Healthy migrant and salmon bias hypotheses: A study of health and internal migration in China

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Abstract: The existing literature has often underscored the "healthy migrant" effect and the "salmon bias" in understanding the health of migrants. Nevertheless, direct evidence for these two hypotheses, particularly the "salmon bias," is limited. Using data from a national longitudinal survey conducted between 2003 and 2007 in China, we provide tests of these hypotheses in the case of internal migration in China. To examine the healthy migrant effect, we study how pre-migration self-reported health is associated with an individual's decision to migrate and the distance of migration. To test the salmon bias hypothesis, we compare the self-reported health of migrants who stay in destinations and who return or move closer to home villages. The results provide support for both hypotheses. Specifically, healthier individuals are more likely to migrate and to move further away from home. Among migrants, those with poorer health are more likely to return or to move closer to their origin communities.

Keywords: China; Internal migration; Rural-urban migration; Return migration; Health; Healthy migrant; Salmon bias

Introduction

The relationship between migration and health is an important topic of investigation for two reasons. First, it offers a better understanding of various factors that can play a part in the migration decision-making process. Second, it enhances our knowledge about the health profiles of the migrant population and how it may change over the course of migration and adjustment. Previous studies on migration and health, almost all conducted in the context of international migration to the U.S., have documented a clear immigrant health paradox: despite having low levels of socioeconomic status and limited access to health services, immigrants in the United States, especially Hispanic immigrants, generally enjoy better health outcomes than the native population in terms of mortality rate, chronic conditions, and mental health (Hayward & Heron, 1999; Halliday & Kimmitt, 2008; Rubalcava et al., 2008; Markides & Eschbach, 2011; Villa et al., 2012; Riosmena & Dennis, 2012). This health advantage is especially evident in the early stages of migration, though it tends to diminish over time in tandem with acculturation (Smith, 2003; Antecol & Bedard, 2006; Castro, 2007).

Two explanations are commonly offered to understand this health paradox. The first is the "healthy migrant" hypothesis, which states that migrants represent a positively selected group of individuals with respect to health, relative to the general population in origin societies (Palloni & Morenoff, 2001; Chiswick & Miller, 2008). This selection process makes immigrants stand out in terms of health levels when compared with the general population in destination countries. This positive selection even holds for migrant populations from relatively under developed origins experiencing high rates of mortality and morbidity (Abraído-Lanza et al. 1999; Markides & Eschbach, 2011).

In order to endure the demanding journey, migrants often require considerable physical stamina. Moreover, migration causes disruption in an individual's life and requires adaptation to a new environment and lifestyle. The process of migration is so stressful and challenging that an individual with relatively poor health is less likely to undertake migration. In addition, migrants often have physically demanding jobs. This means that those who can endure such jobs and succeed economically are more likely to migrate than others. The theory of the New Economics of Labor Migration (Stark, 1984) suggests that migration is a household survival strategy. Within this framework, migrants are likely to be selected within the household among eligible members—that is, those who are more capable, including having good health status, are more likely to migrate because of a higher propensity of achieving economic success. Formal health screening, especially in the context of international migration, may further select healthy people. This holds particularly true with respect to infectious diseases (Chiswick & Miller, 2008).

Facilitated by the availability of suitable data on migrants and the origin population (including pre-migration characteristics), there has been a growth of systematic empirical research testing the healthy migrant hypothesis. Rubalcava et al. (2008) study the healthy migrant effect in Mexico-US migration by using nationally representative longitudinal data obtained from following a sample of the Mexican population over time (some migrants moved to the U.S. between waves of the survey). Though they find some evidence for the health selection of migrants, it seems to apply to females and rural males only and is quite modest in magnitude. In theory, international migration entails greater barriers to migration and more disruption of social networks than internal migration. This could lead to a higher

degree of health selection in the process of international migration. Empirical research, however, does not necessarily support such a speculation.

Studies based on internal migration generally find support for the healthy migrant hypothesis, but they also show the complexity of the relationship. Using longitudinal data from Indonesia, Lu (2008) provides some support for the healthy migrant effect in the context of internal migration. The study further highlights the complex process of health selection, which varies across different dimensions of health as well as by age. Young people with chronic diseases are less likely to move. By contrast, older people with chronic diseases have a higher propensity to move. Presumably, this is because the young often migrate for work-related reasons. For older people, migration may be a response to health deterioration and be taken as a means of receiving better health care services or family care.

A few studies have examined the healthy migrant hypothesis in China. Chen (2011) uses survey data in Beijing that include a sample of migrants and urban residents, and finds the healthy migrant effect for migrants on the basis of self-rated physical health, but not psychological distress. Tong and Piotrowski (2012) utilize longitudinal data over a decade and contrast migrants and non-migrants at the origin. They show that migrants are positively selected for health, especially self-reported health. However, they find that the level of the impact of health on migration declined over time as migrants become less selective in general.

