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ABSTRACT

The Impact of Rural-Urban Migration on the Health of the Left-behind Parents*

Since the reform and opening up in 1978, China has begun a period of rapid industrialization and urbanization. Along with an increasing number of rural people migrating to urban area for jobs, there are a considerable number of elderly parents left behind in the rural area. The impact of migration of the adult children on the health of their left-behind parents is ambiguous. On the one hand, the additional income from the children's jobs can allow their parents to afford better health care and nutrition; on the other hand, the migration necessarily reduces the amount of time the children have to take care of their parents. This paper uses the Rural Urban Migration in China data to empirically investigate the effect of adult children's migration on the health of the left-behind parents. Based on a linear probability model with instrumental variable correction, we find that having one additional adult child migrated to an urban area increases the probability of the left-behind elderly parents being in poor health condition by about 8%. Furthermore, parents having only one child, from low-income households, or aged above 60 years are affected more. Our results point out that the parents with only one child is the most vulnerable group and highlight the importance of establishing a formal care system for the rural elderly to complement the traditional family care in rural China.

JEL Classification: O15, J14, I15

Keywords: left-behind parents, health, rural-urban migration, China

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I. Introduction

According to the 2000 Chinese census, 10.5% and 7% of the Chinese population are aged above 60 and 65, respectively, and China has become an aging society. The problem of aging is especially challenging in rural China. Between the 2000 and 2010 censuses, the aging population (age above 60) increased by 4% in rural China, compared with 2% in urban areas. In 2012, 194 million Chinese were older than 60, and they accounted for 14.3% of the total population; of these, 117 million were in rural China, and accounted for 17% of the total rural population (see Cai et al, 2012; Wu, 2013).

Traditionally, rural China has relied on the family for old age support, partly due to the lack of a social safety network and partly due to cultural tradition.

Along with the aging population, China has also been experiencing rapid urbanization. The share of urban population increased from 18% in 1978 to 46% in 2008. By the end of 2008, there were a total of 140 million rural-to-urban migrant workers; in 2014, this number increased to 168 million. The massive rural-to-urban migration inevitably has deepened the aging problem (Kuhn, 2001), eroded the foundation of traditional family support, and led to the presence of millions of left-behind parents in the rural areas. There were about 40 million such parents according to a news report in 2011 (Xinhua News Agency, 2011).[1]

Studying how the migration of the adult children affects the well-being of their left-behind parents is an important task.[2]

In principle the effect is ambiguous. On the one hand, the children who have

[1] Xinhua News Agency is a state-run news agency and one of the most authoritative news sources in China.
[2] In the literature, there are a handful of studies on the left-behind children in China, e.g. Zhang et al. (2014) on cognitive achievements, Zhao et al. (2014) and Zhou et al (2014) on education and school performance, and Mu and De Brauw (2015) on nutrition of the left-behind children, but there are almost no studies on the left-behind parents in rural China.

migrated to the city to work can remit money back home and positively affect the health of the left-behind parents (e.g., Stark and Bloom, 1985; Vanwey, 2004). Kuhn et al (2011) find that the children's migration indeed has a positive effect on their parents in Indonesia, but a simulation by Antman (2013) shows a migrated child does not necessarily improve the financial condition of the parents.

On the other hand, the rural-to-urban migration also has several possible negative effects on the health of the left-behind parents. One negative channel is through the classical model of time allocation (Becker, 1965; Grossman, 1972), i.e., the emigrated children have less time to take care of their parents. Another one is migration estranges parents and children (Hermalin and Myers, 2002), and thus makes the children less likely to take care of their parents (Kuhn, 2001). Both will worsen the health of the left-behind parents. A series of studies by Antman (2010, 2012, and 2015) indeed find such negative effect. The negative effect can be due to reduced time allocation to take care of the left-behind parents, as well as due to the increased the psychic cost of their left-behind parents resulting from their children's emigration.

In this paper, using a rich data set, the Rural Urban Migration in China (RUMiC), we empirically investigate the impact of rural-to-urban migration on the health of the left-behind parents. Our approach here is similar to that of Antman (2010, 2015), who studied how the migration of the children from Mexico to the United States affected their left-behind parents.

One potential obstacle to establishing the causal effect of children's migration on the health of their parents is reverse causality. Giles and Mu (2007) found that the health of the parents affects their children's migration decision in China. To address this issue,

we rely on the instrumental variable approach to correct for simultaneity bias.

We use self-reported health status (SHS) as the main measurement in this study; in addition, we explore the mental health as well as illness of the left-behind parents.

Our results suggest that having adult children who migrated to an urban area significantly increases the probability of the left-behind elderly parents being in poor health condition; one additional migrated adult child increases the probability of his or her parents' being in poor SHS significantly, by about 8%. Furthermore we find that parents who are from low-income households, or are more than 60 years old are affected more.

In particular, we find that the parents with only one child are the most vulnerable group. The SHS of these parents is 43.7% more likely to be poor if their only child migrates. Risk-sharing in a larger household, the tendency of bigger families to have someone at home to take care of the parents, and the siblings' interaction in migration decision as discussed in Stohr (2015) are possible explanations. Because of the family planning policy, the size of this group is likely to increase very rapidly. Household size in the rural China has decreased from 3.61 in 2004 to 3.19 in 2013. This highlights the importance of establishing a formal care system for the rural elderly to complement the traditional family care in rural China.

Our results also show that the migration of adult children adversely affects the mental health of the parents, but not the illness of the left behind parents.

The remainder of the paper is as follows: Section 2 introduces the institutional background; Section 3 describes the data and main variables; Section 4 outlines the econometric framework, discusses our choice of instrumental variables, and presents empirical results; and Section 5 concludes the paper.

II. Institutional Background

China started economic reform in1978 and it has enjoyed rapid economic growth for more than three decades, but there is still significant segregation between rural and urban population. This segregation has been legally enforced by the household registration (*Hukou*) system since the 1950s, and was intensified in the 1960s following the failure of the Great Leap Forward and the devastating famine in the late 1950s. The more profound reason behind this segregation was the Chinese government's urban-biased and heavy-industry-biased development strategy beginning in the 1950s. The farmers were considered by the government as an important resource to facilitate this distorted macro policy, and it was necessary to tie them to the land to provide cheap agricultural products to the industrial sector and urban areas (see Lin, Cai, and Li, 1994).

This segregation generated striking disparity between rural and urban population in multi-dimensions. Figure 1 shows significant income difference between rural and urban people. The ratio of urban to rural per capita income was about 2.6 in 1978 and increased to around 3.3 in 2010.

----Figure 1----

Besides income, the rural population in China does not enjoy the same level of other social benefits. Two notable benefits are health care insurance and pension.

