1995 to 90% in 2002, this is still lower than attendance rates of local children [69]. These results are particularly striking considering the finding that migrant children in Shaanxi province outperformed local children when they first arrived to the city but that gaps developed later, perhaps due to the low quality of migrants' schools [40].

2.1.2 Health outcomes among China's left behind migrant children

The direction of the effect of parental migration on health of left-behind children is mixed in the Chinese literature, perhaps for similar reasons: parental migration is associated with less parental involvement but also with an increase in family income that can be used for investments in health and nutrition. De Brauw and Mu found that children aged 7-12 were more likely to be underweight if they had a migrating parent and younger children were less likely to be underweight, but only if left without the care of a grandparent [19]. Lu examined father migration using longitudinal data from Gansu, and found that father migration is associated with increased protein intake among boys [55]. In contrast, as children get older, some unhealthy behaviors seem to be more prevalent among left-behind children than other adolescents. A study in Guangdong, China, indicated that left behind adolescents showed higher rates of overweight as well as a variety of other poor health behaviors ranging from physical inactivity, tobacco use, excessive alcohol use, and suicidal ideation as compared to their classmates [24]. [6]

[6] This study did not correct for selection, but their results work against the healthy-migrant hypothesis.

Descriptive results from several cross-sectional surveys in selected cities have shown that migrant children who move with their parents are less healthy than local children, experiencing higher mortality and prevalence of low birth weight and anemia [16], as well as higher rates of infectious diseases including parasitic diseases, diarrheal disease, and tuberculosis [37]. However, this may in part occur due to the different prices migrants and official residents face for local health services [31, 83]. In practice, migrants often can not bring their health benefits with them, and only a minority of employers provide health insurance that can compensate for the lost benefits [17].[7]

2.1.3 Psychological outcomes among China's left behind migrant children

In contrast to the Chinese literature on education and health effects of parental migration, the literature on the psychological impacts of separation from parents show a straightforward relationship between being left behind and negative psychological consequences including increased risk of loneliness, depression and anxiety, especially for children left behind at young ages. Many of these studies did not perform corrections for migrant self-selection, but corrections for healthy-migrant selection effects would likely make these results stronger.

Psychological questionnaires indicate that left behind migrant children, even those living with family members, suffer from increased risk of loneliness, anxiety, and depression [33, 35, 49, 88], and that migration has negative effects on psychosocial development [41]. Based on a survey of children aged 8-14 years in Shandong province using the Children's Loneliness Scale, Jia and Tian found that left-behind children were about twice as likely to feel lonely than comparable rural children; low frequency of communication with one's parents or having a poor relationship with one's parents increased the risk of most severe loneliness [38]. A dose-response relationship has also been documented, such that children whose parents left when they were younger showed more severe problems [52]. Indeed, Fan and co-authors found that the effect of being left behind by parents on anti-social behaviors and psychopathology was fully statistically accounted for by the duration of time left behind [23]. More generally, a meta-analysis of articles related to the mental health status of left behind rural migrant children between 1994

[7] A study in Yiwu, Zhejiang province in 2005 found that prenatal check-ups cost up to a third of migrant workers' monthly salaries and medical expenses for a complicated delivery could cost 5 times their monthly salary [83]. Indeed, access to maternal care is one of the key public health concerns related to migration in China [37].

and 2009 found significant increase in risk for not only anxiety and depression but also many other psychological symptoms on the Symptom Checklist 90 (SCL-90) including somatization, interpersonal sensitivity, cognitive performance deficits and sleep difficulties [79]. [8]

2.2 Location-specific government investment in China

The New Cooperative Medical Scheme (NCMS) exemplifies the Chinese social policy framework where government dollars are targeted to citizens according to their place of residence and *hukou*. In effect, the scheme increased governmental investment in rural *hukou* children in rural areas but not urban areas. In this sub-section, I review the characteristics of this policy as a motivating example of Chinese social policy under the *hukou* system.

Before the implementation of the NCMS in 2003, the majority of the rural population in China had no health insurance and poor health was a leading cause of household poverty in rural areas [51]. The Cooperative Medical System of the Mao era, which had once covered up to 90% of Chinese peasants, disappeared after the introduction of the Household Responsibility System in 1979 and a city-based social health insurance scheme took its place, offering no coverage to rural households or migrant laborers. As a result, many families had to pay for health services out of pocket. Out of pocket payments accounted for 20% of total health expenditure in China in 1978 but reached almost 60% in 2002 [32, 86]. In addition, an estimated 16% of rural households incurred catastrophic medical spending in 2003 [36].

The NCMS was introduced in 2003 as a locally implemented, voluntary health insurance scheme for China's rural population. The premiums cost 10 yuan per year per individual enrolled. Adding this contribution to the government contributions, funding per individual totaled 50 yuan or about a third of typical annual medical expenditure for a rural individual in western and central China at the time [59]. The scheme was rolled-out aggressively, covering 86% of the rural population in 2007 and 90% in 2011 [36, 58], including more than 95% of rural counties [36, 60].

The benefits of the health insurance scheme, however, were only available to individuals living in their official place of residence. Targeted government insurance programs in the urban areas, including

[8] These problems are likely related to the frequency and quality of contact with parents. A survey of migrant workers in Beijing found that about 80% of children talked to their parents on the telephone only once every two weeks [50]. A survey in Changsha, Hunan province showed that 44% of left behind migrant children saw their parents once a year, the same number twice a year, and 3% once every 2 years [18].

the Urban Employee Basic Medical Insurance and the newer Urban Resident Basic Medical Insurance plan, cover urban *hukou* residents but not migrant workers or their children [48]. In addition, although migrant workers could opt to enroll in the NCMS, the majority opted not to participate because reimbursement for non-local hospitals - where local governments chose to provide it - was often found to be slow and inconsistent [31].[9] Therefore, the NCMS exemplifies the trend of Chinese policies increasing governmental investment in residents according to location and *hukou* status.

The NCMS also exemplifies how national policy is often implemented in a heterogeneous way at the local level, with each local government able to customize to fit its needs, priorities, and budget. Each county-level jurisdiction was free to design its own health insurance scheme to a large extent according to local needs and budget, as long as minimum requirements were met [74]. A similar situation is evident in urban policy. For example, research on China's *dibao* (minimum income) program has indicated that small cities are less generous and larger cities more generous toward local-*hukou* residents [71]. In addition, mandates to provide services to migrants may also have varying levels of compliance across locations. In 2003 the Chinese government issued a mandate that educating migrant children was the responsibility of the local government [62]. However, the reform failed to shift the burden of financing away from cities and there were a number of practical reasons not to comply,[10] resulting in mixed results [20, 45].

