

Risk Attitudes and Household Migration Decisions

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Abstract

This paper analyses the relation between individual migrations and the risk attitudes of other household members when migration is a household decision. We develop a simple model that implies that which members migrate depends on the distribution of risk attitudes among all household members, and that the risk diversification gain to other household members may induce migrations that would not take place in an individual framework. Using unique data for China on risk attitudes of internal (rural-urban) migrants and the families left behind, we empirically test three key implications of the model: (i) that conditional on migration gains, less risk averse individuals are more likely to migrate; (ii) that within households, the least risk averse individual is more likely to emigrate; and (iii) that across households, the most risk averse households are more likely to send migrants as long as they have at least one family member with sufficiently low risk aversion. Our results not only provide strong evidence that migration decisions are taken on a household level but also that the distribution of risk attitudes within the household affects whether a migration takes place and who will emigrate.

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I. Introduction

A recent and growing body of empirical literature suggests that individual risk aversion has a significant impact on a wide range of individual choices, including portfolio diversification, engagement in healthy behaviours, occupational choices, wealth accumulation, technology adoption and migration decisions (see, among others, Barsky et al., 1997; Bonin et al., 2007; Guiso & Paiella, 2008; Dohmen et al., 2011; Liu, 2013; Jaeger et al. 2010). All these papers explore the relationship between *individual* decision making and the individual's *own* risk aversion. However, when decisions are taken at the household level, the benefit of risk diversification to the more risk averse household members may also influence the decisions of one particular member. One context in which other household members' risk aversion may affect the behaviour of one focal individual is rural-urban migration in developing countries.⁵

In this paper, therefore, we analyse how the probability of a household sending a migrant depends on the distribution of risk attitudes within the household. In doing so, we focus on three aspects. First, we re-examine whether migrants are indeed less risk averse than non-migrants. Second, we investigate whether the risk aversion of other household members affects *who* emigrates from a particular household. Finally, we analyse *which households* send migrants and how this choice depends on the distribution of risk aversion among household members, as well as on the individual risk aversion of the potential emigrants.

To structure our empirical investigation, we develop a theoretical framework of household migration decisions from which to derive a set of testable implications. Our model draws on an earlier literature on household migration decisions and risk (e.g. Stark & Levhari, 1982; Hoddinott, 1994), but is most closely related to Chen et al. (2003). We add to this work by introducing heterogeneous risk preferences among family members in a setting

⁵ There exists a mainly theoretical body of literature suggesting that migrations in this context may be driven by motives of risk diversification (see e.g. Rosenzweig & Stark, 1989). However, these papers do not speak to the question as to how the *distribution* of risk attitudes within the household affects migration decisions.

in which the family chooses not only whether to send a migrant but also whom to send.⁶ Our model provides us with testable implications on migrant selection at the individual level, both within households and across households. We test the model predictions using survey data on internal migration in China, a country that has experienced massive migration flows from rural to urban areas in recent years.⁷ As explained in section IIIA, the Chinese institutional setting makes household decision models a particularly appropriate tool for analysing internal migration in this country (see also Taylor, Scott, & deBrauw, 1999, 2003).⁸ We base our analysis on a unique dataset that includes responses to a set of items designed to elicit risk aversion from both migrants and non-migrants in their areas of origin. The reliability of this measure has been experimentally validated.

We find that in the context of internal migration in a large developing country (in this case, China), individuals who migrate are less risk averse than those who do not migrate. This result lends further support to the findings of Jaeger et al. (2010) and Gibson and McKenzie (2011); our findings further imply that migrations are considered to be risky.⁹ We then investigate how migration decisions of one household member are affected by the risk aversion of other household members. In line with our model assumptions, we show that individuals who are the least risk averse in their households are more likely to migrate than those with identical risk aversion but who are not the least risk averse in their household. At the household level, we find that more risk averse households are more likely to send migrants, but only if they have at least one household member who is sufficiently risk loving.

⁶ Only few papers study risk sharing when preferences are heterogeneous across households (Mazzocco and Saini, 2012; Chiappori et al., 2014) or within households (Mazzocco, 2004), but none of them study migration decisions.

⁷ According to the Chinese National Bureau of Statistics, the number of internal immigrants in China increased from about 30 million in 1996 to over 150 million in 2009; that is, from 2.5 to more than 11% of the total resident population.

⁸ China provides an ideal context for our study: under the *hukou* residence system (see Section IIIA for more details), migrants in urban areas have limited access to public services such as health, unemployment benefits, and child education in cities. They therefore leave the rest of the family behind while still keeping strong ties to the origin community in the expectation that they will eventually be returning.

⁹ In line with that, Bryan et al. (2014) provide strong evidence for Bangladesh that migration is perceived to be risky and that for this reason individuals refrain from migrating despite large gains and small costs.

These results suggest that internal rural-urban migration in China is a household decision and that the distribution of risk aversion within households is an important additional factor determining the selection of individuals and households into migration.

This role of risk diversification in migration decisions has been previously explored in the migration literature both when the migration decision is an individual choice (e.g. Dustmann, 1997) and when it is made at the household level (see e.g. Stark & Levhari, 1982; Rosenzweig & Stark, 1989; Chen et al., 2003; Morten, 2013).¹⁰ Nevertheless, although these papers pinpoint risk diversification as a key element in a household's decision problem, they do not investigate the relation between risk attitudes and migration choices within and across household units nor do they discuss how the distribution of risk attitudes within households may affect the migration decision. Yet understanding who emigrates, how emigrants compare with other household members, and which households send migrants is crucial for assessing determinants and consequences of migration. Such an understanding is central, for example, to the issue of migrant selection based on unobservable characteristics determining productivity, which has important economic consequences for both receiving and sending communities (see e.g. Borjas, 1987; Borjas and Bratsberg, 1996; Chiquiar & Hanson, 2005; McKenzie & Rapoport 2010; Dustmann, Fadlon & Weiss, 2011). To date, however, such selection has been addressed primarily using models of individual migration decisions. Our analysis, in contrast, employs a household-level migration decision model to show that the risk preferences of *other* household members and their distribution within the household may not only determine who and how many emigrate but may also influence the level of risk aversion of the migrant population. This latter point is especially important in the face of recent findings that risk aversion is negatively correlated with both cognitive ability (Dohmen

¹⁰ The importance of household migration decisions as mechanisms to cope with unexpected negative shocks is illustrated by Jalan and Ravallion (1999) for rural China, who show the poorest households passing up to 40% of income shocks onto current consumption. Further, Giles (2006) and Giles and Yoo (2007) show that the liberalization of internal migration flows in China in the early '90s provided rural household with a new mechanism to hedge against consumption risk.

et al. 2010) and the probability of engaging in entrepreneurial activity (Ekelund, Johansson, & Lichtermann, 2005; Levine & Rubinstein 2014), which point to it being a key factor determining immigrant success.

The remainder of the paper is organized as follows. Section II outlines our theoretical framework for the relation between individual risk aversion and the household decision of whether to send a migrant and whom to send, and then develops the empirical implications of this relation. Section III describes the institutional background and data, and section IV explains our empirical strategy. Section V reports the estimation results, and section VI concludes the paper.

II. A Model of Household Migration Decision with Individual Heterogeneity in Risk Aversion

A. Setup

We denote individual earnings by y_j , where $j = S, D$ for source (S) and destination (D) region, and assign earnings a deterministic component \bar{y}_j and a stochastic component ϵ_j , with $E(\epsilon_j) = 0$; $V(\epsilon_j) = \sigma_j^2$ for $j = S, D$.¹¹ We further assume that shocks in source and destination regions are uncorrelated: $Cov(\epsilon_S \epsilon_D) = 0$.¹² Migration to region D incurs a monetary cost c that is heterogeneous across households but homogenous within households.¹³ Earnings in the two regions are thus

$$y_S = \bar{y}_S + \epsilon_S \tag{1}$$

$$y_D = \bar{y}_D - c + \epsilon_D \tag{2}$$

¹¹ In the context of rural-urban migration in China, the variance in earnings of urban migrations stems primarily from unemployment risk, while wages for rural migrants are fairly compressed around the subsistence level (see section III.A).

¹² Allowing for a non-zero correlation between shocks in source and destination regions does not change any of our conclusions (see Appendix section VI.C) but does complicate our analysis.

¹³ This assumption reflects the fact that households may differ in their wealth, access to credit, distance from the destination region, etc. but that, within each household, the cost of financing the migration of one member or the other does not differ.

Here, each household consists of two members who can perfectly pool their income only if they are both residing in the same origin region S .¹⁴ We use \tilde{Y} to denote total pooled household income and \tilde{y} to represent the amount each individual receives from the pooled income. If both members stay in S , the total pooled household income is given by $\tilde{Y}_{SS} = 2y_S$, and each individual receives exactly $\tilde{y}_{SS} = y_S$.

If one individual migrates, distance and frictions will only allow imperfect income pooling. In particular, the member who remains in region S will pool her entire income y_S and receive a full quota of the total pooled income, while the member who migrates to region D will only contribute a fraction α of his earnings y_D and will receive the same fraction α of the full quota. Hence, total pooled income if one household member has emigrated is given by $\tilde{Y}_{SD} = y_S + \alpha y_D$. Defining \tilde{y}^{NM} and \tilde{y}^M as the individual disposable income of the non-migrant (NM) and migrant (M) household member, respectively, yields:

$$\tilde{y}^{NM} = \tilde{Y}_{SD}/(1 + \alpha) \quad (3)$$

$$\tilde{y}^M = \alpha[\tilde{Y}_{SD}/(1 + \alpha)] + (1 - \alpha)y_D \quad (4)$$

It is thus parameter α that determines the extent to which the household engages in risk diversification across its members and the level of insurance the migrant receives against uncertainty in the destination region. If α equals zero, the migrant is fully exposed to uncertainty in region D (which is equivalent to the case of an individual migration decision). If instead, α equals one, migration can reduce the overall household variance in income, and the migrant and non-migrant members face the same exposure to uncertainty.

B. Household Migration Decision

The household's decision to send a migrant to the destination region D is made by comparing the household utility of no migration with that of sending one household member to region D .

¹⁴ Our theoretical framework can be straightforwardly extended to N household members. For example, in the subsequent simulation (see Appendix section AII), we use four household members, reflecting the average household size in our data.

We assume that household members differ only in their degree of risk aversion k , have a mean-variance utility function, and jointly maximize the sum of their utilities to act as a coherent unit.¹⁵

If both members remain in the source region S , the household utility is given by

$$U_{SS} = [E(y_S) - k_1 V(y_S)] + [E(y_S) - k_2 V(y_S)] = 2\bar{y}_S - (k_1 + k_2)\sigma_S^2 \quad (5)$$

If instead one household member remains in region S (individual 1) and one migrates to region D (individual 2), the household utility is given by

$$\begin{aligned} U_{SD} &= [E(\tilde{y}^{NM}) - k_1 V(\tilde{y}^{NM})] + [E(\tilde{y}^M) - k_2 V(\tilde{y}^M)] = \\ &= \underbrace{\left[\left(\frac{\bar{y}_S + \alpha(\bar{y}_D - c)}{1 + \alpha} \right) - k_1 \left(\frac{\sigma_S^2 + \alpha^2 \sigma_D^2}{(1 + \alpha)^2} \right) \right]}_{NM} + \underbrace{\left[\left(\frac{\alpha \bar{y}_S + (\bar{y}_D - c)}{1 + \alpha} \right) - k_2 \left(\frac{\alpha^2 \sigma_S^2 + \sigma_D^2}{(1 + \alpha)^2} \right) \right]}_M \end{aligned} \quad (6)$$

The household will send a migrant whenever $U_{SD} - U_{SS} > 0$:

$$\begin{aligned} U_{SD} - U_{SS} &= \underbrace{\left(\frac{\bar{y}_S + \alpha(\bar{y}_D - c)}{1 + \alpha} - \bar{y}_S \right)}_{\Delta E(\tilde{y}^{NM})} - k_1 \underbrace{\left(\frac{\sigma_S^2 + \alpha^2 \sigma_D^2}{(1 + \alpha)^2} - \sigma_S^2 \right)}_{\Delta V(\tilde{y}^{NM})} + \\ &+ \underbrace{\left(\frac{\alpha \bar{y}_S + (\bar{y}_D - c)}{1 + \alpha} - \bar{y}_S \right)}_{\Delta E(\tilde{y}^M)} - k_2 \underbrace{\left(\frac{\alpha^2 \sigma_S^2 + \sigma_D^2}{(1 + \alpha)^2} - \sigma_S^2 \right)}_{\Delta V(\tilde{y}^M)} > 0 \end{aligned} \quad (7)$$

These terms thus characterize the change in expected earnings and earnings variance from migration (with respect to non-migration) for both the migrant and the non-migrant household member.

We now identify the conditions under which expression (7) (i.e. the household gains from the migration of one of its members) is positive.¹⁶ We first consider the changes in the expected earnings of the non-migrant and migrant, $\Delta E(\tilde{y}^{NM})$ and $\Delta E(\tilde{y}^M)$. Both these will be

¹⁵ The assumption that the family acts as a coherent unit can be justified either (a) based on the existence of a dominant head of household or (b) by a family utility function that is the aggregate of individual utility functions (assuming all household members have the same preferences, including risk aversion) (see Chen et al., 2003). In our case, household members do not have homogenous preferences (i.e. they differ in risk aversion), so we assume that a dominant head of household makes the decision of who migrates on behalf of the household.