Before the economic reforms, a village-based Cooperative Medical Scheme (CMS) covered 90 percent of rural residents and was their primary channel for accessing basic health care services. Along with the economic reform since 1978 and the transition from the collective commune system to the "household responsibility system", the CMS collapsed in most rural areas because it lost its main financial support from the collective

commune welfare fund. The health insurance coverage rate dropped dramatically from 90% in 1980 to 5% in 1985 (Liu and Cao, 1992). Since then, most rural residents have remained uninsured. This situation did not change until the Chinese government began to implement a nationwide project known as the New Cooperative Medical Scheme (NCMS) in rural China in 2003. By 2010, the NCMS covered 835.6 million rural residents, nearly two-thirds of the Chinese population. Though the health insurance coverage in rural area has increased drastically, the objective of the NCMS is to provide low-cost basic health care services, and the benefit level is considerably lower than its urban counterpart.

During the 1950s through the 1970s, China's formal pension scheme mainly covered urban workers, while the rural residents did not have any pension coverage and mainly depended on their families for old-age support (Shi, 2006). This situation remained basically unchanged until 2009; there were over 90 percent of the rural elderly did not have any pension coverage in 2007 (Shen and Williamson, 2010). Aiming at providing basic social security for rural residents, the government launched a nationwide rural pension program, the New Rural Pension Scheme (NRPS), in 2009. The program rolled out very quickly, and by 2012, it covered all counties. The pension benefit varies by county, but a national guideline stipulates that the basic benefit is only 55 Chinese Yuan (about 9 US Dollar) per month, which is obviously quite low.[3]

As a consequence of the segregation, the yearly average migration rate for China was only 0.24, compared with world average of 1.84 from 1950 to 1990 (Zhao, 2000). The urbanization process was severely hindered: at 11.7% in 1949 and only increased by less than 3% to 14.5% in 1978 (Wu, 1994).

After the China economic reform, the Household Responsibility System (HRS)

[3] Both the NCMS and the NRPS are voluntary programs.

eventually replaced the collective production-team system. The HRS returned some degree of personal freedom to the rural people, increased their productivity, led to the availability of food in the urban free market, and generated surplus labor in rural areas (Zhao, 1999).

In the urban areas, the creation and development of the special economic zones, the expansion of the non-state sector and the loosening of the urban employment policy created the demand for migrants (Meng and Zhang 2001). The shift of the development strategy from capital-intensive industries towards more labor-intensive industries has also created more jobs in the urban areas.

All of these factors made the migration from rural to urban possible and necessary. Since the mid and late 1980s, rural to urban migration became a constant social phenomenon. The exact number is disputable (see, e.g. Rozelle, et al, 1999), but numbers cited in Sicular and Zhao (2002) indicate that the quantity of rural to urban migration doubled between late 1980s and mid 1990s, where in 1989 the migrants were 8.9 million and in 1994 increased to 23.0 million. Cai (1996) estimated that there were 34.1 million migrants based on the 1990 census. According to the National Bureau of Statistics, by the end of 2008, there were a total of 225 farmer-turned-workers, and among them 140 million were migrant workers, i.e. not commuting between home and workplace.

III. Data and Key Variables

1. Data Set

The data set used in this paper is the Rural Urban Migration in China (RUMiC), which is a joint scientific endeavor by the Australian National University, University of Queensland, Beijing Normal University, and Institute for the Study of Labor (IZA). The

RUMiC survey includes 8000, 5000, and 5000 rural, urban, and migrant households, respectively. More detailed information on this survey can be found in Akgüç, Giulietti, and Zimmermann (2014).

For the purpose of this study, we use the first two waves of the survey and restrict our study sample to rural households. The first two waves of the survey conducted in 2008 and 2009. Depend on the variables, some of them are based on the information of previous year, such as health insurance status of the family members, other variables are on current state, e.g. self-reported health status. The survey of the rural sample covers eight provinces (Jiangsu, Zhejiang, Guangdong, Hebei, Hubei, Anhui, Henan, and Sichuan), plus one provincial-level municipality (Chongqing). Though it is not a national sample, this rural sample is representative of the rural population in these nine provincial areas, and these areas are the main labor-force-exporting areas in China. .

In our study sample, we restrict ourselves to the households containing both adult children and parents, and we focus on the household heads and their spouses; we further restrict the sample to parents whose age is above 50 and delete observations with key missing variables. The main sample includes 3,169 households and 5,391 parents.

2. Dependent Variable

Measurement of health status is crucial for our research. In the literature, there are many measures, including quality-adjusted life years (see Cutler and Richardson, 1997), disability-adjusted life years (see World Bank, 1993), and the quality of well-being scale (see Kaplan and Anderson, 1988). Field and Gold (1998) provide an excellent survey. In this paper, we construct health measures from the second wave of the RUMiC data. We use the SHS as our main measurement. In the survey, it is determined by the following

question:

"Your current state of health (compared to people at the same age as you)

① Excellent ② Good ③ Average ④ Poor ⑤ Very Poor"

Compared with continuous measures, this indicator has several advantages. First, the SHS is a composite indicator that can reflect health status more comprehensively. Second, though this measure is not perfect, many studies have shown that the SHS can effectively predict mortality, loss of functional ability, sick leave, and other objective health indicators (Mossey and Shapiro, 1982; Kaplan and Camacho, 1983; Idler and Kasl, 1995). Third, the SHS is simple and easy to obtain. Currently, in a developing country like China, it is difficult to obtain detailed data to construct other comprehensive health indicators. Fourth, one advantage of categorical measures is that in some degree they can mitigate the measurement error problem, since only order matters. Notable studies using the SHS include Case, Lubotsky, and Paxson (2000) and Currie and Stabile (2003).

Panel A of Figure 2 shows the corresponding frequency distributions separately for parents with and without migrating adult children. We can see that the SHSs of the parents without migrating children are better.

----Figure 2----

In order to facilitate quantitative analysis, interpretation and further mitigate measurement error, following the practice of Li and Zhu (2006), we further group the SHS into two categories, namely, we treat "Excellent" and "Good" as one category and code it to 0, and treat "Average", "Poor", and "Very Poor" as the other category, and code it to 1.[4] The distribution based on the two categorical SHSs is shown in panel B of

[4] We also experimented with ordered probit and LPM models based on the original five categorical SHS, and the results are qualitatively similar.

Figure 2. As in panel A, the parents without migrating children have better SHSs.[5]

Besides the above main measurement, we also investigate two additional health measurements. One is mental health. For the mental health, we based on the 12 questions of the General Health Questionnaire and use the Likert scoring method. The lowest score is 12 and highest is 48, and the higher score indicates poorer mental health.

The other is the illness of the left behind parents. This measure is directly from the following question in the survey:

"Were you sick or injured in the last three months? (including chronic or acute disease) ① Yes ② No"

We use "1" indicate Yes and "0" No in the paper.

3. Independent Variables

Our independent variables are from the first wave of the RUMiC. The key independent variable is the number of migrated adult children in the household.[6] A migrant is defined as an person aged above 18 who migrated for more than three month for the purpose of work or doing business in 2007. Besides that variable, the health of the parents could be affected by many other factors. In order to avoid bias from omitted variables, we control a rich set of variables in our empirical models. Table 1 presents descriptive statistics for these key variables.

----Table 1----

We first include the personal characteristics of the parents. The variables include age and its square, gender, marital status, level of education, health insurance status, and

[5] As in Figure 2, the binary SHS in Table 1 also shows that parents with migrating children have worse health.