Indeed, the *hukou* system itself is increasingly implemented at the local level, and in such a way that individuals with rural *hukou* often find that the locations willing to grant them local *hukou* are the locations whose offers they don't wish to accept. Wing Chan and Buckingham note that the "devolution of responsibility for *hukou* policies to local governments" has been ongoing since the late 1990's, such that each town or city can decide which types of migrants will be eligible to earn local *hukou*.[11] The result is that small towns and places with minimal social benefits have the "lowest threshold of entry," whereas desirable locations that provide locals with good public services only grant *hukou* to applicants

[9] Also, few employers offer migrant workers health insurance that could compensate for missing NCMS benefits [17].

[10] Cities are not informed about the number of migrant students, so planning service provision is challenging. Some cities are worried that if they become more generous, the number of migrant children in their city will increase, thereby increasing their financial burdens without increasing revenue enough to cover the costs. Finally, migrant students may sometimes leave their schools to migrate again with their parents, resulting in increased dropout rates; officials may feel pressure to keep reported dropout rates low.

[11] The 2014 *hukou* reforms reinforce this trend.

who meet criteria such as being very wealthy, educated or skilled, or being a close family member of a person with local *hukou* [81]. Because rural *hukou* people accepting a *hukou* elsewhere must give up their title to land in their village, many rural *hukou* people apparently do not find the opportunities for *hukou* changes that are within their reach to be financially worthwhile. This is evidenced by the fact that, despite hukou reform initiatives in 1997, only 1.39 million migrants (about 1%) had changed their *hukou* by 2002. In the desirable city of Harbin, only 200 migrants out of the 1 million migrants in the city of Harbin were named "advanced workers" and given Harbin *hukou* [30]. In this context, national policy to increase offers of urban *hukou* to rural people, if implemented at the local level as in the past, will not give rural *hukou* people equal access to urban public services in practice [76].

3 Justification for the theoretical framework

Based on the evidence reviewed in the previous section, I conclude that two factors should be taken into account in modeling the direct and indirect impacts of changes to Chinese government policy on rural *hukou* children: (1) parental money and time investments in children, and how these change as a result of migration decisions, and (2) location-specific government investment in children in China.

3.1 Parental money and time investments in children, and how these change as a result of migration decisions

The literature comparing Chinese left-behind children with other rural Chinese children shows mixed evidence as to whether left-behind children are helped or harmed by their parents' migration. However in many cases, the mixed evidence seems to line up with arguments of many previous researchers: namely, because left-behind children experience both positive factors (parental remittances) and negative factors (parental absence), the impact of being left behind could be negative or positive, depending on the balance of these two factors [4, 63, 91]. In some cases, such as children's psychological development, parental absence seems more important than remittances [23, 38, 52]. For children's school attendance, the opposite may be true [34, 54], especially because remittances from migrant parents can represent an increase in household income by 8.5-13.1 percent, and credit constraints are important determinants of

educational investment in rural China [12, 21]. I conclude that in addition to taking migration effects into account, it is important to account for these two positive and negative factors - parental spending on children and parental time with children - when analyzing direct and indirect impacts of Chinese policies on child development.

3.2 Location-specific government investment in children in China

Social services provided by the Chinese government often follow a pattern wherein official residents (those with local *hukou*) are eligible for higher benefits than non-residents (those with non-local *hukou*), and the generosity of benefits varies by location [15, 40, 76, 81]. In exploring this issue, I discussed the New Cooperative Medical Scheme as an example [31, 74], and briefly mentioned other examples including comparable urban-only health insurance schemes and place-specific minimum income (*dibao*) programs [45]. The lower availability of social services for Chinese rural *hukou* children in urban areas is likely to persist despite announcements of *hukou* reforms this summer. This is because the latest reforms do not change the following two characteristics of the system: (1) *hukou* in desirable locations[12] are available only for those who meet criteria set by the city (often, a points system based on wealth and education), and (2) individuals who forgo their rural *hukou* forgo the land entitled to them in their home village. For many rural Chinese, obtaining one of the urban *hukou* that are within their reach will continue, in practice, to not be worth the cost [75, 81]. Therefore, the pattern wherein rural *hukou* people receive lower levels of social services in the city is expected to persist and should be taken into account explicitly in modeling the response of the Chinese family to changes in government services.

4 Model

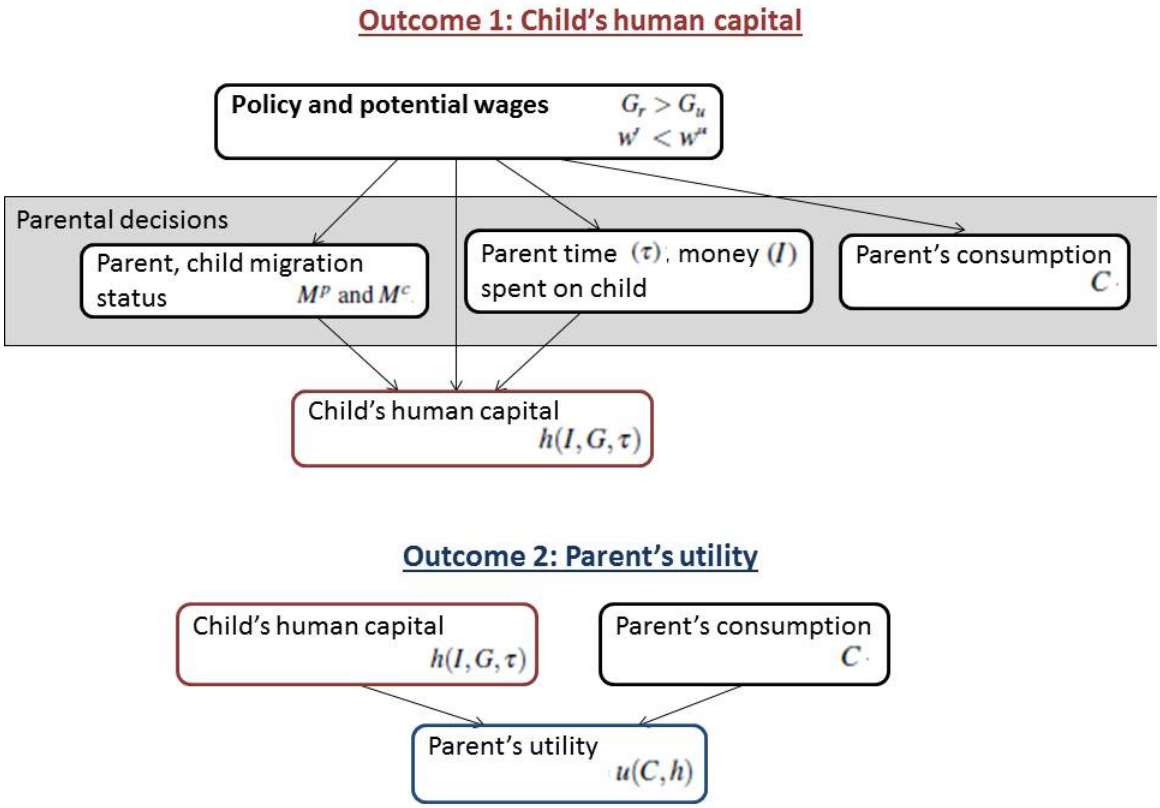
See Figure 1 for a non-technical summary of the model including policy inputs, parental decisions and consequences for themselves and children.