The second explanation for the better health of migrants is the salmon bias hypothesis, or selective return migration, which postulates that unhealthy migrants or migrants who experience deteriorating health have a greater tendency to return or to move closer to their

origin communities than healthier migrants (Abraído-Lanza et al. 1999). Migrants facing health problems are less capable of achieving high productivity in destination labor markets. This could lead to decreasing earnings and a lowered standard of living. These factors, along with constraints in affording and effectively utilizing health care services, separation from family, lack of a supportive network, and various sources of work-related stress in the destination, make returning or moving closer to home a more attractive option to migrants.

Empirical investigation of the salmon bias hypothesis has been very scarce because it requires data tracking migrants who return and who stay. Ullmann et al. (2011) provide some useful findings in their study, which compares returned migrants and non-migrants in Mexico while controlling for their early-life health profiles. It shows worse health for return migrants compared to non-migrants in terms of obesity, smoking, and psychological health. Turra and Elo (2008) present one of the first direct assessments of salmon bias in Hispanic migration to the U.S., and find very modest evidence for the hypothesis. Their study also calls for the use of longitudinal surveys that follow individuals in and out of migrant destinations for a better evaluation of selective return processes. By contrast, Sander (2007) examines return migration from Germany to Turkey and suggests that for male migrants, those with poorer health are less likely to return than those with better health. This observation is used to explain the declining health of immigrants in destination societies.

Examining the presence and magnitude of both selective migration and selective return migration is a crucial step in fully understanding the health consequences of migration. Research on the effects of migration on health is potentially plagued by these processes of selection. Observed effects are not necessarily evidence of the consequences of migration, but

may arise from the selective feature of migrants on health. For example, if migrants are favorably selected on health, one may conclude with a positive migration effect on health even when the health of migrants remains or slightly deteriorates after migration. Additionally, if return migrants are negatively selected with respect to health, migrants who remain in the destinations will appear healthier than the destination population. This could lead us to reach a spurious conclusion of a positive effect of migration on health.

The present research seeks to examine both questions in the context of internal migration in China using longitudinal data. Since the early 1980s, an estimated 220 million migrants have moved from rural areas to work in Chinese cities (National Bureau of Statistics [of China], 2011). At the same time, the existence of a long-standing bifurcated social institution—the household registration [*hukou*] system, which categorizes all citizens into a rural or urban dichotomy—has resulted in various structural and social barriers that preclude migrants from becoming full urban citizens. There is thus limited access to desirable jobs and limited provision of social services for migrants and their families, including health care and education (Solinger, 1999; Hesketh et al., 2008). Whereas most of the existing work is based on international migration to the U.S., we expect a positive health selectivity to be present in the context of internal migration in China because of its unique *hukou* system that has resulted in migrants' precarious conditions. Indeed, previous research has drawn parallel between the conditions of internal migrants in China and international migrants to the U.S. (Roberts, 1997). Therefore, health is likely to be a crucial factor in determining migrants' ability to move and make a living in Chinese cities. In the present study, we adopt an appropriate research design (health measure prior to migration or return) and the appropriate

groups for comparison (non-migrants for the healthy migrant hypothesis, and migrants for the salmon bias hypothesis), and provide evidence for the health selection of migration and return migration in internal migration in China.

Data and methods

Data

Data used are from a national representative longitudinal survey spanning 2003-2007 (The China Rural Production Survey [CRPS]) conducted by the Ministry of Agriculture of China (Qin et al., 2012). The survey used multistage stratified sampling and covered 16 provinces (out of the 31 provinces in the mainland of China) representing different geographical regions and levels of economic development (based on per capita annual net income of rural residents). There were 5, 6 and 5 provinces selected in western, central and eastern China. Within each province, all counties were divided into three categories according to per capita annual net income of rural residents (high, medium, and low). Three counties, one in each of the three income categories, were chosen within each province for 12 provinces, and 6 counties were chosen within each province for the remaining 4 provinces (two counties randomly selected within each of the three income categories). Similarly within each county, villages were classified into three categories by average net income and 3 villages were randomly selected within each county. At the village level, a random sample of 50 households was drawn based on local household registration.

Over the five-year survey period, 180 villages were followed. The village-level data were collected from the village committee. Within these villages, the data for all individuals

registered in the selected households were collected by trained interviewers. The information for individuals below age 16 was gathered from an adult household member. The interviews were conducted in Chinese. One supervisor was assigned to solve the problems that arose in the fieldwork in each county. This person was also responsible for checking the accuracy of the information collected by drawing a random sample of the completed interviews and conducting verification contact. As a result, 34,799 rural residents were surveyed in the first wave (2003). The total number of observations over the five years is 175,698. During the survey period, 2,422 respondents changed from rural to urban *hukou* and were deleted from the analysis. This is because such a change reflects conversion of agricultural land rather than migration.