¹⁶ We do not consider the case in which both household members migrate because in the context we empirically analyse entire households do not emigrate (see section III).

positive as long as the migrant's expected earnings in the destination region (net of migration costs) are larger than in the source region ($\bar{y}_D - c > \bar{y}_S$). We then consider the changes in the earnings variances for the non-migrant and the potential migrant, $\Delta V(\tilde{y}^{NM})$ and $\Delta V(\tilde{y}^M)$. In this model, risk diversification alone may lead the household to choose to send a migrant, even if the earnings differential between source and destination regions is zero (i.e. $\Delta E(\tilde{y}^{NM}) = \Delta E(\tilde{y}^M) = 0$). Figure 1 shows the relation between σ_D^2 (horizontal axis) and the change in earnings variance (vertical axis) for the migrant ($\Delta V(\tilde{y}^M)$) and non-migrant ($\Delta V(\tilde{y}^{NM})$), respectively. Although both terms are increasing functions of σ_D^2 , $\Delta V(\tilde{y}^M)$ is steeper than $\Delta V(\tilde{y}^{NM})$, with slopes of $1/(1 + \alpha)^2$ and $\alpha^2/(1 + \alpha)^2$, respectively, which reflects the higher exposure of the migrant to risk in the destination region.¹⁷ The non-migrant's earnings variance is reduced by migration ($\Delta V(\tilde{y}^{NM}) < 0$) if the variance in destination region D is not excessively larger than in source region S: $\sigma_D^2 < \frac{2+\alpha}{\alpha} \sigma_S^2$. Similarly, the migrant will experience a reduction in earning variance for sufficiently low values of σ_D^2 : $\Delta V(\tilde{y}^M)$ is negative for $\sigma_D^2 < (1 + 2\alpha)\sigma_S^2$. It should also be noted that $\Delta V(\tilde{y}^M)$ crosses the zero line before $\Delta V(\tilde{y}^{NM})$: the threshold for σ_D above which a migration leads to *higher* earnings risk than non-migration is always higher for the non-migrant than for the migrant ($\frac{2+\alpha}{\alpha} > 1 + 2\alpha$). Obviously, the lower the share α of the migrant's earnings that is re-distributed to the non-migrant, the higher (lower) the earnings variance in region D that still reduces the overall earnings variance for the non-migrant (migrant) household member. Finally, if $\sigma_D^2 = \sigma_S^2$, the change in earnings variance is identical (i.e. $\Delta V(\tilde{y}^M)$ and $\Delta V(\tilde{y}^{NM})$ cross), and both individuals benefit from the diversification of income risk.

¹⁷ The difference in the slope of the two lines is inversely related to the parameter α , which determines the degree of income pooling: when income pooling is perfect ($\alpha=1$) the two lines overlap.

The intersection of these two lines with each other and with the zero line creates three different scenarios for $\sigma_D^2 > \sigma_S^2$.¹⁸ To the right of the two-line intersection but before either line intersects the x -axis ($\sigma_D^2 < (1 + 2\alpha)\sigma_S^2$; area I in the graph), σ_D^2 is only moderately larger than σ_S^2 , so risk diversification leads to a decrease in earnings risk for both migrant and non-migrant. For intermediate values of σ_D^2 , $((1 + 2\alpha)\sigma_S^2 \leq \sigma_D^2 < \frac{2+\alpha}{\alpha} \sigma_S^2$; area II), earnings risk decreases for the non-migrant but increases for the migrant. Finally, for high values of σ_D^2 , ($\sigma_D^2 \geq \frac{2+\alpha}{\alpha} \sigma_S^2$; area III), migration increases earnings risk for both household members.

The actual decision to migrate, however, also takes into account the relative gains in expected earnings. In the case of a zero earnings differential (net of migration cost) between source and destination region, migration will always be optimal in area I (in which both individuals reduce their exposure to risk by having one migrant in the household). There will be migration in area II as long as the utility gain in reducing uncertainty of the non-migrant member more than compensates for the loss experienced by the migrant. Finally, no migration will take place in area III. Positive earning differentials, however, may shift these decisions, meaning that migration may also take place in area III.

C. Who Will Emigrate?

We now investigate the household's choice of whom of its members to send as a migrant. We first note that if the earnings variance is higher in the destination region than in the source region ($\sigma_D^2 \geq \sigma_S^2$), the migrant is always exposed to at least as high an income variance as the non-migrant (for any value of $0 \leq \alpha \leq 1$):

$$V[\tilde{y}^M] = \left(\frac{\alpha^2 \sigma_S^2 + \sigma_D^2}{(1+\alpha)^2} \right) \geq V[\tilde{y}^{NM}] = \left(\frac{\sigma_S^2 + \alpha^2 \sigma_D^2}{(1+\alpha)^2} \right) \quad \text{if} \quad \sigma_D^2 \geq \sigma_S^2. \quad (8)$$

¹⁸ A fourth case (area 0 in the graph) arises whenever $\sigma_D^2 < \sigma_S^2$. In this scenario, not only does the earnings risk decrease for both migrant and non-migrant, but the earnings risk of the migrant is lower than that of the non-migrant.

The decision of which of the two individuals will emigrate will be based on the comparison of household utility when one member, rather than the other, migrates. We have:

Proposition 1. As long as migration is riskier than non-migration, $V[\tilde{y}^M] \geq V[\tilde{y}^{NM}]$, it is always optimal to choose the least risk averse individual in the household as the potential migrant (although it may be optimal to send nobody. If instead $V[\tilde{y}^M] \leq V[\tilde{y}^{NM}]$, it is optimal to choose the most risk averse individual in the household.

Proof. See Appendix A.I.A

If migration choices are made at the individual level, only the *absolute* risk aversion of individuals should matter for the migration decision. Proposition 1, however, implies that if the decision is taken at the household level, the elasticity of migration probabilities to individual risk aversion depends also on the way individuals with different risk attitudes mix within the household. Hence, the *relative* risk aversion of individuals with respect to the risk aversion of other household members should also matter. In other words, whereas two individuals with identical risk aversion would, all else being equal, have the same probability of migrating in an individual migration decision model, in a household decision model, that probability will differ depending on the composition of the risk aversion of the other household members.

Empirically, an individual decision model (which corresponds to the case where $\alpha = 0$) would predict a lower average risk aversion among the migrant population than among the non-migrant one when income variance at destination is higher than in the source region. This prediction is also compatible with the household migration decision model outlined above. However, whereas the individual model makes no predictions about how the migration probability relates to the risk aversion of other household members, the household decision model predicts that the relative position in the within household risk aversion

ranking – and not just the absolute risk aversion – matters for the migration probability. This is one of the implications of the model that we will test below.

D. Which household will send a migrant?

Which households, then, are more likely to send migrants? The answer involves two counteracting factors within each household. On the one hand, migration can reduce the income uncertainty of the non-migrant household members, and their utility gain increases with their risk aversion. On the other hand, if migrating involves more exposure to uncertainty, the household needs members with sufficiently low risk aversion as suitable candidates for migration. Hence, in a household in which everyone is very risk averse, although there is a strong desire for risk diversification, no member will be a good candidate for migration. Conversely, in households in which all members have low risk aversion, there will be many candidates for migration but lower demand for risk diversification. Thus, the likelihood of a household sending a migrant will depend on the *distribution* of risk attitudes within the household. We formalize this intuition in the following proposition:

Proposition 2

- (i) *Consider two households that differ only in the risk aversion of their members but have identical average risk aversion. If migration increases (reduces) the exposure to risk of the migrant member, the household with more (less) variation in its members' risk preferences will benefit the most from migration.*
- (ii) *Consider two households that differ only in the degree of risk aversion of the least risk averse individual. If migration increases (reduces) the exposure to risk of the migrant member, the household whose least risk averse individual has lower (higher) risk aversion will benefit the most from migration. [Alternatively: Consider two households that differ only in the degree of risk aversion of the most risk averse individual. If migration reduces (increases) the exposure to risk of the*

non-migrant member, the household whose most risk averse individual has higher (lower) risk aversion will benefit the most from migration.]

Proof. See Appendix A.I.B.

According to proposition 2, when migration is risky households are more likely to send migrants if they have some members with low risk aversion (who are good candidates for migration) and some with high risk aversion (who will gain most by sending another household member to reduce their exposure to income uncertainty). This observation implies that, beyond the risk aversion of individual members, the within household dispersion in risk aversion affects the likelihood that a household sends a migrant. Again, this is an implication tested below.

E. An Illustration of Individual and Household Decisions

Our model suggests that the risk attitudes of other household members, in addition to the risk preferences of individuals, should matter in shaping individuals' migration choices. Before exploring this question empirically, we examine the implications of an individual versus a household decision model for migration rates and for the selection of migrants and non-migrants according to their risk aversion. In the individual model, there is no income pooling ($\alpha = 0$) and each agent autonomously decides whether it is optimal to migrate or not. In the household decision model, instead, household members pool income ($0 < \alpha \leq 1$) and take joint decisions on the migration of their members.

In our simulation, we generate a population of 10,000 individuals with mean-variance utility functions that are randomly assigned a value of willingness to take risks (varying between zero and ten) whose distribution mimics the one we observe in our data. Further, we choose values for expected earnings $E(y_S)$ and earnings variance $V(y_S)$ in the source region S , assume that expected earnings $E(y_D)$ in destination region D are twice as large as in region

S , and vary the earnings variance $V(y_S)$ to study how migration choices react to relative changes in the earnings variance in the two regions.¹⁹

We then simulate migration decisions under the two models discussed above: the individual model and the household model. In the first case, decisions are made individually, and individuals face the same expected income and income variance but differ in migration costs.²⁰ In the second model, we assign individuals to households so that the within household correlation in risk aversion roughly resembles that in our data (the within household standard deviation of willingness to take risks is 0.9). Each household has four members, the average household size in our data, which results in 2,500 households in the simulation. Once households are formed, we randomly reassign migration costs to the household using the same distribution as above. Finally, we assume that migrants pool about a third of their income with the origin family (i.e. we set the parameter $\alpha = 0.3$), and that at most one individual can migrate from each household. As in our model, a household chooses to send a member to destination region D if the utility is higher than the utility from keeping all members in region S .

Figure 2 plots the predicted migration rates and the average willingness to take risks among migrants and non-migrants for the two models. The horizontal axis carries the earnings variance in the destination region D relative to the source region S (with expected earnings in region D assumed to be twice as high as in region S), while the vertical axis carries the migration rate on the left-hand side and the average willingness to take risks on the right-hand side. In both models the trend of the simulated migration rates are similar: when the variance ratio $V(y_D)/V(y_S) < 1$ the migration rates (solid line) are close to 100%, but

¹⁹ We set: $E(y_S) = 16$; $V(y_S) = 40$; $E(y_D) = 32$ and we let $V(y_S)$ vary in the interval: $[0.1 * V(y_D) \leq V(y_S) \leq 10 * V(y_D)]$.

²⁰ We assume migration costs are uncorrelated with risk attitudes. In our simulations, individuals are assigned a (pseudo) random value of migration cost drawn from a chi-squared distribution with 2 degrees of freedom so that the mean value of migration costs (7.9) is approximately equal to half of the expected earnings in the source region.

they gradually decline as uncertainty in the destination region increases (relative to the source region). Similarly, both the individual and the household decision models imply that sorting leads to a higher average willingness to take risk for migrants (dash-dotted line) than for non-migrants (dashed line) when there is lower uncertainty in the source region than in the destination. Thus, migrants will always be less risk averse than non-migrants no matter whether the migration decision is taken at the individual or household level.

The two models diverge, however, in their quantitative predictions of the migration rate for any given level of relative earnings variance in the two regions. Whereas the individual model predicts a rapid decline in the share of migrants with increasing uncertainty in the destination region, such decline is less pronounced when migration decisions are taken at the household level. Thus, the household migration model predicts positive migration rates for levels of destination uncertainty for which an individual model would predict zero migration. It does so because first, the other household members benefit from risk diversification even if the earnings variance in the destination region is high and second, the migrant is partially insured against risks in the destination region by household members who stay at home.²¹ Both these factors are absent in a model in which migration decisions are made at the individual level.²² It is thus important to understand whether migration decisions are taken at the individual or the household levels and whether they depend on the level of risk aversion of other household members. We address both these issues empirically in the remainder of the paper.

²¹One can show that the lower is the share of income that the migrant pools with the rest of the family (parameter α in the model), the faster the migration rate drops as relative uncertainty in the destination region increases.

²² When the risk aversion of the most risk averse household members increases, and the insurance parameter α increases, the solid line in panel B of Figure 2 shifts further outwards.

III. Background and Data

A. Internal Migration in China

In the late 1970s, rural communities in China moved from a “commune system” to a “household responsibility system” under which households, which were allocated land use rights, could choose their own crops, and were allowed to sell their produce freely on the market. While this shift significantly increased agricultural productivity, many basic social services provided by the communes were abolished, so households found themselves in the situation of having to finance their own health and education, as well as having to deal with other unforeseeable risks, such as adverse weather conditions. This change increased the need to diversify the sources of household income, but before the early 1990s, such diversification was limited by relatively strict rural-urban segregation enforced through a household registration system (or *hukou*) that gave people the right to live only in the jurisdiction of their birth (see Meng, 2012). It was not until the late 1990s, when the massive economic development of urban areas created a significant increase in demand for unskilled labour that the government began to loosen its enforcement of migration restrictions. According to data from the Chinese National Bureau of Statistics (NBS), the total number of rural-urban migrants increased from around 30 million in 1996 to 150 million in 2009, a rise from 2.5 to 11% of the total resident population.

However, the lack of an urban *hukou* prevents migrants in cities from accessing certain occupations and excludes them and their dependants from health care, pension insurance, unemployment insurance, and many other social services available to urban *hukou* holders (Meng & Zhang, 2001). The *hukou* system thus prevents rural migrants from settling in cities and causes them to leave their families behind (Meng & Manning, 2010). As a result, complete households seldom migrate to urban areas in China, choosing instead to send particular household members to migrate to urban centres (as represented by our model in the

previous section). Migrants generally engage in circular migration and repeated short term migration spells are common (in our sample, migrants spend an average 9.6 months per year working in destination regions and the remaining 2.4 months at home).