Each household contains one parent and one child, both with rural *hukou*.[13] Parents are the sole decision-makers in the household and maximize a smooth function of their current consumption (C) and

[12] Typically, desirable locations are larger cities providing more generous benefits [71].

[13] This helps to simplify the analysis, which can be readily extended to multi-parent or multi-child households.

Figure 1: Summary of the model including policy inputs, parental decisions and child's human capital



their children's human capital (h):

$$U = u(C, h)$$

Parental migration and child migration are denoted as M^p and M^c, respectively. $M^p = 1$ if the parent migrates and $M^p = 0$ if the parent does not migrate. Likewise, $M^c = 1$ if the child migrates and $M^c = 0$ if the child does not migrate.

Each parent is endowed with one unit of time. When the child and parent live in the same location, the parent has the option of spending some fraction of their time (τ) with the child. The remainder of the time parents work, earning wage w which varies by location:

$$w = \begin{cases} w_u & \text{if parent migrates (that is, } M^p = 1) \\ w_r & \text{if parent doesn't migrate (that is, } M^p = 0) \end{cases}$$

In addition, all parents have the option of investing money (of amount I) in their children. Therefore, parents face the budget constraint:

$$w(1 - \mathbb{I}[M^p = M^c]\tau) = C + I$$

where $\mathbb{I}$ denotes the indicator function.

Children's human capital is determined by (1) the amount of time spent with the parent;[14] and (2) monetary investments in him or her. Spending on the child comes from the parents (I) and from the government. Government spending on the child varies based on the child's migration status: G_r or G_u in rural or urban areas, respectively. The child's human capital production function can be summarized as follows:

$$h = h(I, G, \tau)$$

$$\text{where } G = M^c G_u + (1 - M^c) G_r$$

[14] In practice, when children are left behind in the rural area they are cared for by an alternate caregiver such as grandparents. We can interpret such that the value of alternative caregiver time has been normalized to 0 in this model.

4.1 Assumptions

I assume that:

Assumption 1 *Parents care about children's human capital and their own consumption, but with decreasing marginal returns to each.*[15]

$$u_h(C,h) > 0;\ u_C(C,h) > 0$$

$$u_{hh}(C,h) < 0;\ u_{CC}(C,h) < 0$$

Assumption 2 *$u(C,h)$ is additively separable in C and h:*

$$u(C,h) = \mu(C) + \nu(h)$$

Assumption 3 *Investments of parental money, government money, and parental time increase children's human capital. However, there are decreasing marginal returns to each:*

$$h_I(I,G,\tau) > 0;\ h_\tau(I,G,\tau) > 0;\ h_G(I,G,\tau) > 0$$

$$h_{II}(I,G,\tau) < 0;\ h_{\tau\tau}(I,G,\tau) < 0;\ h_{GG}(I,G,\tau) < 0$$

In addition, government and parental monetary investment in children are substitutes:

$$h_{GI}(I,G,\tau) \leq 0$$

Assumption 4 *The production function of h is additively separable in money and time inputs:*

$$h(I,G,\tau) = m(I,G) + t(\tau)$$

[15]Note that I am introducing simplifying notation of the form $g_x(x,y) = \frac{\partial g(x,y)}{\partial x}$ and $g_{xy}(x,y) = \frac{\partial^2 g(x,y)}{\partial x \partial y}$.

Assumption 5 *The government spends more money on rural* hukou *children if they live in rural areas:*

$$G_r > G_u$$

As noted in the literature review section, this assumption is broadly consistent with past and recently proposed *hukou* reforms in China. Particularly wealthy or talented individuals will continue to be able to trade their rural *hukou* for desirable urban *hukou* with generous social benefits, but most rural people will not find their options for urban *hukou* appealing enough to forgo the land rights that a rural *hukou* provides them [75, 81].

Assumption 6 *Wages for parents are higher in urban areas than rural areas:*

$$w^r < w^u$$

Due to the drawbacks to migration noted in the previous assumptions, only parents who would earn higher wages in the city would consider migrating. I am assuming that all parents in the study would consider migrating. This is broadly consistent with decades of research on the rural-urban wage gap and waves of rural-to-urban migration documented in China since the 1980s [64, 65, 89].

4.2 Parental decisions

4.2.1 Migration decisions

Given the above framework, each parent is faced with the following discrete choice problem:

- $M^p = 1$ and $M^c = 1$ (parent and child migrate together)
- $M^p = 0$ and $M^c = 0$ (neither parent nor child migrates)
- $M^p = 1$ and $M^c = 0$ (parent migrates and child is left behind)

Within each of these scenarios, the parent can select the optimal I, C, and perhaps τ, to maximize her utility. When the child is left behind, the parent is not able to spend time with the child and therefore τ is not a choice variable.

To define notation, let C^*_{10} and $h^*_{10}\left(I^*_{10}, G_r, 0\right)$ denote the optimal choice of C and h conditional on $M^p = 1$, $M^c = 0$ (that is, the first subscript in C^*_{10} indicates $M^p = 1$ and second indicates $M^c = 0$). Then $u^*_{10}\left(C^*_{10}, h^*_{10}\right)$ is the utility of the parent at the optimum conditional on $M^p = 1$, $M^c = 0$. The optimal choices and utility for the other migration scenarios are similarly denoted using stars and subscripts. With this notation, we can summarize parental choices and the corresponding utility as follows:

$$U = \max_{M^p, M^c} \begin{cases} u^*_{11}\left(C^*_{11}, h^*_{11}\left(I^*_{11}, G_u, \tau^*_{11}\right)\right) \\ u^*_{00}\left(C^*_{00}, h^*_{00}\left(I^*_{00}, G_r, \tau^*_{00}\right)\right) \\ u^*_{10}\left(C^*_{10}, h^*_{10}\left(I^*_{10}, G_r, 0\right)\right) \end{cases}$$

Any of the three migration scenarios could be most appealing to parents, and the key tradeoffs are as follows. First, parents make more money in urban areas than rural areas by assumption 6. Second, children receive a higher governmental transfer in the rural areas by assumption 5. Third, parents are unavailable to spend time with left-behind children.[16] If the importance of parental time is sufficiently large then migrating parents will not wish to leave their children behind.