The response rate was high because local officials endorsed the survey. In total, 847 people refused to be interviewed in 2003. The refusal rate remained similar throughout the five years. With respect to sample attrition, 960, 1,577, 2,234 and 2,352 individuals were lost to follow up in the years 2004 to 2007, respectively.

It is important to note that because the majority of rural migrants retain their rural *hukou* status, they were included in the household roster and, therefore, the survey. The survey was conducted each year during the Spring Festival, when many migrants return home to visit. For these migrants, face-to-face interviews were conducted. For migrants who stayed in cities during the holiday, their phone numbers were obtained from family members, which allowed interviewers to call them while they were in the family to gather basic socioeconomic and health information. Because cell phone use was very prevalent in China, even among migrant workers (Li & Han, 2011), the survey team was able to reach the majority of migrants who

did not visit home during the holiday (over 90%). Our analytic sample includes non-student individuals aged 16 to 65 (inclusive). We excluded a small number of international migrants (less than 400) because the decision-making process between internal and international migration may differ. This yields 98,350 observations for the analysis. The proportion of migrants in the sample is, respectively, 26.17%, 28.05%, 29.49%, 31.18% and 31.94% in each of the 5 waves. This reflects a steady increase in the scale of migration from rural China.

Measures of health

We use self-reported health as the health indicator. Although health is considered a multidimensional construct, empirical studies have suggested that self-reported health can generally predict an individual's overall health well, and it is generally consistent with more objective measures of physical or mental health (Ider & Benyamini, 1997; Biddle et al., 2007; Chiswick & Miller, 2008). This is true in China as well (Niu 2013). However, we note that self-rated health is sensitive to culture and the reference population used, especially since migrants and non-migrants may differ on some unobserved characteristics. Nevertheless, these possibilities are not likely to be a major concern, especially in the study of health selection of internal migration. In the comparison of rural-origin people who migrate and who stay, the two groups tend to share similar cultural background and the same reference population, namely rural residents. The same can be argued for the study of salmon bias hypothesis, in which migrants who stayed and who return tend to share a similar reference population (urban residents). We created two variables. One is a dichotomous health measure with excellent health coded as 1 (about 56% of the respondents reported having excellent

health) and others as 0. The other is a four-item variable with excellent health coded as 4 and poor (and very poor) health coded as 1 (excellent, good, fair, and poor/very poor health).

Measures of migration status

We study two measures of migration status using available information in the data ("in the past year, how many days were you away for work"; and "where did you migrate for work"). The first measure is a dichotomous measure of migration status during the year prior to the interview. When we use different number of days away for work (1, 15, 30, 60 and 90 days) as the cut-off to determine an individual's migration status, the percentages are 29.43%, 29.09%, 28.96%, 27.46% and 25.86% respectively. Consistent with previous research (deBrawu et al., 2002), we use 30 days as the cut off. Thus, an individual is defined as a migrant if he or she migrated for work for more than 30 days in the past year. Otherwise the individual is considered a non-migrant. We conducted sensitivity analyses using different cut-points to define migration, which yield similar results. For the second measure, we use information on the distance of migration to create a discrete variable: in the home village, migrant across villages within the same township, migrant across townships within the same county, migrant across counties within the same province, and migrant across provinces. The higher the value, the farther away the migrant is from the home village.

Other covariates

Other covariates include the socioeconomic and demographic characteristics of the individual, household, and village that may be related to migration and health. Specifically,

we control for an individual's age, gender, and education, the total number of family members in the household, the number of children and elderly in the household, total landholding of the household, annual household income (log transformed), village annual income per capita (log transformed), village landholding per capita, and village migrant ratio (proportion of migrants to labor at the village level). Income variables are adjusted by CPI to the 2003 income level. As for missing data, around 2.95% of the cases, or about 3,000 cases, are missing on any of the measures. The rate of missing information is relatively small and we dropped the missing data in the analysis. Statistical tests show no significant difference between included and excluded cases on the outcome variables.

Analysis

Data analysis was conducted using Stata version 10 (StataCorp, 2009). We pooled different waves of the survey in the analysis. The independent variables, including health status, were all lagged one year of the migration status variable. This strategy allows for identifying clearer temporal ordering in the analysis. In models where the dichotomous migration status is the outcome variable, we use random effects logistic regression models to predict migration status based on health and other covariates. In models where the more detailed migration measure (five-category variable of distance of migration) is the outcome variable, we estimated ordinal logistic regression models. In all models, we used probability weights and adjusted the standard errors for the complex survey design using the svy command in Stata (Blair & Schneeberg, 2013).