Rural migrants face difficult conditions in urban areas, with average wages at the lower end of the urban wage distribution (Meng & Zhang, 2001; Frijters et al., forthcoming), receiving unequal pay even within the same occupation (Meng & Zhang, 2001), with about one in three falling below the poverty line (Du et al., 2005). Strenuous working hours, poor housing, and no access to health care are all factors that lead to serious health hazards (Du et al., 2005), contributing to the various risks associated with migration. In line with the theoretical model outlined in the previous section, if migrants are exposed to more uncertainty in the destination region than at home we should expect them to be relatively less risk averse than the non-migrant population.

B. Data and Samples

Our primary data source is the Rural Household Survey (RHS) from the Rural-Urban Migration in China (RUMiC) project (henceforth RUMiC-RHS). RUMiC began in 2008 and it conducts yearly longitudinal surveys of rural, urban, and migrant households. The RUMiC-RHS was conducted for 4 years and administered by China's National Bureau of Statistics. It covers 82 counties (around 800 villages) in 9 provinces identified as either major migrant sending or receiving regions and is representative of the populations of these regions. The survey includes a rich set of individual and household level variables that contains not only the usual demographic, labour market, and educational data but also information on individual migration experience and subjective rating of willingness to take risks, both particularly relevant to this study. Unlike other surveys, it records information on all household members whose *hukou* are registered in the household. Thus, household members

who were migrated to cities at the time of the survey were also included. Information on household members who were not present at the time of the survey was provided by the main respondent. However, questions related to subjective issues and opinions (e.g. risk attitudes) are only answered by individuals who were present at the time of the survey. In this paper, we use data from the 2009 RUMiC-RHS, conducted between March and June of that year, which was the first wave that reports information on risk aversion.

To identify migrants, the survey includes questions on the number of months each individual spent living away from home during the previous year (i.e. 2008) and the reason for their absence (e.g. education, military service, work/business, visiting friends and relatives.) We thus define a *labour migrant* as an individual who spent 3 or more months away from home in the previous year for work or business purposes.

In the 2009 wave of the RUMiC-RHS survey interviewees were asked to rate their *attitudes towards risk*. The question states “In general, some people like to take risks, while others wish to avoid risk. If we rank people’s willingness to take risks from 0 to 10, where 0 indicates ‘never take risk’ and 10 equals ‘like to take risk very much,’ which level do you think you belong to?” According to a recent literature, responses to direct questions on self-reported risk aversion are reasonable proxies of more objective measures of risk attitudes obtained from having respondents playing lotteries (Ding, Hartog, & Sun, 2010; Dohmen et al., 2011). Moreover, Frijters, Kong, and Meng (2011) have specifically validated the risk attitude question used in the RUMiC survey.²³

In our empirical analysis, we test the predictions of the theoretical model presented in section II by investigating individual as well as household migration probabilities (see section IV). For the *individual* level analysis we focus on individuals who are in the workforce and

²³ Frijters, Kong, and Meng (2011) ask a random sub-sample of 1,633 rural-urban migrants from the Urban Survey to play a risk game similar to that used by Dohmen et al. (2011). They find that self-assessed risk and the risk measures revealed by the game are highly correlated, with a correlation coefficient of 0.7.

who, therefore, are potential migrants. The 2009 RUMiC-RHS survey includes 17,658 individuals in the labour force (i.e. aged between 16 and 60 and not currently at school or disabled) who provide information about age, gender, educational level and migration status.²⁴ To be able to carry out our analysis we restrict the sample to individuals living in households where at least two members in the work force have reported risk preference, which reduces the sample to 7,808 individuals. As Panel A in Appendix Table A1 shows, the sample of individuals in households we focus on is almost identical in observables to that of individuals in households in the overall sample. Information on risk aversion is available for 81% of that sample, leading to a final estimating sample of 6,332 individuals. For the household-level analysis, we use all households where at least two members reported their willingness to take risks, but we also include individuals above age 60, as their risk aversion is likely to matter for decisions of the household whether or not to send a migrant, which results in a sample of 2961 households.²⁵ Panel B in Table A1 shows that these households are almost identical in observable characteristics to the overall sample.

The risk attitudes question can only be answered by respondents who are present at the time of the survey, which is a potential problem for migrants. In our data, the share of non-responses is higher among migrants (55%) than among non-migrants (10%).²⁶ This may be problematic if unobservables that affect the probability to be present at the time of the interview are correlated with individual risk aversion, conditional on observables. There is no reason to believe that migrants who happened to be present at home between March and June

²⁴ The 2009 RUMiC-RHS survey includes a total of 32,249 individuals. We focus on those aged 16–60 because the probability of being a migrant drops below 1% for individuals over 60. Nevertheless, shifting the upper bound of this age range by five years (in either direction) does not alter our empirical findings.

²⁵ Excluding individuals over 60 from the household sample lead to very similar estimation results.

²⁶ In comparison with similar surveys in other developing countries, the RUMiC-RHS survey has a much higher response rate for migrants, due to the special institutional settings of internal migration in China. As discussed earlier, most migrants are still subject to a rural *hukou* in their home village and leave their immediate family behind to go and work in cities. To look after their left-behind relatives, repeated short term migration spells are common. In our sample migrants spend on average 9.6 months per year working in destination regions and 2.4 months at home. Moreover, the majority of migrants return home for the Chinese New Year (or Spring Festival), celebrated between late January and early February, and stay on for some weeks or months. All this increases the chances of finding migrants in their home village at the time of the survey.

in 2009 differ systematically in risk attitudes from migrants who were absent. To nevertheless test this hypothesis, we make use of the fact that we observe individual characteristics also for those who are absent at the time of the survey as these are reported by other family members; as discussed above, attitudes towards risk is the only missing information in such cases. We estimate a simple selection model using family events such as death, marriage, or birth that occurred before or after the interview as instruments to identify the participation equation, i.e. whether the migrant was present at the interview. These events, while arguably uncorrelated with migrants' risk attitudes, may have induced the individual to return to the home village, or to remain longer at home, and hence increased the probability of participating in the survey. We then construct the generalised residuals and include them in an equation where willingness to take risk is the dependent variable, conditioning in both equations on other observables that are used in the main analysis. A test of correlation between the unobservables determining survey participation and individual risk attitudes corresponds then to a simple t-test of whether the coefficient of the generalised residual is significantly different from zero. Despite our instruments being strong predictors for interview participation, we cannot reject the null hypothesis that the residual correlation in risk aversion and interview participation is zero for any of the specifications we estimate. We provide details of this test in appendix A.II, and report estimates in Table A 2.

C. Descriptive Statistics

We provide descriptive statistics on individual characteristics in the upper panel of Table 1. The numbers show that males account for about half our sample, with an average age of 43.8 years and an average education of 7.15 years. About 92% of our respondents are married and have on average 3.1 siblings and 1.7 children. The average of our measure of willingness to take risks is 2.6 (with a standard deviation of 2.4). The lower panel of Table 1 shows the characteristics of the 2,961 households in our sample. The average household size is 4.1, with

an average of 2.9 individuals of working age.²⁷ About 16% of the households in the sample have at least one member who migrated in the previous year, and 11% of the individuals in our sample can be classified as migrants, with the rate among males and females being 14.0% and 7.9%, respectively. Further, about 23% of the interviewees in our sample reported having migrated at least once in the past. In our empirical analysis, we will use this as a second measure for migration status to check the robustness of our findings.

The distribution by migrant status of our measure of willingness to take risk, which ranges between 0 (highest level of risk aversion) and 10 (lowest risk aversion), is plotted in Figure 3. For both groups of respondents, the distribution is skewed to the left: the mode value is zero for both migrants and non-migrants, and the share of respondents categorizing themselves as being at the highest level of risk aversion is 18% and 31%, respectively. The unconditional mean of the measure is 2.4 and 3.6 for non-migrant and migrants, respectively. Hence, the migrant distribution is clearly shifted more towards less risk aversion than the non-migrant distribution.

Our data also show a correlation between individual and household risk preferences that supports Dohmen et al.'s (2012) claim that intergenerational transmission of risk attitudes and assortative mating of parents may generate within household correlation in preferences towards risk. Nevertheless, there is still substantial heterogeneity in the way individuals with the same degree of risk aversion are matched with other household members' risk preferences. To demonstrate these features, we compute the residuals from regressing individual willingness to take risks on basic demographic controls (gender, age, and age squared) and a full set of county of residence dummies. Figure 4 plots the residuals for each individual in our sample (on the vertical axis) versus the average of other household members (on the horizontal axis); the fitted line shows a clearly positive relation between individual

²⁷ The one-child policy introduced in 1979 was less restrictive in rural areas (allowing rural families to have a second child if the first one was a girl) and less strictly enforced. In our sample, individuals born before and after 1979 have an average of 3.3 and 2.1 siblings, respectively.

and household residual risk attitudes (with a correlation of about 0.58), which confirms Dohmen et al.'s (2012) findings. On the other hand, the scatter plot also shows considerable variation, a within household heterogeneity we exploit in our regression analysis (see section IV).²⁸

IV. Empirical Strategy

In our empirical analysis, we regress the probability of being a migrant, or the probability that a household sends a migrant, on different measures of willingness to take risk at both the individual and household level, as well as on a large set of background controls (individual characteristics, household characteristics, and area fixed effects). Our analysis addresses two issues: first, how risk aversion determines individual migration decisions, and second, the role of risk attitudes at the household level for migration decisions. In this second part, we first test whether and to what extent individuals are chosen to migrate according to their *relative* risk preferences within the family (*within household migration decision*) and then which households are more likely to send migrants (*across household migration decision*).

Individual migration decision. To assess this first aspect, we estimate the following equation:

$$\Pr(M_{ihk} = 1) = \alpha_0 + \alpha_1 wtRisk_{ihk} + \mathbf{X}'_{ihk}\beta + \mathbf{W}'_{hk}\theta + \eta_k + \epsilon_{ihk} \quad (9)$$

where i indexes individuals, h households, and k administrative counties. The variable M_{ihk} is an indicator of whether individuals have spent at least 3 months working outside their origin area during the previous year. Our main variable of interest is the willingness to take risks, $wtRisk_{ihk}$, measured on a scale from 0 (most risk averse) to 10 (least risk averse). The vector \mathbf{X}'_{ihk} collects a set of individual-level covariates that are important determinants of

²⁸ This is in line with evidence provided by Mazzocco (2004) of imperfect assortative mating on risk aversion in US couples. Using data from the Health and Retirement Study (HRS), he shows that self-reported risk attitudes differ between husband and wife for about 50 percent of the couples in the sample.

individual migration probability, including gender, age, age squared, marital status, number of children, years of education, number of siblings, and birth order. The vector \mathbf{W}'_{hk} includes a set of family characteristics, such as household size and structure (number of family members under 16, in the work force, or older than 60); and per capita house value (in logs). We also include county fixed effects η_k to capture any time invariant observable and unobservable area characteristic that may be correlated with both attitude towards risk and propensity to migrate.²⁹ An individual or household migration decision model in which migration implies exposure to higher uncertainty would suggest that migrants are less risk averse than non-migrants. Therefore, if Chinese rural migrants are exposed to higher uncertainty in urban areas than their relatives who remained at home, we would expect the coefficient α_1 in equation (9) to be positive.

Within household migration decision. Proposition 1 of our theoretical model implies that the individual probability of being a migrant should depend on both the individual's own risk aversion and the risk aversion of other household members (section IIC).

We test this proposition in two ways: First, we estimate individual-level regressions as in equation (9) but now including both the individual's absolute risk preferences ($wtRisk_{ihk}$) and the individual's position in the household ranking of willingness to take risk ($wtRisk_rel_{ihk}$) among members in the workforce. This way, we can use the coefficient on the $wtRisk_rel$ variable to identify individuals with higher relative risk preference within the family from individuals who have the same level of risk preference ($wtRisk$) but are in different positions on the risk aversion ranking within their respective households. According to proposition 1, when migration is risky, all else being equal, the least risk averse individuals in a household should have a higher probability of migrating. The ordinal measure of risk

²⁹ Dohmen et al. (2012) provide evidence of correlation in risk aversion among individuals residing in the same area, showing particularly that once parental attitudes are controlled for, regional risk attitudes are correlated with children's risk attitudes.

preferences should thus have an effect over and above the effect of the cardinal measure. If migration is purely an individual decision, then once individual risk attitudes are controlled for, the position in household ranking should not influence the migration probability (i.e. the coefficient on the $wtRisk_rel$ variable should not be statistically different from zero).

Our second approach is to re-estimate equation (9) including both individual risk attitudes ($wtRisk_{ihk}$) and the average risk preferences of the other household members who are in the workforce ($wtRisk_oth_{ihk}$). Conditional on their own risk attitudes, individuals who belong to a household in which the other members are relatively less willing to take risks (i.e. have lower values of the $wtRisk_oth$ variable) should be more likely to migrate (because they are more likely to be the least risk averse in the household). If migration implies a higher exposure to uncertainty, we would thus expect to find a positive coefficient on the $wtRisk$ variable (as in all previous regressions) and a negative coefficient on the $wtRisk_oth$ measure.

Across household migration decision. Finally, to assess which households have a higher probability of sending migrants, we estimate *household-level* regressions of the probability of sending a migrant, and then test statements (i) and (ii) of proposition 2 (see section II.D).

The first statement suggests that, conditional on having the same mean risk aversion, households with a larger variation in risk preferences should be more likely to send migrants.

We test this prediction by estimating the following equation:

$$\Pr(M_{hk} = 1) = \delta_0 + \delta_1 HH_avg_wtRisk_{hk} + \delta_2 HH_range_wtRisk_{hk} + \mathbf{W}'_{hk}\theta + \eta_k + u_{hk} \quad (10)$$

where the probability that a household sends a migrant depends on the average risk aversion in the household (HH_avg_wtRisk), the within-household range in risk attitudes (HH_range_wtRisk), other household controls and area fixed effects. Conditional on

household average risk aversion, we expect households with a larger variance in risk attitudes to be more likely to send a migrant.