[6] Our definition of left-behind parents differs from the one in Connelly and Maurer-Fazio (2015). We treat parents with 1 or more migrant adult children as left-behind parents, disregard if there are still other family members remain in the household or not. So their approach highlights binary scenario, and our approach captures marginal effect from one additional migrant adult child.

labor market variables. Age captures the depreciation of the health capital of the parents. Education is an important contributor to health, as discussed in Grossman (1972): a higher level of education may be beneficial to health production. Health insurance allows insured individuals to reduce their health expenditure and to improve their health status through the input of health care.

The second group of controls is household characteristics. This group of variables includes household size, household income, and number of grandchildren in the household. Household size may reflect the degree of risk and resource sharing within the household. Following the study of Gertler et al. (1987), we also include per capita household income as an explanatory variable, since the average household income is less sensitive to individual health status than individual income, and in any case it is hard to calculate individual income in rural China. Grandchildren are possible able to provide companionship to the left-behind parents and alleviate their loneliness, so we include the number of grandchildren in the model. In this part, we also have information on the types of toilet. We divide the toilets into three types: flush toilet, dry latrine, and no toilet in the household.

The last group of variables we control for is village-level variables. The first category is health accessibility, and for this purpose we use whether the village has a medical facility, such as medical station, private clinics, or a doctor. The second category is the sanitary environment of the village, viz., the type of drinking water source. We have five categories: running water, deep well water, shallow well water, river & lake, and others.

Finally, we control for lagged health status from the first wave; and we include

the provincial dummies to control for province-level fixed effects.[7]

4. Instrumental Variables

As discussed before, the health of the parents might affect the migration decision of their children (Giles and Mu, 2007). In order to address the bias arising from this simultaneity, we apply an instrumental linear probability model (IV-LPM) as our main empirical approach.

We choose the interaction of migration probability at village level with the number of adult male children in the household as our instrumental variable, and will discuss the rationale for this choice in next section.

IV. Empirical Strategy and Results

1. Empirical Strategy

Since our main dependent variable is a binary SHS, our analysis is based on a linear probability model (LPM): [8]

$$health_i = \alpha + \beta M_i + X_i\gamma + \varepsilon_i \quad (1)$$

where ε_i is a random error. In our data, we observe $Health_i$, a binary SHS of the parents; $Health_i = 1$ indicates poor health, and 0 good health. M_i is the variable of our interest; it is the number of migrant adult children in the household, and its coefficient β captures the marginal effect of one additional child's migration on the health status of the left-behind parents.

X_i are other control variables as discussed in the previous section, including the characteristics of the parents, the household, the community, lagged health status, and

[7] We do not control for village dummies, instead we control for a host of village characteristics, since there are too many villages; and the coefficients of the village characteristics are also informative.

[8] We also estimate IV-Probit model, and the results are similar. Compared with IV-Probit model, the coefficients of the LV-LPM directly reflect marginal effect and are easy to interpret.

provincial fixed effects. The SHS was measured in the second wave, and the number of migrant adult children was measured in the first wave.

2. The Choice of the Instrumental Variables

To address the possibility of reverse causality, we apply the IV method, and our main results are based on an IV-LPM model.

It is important to discuss how we choose the IVs. The IVs should be significantly correlated with M_i, the number of migrant adult children in the household, but have no correlation with ε_i. One possible IV is migration probability at the village level. As suggested by Mansuri (2006), we choose the interaction of the village-level migration probability with the number of adult male children in the household as the IV. The rationale of our choice is as follows.

First, we note that many studies have found that social networks are closely related with the migration behavior of the household members. For examples, Massey et al (1993) pointed out that the social network can provide useful information on the destination of potential migrant workers; Munshi (2003) demonstrated that the social network can improve the economic return of migrant workers; theoretical work by Calvo-Armengol and Jackson (2004) shows that the social networks can reduce migration and job search costs; All these studies indicate that the social network increases the probability of migration. The RUMiC data, the data set used in this paper, also shows that about half of the migrants find their job through social network. Therefore, for households in a village with a richer experience of migration, their members will have a higher probability of migration.

Following the practice in the literature, utilizing a village-level survey in the

RUMiC, we construct a variable which measures the proportion of the adult migrants in the village as our IV. This IV surely is correlated with the number of migrant adult children in a household, but is unlikely to correlate with the health of the parents at the individual household level.

Second, although our IV is unlikely to correlate with unobserved household characteristics, it is possible that it correlates with health status at the village level as well as with unobserved village characteristics. To solve this problem, we need to construct an IV which varies across villages as well as across households. To construct an IV varying with households, we look at the characteristics of the households. In rural China, women generally take care of the household chores, and men are more likely to participate in farm activities. If the household has only one adult male, he is unlikely to migrate to an urban area. In fact, among the households with only one adult male, only 40% have lost one or more members to migration, compared with more than 50% of households have migrant household members for the whole sample.

Nonetheless, for a valid IV, we also need to know that the number of adult male children in the household is not correlated with the health status of the parents. In Table 2, we informally test if this argument is supported by the data. The results show that after controlling other household characteristics, the number of adult males has no effect on the SHS of their parents.

----Table 2----

Last, as Bound, Jaeger, and Bake (1995) pointed out, it is necessary to test whether an IV is weak or not, since weak IVs can do more harm than good in a finite sample. Table 3 is the first stage of our estimation, and it shows that our IV has a

significant positive effect on the number of migrated children in the household. The *F*-statistics are well above 10; this indicates that weak IV is not a problem in this study.

----Table 3----

However, we admit that the validity of the exclusion restriction of an IV is impossible to test. In the migration literature, another often used IV for migration decision is some exogenous shocks at village level, such as rain fall; however, in our research context such shock is likely to directly affect the well-being, e.g. health status, of the left-behind household members, and is unlikely to be valid.

Giles and Mu (2007) find that the poor health of the parents negatively affects the rural-to-urban migration decision of their children. Given their finding, the OLS estimates in our paper are downward bias. After correcting the bias, we find that our IV estimates are consistent with Giles and Mu (2007) reversed causality story.

3. Main Results and Robustness

In this section, we summarize our main findings. Table 4 presents estimates from both PLM and IV-PLM models. The key variable is the number of adult migrant children, as discussed before.

----Table 4----

The effects of the key variable are significantly positive for both LPM and IV-LPM models (columns 1 and 3). Remember that 1 indicates a worse SHS, so the results show that migration has a negative effect on the health of the left-behind parents. One migrant adult child increases the likelihood that the parents' SHS is bad by 2 or 8 percent, depending on the model. It is possible that this effect depends on the number of adult children in the household, and we will discuss this issue in the next section.

After closely examining the estimates from both models, we find that the one from the LPM model is smaller (2% compared with 8%), which is consistent with the reserve causality story.[9] The result from the IV-LPM is less significant, which is marginally significant at 5% level. This is not surprising, since IV estimation generally results in larger standard errors.