The random effects logistic regression was formulated in equation (1). Y_{it} is the

migration status of individual i in year t; α is the intercept; β is the vector of coefficients for X_{it-1}; u_i is the random effects which follow a normal distribution with mean zero and variance σ^2; and ε_{it-1} is the error item.

$$ln\left(\frac{P(Y_{it}=1|X_{it-1},u_i,\varepsilon_{it-1})}{P(Y_{it}=0|X_{it-1},u_i,\varepsilon_{it-1})}\right) = \alpha + \beta X_{it-1} + u_i + \varepsilon_{it-1} \quad (1)$$

The ordinal logistic regression estimate cumulative probability C_{ijt} that individual i is in the jth or a higher category of migration distance in year t. m is the observed distance of migration. The cumulative probability C_{ijt} can be written as equation (2).

$$C_{ijt} = \mathrm{E}(m_{it} \leq j) = \sum_{k=1}^{j} E\ (m_{it} = k) \quad (2)$$

The ordinal logistic regression is formulated as equation (3), where x_{it-1} is the vector of one-year lagged variables that influence an individual's migration status, γ_j is the threshold in increasing order ($\gamma_1 < \gamma_2 < \cdots < \gamma_{j-1}$), and θ is the vector of coefficients.

$$Logit(C_{ijt}) = log\ (\frac{C_{ijt}}{1-C_{ijt}}) = \gamma_j - \theta x_{it-1} \quad (3)$$

It should be noted that the sample selection criteria vary between testing the healthy migrant hypothesis and testing the salmon bias hypothesis. To study the healthy migrant hypothesis, we restrict the analysis to individuals who were non-migrants in the previous wave (prior to the year when the migration variable was measured). This way we are able to compare the health of rural residents who remained in the village with the health of those who migrated in the subsequent year. In contrast, in order to study the salmon bias hypothesis migrants' stay in destination, we restrict the analysis to individuals who were migrants in the previous wave. This permits us to compare the health of migrants who stayed in destinations with those who returned or moved closer to sending communities by the subsequent wave.

Results

Descriptive statistics

The descriptive statistics for variables used in the analysis are shown in Table 1. On average, the sample consists of 29% migrants. About 56% of the sample report excellent health. The average household size is about 4. In terms of demographic characteristics, men account for 52% of the sample. Around 13% of the sample are between age 16 and 25, 19% are between age 26 and 35, 24% are between age 36 and 45, and 29% are between age 46 and 55. The 56-65 age group accounts for almost 16% of the sample. Consistent with earlier research, rural residents in China have very limited educational attainment. Over 46% of the sample is illiterate or has only completed some elementary-school education. Less than 7% has some senior middle school or college education. The average household annual income is 17,500 yuan, which is around $2,114 in the mid 2000s. At the village level, we see that the migrant ratio is around 25%, highlighting the prevalence of out-migration from rural areas.

[Table 1 about here]

Table 2 presents descriptive statistics of health status by migration status for the sample. We show statistical tests of the difference between groups. On the upper left panel, we see that over 50% of non-migrants reported excellent health, comparing to over 64% of migrants (health measured prior to migration). On the upper right panel, we observe a clear gradient by the distance of migration, with those moving the furthest distance (across provinces) reporting the highest proportion of excellent health, followed by those moving across counties and across townships. These results provide some preliminary evidence in support of

the positive health selection of migrants. Furthermore, they illustrate how longer-distance migrants are especially positively selected with respect to health. On the bottom of Table 2, we present descriptive statistics comparing continuing migrants and return migrants. They show some preliminary support for the salmon bias hypothesis: that is, a lower percentage of return migrants reported excellent health than migrants who stayed.

[Table 2 about here]

Test of the healthy migrant hypothesis

As reported in Table 3, we find support for the healthy migrant hypothesis in the context of internal migration in China. For both the dichotomous and continuous health measures, we see a positive relationship with migration status. In particular, Model 1 shows that having excellent health significantly increases the likelihood of migration for work. Moreover, as an individual has better health (Model 2), he or she becomes increasingly more likely to migrate. In turning to the discrete measure of distance of migration, we see a similar story: rural residents with better health are not only more likely to migrate, but have a higher propensity to move further away to seek better or potentially more diverse employment opportunities (Model 3 and 4).

[Table 3 about here]

The coefficients of other covariates are in general as expected. Men and younger people are more likely to undertake migration and to move further away for work than are women and older people. Higher levels of education generally increase the chances of migration as well as the distance of migration, though people with some college education seem to be the exception. For this education group, the coefficients are positive, but they lack statistical

significance. This result should be interpreted with caution because of the very small sample size of college-education respondents. Interestingly, a higher dependency ratio (more children and elderly) reduces the likelihood of migration and the distance of migration, presumably because of the household's need for care. Moreover, higher levels of household income and village economic conditions seem to deter out-migration. This result may be due to the availability of better income-generating opportunities in these villages and, thus, less incentive and need for economic migration.

As has been documented in many other countries, migration networks play an important role in sustaining migration (Massey, 1990). This finding speaks to the importance of migrant networks in providing crucial information and assistance in the migration process, as well as in creating a sense of relative deprivation that motivates villagers to follow the footsteps of previous migrants. As a result, people in villages with a high prevalence of out-migration are more likely to migrate.