The second statement in proposition 2 implies that (if migration implies exposure to higher uncertainty) the probability of a household sending a migrant increases with the willingness to take risk of the least risk averse member but simultaneously decreases with the willingness to take risk of the other (non-migrant) members. To test this implication, we estimate the following household-level equation:

$$\Pr(M_{hk} = 1) = \gamma_0 + \gamma_1 HH_max_wtRisk_{hk} + \gamma_2 HH_oth_wtRisk_{hk} + \mathbf{W}'_{hk}\theta + \eta_k + u_{hk} \quad (11)$$

where we separately include in the regression the risk preferences of the least risk averse individual in the household (HH_max_wtRisk) and then the average risk attitudes among the other household members (HH_oth_wtRisk). Our theoretical framework would lead us to expect the coefficients on these two risk measures to have opposite signs if migration exposes the migrant to higher uncertainty but allows the household to diversify risk and thus reduce the other household members' risk exposure. In particular, we would expect a positive coefficient on the first variable and a negative one on the second.

V. Results

We first present our findings for individual and within household migration decisions and report the results of our robustness checks against alternative interpretations of our results (section V.A and V.B). We then discuss our results for across household migration decisions (section V.C).

A. *Individual Risk Aversion*

Table 2 summarizes the results from our estimation of a linear probability model of the individual probability of migrating based on equation (9).³⁰ Here, we use two alternative measures of migration status: whether the individual migrated for work during the year before the survey (columns 1–4) and whether the individual had ever migrated in the past (columns 5–8). In all regressions, we include a full set of 82 county dummies and cluster the standard errors at the household level to allow for within household correlation in the error terms.

In column 1, we report the results of regressing individual migration status on our measure of willingness to take risk, after which we successively add in further individual and household controls (columns 2–4). All estimates show a strong positive association between individual willingness to take risks and the probability of being a migrant, which suggests that individual risk attitudes play an important role in determining individual propensities to migrate. The estimated coefficient on the *wtRisk* variable reduces in magnitude when basic individual controls are included (from 0.014 in column 1 to 0.005 in column 2), but remains stable when additional individual controls and household characteristics are added in (columns 3–4). This pattern is consistent with basic demographic characteristics such as gender and age being strong predictors of individual risk attitudes (see among others, Barsky et al. 1997 and Borghans et al. 2009). The effect estimated is economically relevant: in our most restrictive specification (column 4), a one standard deviation increase in the willingness to take risks is associated with a 1.2 percentage point increase in the migration probability, corresponding to an 11% increase with respect to the baseline migration probability of 11%. This positive relationship between willingness to take risks and probability of migration is

³⁰ The marginal effects based on probit or logit estimators, reported in Appendix Table A2, are almost identical to those reported here.

consistent with internal migration in China exposing migrants to higher level of uncertainty than non-migrants.

In columns 5–8 of Table 2, we report estimates for the alternative migration status measure of whether individuals have ever migrated for work. About 23% of the interviewees in our sample reported having migrated at least once in the past. As before, willingness to take risk is a strong predictor of migration status: in the most general specification (column 8), a decrease of one standard deviation in the willingness to take risk is associated with a 3.3 percentage points increase in migration probability, corresponding to about 14% of the baseline sample probability, an estimate that is very close to the one obtained with migration in year 2008 as the main outcome.³¹

To investigate the linearity in the relation between migration propensity and risk attitudes, we estimate equation (9) with a set of five dummies for different levels of willingness to take risks (the excluded dummy corresponds to a zero willingness to take risks). Panels A and B of Figure 5 report the estimated coefficients and their 90% confidence intervals for the two measures of migration based on the specification in columns 4 and 8 of Table 2. The figure shows a clear and almost linear relation between migration probability and individual willingness to take risks above values of about 2.

Our findings on individual migration decisions are much in line with previous findings in the literature. For instance, while a one standard deviation decrease in individual risk-aversion leads to an 11% or 14% increase, respectively, in the baseline probability of having migrated in the previous year or overall, Jaeger et al. (2010), using a specification almost identical to that reported in column 2 of Table 2, report that a one standard deviation decrease in individual risk aversion leads to a 12% increase in the baseline migration probability.

³¹ In Appendix Table A3, we report estimated coefficients on the other controls. As expected, male, non-married and younger individuals are more likely to migrate, while education does not seem to predict migration status (see column 4).

One concern with our results is that, because attitudes towards risk are measured after the migration decision, the migration experience itself may have affected the risk attitudes reported during the interviews. We can investigate this possibility by exploiting the longitudinal nature of the survey. Almost half of our estimation sample reported risk attitudes in both the 2009 and the 2011 waves of the RUMiC-RHS. These repeated measures, together with the information on 2010 migrations, allow us to investigate two empirical questions: Do individuals report consistent measures of risk aversion over time? Are migration experiences systematically associated with changes in self-reported risk aversion? The Appendix Figure A2 reports the distribution of changes in self-reported risk attitude between 2009 and 2011. In our sample, the average change in self-reported risk attitudes over these two years is small, 0.39 for a measure ranging between 0 and 10. About one fourth of the respondents reported exactly the same value in both surveys, while almost half reported changes smaller than or equal to plus or minus one, and about 80% showing changes ranging between 0 and 3. These numbers suggest that interviewees consistently report their risk preferences over time.³²

One concern may be that migration experiences are systematically related to changes in risk aversion. To investigate this, we follow Jaeger et. al. (2010) and regress the change in self-reported willingness to take risks between 2009 and 2011 (from the 2009 and 2011 waves of the RUMiC-RHS) on a dummy variable that equals one if the individual migrated in 2010. We report results in Panel A (columns 1-4) of Appendix Table A5. Alternatively, we regress the willingness to take risks reported in 2011 on a dummy for migration in 2010 and on the willingness to take risks reported in 2009 (Panel A, columns 5-8). We gradually include in the specification the individual and household controls used in our main analysis of

³² On average, the change in self-reported risk aversion over two consecutive waves (2009 and 2010) is 0.2 and almost 40 percent of the sample reports identical risk preferences. A few recent papers suggest that individuals may be less willing to take risks after being affected by major negative events such as natural disasters (Cameron and Shah, forthcoming), war and extreme violence (Callen et al., 2014), or financial crises (Guiso, Sapienza, & Zingales, 2013). However, it is unclear whether this behavioural response is due to a change in the underlying degree of risk aversion, or to an increase in the degree of uncertainty individuals are exposed to.

individual selection, using the same specifications as in Table 2. According to the estimation results, having migrated in 2010 does not affect the observed change in risk preferences or the level of risk preferences in 2011 when controlling for risk attitudes in 2009. In all specifications, estimated coefficients are not significant and of small magnitude.

Panel B of Table A5 reports the same regressions than Panel A, but we distinguish between individuals who migrated *only* in 2010 and individuals who migrated in both 2008 and 2010. Again, estimates are very small for both measures, and not significantly different from zero throughout.

To further investigate a possible relation between our measure of risk aversion and migration experience, we use data from various waves of the Urban Migrant Survey (UMS) of the RUMiC project and test whether risk preferences vary across migrations of different duration. In particular, we regress risk attitudes of migrants on the years since first migration, while controlling for individual characteristics as well as for city and year fixed effects. We report estimates in Appendix Table A6, where columns 1 and 2 report results unconditional and conditional on individual fixed effects, respectively. Estimated coefficients of migration duration are very small in magnitude and never significantly different from zero. We conclude from all these tests that risk attitudes are not systematically affected by previous migration experiences.

B. Within Household Migration Decision

As pointed out earlier (section II.C), finding that individual risk aversion determines migration choices is compatible not only with a model of individual choice but also with a model in which migration decisions are taken at the household level (as in the model developed in section II). If such decisions are taken on a purely individual level, however, the risk attitudes of other household members should play no role in determining migration

decisions. We now further examine the role of the household in migration decisions by exploring the testable implications of our propositions 1 and 2.

Proposition 1 (section II.C) implies that the individual probability of being a migrant should depend on both the individual's own risk aversion and the risk aversion of other household members. As indicated before (see section IV), we test this proposition in two ways.

In our first approach, we still run individual-level regressions but now explicitly include both the individual's absolute risk preferences (*wtRisk*) and the individual's position in the household ranking of willingness to take risk (*wtRisk_rel*) among members in the work force. The coefficient on this latter variable is identified from individuals who have the same level of willingness to take risk (*wtRisk*) but who hold different positions in the risk aversion ranking within their respective households. According to proposition 1, the individual probability of migrating should increase with both the cardinal and ordinal measures of willingness to take risks. We also use two alternative measures for the variable *wtRisk_rel*: the individual ranking in risk attitudes within the household and a dummy variable indicating the household member with the highest willingness to take risks.³³ To construct the individual rankings, we rank household members by their willingness to take risks, assigning a value of 1 to the most risk-averse person and a value of n (where " n " is the number of people with risk measure in the household) to the least risk averse individual, and we then normalize this measure by the number of members reporting risk preferences. Both these measures increase with the focal individual's willingness to take risks. If, as proposition 1

³³ In constructing these variables, we need to decide how to treat cases in which some household members reported identical values of risk attitudes. For the ranking measure, we assign an average ranking to individuals with the same willingness to take risks (e.g. if two individuals are ranked second in the household, we assign a ranking of 2.5 to each and a ranking of 4 to the next household member, if any). In our second procedure, we assign the value 1 if the individual has the lowest risk aversion in the household, irrespective of other household members possibly reporting the same level of willingness to take risks. We have experimented with alternative methods for dealing with ties in other unreported regressions, but our empirical results do not change. These estimates are available upon request.

suggests, being relatively more willing to take risks with respect to the other household members makes individuals more likely to migrate, then we would expect positive coefficients for both the level and the relative risk variables.

We report estimation results in Table 3, for specification 4 of Table 2 (which includes county fixed effects as well as individual and household controls and clusters standard errors at the household level). For comparative purposes, column 1 of Table 3 exactly replicates column 4 of Table 2. In columns 2–5, we add our two alternative measures of relative risk attitudes, where we include only the relative measure for each variable in even columns and both the relative and absolute willingness to take risks in odd columns. Consistent with our theoretical predictions, the estimated coefficients are positive and significant for all relative measures of willingness to take risks. This finding also holds when we include both absolute and relative attitudes towards risk (columns 3 and 5): the estimated coefficients are positive and significant on both variables, implying that the relative measure of risk attitudes also affects the probability of migrating over and above the individual’s absolute risk preference. As a result, not only are individuals with low risk aversion more likely to migrate, but this probability increases for those who are relatively less risk averse than their family members. Specifically, according to the estimates in column 5, being the least risk averse in the household implies a 1.4 percentage point higher likelihood of migrating (around 13% of baseline) than for an individual with the same individual risk attitude who is not the least risk averse in the household.

Our second approach to investigating within household selection is to add in the average risk preferences of the other household members who are in the workforce (*wtRisk_oth*), in addition to the individual risk attitudes (*wtRisk*) variable. Following the structure of the previous columns in Table 3, column 6 reports the results for the *wtRisk_oth* variable alone, while column 7 lists the outcomes when both variables are included. Our expectations are

that the average risk preferences of other household members will have no predictive power alone, but, conditional on individuals' own risk attitudes, an individual in a household where the other members are relatively less willing to take risks (i.e. have lower values of the *wtRisk_oth* variable) should have higher probability of migration. Both hypotheses are supported by the data: the estimated coefficient on *wtRisk_oth* is zero (column 6) but becomes significant and negative once we condition on individual willingness to take risks (column 7). As in all previous regressions, the coefficient on this latter variable is positive and significant.

A first important implication of our analysis is therefore that migration decisions in the context that we study are taken on the level of the household rather than the single individual. Our results further provide strong evidence of within-household migration decision being consistent with a model, where beyond individual willingness to take risks, risk preferences of other household members matter in determining migration decisions, with the direction of the effects being in line with our Proposition 1.

C. Across Household Migration Decision

We now turn to the last part of our analysis, where we investigate which households have a higher probability of sending migrants. We first estimate household-level regressions of the probability of sending a migrant, and then test parts (i) and (ii) of proposition 2 (see section IID).

The first part of the proposition suggests that, conditional on having the same mean risk aversion, households with a larger variation in risk preferences should be more likely to send migrants. In Table 4, we report the results of regressing a dummy variable for whether a household sends at least one migrant on the average and the within household range of

willingness to take risks, with other household controls and county fixed effects included.³⁴ When the regression includes only the household's average risk aversion (columns 1 and 3), the coefficient is positive and strongly significant: households that are on average less risk averse are more likely to engage in migration. As correlation in risk attitudes within households is sizeable in our sample (see section III.C), this finding may simply reflect that less risk averse individuals are more likely to migrate and to belong to households whose members are also less risk averse. Hence, in columns 2 and 4 of Table 4, we also add in the within household range in risk attitudes. These estimates indicate that, in line with our theoretical model, households with a higher variation in risk preference across members are also more likely to send migrants *conditional* on the average household risk aversion. In both specifications, only the range, and not the mean, of household risk preferences is significantly (and positively) associated with having sent a migrant.