Among the other important factors, we find that the role of education is in general insignificant, except the ones with 14-year of education and above. One possible reason is that the education level of the old population in the rural area does not vary much.

Marital status and age are not important, either. There is a considerable gender effect. A mother is 4% more likely than a father to be in bad health (columns 1 to 4); however, the interaction term between female and the number of adult migrant children is insignificant (columns 5 to 8).

Both higher per capita income of the household and a bigger household are associated with better health of the parents. For the former, it is likely that the richer household can afford better health care. For the latter, one possible rationale is that the bigger the household, the more able it is to share risk and to alleviate a negative health shock; at the same time, in a bigger household, even if a child has migrated to the urban area, it is more likely that there is someone to take care of the left-behind elderly.

In Appendix Table 1, we experiment different specifications. This exercise serves two purposes. One is to check if the results from our base model are robust; the other is to examine if the children's migration affects their parents' health through the household income.

[9] The significant 2% estimated from the OLS can be treated as the lower bound of the impact of the adult children's migration on the health of the left-behind parents.

First, we exclude household per capita income from the control variables (columns 3 and 4). The estimated coefficient of the number of migrant children remains virtually unchanged compared with the base model (see columns 1 and 2, which is copied from columns 3 and 4 of Table 4). It might imply that the additional household income from the children's migration is not an important channel.[10]

Next, we exclude working status of the parents alone (columns 5 and 6), working status plus the household per capita income (columns 7 and 8). Results from these two specifications are very similar to one from our base model.

Last, we exclude working status of the parents, household per capita income and household size (columns 9 and 10). The estimate remains significant but somehow decreases a bit.

4. Heterogeneous Effects

Our main results show that there are considerable differential effects between females and males and along the dimensions of household size and household income. In this section, we look into the heterogeneous effects on several important dimensions: gender, age, household size, income level, and whether a parent is a household head or not. These results are summarized in Table 5, and we focus on the estimates from IV-PLM.

----Table 5----

Panel A shows results separately by male and female. Though in the pooled regression the mother is more likely to be associated with bad health, the results based on separated samples do not show significant differences between mother and father. One

[10] In Appendix Table 2, we investigate the association of the children's migration and the household per capita income. The result shows that an additional adult child migrant is associated with less than 2% increase in the household per capita income. Of course, we should not interpret this association as causality.

explanation is the gender difference does not go through the children's migration channel, as shown in columns (5) and (7) in Table 4, the interaction term between female and the number of adult migrant children is insignificant.

In our main regression the age effect is insignificant, and this is counterintuitive. To further explore the role of age, in panel B we divide the sample into two parts: the ones with age below 60 and the rest. The results are very different. Having an additional child migrated has no significant effect on the SHS of the younger left-behind parents, but significantly increases (by 17.8%) the likelihood for the older ones (age above 60) to have poor health status. This is reasonable. First, the relatively young parents are likely to be still in good health and able to do some household chores, so that the migration of their children may have little impact on their health. If parents are relatively old, they are more likely to be in bad health and need to be cared for by their children, and then the impact may be more significant.

Now we turn to the role of family size. As discussed earlier, first, the bigger a household is, the more able it is to share risk and mitigate negative health shocks. Second, in the bigger household, even if some child has migrated to the urban area, there is still someone at home to take care of the elderly in the household (also see the discussion in Antman, 2012 and Stohr, 2015). In panel C we divide the sample into parents with only one child and with more than one child. The results are strikingly different. For the parents with only one child, the migration of the only child significantly affects the health of the left-behind parents; the SHS of these parents is 43.7% more likely to be poor. But for the parents with more than one child, the migration of their children has insignificant effect. This finding has important policy implications. Because of the family planning

policy, the size of parents with only one child is likely to increase very rapidly. From 1978 to 2013, the national household size has decreased from 4.66 to 3.03, and household size in the village has decreased from 3.61 in 2004 to 3.19 in 2013, see Figure 3.[11] It is important and urgent to establish old age support system to complement the traditional family care in rural China, though the traditional family-based support still plays an important role in rural China (Cheng et al. 2015).

----Figure 3----

It is possible that the income level of the household also plays a role. For example, a rich household can hire someone to take care of the left-behind parents if the adult children are away, and this will alleviate the impact of children's migration on the health of the parent. In order to explore this issue, we divide the households into two groups according to the median per capita income. Panel C indeed shows that the parents from the lower-income households suffer more. However, when we interpret this result, we should note that the household income is an endogenous variable itself, and can be influenced by the migration of the household members.

Last, we investigate if the household head plays a role. A household head may play a leading role and share more responsibility in the household. If an adult child migrates out, the left-behind household head needs to share more burdens than her/his spouse, and this could adversely affect her/his health more. In panel E, we find that the household head in fact suffers more health loss.

Overall, our results suggest that the migration of the adult children has larger adverse effects on parents who are older, have only one child, are from a poor household,

[11] The household size was 4.33 in 1953, kept increasing and peaked at 5.05 in 1975, and started to decrease from then on. The initial increasing was likely due to the baby boom after the end of the civil war.

or act as a household head.

5. Other Health Measures

Besides the SHS, we also examine the relationship between children's migration and parental health using other measures. One is mental health, which is based on the 12 questions of the General Health Questionnaire. Using the same data set, Akay et al. (2012) applies this measurement to study the subjective-well being of the rural-to-urban migrants. The other is a binary variable indicates if an observation was sick or injured in the last three months.

----Table 6----

Table 6 summarizes the results based on these two measurements. From both OLS and IV-PLM, we can see that the children's migration and parents' mental health have a significantly negative relation at 10% level. This is consistent with the story of Antman (2015). However, there is no significant effect of children's migration on the sickness of their parents. One possible reason is that it take longer time for the children's migraing having an impact on the physical health of their parent.

V. Conclusions

Using the rural sample of the RUMIC data, we apply IV-LPM model to investigate if the adult children's migration adversely affects the health of their parents.

After correcting possible bias from reverse causality, we find that having children migrated to urban area indeed increases the probability of the left-behind elderly parents being in poor health: one additional migrated adult child increases that probability by about 8%. Though in theory it is possible that a migrated child can improve the health of his/her parents by send back more money, our study suggest that having someone at

home to take care of the elderly is more important, especially for poor households.

The above argument is also supported by our heterogeneous effects analysis. After dividing the sample into parents with only one child and with more than one child, we find that only the parents with one child suffer significantly; the SHS of these parents is 43.7% more likely to be poor if their only child migrates. Risk-sharing in a larger household, the tendency of bigger families to have someone at home to take care of the parents, and the siblings' interaction decision are possible explanations. This result shows that the parents with only one child are the most vulnerable group. Because of the family planning policy, the size of this group is likely to increase very rapidly, and that highlights the importance of establishing formal care for the rural elderly to complement the traditional family care in rural China.