Test of the salmon bias hypothesis

Table 4 offers some support for the salmon bias hypothesis. Among migrants, those with a better health status are more likely to stay in the destination. By contrast, migrants with poorer self-reported health have a stronger tendency to return or to move closer to home. These patterns are consistent regardless of whether we examine the dichotomous or continuous self-reported health measure (Model 1 and 2). Controlling for current health status, migrants who experience deteriorating health are also more likely to return. When the distance of migration is examined, the results suggest that healthier migrants tend to work further away from home, whereas less healthy migrants are more likely to return or to choose

a destination closer to home for work (Model 3 and 4).

[Table 4 about here]

When it comes to other covariates, the results show that men are more likely to be continuing migrants than to be return migrants. This is true for younger individuals as well. The education of migrants does not seem to affect their subsequent migration decisions, presumably because many of them are concentrated in the low-skilled and low-pay labor market. In regressions in Table 4, we also include the annual income of migrants, and find that the economic status of migrants is positively related to their decision to stay in the destinations. Other covariates measured at the household or village level prove to have similar relationships to migration, as described in Table 3.

Discussion

Over the past several decades, rural-to-urban migration has become a prominent feature in China. Set against this background, the present study examines the presence of selective migration and selective return migration on the basis of health, using nationally representative longitudinal data. We employ measures of health status prior to migration or prior to return, and restrict the analyses to the appropriate sample. To test the healthy migrant hypothesis, we use the non-migrants sample (at the previous wave), and compare the health of those who stay and those who later migrate. When testing the salmon bias hypothesis, we compare the health (at the previous wave) of migrants who remain at destinations with those who later return or move closer to their home villages. In addition, we seek to add to the relevant literature by investigating not only a dichotomous measure of migration, but also a

measure indicating the distance of migration.

The results provide support for both hypotheses. Although the size of the coefficient suggests that health is not the most important determinant of migration, migration turns out to be a selective process with respect to health in the context of internal migration in China. Rural residents with better self-reported health prior to migration are more likely to migrate at a later time than those who are less healthy. Moreover, a better health status seems to enable an individual to migrate further away from home to seek better and more varied economic opportunities.

With respect to return migration, the results demonstrate a negative health selection of return migration. Healthier migrants are more likely to remain at destinations, whereas less healthy migrants have a higher propensity of return, or to move for work closer to home. Migrants experiencing deteriorating health also tend to return to or moving closer to their hometown. To some degree, this tendency may be due to the decreased capabilities of less-healthy migrants to maintain a high level of productivity and, consequently, a stable source of income. It may also be a reflection of the inferior working conditions and lack of social protection facing migrants in Chinese cities. As a result, migrants have very limited access to health care services in the destinations (Zhu, 2009). In the mean time, because of the nature of their work, migrants often suffer a high risk of occupational hazards and work-related injuries (Niu, 2013). Without adequate access to health care and labor protection, migrants with declining health tend to lose their jobs and often have to resort to returning or moving closer to their home villages as a survival strategy.

When comparing our findings in China to similar studies in other developing settings

(for example, internal migration in Indonesia; Lu, 2008), the level of health selectivity appears to be stronger in China. We think that this is partly attributable to the various structural and social barriers facing Chinese migrants in becoming full citizens in urban areas, which often do not apply to internal migrants in other developing countries. Indeed, previous research has drawn parallels between internal migration in China and international migration across national borders (Roberts, 1997). The variety of difficulties that face rural-to-urban migrants in China raises the importance of individual characteristics such as health, in migration decision-making and subsequent migration (and return) processes.

We would like to note the several limitations of this study. We are limited to examining only one measure of subjective health. Studies using a variety of health measures, especially more objective health measures, would provide important additional insights. Also, the data lack crucial health-related measures at origins and destinations (e.g., health environment, living and working environment). Future studies adjusting for a richer set of variables would yield more conservative estimates.

Despite these limitations, our study has some practical implications. First, more public finance should be invested to health care in rural China, as our study shows that less healthy individuals are more likely to remain in rural areas. Improving the health of rural residents can increase their ability to seek employment opportunities and enhance their standards of living. Second, the local city governments should extend basic health services to migrant workers. Poor health can significantly impair migrants' ability to work and make a living in urban areas. From an analytic point of view, the presence of health selection in migration and return migration underscores the complexity of the migration process in the Chinese setting.

Future studies investigating the effect of migration on health in China should seek to account for these aspects of selection in order to reach a more accurate understanding of the migration-health relationship.

References

Abraído-Lanza, A. F., Dohrenwend, B. P., Ng-Mak, D.S., & Turner, J.B. (1999). The Latino mortality paradox: a test of the "Salmon bias" and healthy migrant hypotheses. *American Journal of Public Health*, 89, 1543-1548.

Antecol, H., & Bedard, K. (2006). Unhealthy assimilation: why do immigrants converge to American health status levels. *Demography*, 43, 337-360.