The second part of proposition 2 implies that the probability of a household sending a migrant decreases with the risk aversion level of the least risk averse member and increases with the degree of risk aversion of the other (non-migrant) members. To test this implication, we run household-level regressions of the probability of sending a migrant by separately adding the risk preferences of the individual with the highest willingness to take risks in the household ($HH_max_wtRisk_{hk}$), and then the average risk attitudes of the other household members ($HH_oth_wtRisk_{hk}$). Based on our theoretical framework, we would expect the coefficients on these two risk measures to have opposite signs if migration exposes the migrant to higher uncertainty but allows the household to diversify risk and thus reduce the exposure to risk of other household members. All else being equal, the probability of sending a migrant should be higher for the household in which the least risk averse individual has a

³⁴ We define the within household range as the difference between the highest and lowest values of willingness to take risks reported by each household. The household controls are number of family members under 16, in the work force, and older than 60; per capita house value; size of the family plot; and years of education and age of the head of the household.

higher willingness to take risks (relative to most risk loving individual in other households), so the coefficient on HH_max_wtRisk should be positive. Conversely, the probability of sending a migrant should be higher for households in which the other individuals in the household on average have lower willingness to take risks relative to the average willingness to take risk of other households, implying that the coefficient on HH_oth_wtRisk should be negative.

Columns 1–4 of Table 5 report the estimates of regressing the probability that a household will send a migrant on $HH_max_wtRisk_{hk}$ and $HH_oth_wtRisk_{hk}$. All regressions include county fixed effects, and household controls are added in columns 3–4. When only the willingness to take risks of the most risk loving individual in the household ($HH_max_wtRisk_{hk}$) is included in the regression (columns 1 and 3), we find a positive and strongly significant coefficient. When the specification also includes the average risk aversion of the other household members ($HH_oth_wtRisk_{hk}$), the coefficients on both risk measures are significant but have opposite signs (column 2 and 4): the coefficient on HH_max_wtRisk remains positive (and increases slightly), whereas the coefficient on HH_oth_wtRisk is negative.³⁵ Hence, a household has a higher probability to send a migrant the lower the risk aversion level of the least risk averse member and the more risk averse the other household members are. This conclusion is in line with the predictions of our theoretical model for the case in which a migration that increases exposure to risk for the migrant members allows reduction of income uncertainty for the non-migrant members. The estimates in column 4, specifically, suggest that a one unit decrease in the measure of willingness to take risks of the least risk averse household member implies a 1.5 percentage point increase in the household's probability of sending a migrant, corresponding to a 9%

³⁵ The increase in the size of the coefficient on HH_max_wtRisk when conditioning on HH_oth_wtRisk is compatible with HH_oth_wtRisk having a negative effect on the migration probability and being positively correlated with HH_max_wtRisk .

increase over the baseline household migration probability (see Table 1). At the same time, a one unit increase in the average risk aversion among all other household members, conditional on the most risk loving member's risk attitudes, is associated with a 0.8 percentage points increase in the household's probability of sending a migrant (or a 5% increase), although the coefficient is not precisely estimated.

In column 5 and 6 of Table 5, we check the robustness of our findings to changes in the age limit for individuals to be considered part of the workforce by reducing it from 60 to 50 years. Our estimates, remain unaffected, becoming if anything more significant in spite of a 25% reduction in sample size.

The findings in Table 5, combined with the other estimates in Table 4, suggest that the distribution of risk attitudes within the household plays an important role in the household's decision to send a migrant. Moreover, the direction of the effect is fully consistent with the predictions of our theoretical framework.

VI. Discussion and Conclusions

This paper analyses empirically the relation between the distribution of risk attitudes - within and across households - and migration decisions. It provides strong evidence not only that, in the context of internal migration in China, migration decisions are taken at the household level, but that heterogeneity in risk aversion within the household plays an important part in determining whether a migration takes place, who emigrates, and which households send migrants.

The insight that migration decisions, in the context that we analyse, but also likely in other settings, are taken at household level, and are influenced by risk attitudes of other household members has important policy implications. For instance, the implementation of a policy that creates possibilities to insure against risk – such as the introduction of social

safety net schemes - will possibly increase migrations if decisions are taken on an individual level. When the migration decision is taken at the household level, however, this may work in the opposite direction because it allows risk averse household members to diversify risk in other ways. Our model implies that household migration increases with the share of income pooled between migrant and non-migrant household members, as it allows other household members to diversify risk, and the migrant to insure against risk. Hence, the easier it is for households to transfer income back and forth between source and destination regions the higher will be the likelihood to engage in migration.

In demonstrating that the distribution of other household members' risk attitudes affects decisions to migrate, our analysis suggests that risk attitudes within the household may also affect other choices that are determined on a household level. Examples are the adoption of innovative farming practices, the selection of new crops, or the investment in a new family business, where decisions may be influenced by the distribution of risk attitudes within households and by the possible benefits of risk reduction to members other than the individuals directly concerned. Understanding direction and magnitude of the interactions between the effects of such decisions on different household members and their risk preferences should be an interesting avenue for future research, with the potential to contribute significantly to a better understanding of key economic decisions, particularly in developing countries.

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Figures

FIGURE 1.—MODEL

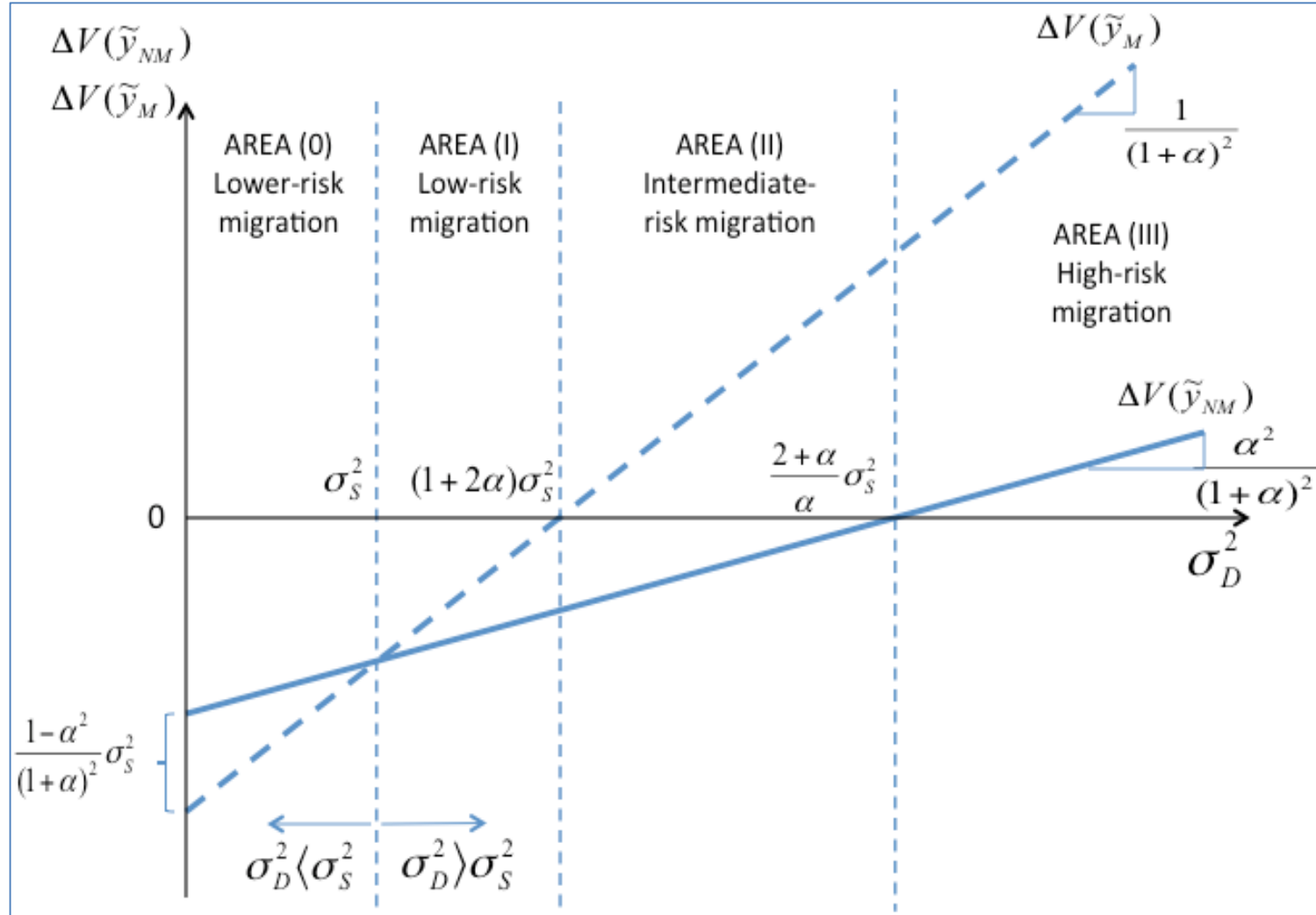
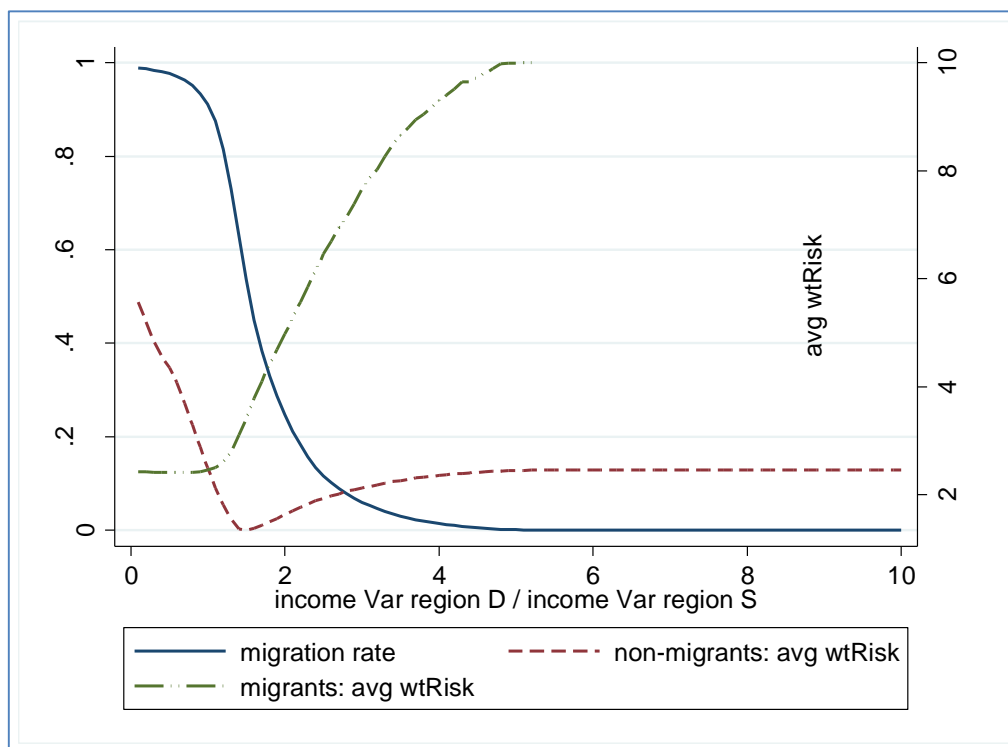