4.2.2 Optimal decisions if the child and parent live in the same location

When the child and parent live in the same location ($M^p = M^c$), the parent has the option of foregoing some income to spend time with the child. In this case, the maximization problem can be summarized as:

$$\max_{I,\tau,C} \left\{u(C,h) + \lambda\left(w(1-\tau) - C - I\right)\right\}$$

where λ is the Lagrange multiplier and

$$h = h(I, G, \tau)$$

The general first order conditions are as follows:

[16] In practice, children must be cared for by alternate caregivers if parents migrate, and the alternate caregiver's time is not necessarily as helpful for children as parent's time.

$$
\begin{aligned}
\{\lambda\} \quad & w(1-\tau) - C - I = 0 \\
\{I\} \quad & u_h(C,h)h_I(I,G,\tau) = \lambda \\
\{\tau\} \quad & u_h(C,h)h_\tau(I,G,\tau)\frac{1}{w} = \lambda \\
\{C\} \quad & u_C(C,h) = \lambda
\end{aligned}
$$

The optimal parental decisions can be solved for using the above set of first order conditions.[17] It is apparent from these equations that at the parent's preferred point, the marginal value of the money spent for personal consumption, monetary investments in children, and foregone earnings due to time spent with children are equated.

4.2.3 Optimal decisions if the child is left behind

When the child is left behind ($M^p = 1,\ M^c = 0$), the parent doesn't have the option of spending time with the child on a regular basis; that is, $\tau = 0$ and τ is no longer a decision variable. Therefore, the maximization problem becomes:

$$\max_{I,C} \{u(C,h) + \lambda\,(w - C - I)\}$$

The first order conditions are:

$$
\begin{aligned}
\{\lambda\} \quad & w - C - I = 0 \\
\{I\} \quad & u_h(C,h)h_I(I,G,\tau) = \lambda \\
\{C\} \quad & u_C(C,h) = \lambda\,\{C\}
\end{aligned}
$$

In this case, the marginal value of the money spent on children is only equated with the marginal value of money spent on the parent's consumption.

[17] In the following section, I will present a closed-form solution after assuming a particular functional form.

5 Parental responses to policy change

5.1 Two policy changes to be considered

I consider parental responses to two possible policy changes. For each change, I will apply the model to analyze the impact of the change on children's human capital.

5.1.1 First policy change: Increase G_r only.

First, the government could increase spending on rural *hukou* children who live in their rural, official place of residence (that is, increase G_r without changing G_u).

An example of a policy similar to this is the New Cooperative Medical Scheme, which provided subsidized health insurance to rural residents only in China starting in 2003 [48, 74]. In practice, migrants could not bring their benefits with them, and few employers provide health insurance that could compensate for the lost benefits [17]. Therefore, the policy change amounted to an increase in G_r without an increase in G_u.

5.1.2 Second policy change: Increase G_u only.

Second, the government could increase spending on rural *hukou* children who have migrated away from rural, official place of residence (that is, increase G_u without changing G_r).

For the purposes of this model, raising G_u such that $G_r = G_u$ is equivalent to eliminating the *hukou* system. However, smaller changes involve giving additional services to children who have migrated. This might be a suitable approximation for the new government policy for expanding access to urban *hukou* over the next 6 years. Highly educated, wealthy, or talented migrants will have access to *hukou* in cities with generous benefits, but most rural people will find desirable *hukou* to be out of their reach. As a result, although some rural *hukou* citizens will gain new rights through access to *hukou* in smaller cities with some social benefits, rural *hukou* people will still not gain access to all the government services available to more privileged urban citizens [75, 29]. Therefore, we can consider that current reforms to the *hukou* system amount to increasing G_u without increasing G_r.

5.2 Parental reactions to policy changes and implications for child human capital

Now, I analyze the policy changes and their impacts on parental utility and child human capital. First, I focus on the case in which a policy change does not trigger a change in migration. Second, I focus on the case where a policy change triggers a change in parental decisions to leave children behind.

5.2.1 Case 1: The parents do not move their family as a response to the policy change.

I first consider the case where G_r changes but the child lives in the urban area, or G_u changes but the child lives in the rural area (i.e., G does not change for the child as a result of the policy), and show that these families are unaffected by the policy change. I next consider the case where G_r changes and the child lives in the rural area, or G_u changes and the child lives in the urban area (i.e., G changes for the child as a result of the policy), and analyze how these families are affected by the policy change.

If G does not change

Result 1 *If a policy change does not affect G given a child's current place of residence, and the child's place of residence does not change, then the child's human capital and parent's utility will not be affected by the policy change.*

Recall that human capital of children is defined as follows:

$$h = h(I, G, \tau)$$

$$\text{where } G = M^c G_u + (1 - M^c) G_r$$

Without loss of generality, consider the example of a child who lives in an urban area ($M^c = 1$); say that G_r increases due to a policy change but the change is not large enough to provoke the parent of the child to send him home. For this child, G does not change because $G = G_u$, and there is no change in G_u.

If G does not change and no other inputs relevant to parental optimization change, then C, I and τ also do not change. Thus, without any change in any of the inputs, human capital ($h(I, G, \tau)$) and parental utility $u(C, h)$ also do not change.

If G changes

Result 2 *If a policy change increases (decreases) G given a child's current place of residence and the child does not move as a result of the policy change, then the child's human capital will increase (decrease).*

As a first step toward proving this result, I show that a governmental investment of level G is equivalent to having the parents receive a monetary transfer of a certain amount, $k(G)$.

Adding notation to fix ideas, say that if G is set to 0 but the parent is given a transfer of size $k(G)$ then the parent will spend $I^*_{k(G)}$ on the child. If instead the government directly invests amount G in the child and gives no transfer to the parent, the parent will choose to spend I^*_G on the child. I want to show that for any amount of government investment G, there exists a direct transfer to parents of amount $k(G)$ that would produce the same levels of h^* and C^*, thereby producing identical levels of utility for parents $u(C^*,h^*)$ and identical levels of human capital for children.

I will work with the optimization problem for children who live in the same place as parents, but the equations I obtain will also hold for left-behind children. This is because the two first-order conditions that both equal λ and are set to equal each other are equivalent to two first-order conditions for the left-behind child case after invoking the assumption about additive separability (see section 4.2.3).