Blair, A., & Schneeberg, A. (2013). Changes in the "healthy migrant effect" in Canada: Are recent immigrants healthier than they were a decade ago? *Journal of Immigrant and Minority Health,* 22, 1-7.

Biddle, N.K., Kennedy, S., & McDonald, J. (2007). Health assimilation patterns among Australian immigrants. *The Economic Records*, 83, 16-30.

Castro, F. (2007). Is acculturation really detrimental to health? *American Journal of Public Health*, 97, 1162-1171.

Chen, J. (2011). Internal migration and health: re-examining the healthy migrant phenomenon in China. *Social Science & Medicine*, 72, 1294-1301.

Chiswick, B., Y., & Miller, P. (2008). Immigrant selection system and immigrant health, *Contemporary Economic Policy*, 26, 555-578.

deBrauw, A., Huang, J.K., Scott, R., Zhang, L.X., & Zhang, Y.G. (2002). The evolution of China's rural labor markets during the reforms. *Journal of Comparative Economics*, 30, 329-353.

Halliday, T., & Kimmitt, M. (2008). Selective migration and health in the USA. *Population Studies*, 62, 321-334.

Hayward, M.D., & Heron, M. (1999). Racial inequality in active life among adult Americans. *Demography*, 36, 77-91.

Hesketh, T., Mfphm, M., & Jun, Y.X. (2008). Health status and access to health care of migrant workers in China. *Public Health Report*, 123, 189-197.

Ider, E.L., & Benyamini, Y. (1997). Self-related health and mortality: a review of twenty-seven community studies. *Journal of Health and Social Behavior*, 38, 21-37.

Li, G., & Han, Y.L. (2011). The application and research of mobile phone on solving rural migrant worker related problems. *Symposium of the Fifth China Digital City Construction*. 5, 665-670 (in Chinese).

Lu, Y. (2008). Test of the "healthy migrant hypothesis": a longitudinal analysis of health selectivity of internal migration in Indonesia. *Social Science & Medicine*, 67, 1331-1339.

Markides, K., & Eschbach, K. (2011). Hispanic paradox in adult mortality in the United States. *International Handbooks of Population*, 2, 227-240.

Massey, D. (1990). Social structure, household strategies, and the cumulative causation of migration. *Population index*, 56, 3-26.

National Bureau of Statistics of China. (2011). *Bulletin of China's sixth nationwide census*. Available at SSRN. http://www.stats.gov.cn/tjgb/rkpcgb/qgrkpcgb/t20110428_402722232.htm. [Accessed at February 8th, 2013] (in Chinese).

Niu, J. (2013). Migration and its impact on the differences in health between rural and urban residents in China. *Chinese Journal of Population Science*, 28, 46-63 (in Chinese).

Palloni, A., & Morenoff, J. (2001). Interpreting the paradoxical in the "Hispanic paradox":

demographic and epidemiological approaches. In M. Weinstein, A. Hermalin, & M. Sotot (Eds.), *Population health and aging* (pp.140-174). New York: New York Academy of Sciences.

Qin, L., Qin, X., & Jiang, Z. (2012). The impact of health on the off-farm labor supply of China's migrant workers. *Chinese Rural Economy*, 27, 38-45 (in Chinese).

Riosmena, F., & Dennis, J. (2012). *Aging, health and longevity in the Mexican-origin population*. New York: Springer Press.

Roberts, K.D. (1997). China's" tidal wave" of migrant labor: what can we learn from Mexican undocumented migration to the United States? *International Migration Review,* 31, 249-293.

Rubalcava L.N., Teruel, G.M., Thomas, D., & Goldman, N. (2008). The healthy migrant effect: new findings from the Mexican family life survey. *American Journal of Public Health*, 98, 78-84.

Sander, M. (2007). *Return migration and the "healthy immigrant effect"*. SOER Working Paper No. 60. Available at SSRN. http://dx.doi.org/10.2139/ssrn.1096456. [Accessed at March 16th, 2013].

Smith, J. (2003). Assimilation across the Latino Generation. *American Economic Review*, 93,315-319.

Solinger, D. (1999). *Contesting citizenship in urban China: peasant migrants, the state, and the logic of the market*. Los Angeles: University of California Press.

Stark, O. (1984). Migration decision making: A review article. *Journal of Development Economics*, 14, 251-259.

Tong, Y.Y., & Piotrowski, M. (2012). Migration and health selectivity in the context of internal migration in China. *Population Research and Policy Review,* 31, 497-543.

Turra, C., & Elo, I. (2008). The impact of salmon bias on the Hispanic mortality advantage. *Population Research and Policy Review*, 27, 515-530.

Ullmann, H.S., Goldman, N., & Massey, D. (2011). Healthier before they migrate, less healthy when they return: the health of returned migrants in Mexico. *Social Science & Medicine*, 73, 421-428.