FIGURE 2.—INDIVIDUAL AND HOUSEHOLD MIGRATION DECISION MODELS

PANEL A: INDIVIDUAL MIGRATION DECISION MODEL



PANEL B: HOUSEHOLD MIGRATION DECISION MODEL

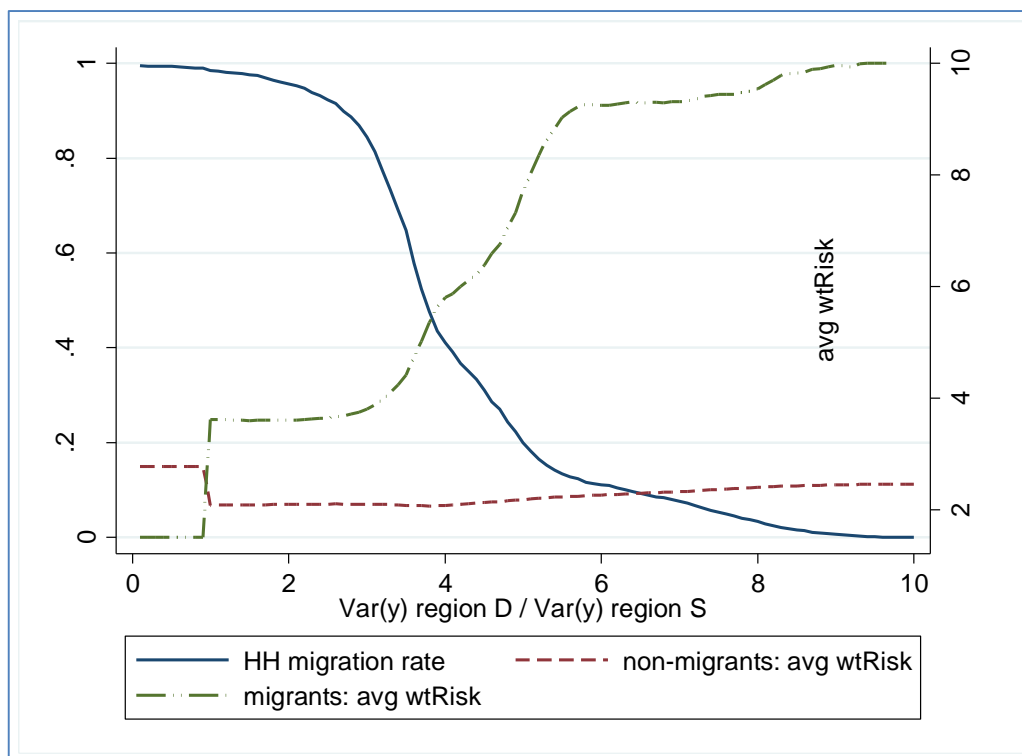
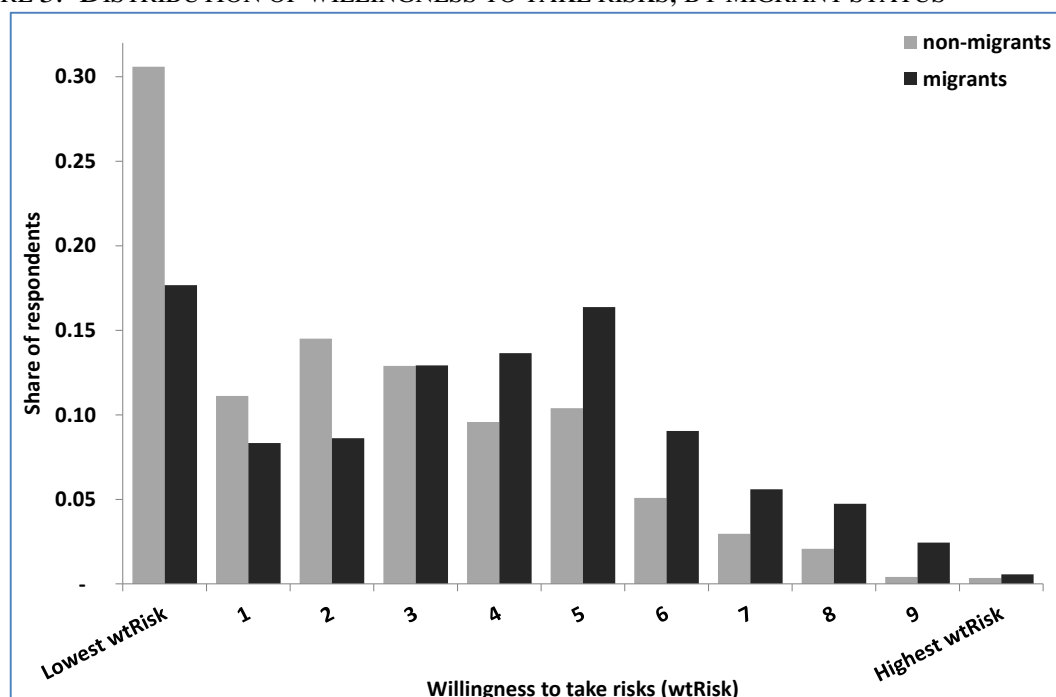
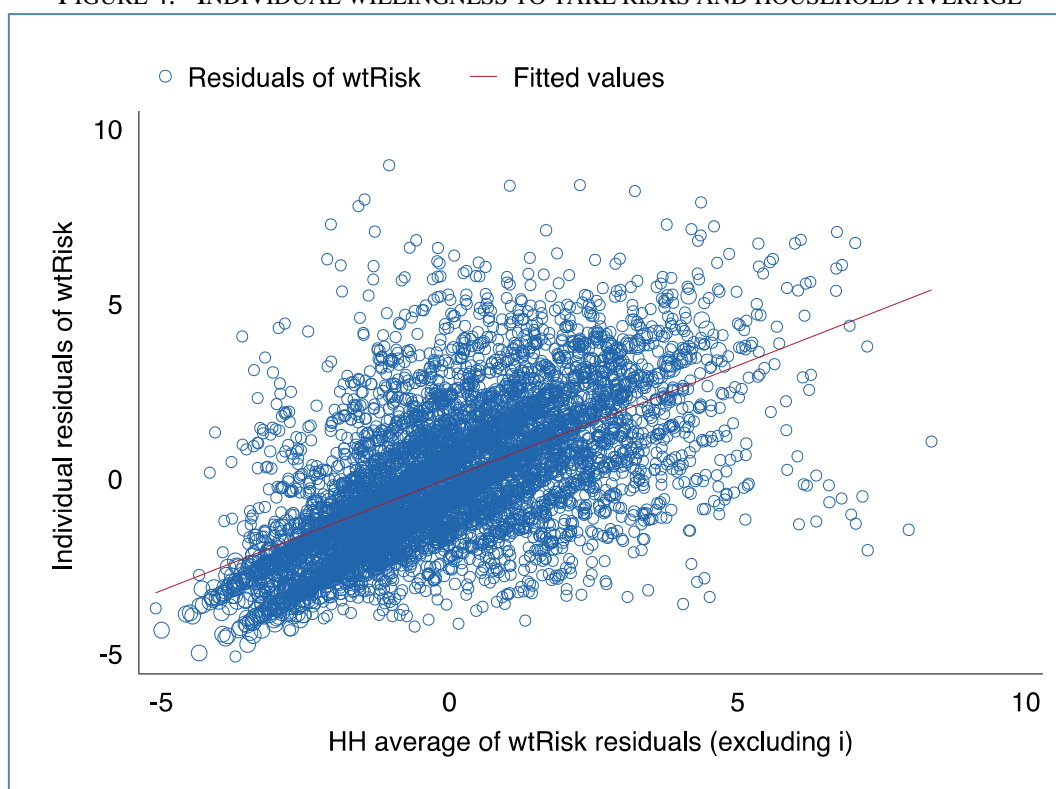


FIGURE 3.—DISTRIBUTION OF WILLINGNESS TO TAKE RISKS, BY MIGRANT STATUS



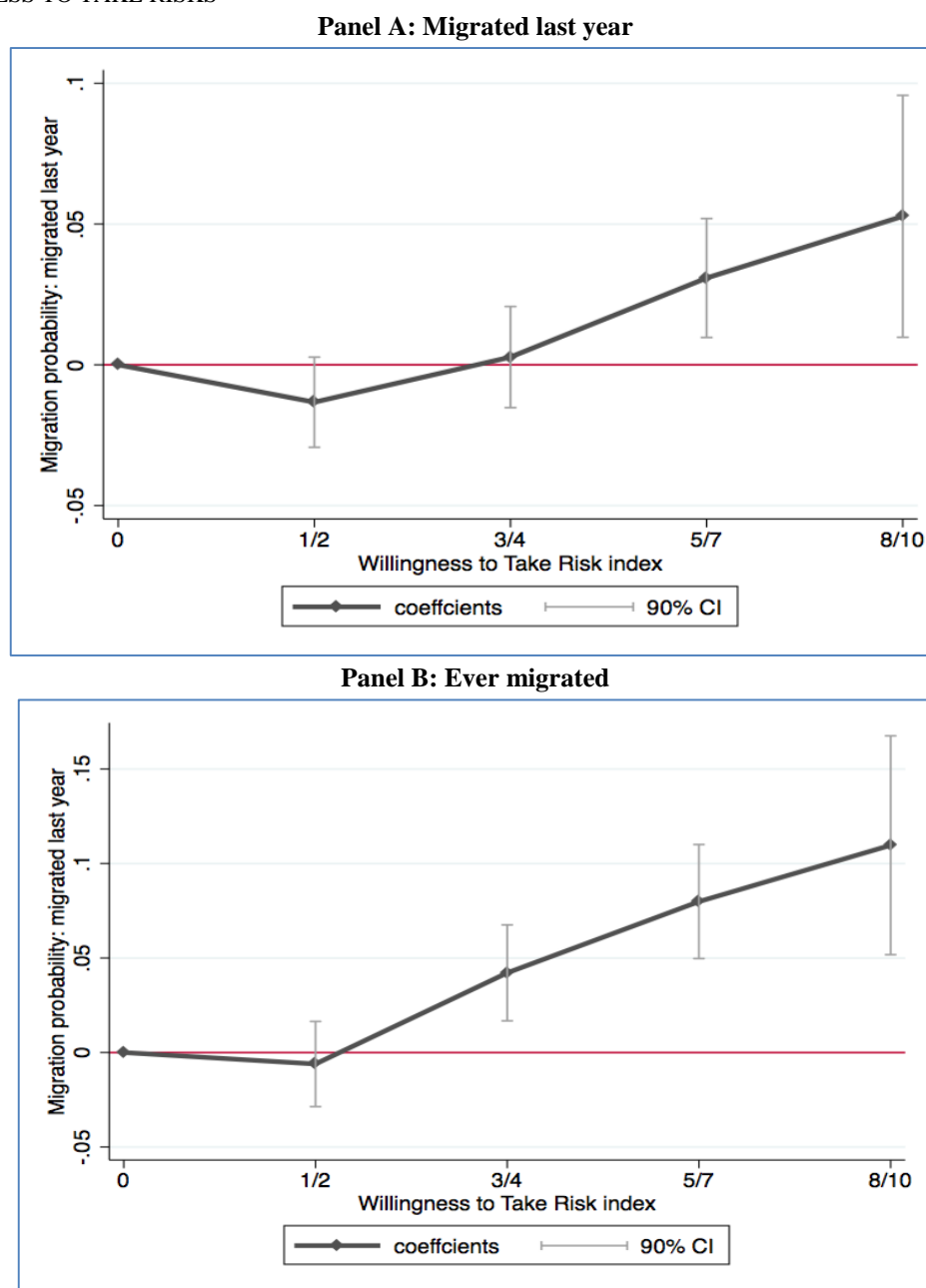
Note. The measure (*wtRisk*) varies between 0 (lowest level of willingness to take risk) and 10 (highest level of willingness to take risk). Source: RUMiC –RHS Survey.

FIGURE 4.— INDIVIDUAL WILLINGNESS TO TAKE RISKS AND HOUSEHOLD AVERAGE



Note: The scatter plot shows residual willingness to take risks for each individual in our estimating sample (vertical axis) versus the average residual willingness to take risks of other members in the household (horizontal axis). Residuals are obtained by regressing individual willingness to take risks on basic demographic controls (gender, age, and age squared) and a full set of county of residence dummies. The figure shows the regression fitted line (correlation = 0.58).

FIGURE 5.— RISK ATTITUDES AND INDIVIDUAL PROBABILITY OF MIGRATING, BY LEVEL OF WILLINGNESS TO TAKE RISKS



Note. In panel A, individuals are defined as migrant if they migrated for work during the year before the survey; in Panel B, if they ever migrated for work in the past. Individual probabilities of being a migrant are regressed on five dummy variables identifying different levels of willingness to take risks in which the excluded category corresponds to a willingness to take risks equal to zero. The graph plots the estimated coefficients on these dummies together with their 90% confidence intervals. Included in the regressions are individual controls (age, age squared, a dummy for male, years of education, a dummy for married relation with HH head dummies, order of birth, number of siblings, and number of children) and household controls (number of family members under 16, in the work force, and older than 60; per capita house value (in logs)), and 82 county dummies.

Tables

Table 1.—DESCRIPTIVE STATISTICS

Variable	Mean	Std. Dev.	Min	Max	Obs
Individuals					
Male	0.50	0.50	0	1	6,332
Age	43.82	10.65	16	60	6,332
Married	0.92	0.27	0	1	6,332
Years of education	7.15	2.83	0	13	6,332
Birth order	2.24	1.33	0	10	6,123
Number of siblings	3.15	1.64	0	11	6,250
Number of child	1.68	0.99	0	7	6,332
Willingness to take risks (wtRisk)	2.57	2.36	0	10	6,332
Migrated last year	0.11	0.31	0	1	6,332
Ever migrated	0.23	0.42	0	1	6,280
Households					
Household size	4.08	1.32	2	11	2,961
HH members aged <16	0.57	0.73	0	5	2,961
HH members in the work force	2.89	1.09	1	8	2,961
HH members aged >60	0.34	0.61	0	4	2,961
HH head's education (years)	7.25	2.58	0	12	2,961
Plot size (Mu, 15Mu = 1 hectare)	4.12	4.08	0	75	2,961
House value per capita (Yuan, in logs)	9.16	1.33	1.20	14.04	2,961
HH avg willingness to take risks	2.46	2.03	0	10	2,961
At least one HH member migrated last year	0.16	0.36	0	1	2,961

Note. The sample includes all individuals in the labour force (i.e. aged between 16 and 60 and not currently in school or disabled) who live in households in which more than one member in the labour force has reported risk attitudes.

Source: 2009 RUMiC-RHS Survey.

Table 2.—INDIVIDUAL MIGRATION DECISION

	Migrated last year				Ever migrated			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
wtRisk	0.014***	0.005***	0.005***	0.005***	0.030***	0.014***	0.014***	0.014***
	(0.0018)	(0.0019)	(0.0019)	(0.0019)	(0.0025)	(0.0027)	(0.0028)	(0.0028)
Basic individual controls		X	X	X		X	X	X
Additional individual controls			X	X			X	X
Household controls				X				X
County fixed effects	X	X	X	X	X	X	X	X
Observations	6,332	6,332	6,103	5,992	6,280	6,280	6,052	5,946
R-squared	0.187	0.288	0.305	0.310	0.148	0.273	0.288	0.292

Note. The table reports estimates from LPM regressions of a dummy for individual migration status on individual willingness to take risk (*wtRisk*) and other controls. The migration status dummy equals one if the individual migrated for work in the year before the interview (columns 1–4) or had ever migrated for work (columns 5–8). The *wtRisk* variable measures individual willingness to take risks (decreasing with risk aversion) and has a mean of 2.57 and a standard deviation of 2.36. The basic individual controls are age, age squared, a dummy for male, years of education, and a dummy for married; the additional individual controls are a dummy for relation to head of household, order of birth, number of siblings, and number of children; and the household controls are household size and structure (number of family members under 16, in the work force, and older than 60); and per capita house value (in logs). All regressions include 82 county fixed effects. The sample includes all individuals in the labour force (i.e. aged between 16 and 60 and not currently in school or disabled) who live in households in which more than one member in the labour force has reported risk attitudes. Robust standard errors are clustered at the household level and reported in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.—WITHIN HOUSEHOLD MIGRATION DECISION: RELATIVE MEASURE AND RISK PREFERENCES OF OTHER HOUSEHOLD MEMBERS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
wtRisk	0.005*** (0.002)		0.003* (0.002)		0.005*** (0.002)		0.009*** (0.002)
wtRisk_rel: ranking in HH normalised		0.070*** (0.018)	0.055*** (0.020)				
wtRisk_rel: Dummy for highest wtRisk in HH				0.016** (0.008)	0.014* (0.008)		
wtRisk_oth: Average wtRisk of other HH members						-0.000 (0.002)	-0.006*** (0.002)
Individual controls	X	X	X	X	X	X	X
Household controls	X	X	X	X	X	X	X
County fixed effects	X	X	X	X	X	X	X
Observations	5,992	5,992	5,992	5,992	5,992	5,992	5,992
R-squared	0.310	0.310	0.311	0.309	0.310	0.309	0.311