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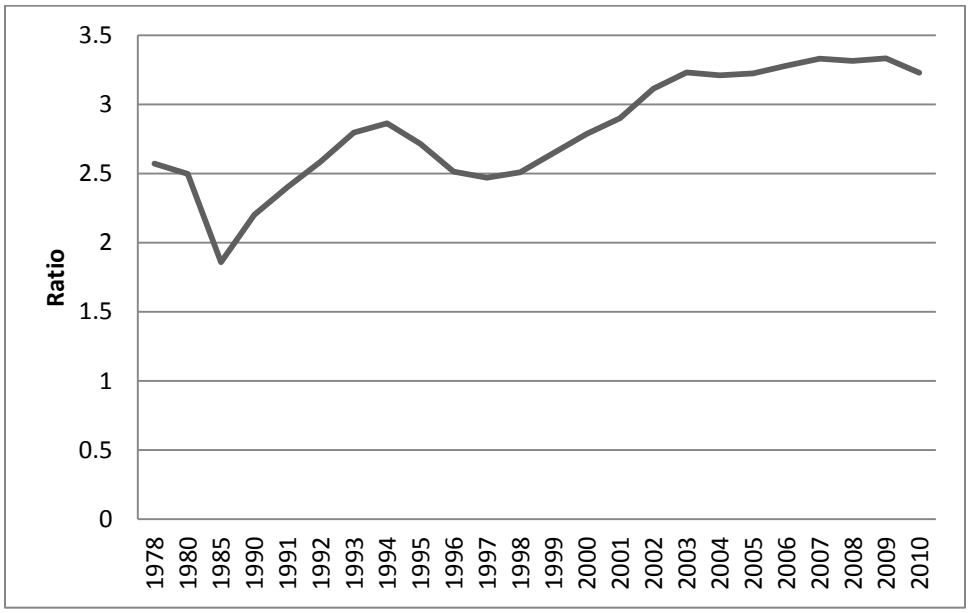
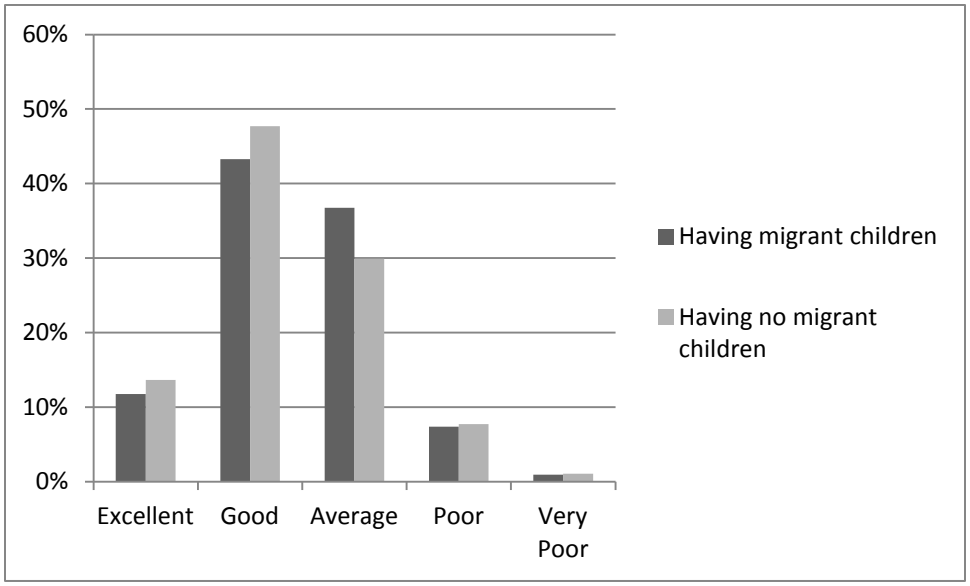
Figure 1. Ratio of Urban to Rural per Capita Income in China



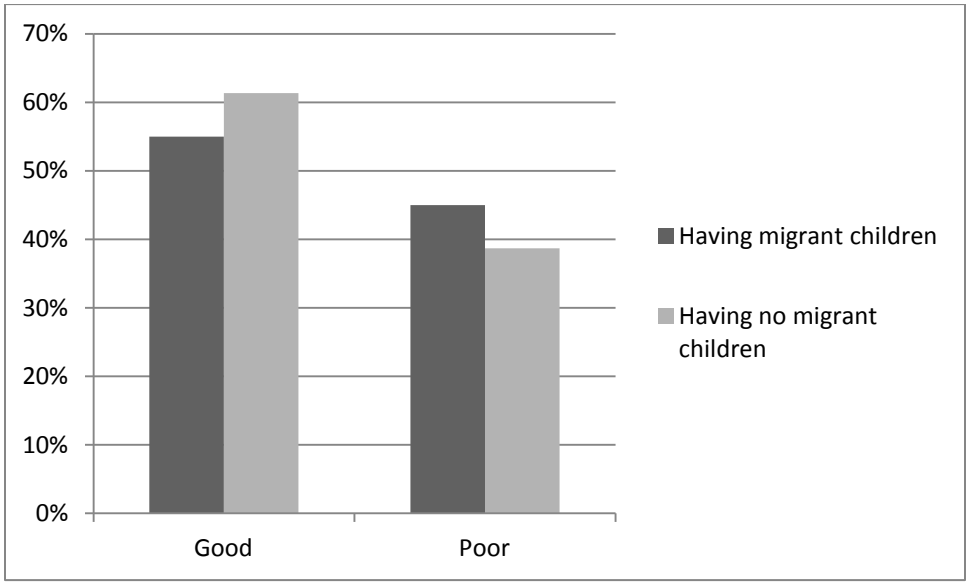
Data Source: China Statistical Year Book (2011)

Figure 2. Self-Reported Health Status

Panel A. Self-Reported Health Status: Five Categories



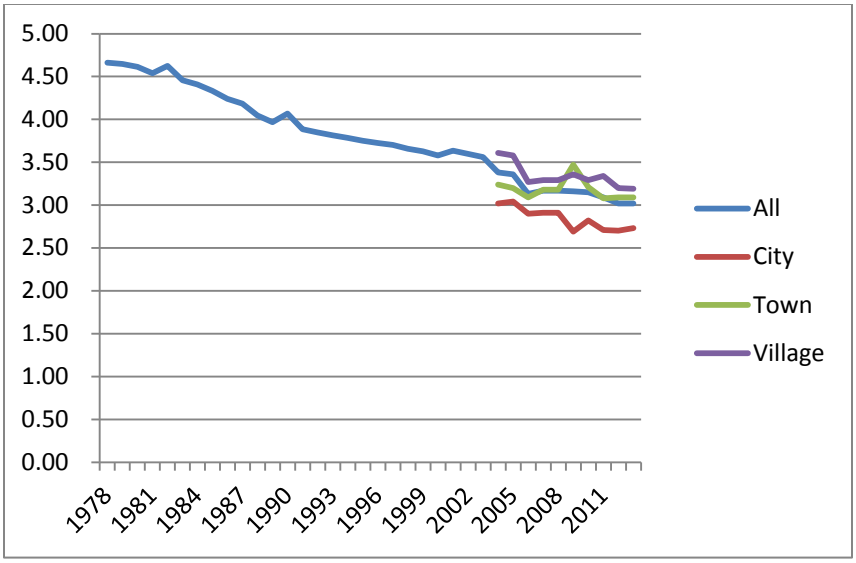
Panel B. Self-Reported Health Status: Two Categories



Notes: 1. Authors' calculation from the Rural Urban Migration in China Survey.