With the hypothetical transfer $k(G)$ included and G eliminated, the budget constraint would become:

$$w\,(1-\mathbb{I}[M^p=M^c]\tau)+k(G)=C+I$$

and therefore the parent's maximization problem would become:

$$\max_{I,\tau,C}\{u(C,h)+\lambda\,(w\,(1-\tau)+k(G)-C-I)\}$$

where $h=(I,0,\tau)$ (because $G=0$). This maximization problem yields the first-order conditions:

$$
\begin{aligned}
\{\lambda\} \quad & w(1-\tau)+k(G)-C-I=0 \\
\{I\} \quad & u_h(C,h)\,h_I(I,0,\tau)=\lambda \\
\{\tau\} \quad & u_h(C,h)h_\tau(I,0,\tau)\frac{1}{w}=\lambda \\
\{C\} \quad & u_C(C,h)=\lambda
\end{aligned}
$$

Because the production function for h is additively separable for time and money by assumption 4, the second and fourth first-order conditions can be combined to yield:

$$u_h(C,h)\,m_I(I^*_{k(G)},0)=u_C(C,h)$$

The comparable condition for the case without transfer $k(G)$ and where $G>0$ is:

$$u_h(C,h)\,m_I(I^*_G,G)=u_C(C,h)$$

Therefore if we define the relationship between G and $k(G)$ so that:

$$m_I(I^*_G,G)=m_I(I^*_{k(G)},0) \tag{1}$$

then the transfer $k(G)$ will produce an identical parental optimization problem and identical results (in terms of $u(C,h)$, C^* and h^*) to the governmental investment of amount G.

I now establish $\frac{\partial k(G)}{\partial G}>0$ by examining what changes are needed to maintain equality 1 when G changes. First, I examine the left hand size of equality 1. Because $m_{IG}<0$ by assumption 3, lowering G would increase $m_I(I^*_G,G)$. I then examine the right-hand side of equality 1. $m_I(I^*_{k(G)},0)$ must also increase because $m_I(I^*_G,G)$ is increasing. Because $m_{II}<0$ by assumption 3, increasing $m_I(I^*_G,G)$ requires decreasing I, which can be forced by decreasing the parent's budget - that is, by decreasing the transfer to parents $k(G)$. In summary, if equation 1 holds, a decrease in G implies an decrease in $k(G)$. By similar logic, an increase in G would imply an increase in $k(G)$.

Based on this, I can conclude that in terms of impacts on parental utility and children's human capital, an increase in G produces an effect equivalent to a monetary transfer to parents, i.e., an increase in $k(G)$.

Having established that an increase in G is effectively equivalent to a transfer of money to parents, I next consider how h^* changes when parents receive a transfer. By assumption 1, parental utility is increasing in both consumption C and human capital of children h, but with decreasing returns to each. Moreover, utility is additively separable with respect to C and h by assumption 2. As a result, parents will prefer to divide their newly gained income between C and h, investing in h using a balance of time and money spent with children. In summary:

$$\frac{\partial C^*}{\partial k(G)} > 0 \text{ and } \frac{\partial k(G)}{\partial G} > 0 \implies \frac{\partial C^*}{\partial G} > 0$$

$$\frac{\partial h^*}{\partial k(G)} > 0 \text{ and } \frac{\partial k(G)}{\partial G} > 0 \implies \frac{\partial h^*}{\partial G} > 0$$

I have shown that h^* increasing in G and furthermore, that $u(C^*, h^*)$ is increasing in G.

5.2.2 Case 2: Parents react to the policy change, and part of their response involves moving their family.

Result 3 *If $U_{11}^* = U_{01}^*$ for some parents, then an increase in G_r will increase the number of left-behind migrant children whereas an increase in G_u will decrease the number of left-behind migrant children.*

I have shown that:

$$\frac{\partial U_{11}^*}{\partial G_r} = 0;\ \frac{\partial U_{01}^*}{\partial G_r} > 0;\ \frac{\partial U_{00}^*}{\partial G_r} > 0 \tag{2}$$

$$\frac{\partial U_{11}^*}{\partial G_u} > 0;\ \frac{\partial U_{01}^*}{\partial G_u} = 0;\ \frac{\partial U_{00}^*}{\partial G_u} = 0 \tag{3}$$

Therefore, after an increase in G_r:

- A parent that previously had $U_{11}^* = U_{10}^*$ would now prefer to send their child back to the rural area (possibly *increasing* the number of left-behind migrant children), and
- A parent that previously had $U_{11}^* = U_{00}^*$ would now prefer to move home with their child (not

affecting the number of left-behind migrant children).

Likewise, after an increase in G_u:

- A parent that previously had $U_{11}^* = U_{10}^*$ would now prefer to bring their child to live with them in the urban area (possibly *decreasing* the number of left-behind migrant children), and
- A parent that previously had $U_{11}^* = U_{00}^*$ would now prefer to move to the urban area with their child (not affecting the number of left-behind migrant children).

I now consider the families at the following margin relevant to the number of left-behind migrant children:

$$u_{10}^*\left(C_{10}^*, h_{10}^*\right) = u_{11}^*\left(C_{11}^*, h_{11}^*\right)$$

and compare h_{10}^* with h_{11}^*. I will use this analysis to prove the following:

Result 4 *$h_{10}^* < h_{11}^*$ for families at the margin $u_{10}^*\left(C_{10}^*, h_{10}^*\right) = u_{11}^*\left(C_{11}^*, h_{11}^*\right)$.*

Result 5 *An increase in G_r will* decrease *the human capital of children who become left-behind as a result of this policy change. In contrast, an increase in G_u will* increase *the human capital of left-behind children who become migrant children as a result of this policy change.*

In order to prove result 4, I note that for a family with $u_{10}^*\left(C_{10}^*, h_{10}^*\right) = u_{11}^*\left(C_{11}^*, h_{11}^*\right)$, three scenarios exist:

- $C_{10}^* = C_{11}^*$ and $h_{10}^* = h_{11}^*$ for families with $u_{10}^*\left(C_{10}^*, h_{10}^*\right) = u_{11}^*\left(C_{11}^*, h_{11}^*\right)$
- $C_{10}^* < C_{11}^*$ and $h_{10}^* > h_{11}^*$ for families with $u_{10}^*\left(C_{10}^*, h_{10}^*\right) = u_{11}^*\left(C_{11}^*, h_{11}^*\right)$
- $C_{10}^* > C_{11}^*$ and $h_{10}^* < h_{11}^*$ for families with $u_{10}^*\left(C_{10}^*, h_{10}^*\right) = u_{11}^*\left(C_{11}^*, h_{11}^*\right)$

I prove result 4 by showing that only the third scenario is consistent with the first-order conditions of the model. I then work with this result to show result 5.