Note. The table reports the estimates from LPM regressions of a dummy for individual migration status (in the previous year) on different measures of willingness to take risks (at both the individual and household level) and other controls. The *wtRisk* variable measures individual willingness to take risk (which decreases with risk aversion) and has a mean of 2.57 and a standard deviation of 2.36. Columns 2–9 include two alternative measures of the individual’s position in the household ranking of willingness to take risk among members in the work force (i.e. aged between 16 and 60 and not currently in school or disabled): (i) individual ranking in risk attitudes within the household, obtained by ranking household members by their willingness to take risks, assigning a value of one to the most risk-averse person and progressively higher values to the other members, and then normalizing this measure by the number of members reporting risk preferences (columns 2–3); (ii) an indicator for the individual having the highest willingness to take risks in the household (columns 4–5). In columns 6–7, we include the average risk preferences of the other household members who are in the workforce (*wtRisk_oth*). The individual controls are age, age squared, a dummy for male, years of education, a dummy for married, relation with HH head dummies, order of birth, number of siblings, and number of children; and the household controls are household size and structure (number of family members under 16, in the work force, and older than 60); and per capita house value (in logs). All specifications include county fixed effects. The sample includes all individuals in the work force (i.e. aged between 16 and 60 and not currently in school or disabled) who live in households in which more than one member in the work force has reported risk attitudes. Robust standard errors are clustered at the household level and reported in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table 4.—ACROSS HOUSEHOLD MIGRATION DECISION (A)

	(1)	(2)	(3)	(4)
HH_avg_wtRisk	0.010*** (0.003)	0.004 (0.004)	0.009*** (0.003)	0.003 (0.004)
HH_range_wtRisk		0.017*** (0.004)		0.016*** (0.004)
Household controls			X	X
County fixed effects	X	X	X	X
Observations	2,961	2,961	2,961	2,961
R-squared	0.306	0.311	0.314	0.319

Note. The table reports estimates from LPM regressions of a dummy that equals one if the household has at least one migrant member in the labour force on different household-level measures of willingness to take risks and other controls. The variables *HH_avg_wtRisk* and *HH_range_wtRisk* measure the average and the range of willingness to take risks in the household, respectively. The household controls are household size and structure (number of family members under 16, in the work force, and older than 60); per capita house value (in logs); size of the family plot; and the years of education and age of the head of household. All specifications include 82 county fixed effects. The sample includes all households in which at least two individuals have reported risk attitudes, and at least one of these is in the labour force (i.e. aged between 16 and 60 and not currently in school or disabled). Robust standard errors are reported in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table 5.– ACROSS HOUSEHOLD MIGRATION DECISION (B)

	(1)	(2)	(3)	(4)	(5)	(6)
HH_max_wtRisk	0.012*** (0.003)	0.017*** (0.004)	0.011*** (0.003)	0.015*** (0.004)	0.016*** (0.004)	0.017*** (0.004)
HH_oth_wtRisk		-0.009* (0.005)		-0.008 (0.005)	-0.012** (0.006)	-0.012** (0.006)
Household controls			X	X		X
County fixed effects	X	X	X	X	X	X
WF age range:						
16-60	X	X	X	X		
16-50					X	X
Observations	2,961	2,961	2,961	2,961	2,189	2,189
R-squared	0.310	0.311	0.317	0.318	0.350	0.356

Note. The table reports estimates from LPM regressions of a dummy that equals one if the household has at least one migrant member in the labour force on the risk preferences of the individual with the highest willingness to take risks in the household ($HH_max_wtRisk_{hk}$), the average risk attitudes among the other household members ($HH_oth_wtRisk_{hk}$) and other controls. In columns 1–4, the age bracket for workers to be considered part of the workforce is 16–60; in columns 5–6 it is 16–50. The household controls are household size and structure (number of family members under 16, in the work force, and older than 60); per capita house value (in logs); size of the family plot; and years of education and age of the head of household. All specifications include 82 county fixed effects. The sample includes all households in which at least two individuals have reported risk attitudes, and at least one of these is in the work force (i.e. within the defined age bracket and not currently in school or disabled). Robust standard errors are reported in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Appendix

A.I. Theoretical Framework

A. Proof of Proposition 1

Assume that individual 1 is more risk averse than individual 2 so that $k_1 > k_2$. Then the difference in household utility when individual 2 emigrates instead of individual 1 is

$$\begin{aligned} & U_{SD}(1 = NM; 2 = M) - U_{SD}(1 = M; 2 = NM) = \\ & = [E(\tilde{y}^{NM}) - k_1 V(\tilde{y}^{NM}) + E(\tilde{y}^M) - k_2 V(\tilde{y}^M)] - [E(\tilde{y}^M) - k_1 V(\tilde{y}^M) + \\ & + E(\tilde{y}^{NM}) - k_2 V(\tilde{y}^{NM})] = (k_1 - k_2)[V(\tilde{y}^M) - V(\tilde{y}^{NM})] \quad (A.1) \end{aligned}$$

The first term is positive because $k_1 > k_2$. The sign of the second term depends on the relative size of the earnings variance of being a migrant vs. not being a migrant, although it will always be positive as long as $\sigma_D^2 \geq \sigma_S^2$ (see proposition 1). Hence, as long as the earnings variance is higher for the migrant, which in our setting will always be the case if the earnings variance is larger in the destination (see Figure 1), it is optimal to choose the least risk averse individual in the household as the potential migrant. Nevertheless, it may still be that $U_{SD} < U_{SS}$, so that it is optimal for the household to send no migrant.

B. Proof of Proposition 2

Given two households, h_A and h_B , which differ only in the degree of their members' risk aversion, then it follows from proposition 1 that in both households, if a migrant is sent, it will be the member with the lowest risk aversion. Assuming that in both households individual 2 is less risk averse than individual 1, each household will evaluate whether the household utility increases when individual 2 migrates compared to the non-migration option.

For both households, the utility gain from migration is

$$\Delta U^j = \Delta E(\tilde{y}^{NM}) - k_1^j \Delta V(\tilde{y}^{NM}) + ME(\tilde{y}^M) - k_2^j \Delta V(\tilde{y}^M) \quad j = h_A, h_B \quad (A.2)$$

Which household gains the most from migration depends on the difference in utility gains:

$$\Delta U^{h_B} - \Delta U^{h_A} = \Delta V(\tilde{y}^{NM})(k_1^{h_A} - k_1^{h_B}) + \Delta V(\tilde{y}^M)(k_2^{h_A} - k_2^{h_B}) \quad (A.3)$$

We can now prove statements (i) and (ii) of proposition 2:

(i) Supposing that the two households have the same average risk aversion ($\bar{k}^{h_A} = \bar{k}^{h_B}$) but differ in the within household variance in risk attitudes, $k_1^{h_A} - k_2^{h_A} \neq k_1^{h_B} - k_2^{h_B}$, we can substitute $k_1^{h_A} = 2\bar{k}^{h_A} - k_2^{h_A}$ and $k_1^{h_B} = 2\bar{k}^{h_B} - k_2^{h_B}$ into A.3:

$$\begin{aligned}\Delta U^{h_B} - \Delta U^{h_A} &= \Delta V(\tilde{y}^{NM})(2\bar{k}^{h_A} - k_2^{h_A} - 2\bar{k}^{h_B} + k_2^{h_B}) + \Delta V(\tilde{y}^M)(k_2^{h_A} - k_2^{h_B}) = \\ &= (k_2^{h_B} - k_2^{h_A})(\Delta V(\tilde{y}^{NM}) - \Delta V(\tilde{y}^M))\end{aligned}\quad (\text{A.4})$$

Given that $\Delta V(\tilde{y}^{NM}) < \Delta V(\tilde{y}^M)$ (for $\sigma_D^2 \geq \sigma_S^2$; see section IIB), household B will benefit more from migration ($\Delta U^{h_B} > \Delta U^{h_A}$) if its least risk averse member is less risk averse than the least risk averse member of household A ($k_2^{h_B} < k_2^{h_A}$). Having assumed that the average risk aversion in the two households is the same, this last condition implies also that the most risk averse individual in household B must be more risk averse than the most risk averse individual in household A ($k_1^{h_B} > k_1^{h_A}$). Hence, for household B to benefit more from migration than household A, the risk attitudes of household members must be more heterogeneous.

(ii) Assuming that member 1 has the same level of risk aversion in both households ($k_1^{h_A} = k_1^{h_B}$), while member 2 is less risk averse in household 2 ($k_2^{h_A} > k_2^{h_B}$), then the difference in utility gain reduces to

$$\Delta U^{h_B} - \Delta U^{h_A} = \Delta V(\tilde{y}^M)(k_2^{h_A} - k_2^{h_B}) \quad (\text{A.5})$$

so that $\Delta U^{h_B} > \Delta U^{h_A}$ as long as $\Delta V(\tilde{y}^M) > 0$ (areas II and III in Figure 1) and $\Delta U^{h_B} < \Delta U^{h_A}$ if $\Delta V(\tilde{y}^M) < 0$ (area I in Figure 1). That is, if migrating increases (reduces) the exposure to risk of the migrant member, the household that gains most from migration is the household in which individual 2 (i.e. the least risk averse in her own household) is less (more) risk averse.

Supposing instead that member 2 (with the lowest risk aversion in each household) has the same level of risk aversion ($k_2^{h_A} = k_2^{h_B}$) in both households while member 1 is less risk averse in household 2 ($k_1^{h_A} > k_1^{h_B}$), then the difference in utility gains from migration between the two households is

$$\Delta U^{h_B} - \Delta U^{h_A} = \Delta V(\tilde{y}^{NM})(k_1^{h_A} - k_1^{h_B}) \quad (\text{A.6})$$

Now, $\Delta U^{h_B} > \Delta U^{h_A}$ as long as $\Delta V(\tilde{y}^{NM}) > 0$ (area III in Figure 1) and $\Delta U^{h_B} < \Delta U^{h_A}$ if $\Delta V(\tilde{y}^M) < 0$ (area I and II in Figure 1). In other words, if migration exposes the non-migrant individual to lower (higher) uncertainty, the household gaining the most from migration is the household where individual 1 is less (more) risk averse.

C. Extension: Non-Zero Correlation ($\sigma_{SD} \neq 0$)

Assuming now that $\text{Cov}(\varepsilon_S \varepsilon_D) = \sigma_{SD} \neq 0$, the household utility from sending one migrant to region D is

$$\begin{aligned} U_{SD} &= [E(\tilde{y}^{NM}) - k_1 V(\tilde{y}^{NM})] + [E(\tilde{y}^M) - k_2 V(\tilde{y}^M)] = \\ &= \underbrace{\left[\left(\frac{\bar{y}_S + \alpha(\bar{y}_D - c)}{1 + \alpha} \right) - k_1 \left(\frac{\sigma_S^2 + \alpha^2 \sigma_D^2 + 2\alpha \sigma_{SD}}{(1 + \alpha)^2} \right) \right]}_{NM} + \underbrace{\left[\left(\frac{\alpha \bar{y}_S + (\bar{y}_D - c)}{1 + \alpha} \right) - k_2 \left(\frac{\alpha^2 \sigma_S^2 + \sigma_D^2 + 2\alpha \sigma_{SD}}{(1 + \alpha)^2} \right) \right]}_M \end{aligned} \quad (\text{A.7})$$

The household will now send a migrant whenever $U_{SD} - U_{SS} > 0$:

$$\begin{aligned} U_{SD} - U_{SS} &= \underbrace{\left(\frac{\bar{y}_S + \alpha(\bar{y}_D - c)}{1 + \alpha} - \bar{y}_S \right)}_{\Delta E(\tilde{y}^{NM})} - \underbrace{k_1 \left(\frac{\sigma_S^2 + \alpha^2 \sigma_D^2 + 2\alpha \sigma_{SD}}{(1 + \alpha)^2} - \sigma_S^2 \right)}_{\Delta V(\tilde{y}^{NM})} + \\ &+ \underbrace{\left(\frac{\alpha \bar{y}_S + (\bar{y}_D - c)}{1 + \alpha} - \bar{y}_S \right)}_{\Delta E(\tilde{y}^M)} - \underbrace{k_2 \left(\frac{\alpha^2 \sigma_S^2 + \sigma_D^2 + 2\alpha \sigma_{SD}}{(1 + \alpha)^2} - \sigma_S^2 \right)}_{\Delta V(\tilde{y}^M)} > 0 \end{aligned} \quad (\text{A.8})$$

Here, as explained in section IIB, the terms characterize the change in expected earnings and in earnings variance from migration (with respect to non-migration) for both migrant and non-migrant members of the household. The presence of a non-zero correlation between shocks in source and destination regions ($\sigma_{SD} \neq 0$) does not substantially change the

conditions under which the household gains from the migration of one of its members (see section II.B). It should be noted that the change in earnings variance for both the migrant ($\Delta V(\tilde{y}^M)$) and the non-migrant ($\Delta V(\tilde{y}^{NM})$) now increases with the correlation σ_{SD} , with the first derivative being identical for both terms:

$$\frac{\partial \Delta V(\tilde{y}^M)}{\partial \sigma_{SD}} = \frac{\partial \Delta V(\tilde{y}^{NM})}{\partial \sigma_{SD}} = \frac{2\alpha}{(1 + \alpha)^2} > 0 \quad (\text{A. 9})$$

In Figure 1, a positive (negative) correlation σ_{SD} implies an upward (downward) shift in the intercepts of the functions $\Delta V(\tilde{y}^M)$ and $\Delta V(\tilde{y}^{NM})$ and reduces (increases) the threshold values of σ_S^2 for which migration implies a reduction in earnings variance. In other words, if the shocks in source and destination regions are positively (negatively) correlated, migration will allow the household to reduce exposure to risk for lower (higher) values of σ_S^2 , as compared to the case where the correlation is zero.