2. In panel B, we group the SHS into two categories, namely, we treat "Excellent" and "Good" as "Good", and treat "Average", "Poor", and "Very Poor" as the "Poor".

Figure 3. Household Size in China: 1978 to 2013



Data Sources: Data before 2004, China Population Yearbook;
Data from 2004, China Population and Employment Yearbook

Table 1. Summary Statistics of Main Variables

Variables	Total Sample		Sample without Migrant Children		Sample with Migrant Children		
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	
Self-reported health status (dummy, 1 indicates poor health)	0.419	0.493	0.387	0.487	0.450	0.498	***
Number of migrant adult children in the household	0.785	0.942	0.000	0.000	1.533	0.766	***
Number of adult male * Migration rate at village	0.441	0.334	0.348	0.299	0.529	0.342	***
Female (dummy)	0.457	0.498	0.450	0.498	0.464	0.499	
Age	57.337	5.773	57.402	6.056	57.275	5.490	
Age squared	3320.855	707.291	3331.655	749.248	3310.574	664.874	
Education level: 0 years	0.129	0.335	0.124	0.330	0.134	0.340	
1–6 years	0.473	0.499	0.471	0.499	0.476	0.500	
7–9 years	0.333	0.471	0.338	0.473	0.329	0.470	
10–13 years	0.062	0.242	0.064	0.245	0.060	0.238	
14 years and above	0.002	0.045	0.003	0.055	0.001	0.033	
Married (dummy)	0.956	0.206	0.947	0.224	0.964	0.186	***
Have medical insurance (dummy)	0.990	0.100	0.987	0.115	0.993	0.083	**
Working status (dummy, 1 indicates working)	0.810	0.392	0.768	0.422	0.851	0.356	***
Annual working days	181.411	113.036	178.895	118.838	183.806	107.188	
Log household per capita income (Chinese Yuan per year)	8.625	0.588	8.669	0.630	8.584	0.542	***
Family size (number of household members)	4.709	1.402	4.582	1.294	4.829	1.489	***
Number of grandchildren in the household	0.656	0.807	0.620	0.773	0.690	0.836	***
Have health facility in village (dummy)	0.921	0.269	0.910	0.286	0.932	0.252	***
Toilet/latrine: Have flushing toilet (dummy)	0.312	0.463	0.382	0.486	0.245	0.430	***
Have dry latrine (dummy)	0.639	0.480	0.564	0.496	0.711	0.454	***
No toilet/latrine (dummy)	0.049	0.216	0.054	0.225	0.045	0.206	
Water sources: Tap water (dummy)	0.424	0.494	0.535	0.499	0.319	0.466	***
Deep phreatic water (dummy)	0.392	0.488	0.313	0.464	0.467	0.499	***
Shallow phreatic water (dummy)	0.161	0.368	0.137	0.344	0.184	0.387	***
River/lake water (dummy)	0.014	0.119	0.008	0.087	0.021	0.143	***
Other water source (dummy)	0.009	0.092	0.007	0.085	0.010	0.098	
Number of observations	5391		2629		2762		

Notes: 1. Data Source: the Rural Urban Migration in China Survey. Except the self-reported health, all other variables are from the first wave.

2. Self-reported status is coded from the original five-categorical variable, and we treat “Excellent” and “Good” as one category and code it to 0, and treat “Average”, “Poor”, and "Very Poor" as the other category, and code it to 1. This variable is from the second wave of the data and refers to health status in 2009.

3. A migrant child is defined as who was older than 18 and migrated for more than three month for the purpose of work or doing business in 2007.

4. All individual level variables are for the parents; toilet type and water source type are defined at village level. Except the SHS

5. Last column indicates t-test for two-group means. *** Significant at 1%, ** Significant at 5%, * Significant at 10%.

Table 2. Number of Adult Males on Self-Reported Health Status of the Parents

Variables	(1) Coefficient	(2) Standard Error
Number of adult males in the household	-0.007	0.011
Lagged self-reported health status (dummy)	0.431***	0.014
Female (dummy)	0.043***	0.014
Age	0.010	0.013
Age squared/100	-0.004	0.011
Reference group: No education		
Education level 1–6 years	-0.008	0.020
Education level 7–9 years	-0.017	0.022
Education level 10–13 years	-0.023	0.030
Education level 14 years and above	-0.236**	0.098
Married (dummy)	0.022	0.031
Have medical insurance (dummy)	0.056	0.054
Working status (dummy, 1 indicates working)	-0.028	0.018
Annual working days/100	-0.005	0.006
Log household per capita income (Chinese Yuan per year)	-0.033***	0.011
Family size (number of household members)	-0.010	0.008
Number of grandchildren in the household	0.010	0.013
Have health facility in village（dummy）	-0.030	0.024
Reference group: No toilet/latrine (dummy)		
Flushing toilet (dummy)	0.025	0.030
Dry latrine (dummy)	0.020	0.030
Reference group: Other water source (dummy)		
Tap water (dummy)	-0.041	0.061
Deep phreatic water (dummy)	-0.045	0.060
Shallow phreatic water (dummy)	-0.043	0.061
River/lake water (dummy)	0.084	0.083
Provincial dummies	YES	
Constant	0.225	0.436
Adj. R-squared	0.219	
Number of observations	5370	

Notes: 1. ***Significant at 1%, ** Significant at 5%, * Significant at 10%.

2. For data source and variable definitions please refer to notes in Table 1.

Table 3. First Stage

Variables	(1) Coefficient	(2) Standard Error	(3) Coefficient	(4) Standard Error
Number of adult males × Migration rate at village	0.739***	0.037	0.466***	0.046
Lagged self-reported health status of the parents			0.065**	0.025
Female (dummy)			0.049*	0.026
Age			0.078***	0.026
Age squared/100			-0.062***	0.021
Reference group: No education				
Education level 1–6 years			0.018	0.039
Education level 7–9 years			0.042	0.043
Education level 10–13 years			0.035	0.063
Education level 14 years and above			-0.475***	0.165
Married (dummy)			0.085	0.053
Have medical insurance status (dummy)			0.318***	0.104
Working status (dummy, 1 indicates working)			0.214***	0.033
Annual working days/100			-0.025**	0.012
Log household per capita income (Yuan per year)			0.049**	0.020
Family size (Number of household members)			0.130***	0.017
Number of grandchildren in the household			-0.176***	0.030
Have health facility in village (dummy)			-0.013	0.042
Reference group: No toilet/latrine (dummy)				
Flushing toilet (dummy)			0.030	0.061
Dry latrine (dummy)			0.235***	0.060
Reference group: Other water source (dummy)				
Tap water (dummy)			-0.010	0.120
Deep phreatic water (dummy)			0.185	0.117
Shallow phreatic water (dummy)			0.079	0.118
River/lake water (dummy)			0.594***	0.174
Provincial dummies	No		Yes	
Constant	0.460***	0.021	-3.580***	0.823
Number of observations	5389		5370	
F-statistics	397.480		52.060	
Adj R-squared	0.069		0.214	

Note: 1. ***Significant at 1%, ** Significant at 5%, * Significant at 10%.