Villa, V., Wallace, S., & Bagdasaryan, S. (2012). Hispanic baby boomers: health inequities likely to persist in old age. *The Gerontologist*, 52, 166-176.

Zhu, L. (2009). Working time and health of migrant workers. *China Social Science*, 23, 133-149 (in Chinese).

Table 1

Weighted descriptive statistics of the Selected Variables: China Rural Production Survey (CRPS): 2003-2007.

Variable	*N*	Mean/Percentage	Std. Dev.
Measures of migration status			
Migration status	78680	28.96%	---
Migration distance			
Inhome village (non-migrant)	78680	69.93%	---
Across villages within the same township	78680	8.15%	---
Across townships within the same county	78680	6.48%	---
Across counties within the same province	78680	7.29%	---
Across provinces	78680	8.14%	---
Measures of health status			
Health dichotomous measure			
Excellent health	78680	55.99%	---
Health (four categories)			
Poor/Very poor	78680	3.09%	---
Fair	78680	7.07%	---
Good	78680	32.73%	---
Excellent	78680	57.11%	---
Deteriorating health	78680	5.77%	---
Other covariates			
Male	78680	52.14%	---
Age			
Age 16-25	78680	12.96%	---
Age 26-35	78680	19.10%	---
Age 36-45	78680	23.65%	---
Age 46-55	78680	28.63%	---
Age 56-65	78680	15.66%	---
Education			
Primary school and illiterate	78680	45.95%	---
Junior middle school	78680	47.37%	---
Senior middle school	78680	6.25%	---
College	78680	0.43%	---
Log of off-farm annual income of migrant	78680	2.41	3.80
Household size	78680	4.08	1.38
Number of children and elderly in household	78680	0.75	0.89
Area of harvest land in household (mu) [b]	78680	11.35	17.42
Log of annual income in household (RMB yuan) [a]	78680	9.77	0.75
Log of annual income per capita in village (RMB yuan) [a]	78680	7.87	0.67
Per capita landholding in village (mu) [b]	78680	1.98	2.55
Proportion of migrants out of total labors in village	78680	25.03%	---

Note: [a] The measures are adjusted for inflation by CPI and the real values are based on Year 2003 Chinese currency RBM yuan. 1 U.S. dollar=8.277 RMB yuan in 2003.

[b] Mu is the unit of land in China. 1 mu = 0.16 acre.

Table 2

Percentages of Excellent Health by Migration Status and Migration Location Status, CRPS 2003-2007.

Migration status				Migration distance			
Category	*N*	Percentage	P-value	Category	*N*	Percentage	P-value
Healthy Migrant [a]			<0.001	*Healthy Migrant* [a]			<0.001
				In home village (non-migrant)	51232	51.67%	
Non-migrants	51897	51.33%		New migrants across villages within the same township	1679	59.68%	
				New migrants across townships within the same county	983	66.36%	
Migrants	4035	64.11%		New migrants across counties within the same province	1021	67.09%	
				New migrants across provinces	1017	70.01%	
Salmon Bias [b]			<0.001	*Salmon Bias* [b]			<0.001
				In home village (return migrant)	3792	58.99%	
Return migrants	3992	62.91%		Migrants across villages within the same township	4735	61.76%	
				Migrants across townships within the same county	4116	69.94%	
Continuing migrants	18756	69.25%		Migrants across counties within the same province	4715	69.97%	
				Migrants across provinces	5390	70.78%	

Note: [a] Restricted to all non-migrants in the previous wave.

[b] Restricted to all migrants in the previous wave.

Table 3

Test of the "Healthy Migrant Effect" for Predicting Migration: Random-effects Logistic Regression and Ordered Logistic Regression of Health Status, Controlling for Previous-wave of Health Status and Other Characteristics, CRPS 2003-2007.