Scenario 1, $C^*_{10} = C^*_{11}$, can be ruled out. In order to satisfy both $u^*_{10}(C,h) = u^*_{11}(C,h)$ and $C^*_{10} = C^*_{11}$, it must be the case that $h^*_{10} = h^*_{11}$. However, I will now show that this case violates the first order conditions and can be ruled out.

First, I can prove by contradiction that in this scenario, it must be that $\tau^*_{11} > 0$ and therefore $I^*_{10} > I^*_{11}$. If $C^*_{10} = C^*_{11}$ and $\tau^*_{11} = 0$, this would yield $I^*_{10} = I^*_{11}$ and $h^*_{10} > h^*_{11}$ which contradicts $u^*_{10}\left(C^*_{10}, h^*_{10}\right) = u^*_{11}\left(C^*_{11}, h^*_{11}\right)$. In particular, if:

$$\begin{aligned} h^*_{11}\left(I^*_{11}, G_u, \tau^*_{11}\right) &= h^*_{11}\left(I^*_{11}, G_u, 0\right) \\ &= h^*_{11}\left(I^*_{10}, G_u, 0\right) \end{aligned}$$

then:

$$h^*_{10}\left(I^*_{10}, G_r, 0\right) > h^*_{11}\left(I^*_{10}, G_u, 0\right)$$

because $G_r > G_u$ by assumption 5. Then $h^*_{10} > h^*_{11}$ and $C^*_{10} = C^*_{11}$ implies:

$$u^*_{10}\left(C^*_{10}, h^*_{10}\right) > u^*_{11}\left(C^*_{11}, h^*_{11}\right)$$

which would contradict $u^*_{10}\left(C^*_{10}, h^*_{10}\right) = u^*_{11}\left(C^*_{11}, h^*_{11}\right)$. Therefore, marginal families must have $\tau^*_{11} > 0$ meaning that if the child is left-behind, parental income will be higher by $\tau^*_{11} w$. Because we are in the case where consumption remains fixed and because parents only spend on C and I, this implies $I^*_{10} > I^*_{11}$.

I now show that $I^*_{10} > I^*_{11}$, $C^*_{10} = C^*_{11}$, and $h^*_{10} = h^*_{11}$ would violate the first-order conditions. I first apply the assumptions $h_{II} < 0$ (assumption 3), h is additively separable in time in money inputs (assumption 4), $G_r > G_u$ (assumption 5) and $h_{IG} < 0$ (assumption 3) to obtain:

$$h_{II} = m_{II} < 0;\ h_{IG} = m_{IG} < 0$$

$$\begin{aligned} h_I(I^*_{10}, G_r, 0) = m_I(I^*_{10}, G_r) &< m_I(I^*_{11}, G_r) \\ m_I(I^*_{10}, G_r) &< m_I(I^*_{11}, G_u) = h_I(I^*_{11}, G_u, \tau^*_{11}) \end{aligned}$$

$$\implies h_I(I^*_{10}, G_r, 0) < h_I(I^*_{11}, G_u, \tau^*_{11}) \tag{4}$$

According to the first order conditions in sections 4.2.2 and 4.2.3, the optimal decisions if children are left-behind or migrate with their parents must satisfy, respectively:

$$u_h(C^*_{10}, h^*_{10})\, h_I(I^*_{10}, G_r, 0) = u_C(C^*_{10}, h^*_{10}) \tag{5}$$

$$u_h(C^*_{11}, h^*_{11})\, h_I(I^*_{11}, G_u, \tau) = u_C(C^*_{11}, h^*_{11}) \tag{6}$$

I start with equation 5. Replacing using $C^*_{11} = C^*_{10}$ and $h^*_{11} = h^*_{10}$, I obtain:

$$u_h(C^*_{11}, h^*_{11})\, h_I(I^*_{10}, G_r, 0) = u_C(C^*_{11}, h^*_{11})$$

Then substituting using equation 4, I obtain the inequality:

$$u_h(C^*_{11}, h^*_{11})\, h_I(I^*_{11}, G_u, \tau^*_{11}) > u_C(C^*_{11}, h^*_{11})$$

which violates equation 6, one of the first order conditions.

I conclude that this scenario is not possible, because it would involve taking optimal decisions that violate the first order conditions and would therefore not be optimal. That is, I can rule out $h^*_{10} = h^*_{11}$ for families at the margin.

Scenario 2, $C^*_{10} < C^*_{11}$, can be ruled out. In order to satisfy both $u^*_{10}(C,h) = u^*_{11}(C,h)$ and $C^*_{10} < C^*_{11}$, it must be the case that $h^*_{10} > h^*_{11}$. This case can be also ruled out by a similar violation of the same first order conditions.

First, $C^*_{10} < C^*_{11}$ implies $I^*_{10} > I^*_{11}$. Then $I^*_{10} > I^*_{11}$ plus the assumptions 3, 4, 5 and 3 imply equation 4 as in the previous scenario.

Before examining the first-order conditions, I establish a few more properties. I assumed additive separability of the utility function so that $u(C,h) = \mu(C) + \nu(h)$ (assumption 2) and $u_{hh} < 0$ and $u_{CC} < 0$

(assumption 1). If these properties hold, $C^*_{10} < C^*_{11}$ would imply:

$$\mu_C(C^*_{11}) < \mu_C(C^*_{10}) \tag{7}$$

Likewise, $h^*_{10} > h^*_{11}$ would imply:

$$\nu_h(h^*_{11}) > \nu_h(h^*_{10}) \tag{8}$$

As before, I examine the first-order conditions by starting with a first-order condition for left-behind children, equation 5:

$$u_h(C^*_{10}, h^*_{10})\, h_I(I^*_{10}, G_r, 0) = u_C(C^*_{10}, h^*_{10})$$

By additive separability of the utility function, this is:

$$\nu_h(h^*_{10})\, h_I(I^*_{10}, G_r, 0) = \mu_C(C^*_{10})$$

But equations 7 and 8 imply:

$$\nu_h(h^*_{11})\, h_I(I^*_{10}, G_r, 0) > \mu_C(C^*_{11})$$

Finally, applying equation 4 and additive separability of the utility function again yields the final inequality:

$$u_h(C^*_{11}, h^*_{11})\, h_I(I^*_{11}, G_u, \tau^*_{11}) > u_C(C^*_{11}, h^*_{11})$$

which would violate the first-order conditions (equation 6).

I conclude that this scenario is also not possible, because the optimal decisions would violate the first order conditions and would therefore not be optimal.

Scenario 3, $C^*_{10} > C^*_{11}$, must hold and implies $h^*_{10} < h^*_{11}$. Having shown that $C^*_{10} \neq C^*_{11}$ and $C^*_{10} \not< C^*_{11}$, I conclude that $C^*_{10} > C^*_{11}$. In order to satisfy $u^*_{10}(C,h) = u^*_{11}(C,h)$, $C^*_{10} > C^*_{11}$, and assumption 1 (namely, that utility is increasing in C and h), it must be true that $h^*_{10} < h^*_{11}$. This is result 4.