2. For data source and variable definitions please refer to notes in Table 1.

Table 4. Effects of Number of Migrant Children on Self-Reported Health Status of Left-behind Parents

Variables	PLM		IV-PLM		PLM		IV-PLM	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
Number of migrant children in the household	0.020***	0.007	0.080**	0.041	0.012**	0.009	0.113*	0.068
Lagged Self-reported health status	0.429***	0.013	0.425***	0.014	0.429***	0.013	0.424***	0.014
Female (dummy)	0.042***	0.014	0.040***	0.014	0.028	0.017	0.097**	0.049
Number of Migrant Children*Female					0.018	0.013	-0.073	0.062
Age	0.009	0.014	0.004	0.014	0.009	0.014	0.002	0.015
Age squared/100	-0.003	0.011	0.001	0.000	-0.003	0.011	0.002	0.011
Reference group: No education								
Education level 1–6 years	-0.009	0.020	-0.009	0.020	-0.008	0.020	-0.011	0.020
Education level 7–9 years	-0.018	0.022	-0.020	0.022	-0.017	0.022	-0.024	0.023
Education level 10–13 years	-0.023	0.031	-0.025	0.030	-0.022	0.031	-0.030	0.031
Education level 14 years and above	-0.227*	0.134	-0.196*	0.103	-0.228*	0.134	-0.192*	0.105
Married (dummy)	0.022	0.030	0.019	0.032	0.022	0.030	0.017	0.032
Have medical insurance (dummy)	0.048	0.060	0.026	0.057	0.048	0.060	0.024	0.057
Working status (dummy, 1 indicates working)	-0.032*	0.017	-0.046**	0.020	-0.033*	0.017	-0.041**	0.019
Annual working days/100	-0.004	0.006	-0.002	0.006	-0.004	0.006	-0.001	0.007
Log household per capita income (Yuan per year)	-0.034***	0.011	-0.037***	0.011	-0.034***	0.011	-0.038***	0.011
Family size (number of household members)	-0.016**	0.007	-0.026***	0.010	-0.016**	0.007	-0.027***	0.010
Number of grandchildren in the household	0.017	0.012	0.029*	0.015	0.017	0.012	0.031*	0.016
Have health facility in village (dummy)	-0.028	0.023	-0.025	0.024	-0.029	0.024	-0.024	0.024
Reference group: No toilet/latrine (dummy)								
Flushing toilet (dummy)	0.026	0.030	0.028	0.031	0.026	0.030	0.028	0.032
Dry latrine (dummy)	0.016	0.030	0.005	0.032	0.016	0.030	0.0053	0.032
Reference group: Other water source (dummy)								
Tap water (dummy)	-0.041	0.067	-0.038	0.060	-0.041	0.067	-0.038	0.060
Deep phreatic water (dummy)	-0.049	0.066	-0.061	0.060	-0.049	0.066	-0.061	0.060
Shallow phreatic water (dummy)	-0.045	0.067	-0.050	0.060	-0.045	0.067	-0.050	0.060
River/lake water (dummy)	0.071	0.083	0.033	0.085	0.072	0.083	0.032	0.086
Provincial dummies	YES		YES		YES		YES	
Constant	0.278	0.445	0.473	0.465	0.267	0.445	0.515	0.476
Number of observations	5370		5370		5370		5370	
Adj. R-squared	0.220		0.209		0.220		0.203	

Note: 1. ***Significant at 1%, ** Significant at 5%, * Significant at 10%.

2. For data source and variable definitions please refer to notes in Table 1.

Table 5. Heterogeneous Effects of Number of Migrant Children on Self-Reported Health Status of Left-behind Parents

Groups	No. of Migrant Children				Observations
	PLM		IV-PLM		
	(1)	(2)	(3)	(4)	(5)
	Coefficient	Standard Error	Coefficient	Standard Error	
Panel A: Gender					
Female	0.028***	0.011	0.060	0.067	2456
Male	0.011	0.009	0.091*	0.051	2914
Panel B: Age					
Age 60 and Below 60	0.025***	0.008	0.039	0.047	4051
Age above 60	0.004	0.014	0.178**	0.084	1319
Panel C: Number of Children					
With only one child	0.051	0.031	0.437***	0.170	794
More than one child	0.015**	0.007	0.039	0.043	4554
Panel D: Income Level					
Household income above the average	0.019**	0.009	0.062	0.060	3459
Household income below the average	0.023**	0.012	0.115**	0.057	1911
Panel E: Household Head					
Household head	0.009	0.009	0.094*	0.052	3018
Spouse of Household head	0.030***	0.011	0.057	0.066	2431

Notes: 1. ***Significant at 1%, ** Significant at 5%, * Significant at 10%.

2. The control variables are the same as in Table 4.

3. Samples in Panel A, B, C and E are divided by the characteristics of the parents.

4. Please refer to note in Table 1 for data source.

Table 6. Effects of Number of Migrant Children on Mental Health and Illness of Left-behind Parents

Variables	Mental Health Status				Illness			
	OLS		IV		PLM		IV-PLM	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error
Number of migrant children in the household	0.124*	0.085	0.825*	0.674	0.002	0.005	0.023	0.029
Lagged mental health	0.504***	0.015	0.498***	0.017				
Lagged illness					0.216***	0.012	0.213***	0.018
Female (dummy)	1.099***	0.176	1.079***	0.186	0.009	0.010	0.009	0.010
Age	-0.429**	0.181	-0.495**	0.203	-0.003	0.010	-0.005	0.011
Age squared/100	0.378**	0.148	0.430***	0.166	0.005	0.008	0.006	0.009
Reference group: No education								
Education level 1–6 years	-0.616**	0.271	-0.626**	0.308	-0.026*	0.014	-0.026*	0.015
Education level 7–9 years	-0.794***	0.290	-0.851***	0.330	-0.010	0.015	-0.010	0.016
Education level 10–13 years	-0.968***	0.376	-1.022***	0.392	-0.030	0.022	-0.031	0.021
Education level 14 years and above	-1.301	1.360	-0.971	1.382	0.018	0.092	0.029	0.118
Married (dummy)	-0.774**	0.331	-0.835**	0.355	0.028	0.021	0.028	0.021
Have medical insurance (dummy)	0.820	0.733	0.478	0.903	0.059	0.042	0.051*	0.028
Working status (dummy, 1 indicates working)	-0.508**	0.215	-0.653**	0.285	-0.048***	0.012	-0.053***	0.015
Annual working days/100	-0.144*	0.075	-0.122	0.078	-0.011**	0.004	-0.010**	0.005
Log household per capita income (Yuan per year)	-0.102	0.140	-0.154	0.151	0.003	0.008	0.002	0.008
Family size (Number of household members)	0.0391	0.086	-0.083	0.138	-0.011**	0.005	-0.015**	0.007
Number of grandchildren in the household)	-0.054	0.151	0.076	0.193	0.014*	0.009	0.019*	0.011
Have health facility in village (dummy)	-0.242	0.279	-0.204	0.288	0.005	0.016	0.006	0.016
Reference group: No toilet/latrine (dummy)								
Flushing toilet (dummy)	-0.783**	0.338	-0.736**	0.340	-0.001	0.021	-0.000	0.020
Dry latrine (dummy)	-0.119	0.338	-0.235	0.343	0.020	0.021	0.016	0.021
Reference group: Other water source (dummy)								
Tap water (dummy)	0.005	0.759	-0.019	0.584	-0.003	0.046	-0.002	0.021
Deep phreatic water (dummy)	0.205	0.749	0.008	0.602	-0.011	0.045	-0.015	0.051
Shallow phreatic water (dummy)	0.316	0.758	0.217	0.590	-0.036	0.046	-0.037	0.051
River/lake water (dummy)	0.858	0.981	0.275	1.002	-0.071	0.057	-0.084	0.060
Provincial dummies	YES		YES		YES		YES	
Constant	23.410***	5.808	26.640***	6.830	0.072	0.309	0.136	0.354
Number of observations	3508		3508		5315		5315	
Adj. R-squared	0.333		0.320		0.082		0.079	