	RE: Migration status		Ologit: Migration distance	
	Model(1)	Model(2)	Model(3)	Model(4)
Excellent health	0.199***		0.164***	
	(0.04)		(0.04)	
Four-category health (excellent to poor health coded as 4 to 1)		0.108***		0.098***
		(0.03)		(0.03)
Male (Reference: Female)	1.093***	1.097***	0.844***	0.847***
	(0.05)	(0.05)	(0.04)	(0.04)
Age dummy (Reference: Age 16-25)				
Age 26-35	-0.574***	-0.578***	-0.482***	-0.484***
	(0.07)	(0.07)	(0.06)	(0.06)
Age 36-45	-1.188***	-1.195***	-1.035***	-1.039***
	(0.07)	(0.07)	(0.06)	(0.06)
Age 46-55	-1.818***	-1.829***	-1.489***	-1.496***
	(0.07)	(0.07)	(0.06)	(0.06)
Age 56-65	-2.271***	-2.278***	-1.926***	-1.926***
	(0.10)	(0.10)	(0.08)	(0.08)
Education dummy (Reference: primary school or illiterate)				
Junior middle school	0.283***	0.281***	0.227***	0.224***
	(0.05)	(0.05)	(0.04)	(0.04)
Senior middle school	0.261***	0.259**	0.149*	0.147*
	(0.09)	(0.09)	(0.08)	(0.08)
College	0.193	0.187	0.134	0.130
	(0.34)	(0.34)	(0.24)	(0.23)
Household size	0.005	0.005	-0.004	-0.004
	(0.02)	(0.02)	(0.02)	(0.02)
Number of children and elderly in household	-0.073*	-0.073*	-0.066*	-0.066*
	(0.03)	(0.03)	(0.03)	(0.03)
Area of harvest land in household	0.002	0.002	0.002*	0.002*
	(0.00)	(0.00)	(0.00)	(0.00)
Log of annual income in household	-0.354***	-0.353***	-0.298***	-0.298***
	(0.03)	(0.03)	(0.03)	(0.03)
Log of annual income per capita in village	-0.028	-0.027	-0.069*	-0.068*
	(0.04)	(0.04)	(0.03)	(0.03)
Per capita landholding in village	-0.093***	-0.093***	-0.069***	-0.068***
	(0.02)	(0.02)	(0.02)	(0.02)
Proportion of migrants out of total labors in village	1.926***	1.947***	1.804***	1.824***
	(0.14)	(0.14)	(0.11)	(0.11)
Constancy	0.098	-0.174		
	(0.38)	(0.39)		
N	55932	55932	55932	55932

Note: (1) ***p value<0.001; **p value<0.01; *p value <0.05; +p value <0.1. (2) Clustered standard errors are shown in the brackets. (3) Year dummy variables and Province dummy of residence variables are omitted from the table. All covariates are one-year lagged measures.

Table 4

Test of "Salmon Bias Effect" for Predicting Migrants' Stay in Destination: Random-effects Logistic Regression and Ordered Logistic Regression of Health Status, Controlling for Previous-wave of Health Status and Other Characteristics, CRPS 2003-2007

	RE: Migration status		Ologit: Migration distance	
	Model(1)	Model(2)	Model(3)	Model(4)
Excellent health	0.185***		0.111**	
	(0.05)		(0.04)	
Four-category health (excellent to poor health coded as 4 to 1)		0.191***		0.086**
		(0.04)		(0.03)
Deteriorating health	-0.755***	-0.824***	-0.197**	-0.196**
	(0.10)	(0.09)	(0.07)	(0.07)
Male (Reference: Female)	0.456***	0.453***	0.128**	0.129**
	(0.05)	(0.05)	(0.04)	(0.04)
Age dummy (Reference: Age 16-25)				
Age 26-35	-0.205**	-0.202**	-0.514***	-0.516***
	(0.07)	(0.07)	(0.05)	(0.05)
Age 36-45	-0.532***	-0.519***	-0.941***	-0.941***
	(0.08)	(0.08)	(0.05)	(0.05)
Age 46-55	-0.865***	-0.835***	-1.294***	-1.293***
	(0.08)	(0.08)	(0.06)	(0.06)
Age 56-65	-0.981***	-0.916***	-1.496***	-1.488***
	(0.12)	(0.12)	(0.08)	(0.08)
Education dummy (Reference: primary school or illiterate)				
Junior middle school	0.106+	0.098+	-0.018	-0.019
	(0.06)	(0.06)	(0.04)	(0.04)
Senior middle school	0.104	0.098	-0.028	-0.028
	(0.09)	(0.09)	(0.07)	(0.07)
College	0.328	0.313	-0.079	-0.083
	(0.31)	(0.31)	(0.17)	(0.17)
Log of off-farm annual income of migrant	0.209***	0.208***	0.193***	0.193***
	(0.01)	(0.01)	(0.01)	(0.01)
Household size	0.082***	0.080***	0.093***	0.092***
	(0.02)	(0.02)	(0.02)	(0.02)
Number of children and elderly in household	-0.024	-0.024	-0.063**	-0.063**
	(0.04)	(0.04)	(0.02)	(0.02)
Area of harvest land in household	-0.009***	-0.009***	-0.004*	-0.004*
	(0.00)	(0.00)	(0.00)	(0.00)
Log of annual income in household	-0.149***	-0.158***	-0.173***	-0.174***
	(0.04)	(0.04)	(0.03)	(0.03)
Proportion of migrants out of total labors in village	1.583***	1.578***	1.800***	1.801***
	(0.16)	(0.16)	(0.11)	(0.11)
Constancy	1.028**	0.565		
	(0.39)	(0.40)		

N	22748	22748	22748	22748

Note: (1) ***p value<0.001; **p value<0.01; *p value <0.05; +p value <0.1. (2) Clustered standard errors are shown in the brackets. (3) Year dummy variables and Province dummy of residence variables are omitted from the table. All covariates are one-year lagged measures.