Based on the above, I conclude that children who become left behind (no longer left behind) as a result of a policy change will experience a decrease (increase) in human capital. This conclusion (result 5) follows from the results above by the following logic. By equations 2 and 3, we know that families sufficiently close to the margin of $u^*_{10}(C,h) = u^*_{11}(C,h)$ would send migrant children to live in rural areas (i.e., become left-behind) if G_r increases, and would send left-behind children to the city (i.e., become migrant children) if G_u increases. In addition, I have shown that $h^*_{10} < h^*_{11}$ for families at the margin of $u^*_{10}(C,h) = u^*_{11}(C,h)$ (result 4). By the envelope theorem, changes near the optimum will be small; so when we compare h^*_{10} with h^*_{11} for families who are very close to this margin, the relationship $h^*_{10} < h^*_{11}$ should still hold.

I conclude that for a parent who is sufficiently close to the margin $u^*_{10}(C,h) = u^*_{11}(C,h)$ that a policy change would prompt her to change her decision as to whether her child should be left-behind, a decision to (not) leave the child behind as a result of a policy change would result in a decrease (increase) of her child's human capital.

6 Empirical test: Rural-specific government services and probability a child will be left-behind

I have shown that policy changes could influence parents' decisions about whether to leave children behind, and that changes to these decisions could support or undermine the effectiveness of an increase of governmental spending on rural children. However, if no families move as a result of policy changes then these effects may not be important.

The China Health and Nutrition Survey (CHNS) is an excellent resource for testing whether families become more likely to leave their child behind after an increase in governmental investment in rural non-migrant children (i.e., an increase in G_r). The CHNS is a longitudinal survey with nine waves of data collection over 1989 to 2011 which follows families in rural and urban areas of nine Chinese provinces (Guangxi, Guizhou, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Liaoning, and Shandong). The baseline sample of the CHNS included 3,795 households or 15,917 individuals, and the survey includes some information on availability and generosity of local government services and information

on family composition and migration. Tracking of changes in family members' migration status after policy changes is possible due to the longitudinal nature of the study and detailed survey questions about migration of parents and children in the past and present.[18]

To test whether an increase in G_r results in an increase in the number of left-behind migrant children, I consider the example of the New Cooperative Medical Scheme (NCMS), which provided low-cost government-sponsored health insurance for rural *hukou* residents people living in rural areas; this scheme has been discussed in section 2.2 as a policy change that increased G_r. As a result of the scheme, coverage of health insurance in rural areas increased substantially over 2003 to 2011 (see Figure 2). The rural locations sampled in the CHNS show a gradual phase-in of NCMS, such that about 20% of rural individuals surveyed had access to NCMS in their community in 2004, as compared with 64% in 2006 and over 90% in 2009 and 2011.

Before proceeding with estimation, I look for relationships between NCMS roll-out and observed determinants of migration from the Chinese literature [21, 90]. Selected pre-NCMS predictor variables for this analysis include cost and availability of local child care services for very young children (aged <3 years) and young children (aged 3-6 years); availability of public primary, middle and high schools within the community; average years of education among adults; average household size; health[19]; size of local migrant network[20]; remoteness[21]; and local wages for male and female workers. I find that in this data set, communities with more long-term migrant workers prior to NCMS tended to be more remote and were less likely to have a local high school. In addition, rural children were less likely to live with both parents when public or private child care was available in the rural area; there is also evidence that local education resources statistically predict whether parents and children live together. I find that NCMS was more likely to be implemented rapidly (by 2004) in communities with higher wages for a

[18] Questions related to migration include:

- *(For all people present in previous waves; parents and children can be linked)* Is this person still a household member? If no: What year and month did the person move out of the house? Where does this person live now? If yes: Does this person still live in the household? If not, how long has this person been away from home?
- *(For all children, to link the responses)* Who is the child's father? Who is the child's mother?

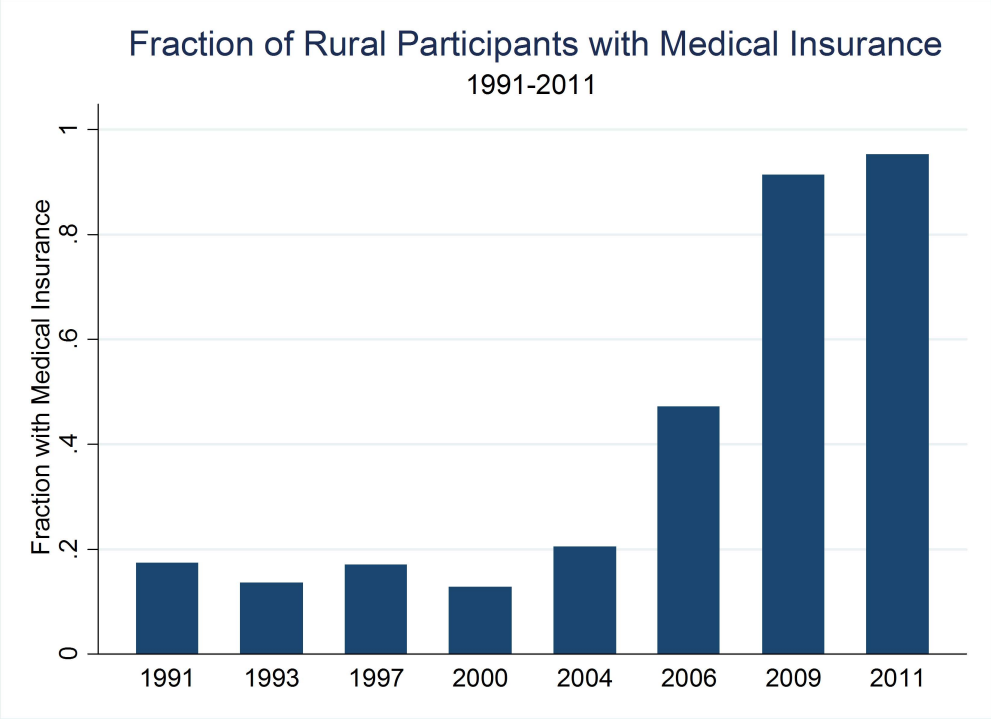
Matching standard definitions for two-parent households in China, I consider a child to be left-behind if there is evidence from any of the questions above that the child lives in the rural area and one or their parents has migrated away in a given year.

[19] Measured as prevalence of disease or injury in the last four weeks.