Note: 1. *** Significant at the 1 percent level, ** Significant at the 5 percent level, * Significant at the 10 percent level.

2. For data source and variable definitions please refer to notes in Table 1

Appendix Table 1. Effects of Number of Migrant Children on Self-Reported Health Status of Left-behind Parents: Different Specifications for IV-PLM

Variables	(1) Coef.	(2) Std Error	(3) Coef.	(4) Std Error	(5) Coef.	(6) Std Error	(7) Coef.	(8) Std Error	(9) Coef.	(10) Std Error
Number of migrant children	0.080**	0.041	0.082**	0.041	0.080*	0.041	0.082**	0.041	0.057*	0.034
Lagged self-reported health status	0.425***	0.014	0.426***	0.014	0.428***	0.014	0.430***	0.014	0.432***	0.014
Female (dummy)	0.040***	0.014	0.039***	0.014	0.047***	0.013	0.047***	0.013	0.049***	0.013
Age	0.004	0.014	0.006	0.014	0.002	0.014	0.004	0.014	0.007	0.014
Age squared/100	0.001	0.000	-0.001	0.012	0.003	0.012	0.002	0.012	-0.000	0.011
Reference group: no education										
Education level 1–6 years	-0.009	0.020	-0.011	0.020	-0.008	0.020	-0.010	0.020	-0.010	0.020
Education level 7–9 years	-0.020	0.022	-0.022	0.022	-0.021	0.022	-0.023	0.022	-0.022	0.022
Education level 10–13 years	-0.025	0.030	-0.030	0.030	-0.026	0.030	-0.032	0.030	-0.031	0.030
Education level 14 years and above	-0.196*	0.103	-0.209**	0.104	-0.195*	0.104	-0.209**	0.104	-0.219**	0.100
Married (dummy)	0.019	0.032	0.015	0.032	0.014	0.032	0.009	0.032	0.000	0.032
Have medical Insurance (dummy)	0.026	0.057	0.025	0.057	0.026	0.056	0.024	0.056	0.032	0.056
Log household per capita income	-0.046**	0.020			-0.039***	0.011				
Working status (dummy, 1 indicates working)	-0.002	0.006	-0.046**	0.020						
Annual working days/100	-0.037***	0.011	-0.003	0.006						
Family size (number of household members)	-0.026***	0.010	-0.022**	0.010	-0.026***	0.010	-0.021**	0.010		
Number of grand children	0.029*	0.015	0.028	0.015	0.029*	0.015	0.028*	0.015	0.000	0.009
Have health facility in village (dummy)	-0.025	0.024	-0.030	0.024	-0.035	0.024	-0.040*	0.023	-0.043*	0.023
Reference group: No toilet/latrine (dummy)										
Flushing toilet (dummy)	0.028	0.031	0.022	0.031	0.031	0.031	0.025	0.031	0.029	0.031
Dry latrine (dummy)	0.005	0.032	0.003	0.032	0.004	0.032	0.002	0.032	0.010	0.031
Reference group: Other water source										
Tap water (dummy)	-0.038	0.060	-0.044	0.060	-0.034	0.060	-0.039	0.060	-0.043	0.060
Deep phreatic water (dummy)	-0.061	0.060	-0.064	0.060	-0.059	0.060	-0.062	0.060	-0.060	0.060
Shallow phreatic water (dummy)	-0.050	0.060	-0.049	0.061	-0.049	0.060	-0.047	0.060	-0.047	0.060
River/lake water (dummy)	0.033	0.085	0.040	0.085	0.033	0.085	0.041	0.085	0.063	0.084
Provincial dummies	YES		Yes		Yes		Yes		Yes	
Constant	0.473	0.465	0.095	0.449	0.496	0.466	0.094	0.451	-0.076	0.435
Number of observations	5370		5370		5384		5384		5384	
Adj. R-squared	0.220		0.207		0.208		0.206		0.212	

Notes: 1. ***Significant at 1%, ** Significant at 5%, * Significant at 10%.

2. Column (1) is the base results from column (2) in Table 4.

3. For data source and variable definitions please refer to notes in Table 1

Appendix Table 2. Children's Migration and Log Household per Capita Income

Variables	(1)	(2)	(3)	(4)
	Coefficient	Standard Error	Coefficient	Standard Error
Number of migrant children	-0.031***	0.008	0.017**	0.008
Female (dummy)			0.016	0.017
Age			-0.050***	0.017
Age squared/100			0.032**	0.013
Reference group: No education				
Education level 1–6 years			0.056**	0.024
Education level 7–9 years			0.053**	0.026
Education level 10–13 years			0.151***	0.037
Education level 14 years and above			0.395**	0.161
Married (dummy)			0.106***	0.036
Have medical Insurance (dummy)			0.009	0.073
Working status (dummy, 1 indicates working)			0.007	0.021
Annual working days/100			0.039***	0.007
Family size (number of household members)			-0.125***	0.008
Number of grand children in the household			0.047***	0.015
Have health facility in village (dummy)			0.128***	0.028
Reference group: No toilet/latrine (dummy)				
Flushing toilet (dummy)			0.161***	0.036
Dry latrine (dummy)			0.046	0.036
Reference group: Other water source (dummy)				
Tap water (dummy)			0.149*	0.080
Deep phreatic water (dummy)			0.089	0.080
Shallow phreatic water (dummy)			-0.032	0.080
River/lake water (dummy)			-0.218**	0.100
Provincial dummies	YES		YES	
Constant	8.650***	0.010	10.330***	0.517
Number of observations	5389		5370	
Adj R-squared	0.002		0.200	

Notes: 1. ***Significant at 1%, ** Significant at 5%, * Significant at 10%.

2. For data source and variable definitions please refer to notes in Table 1.