[20] Measured as fraction of adults who migrate for work for at least a month at a time.

[21] Measured as distance to the closest train station.

Figure 2: The New Cooperative Medical Scheme increased the availability of medical insurance for rural non-migrants starting in 2003 *(Source: Analysis of China Health and Nutrition Survey panel data)*



typical local male worker, and less likely to be implemented by 2006 if the community has a high school. I do not observe associations between timing of NCMS roll-out and measures of size of the migrant network, availability or price of child care for young children, remoteness of the community, wealth and education of local adults, presence in a model township, or health prior to NCMS. There was no evidence of selection in 2009 because roll-out of the program was nearly ubiquitous at this time. See Table 1. Although it is difficult to know that these positive results (6.7% of the tests) were not produced by Type 1 errors alone, I decide to use child-level fixed effects and cluster standard errors by community as a cautious approach.

Limiting the sample to children born in rural areas, I estimate the relationship between propensity of a child being left-behind and availability of NCMS using a panel-data regression following children over multiple years. I estimate four specifications of a linear probability model. From least conservative to most conservative, the specifications are: (a) a model with community-level fixed effects and child-level random effects, (b) a model with child-level fixed effects, (c) a model with child-level fixed effects and

community-specific time trends, and (d) a model with child-level fixed effects and community-specific time trends, plus controls for parents' years of potential work experience and years of education, two factors widely used as predictors of potential wages. See Table 2. In all cases, I cluster standard errors at the community level and control for the age of the child. Based on these regressions, I conclude that the number of left-behind children seems to have increased by about 5% as a result of NCMS implementation.

Table 1: Predictors of NCMS Roll-Out

VARIABLES	(1) NCMS Roll-Out by 2004	(2) NCMS Roll-Out by 2006	(3) NCMS Roll-Out by 2009
Distance from village to township seat	-0.04155	0.01649	0.00000
	(0.029)	(0.023)	(0.000)
Monthly cost of child care for children under 6	-0.00022	0.00016	0.00000
	(0.000)	(0.000)	(0.000)
Public or private child care available for children under age 3	-0.00629	-0.00189	0.00000
	(0.168)	(0.138)	(0.000)
Public or private child care available for children aged 3-6	0.14018	-0.03169	0.00000
	(0.127)	(0.102)	(0.000)
Daily wage for typical local male worker	0.02577*	0.02056	0.00000
	(0.015)	(0.013)	(0.000)
Daily wage for typical local female worker	-0.02420	-0.01313	0.00000
	(0.018)	(0.014)	(0.000)
Fraction of adults who migrate for work over 1 month	-0.00243	0.00406	0.00000
	(0.003)	(0.003)	(0.000)
Distance in km to nearest train station	0.00132	-0.00015	0.00000
	(0.001)	(0.001)	(0.000)
Village has a public primary school	-0.02187	-0.01908	0.00000
	(0.179)	(0.150)	(0.000)
Village has a public middle school	-0.03927	0.05548	0.00000
	(0.182)	(0.145)	(0.000)
Village has a public high school	-0.34221	-0.83271***	0.00000
	(0.391)	(0.274)	(0.000)
Average household income in 2009 yuan	0.00001	0.00000	0.00000
	(0.000)	(0.000)	(0.000)
Average years of education among adults (age 18+)	-0.02771	-0.00197	0.00000
	(0.030)	(0.022)	(0.000)
Fraction self-report sick or injured last 4 weeks	0.90824	0.66232	0.00000
	(1.112)	(0.898)	(0.000)
Village located in a model township	0.07183	0.10387	
	(0.162)	(0.120)	
Communities	71	77	91
R-squared	0.234	0.263	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2: Impact of NCMS implementation on child propensity to be left-behind

	(1)	(2)	(3)	(4)
Rural home has NCMS	0.10777***	0.04934***	0.05238***	0.05258***
	(0.005)	(0.014)	(0.015)	(0.014)
Constant	-0.10889	0.02250***	-7.90532***	16.42270
	(0.133)	(0.008)	(1.227)	(55.120)
Number of rural children	7,028	7,028	7,028	5,117
Control for child's age	1	1	1	1
Control for child-level fixed effects	0	1	1	1
Control for community-specific time trend	0	0	1	1
Control for parents' education and experience	0	0	0	1

Clustered standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

7 Conclusion

The healthy development of rural *hukou* children is of concern in the context of the large and growing income inequality in China. However, supporting the human capital development of rural children is challenging because Chinese social policy typically involves targeting government dollars to citizens according to their place of residence. That is, government dollars do not systematically follow children who move, and parents take this into account when making decisions about how to invest in their children and where their children should live.

In this paper, I analyze an economic model and find that although any increase in government support of children directly helps children, endogenous reactions of parents could reduce (increase) the beneficial effects of policies designed to help rural Chinese children if parents respond by increasing (reducing) numbers of left-behind children. This is a novel result that contributes to the literature in two ways.

First, although the application focuses on China, the results can be situated in a larger literature about the optimal design of government policies. In particular, endogenous migration effects discussed in the "welfare magnet" hypothesis [3, 7, 10, 43, 67] can actually *undermine* the effectiveness of a welfare policy if the people making decisions about migration (in my model, parents) are not the intended beneficiaries of the welfare benefits (in my model, children). In addition, because being left-behind involves a decrease in parental time but increase in parental money invested in children, the impact of being left-behind on children is not readily signed using theory alone [4, 63, 91]; as a result the most common analytical approach involves testing the impact of being left-behind on children's human capital empirically [24, 28, 33, 35, 38, 49, 53, 54, 55, 85, 88, 91]. In this context, my proof that becoming left-behind as a result of a policy change reduces the human capital of children provides a clarification that may be useful for subsequent analysis of policies with endogenous migration and left-behind family members.

Based on the theoretical results, I conclude that if many Chinese parents are near the margin of leaving children behind, migration effects could undermine the effectiveness of targeted government spending to support children in China's rural areas and imply that directly supporting migrant children (as in ongoing *hukou* reforms) may be a more effective method to support rural children. Whether meaningful numbers of rural Chinese parents are near the margin of leaving children behind is an empirical question, and one I explore using the roll-out of the New Cooperative Medical Scheme, a policy that provided government-sponsored health insurance only for rural non-migrants starting in 2003. Using panel data to construct a within-child analysis, I find that a child's chances of being left-behind significantly increased by about 5% as a result of this policy change, indicating that the number of Chinese parents near the margin of leaving children behind may be non-negligible. Based on these results, I conclude that once we factor in endogenous migration effects, increasing government investment in migrant children seems to be a more effective approach (and increasing government investment in non-migrant children a less effective approach) to support children's human capital development than was previously apparent.

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