A.II. Sample selection

The fact that risk aversion is only observed for individuals who were present at home at the interview may bias our estimates if unobservables in the interview participation equation are correlated with risk aversion, conditional on observables.³⁶ To address this concern we estimate the following sample selection model:

$$wtRisk_{ihk}^* = \mathbf{X}'_{ihk}A + \mathbf{W}'_{hk}B + \eta_k + e_{ihk} \quad (\text{A. 10})$$

$$int_{ihk} = 1[y_{ihk}^* = \mathbf{X}'_{ihk}C + \mathbf{W}'_{hk}D + \mathbf{Z}'_{ihk}E + \mu_k + u_{ihk} \geq 0] \quad (\text{A. 11})$$

where $wtRisk_{ihk}^*$ is the latent willingness to take risk and int_{ihk} is a dummy equal one if the individual i was at home at the interview (i.e. $int_{ihk} = 1$ if the latent variable $y_{ihk}^* \geq 0$), so that:

$$wtRisk_{ihk} = \begin{cases} wtRisk_{ihk}^* & \text{if } int_{ihk} = 1 \\ \text{not observed} & \text{if } int_{ihk} = 0 \end{cases}$$

³⁶ Within the migrant population, individuals absent at the survey are more likely to be males, younger and less likely to be married.

The vectors \mathbf{X}'_{ihk} and \mathbf{W}'_{hk} collect the same observable individual-level covariates and family characteristics as in our main outcome equation (9), and η_k and μ_k are county fixed effects. The selection equation is non-parametrically identified by the variable vector \mathbf{Z}_{ihk} that includes major events in the families of interviewees such as pregnancies, births, illnesses, deaths, and that occurred in the months before or after the interview.³⁷ These events, while arguably uncorrelated with risk attitudes, may have induced the individual to return to the home village, or to remain longer at home, and have hence affected the probability of being at home at the time of the interview. To test for selection, we estimate equation (A.11) using a probit model (thus assuming that u_{ihk} is normally distributed) and construct the generalised residuals which we include in equation (A.10) (see Heckman 1978). A test of correlation between the unobservables determining participation and individual risk aversion corresponds to a simple t-test of whether the coefficient of the generalised residual is significantly different from zero.

We report probit estimates of the first stage in the lower panel of Table A 2 where the dependent variable is the probability of being at home for the interview (which occurred between March and June 2009). The first four columns report estimates where we use events that occurred before the interview (during year 2008) as instruments, while the last four columns use events that occurred after the interview, but close enough to the interview date so that their occurrence could have been anticipated by families. The instruments are a dummy for a “pregnancy/birth” in the wider family (column 1 and 5), a dummy for “illness or death” (column 2 and 6), dummies for “pregnancy/birth” and “illness/death” (column 3

³⁷ We gather information about events from the 2009 and the 2010 surveys. The events recorded in the 2009 survey refer to year 2008 and, therefore, took place *before* the 2009 interview. The 2010 survey collected information on events taking place in the twelve months previous to the survey and on their month of occurrence. We combined this information to identify events that took place *after* the 2009 survey but by the end of year 2009.

and 7) and a dummy for any of the events “pregnancy/birth/illness/death” (column 4 and 8).³⁸

In all specifications, we condition on individual and household controls and on county fixed effects. As Table A 2 shows, the occurrence of major life events in the months before the interview (columns 1-4) is a strong predictor for the probability of being at home at the time of interview. Events that happen after the interview (columns 5-8) are also significant in all regressions, although estimates are slightly less precise.

In the upper panel of Table A 2, we report the estimated coefficient on the generalised residuals (or inverse Mills ratios) that we have included in equation A.10. This coefficient is small (ranging from 1.2 and 2.6 percent of the average value of wtRisk in our sample) and not statistically different from zero in any of the specifications, with a coefficient/standard error ratio that is never larger than 0.35. Thus, conditional on observables, individual risk attitudes are not correlated with unobservables that determine participation in the survey.

³⁸ The share of respondents reporting at least one event among pregnancy/birth, illness and death is 9.6% for year 2008 and 3.6% for year 2009.

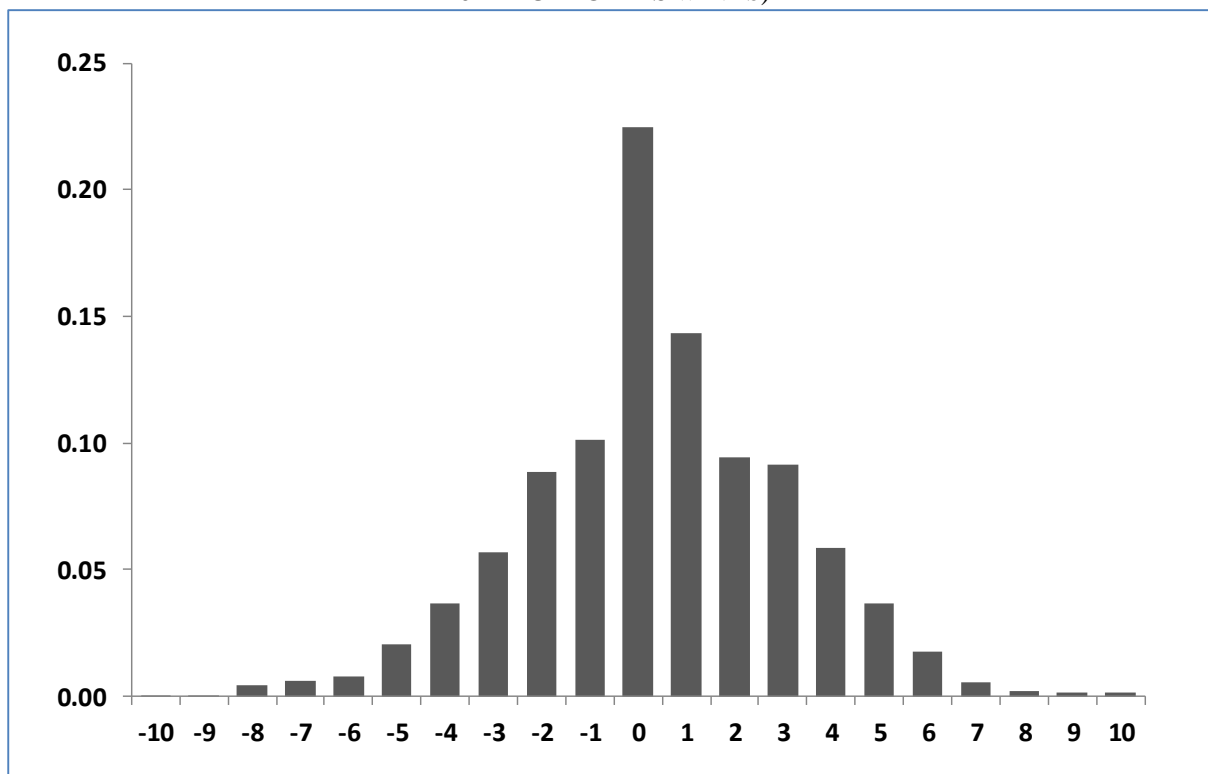
Appendix Figures

FIGURE A1.— MAP OF RUMiC SURVEY



Note. The figure shows the provinces in which the RUMiC survey is conducted.

FIGURE A2.— DISTRIBUTION OF CHANGES IN SELF-REPORTED WILLINGNESS TO TAKE RISKS (2009 AND 2011 RUMiC-RHS WAVES)



Note: The sample is composed of 2,906 individuals from our estimating sample who reported *wtRisk* in both waves.

Appendix Tables

Table A1 – SAMPLE OF INDIVIDUALS IN RELEVANT HOUSEHOLDS VS ENTIRE SAMPLE

	Entire sample		At least 2 individuals reporting wtRisk in the HH	
	Mean	Std. Dev.	Mean	Std. Dev.
<i>Panel A - Individuals</i>				
Male	0.51	0.50	0.51	0.50
Age	40.4	12.16	40.6	12.15
Married	0.82	0.38	0.83	0.37
Years of schooling	7.4	2.76	7.4	2.78
Birth order	2.2	1.31	2.2	1.28
Number of siblings	3.0	1.64	3.0	1.61
Number of child	1.5	1.08	1.5	1.06
Migrated last year	0.22	0.41	0.20	0.40
Ever migrated	0.35	0.48	0.32	0.47
Number of individuals	17,658		7,808	
<i>Panel B - Households</i>				
Household size	4.1	1.30	4.1	1.32
HH members aged < 16	0.58	0.74	0.57	0.73
Hh members in the work force	2.9	1.10	2.9	1.09
HH members aged > 60	0.24	0.52	0.34	0.61
HH head's education (years)	7.5	2.38	7.3	2.58
Plot size (Mu, 15 Mu = 1 hectare)	4.5	4.64	4.1	4.08
House value per capita (Yuan, in logs)	9.1	1.32	9.2	1.33
Number of households	6,425		2,961	

Note. The table compares characteristics of individuals in households in which more than one member in the labour force has reported risk attitudes with those of individuals in other households.

Source: 2009 RUMiC –RHS Survey.

Table A 2 - SAMPLE SELECTION

	Events occurred in 2008				Events occurred in 2009			
<i>Panel a) outcome = wtRisk</i>	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Inverse Mill's	0.054	0.043	0.032	0.032	0.053	0.065	0.063	0.067
	-0.187	-0.185	-0.186	-0.186	-0.193	-0.194	-0.194	-0.194
Observations	5893	5893	5893	5893	5627	5627	5627	5627
R-squared	0.253	0.253	0.253	0.253	0.247	0.247	0.247	0.247
F-stat (Inverse Mills)	0.08	0.06	0.03	0.03	0.07	0.11	0.1	0.12
Prob > F (Inverse Mills)	0.7723	0.8145	0.8651	0.8634	0.7859	0.7377	0.746	0.73
<i>Panel b) outcome = reporting wtRisk</i>	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Pregnancy/Birth	0.013**		0.013**		0.022**		0.021*	
	-0.006		-0.006		-0.011		-0.011	
Illness/death		0.017***	0.017***			0.015*	0.015*	
		-0.007	-0.007			-0.009	-0.009	
Pregnancy/Birth/Illness/Death				0.015***				0.018**
				-0.005				-0.007
Observations	6609	6609	6609	6609	6347	6347	6347	6347
Pseudo R-squared	0.636	0.636	0.636	0.636	0.632	0.632	0.632	0.632
Chi2 (x,N)	3.4	4.77	7.74	6.21	1.88	1.91	3.53	3.83
Prob > chi2	0.0653	0.029	0.0208	0.0127	0.1709	0.1665	0.1713	0.0503

Note. Panel B of the table reports marginal effects from probit regressions of a dummy that equals one if individuals reported risk attitude during the 2009 survey on indicators for a number of major life events having occurred to them and/or their relatives during 2008 or 2009. We define indicators for the following events or combinations of them: pregnancy/birth in 2008 (column 1 and 3), at least one illness or one death in 2008 (column 2 and 3), at least one pregnancy/birth, illness or death in 2008 (column 4), one pregnancy/birth in 2009 (column 5), at least one illness or death in 2009 (column 6), at least one pregnancy/birth, illness or death in 2009 (column 8). The sample includes all individuals (regardless of having reported risk attitudes or not) in the work force (i.e. aged between 16 and 60 and not currently in school or disabled) who live in households in which more than one member in the labour force has reported risk attitudes. Panel A reports estimates from OLS regressions of wtRisk on individual, household controls and the estimated Inverse Mill's Ratio. For each column, the inverse Mills ratio is computed using the instrument(s) reported in the lower panel of the table. All regressions include individual controls (age, age squared, a dummy for male, years of education, a dummy for being married, relation with the HH head dummies, number of siblings, order of birth, and number of children) household controls (household size and structure (number of family members under 16, in the work force, and older than 60); and per capita house value (in logs)) and county fixed effects. Robust standard errors are clustered at the household level and reported in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table A3. – INDIVIDUAL MIGRATION DECISION: PROBIT AND LOGIT ESTIMATES (MARGINAL EFFECTS)

	Probit				Logit			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
wtRisk	0.013*** (0.004)	0.004** (0.002)	0.004** (0.002)	0.004** (0.002)	0.014** (0.005)	0.004* (0.002)	0.003** (0.002)	0.004** (0.002)
Basic individual controls		X	X	X		X	X	X
Additional individual controls			X	X			X	X
Household controls				X				X
County fixed effects	X	X	X	X	X	X	X	X
Observations	6,332	6,332	6,103	5,992	6,332	6,332	6,103	5,992
R-squared	0.232	0.386	0.400	0.409	0.234	0.391	0.404	0.414

Note. The table shows the marginal effects derived using the probit (columns 1-4) and logit (columns 5-8) estimators of an individual indicator for migrants (in the previous year) on individual willingness to take risk (*wtRisk*) and other controls. The *wtRisk* variable measures individual willingness to take risks (decreasing with risk aversion) and has a mean of 2.57 and a standard deviation of 2.36. The basic individual controls are age, age squared, a dummy for male, years of education, and a dummy for married; the additional individual controls are: relation with HH head dummies, order of birth, number of siblings, and number of children; and the household controls are household size and structure (number of family members under 16, in the work force, and older than 60); and per capita house value (in logs). All regressions include 82 county fixed effects. The sample includes all individuals in the labour force (i.e. aged between 16 and 60 and not currently in school or disabled) who live in households in which more than one member in the labour force has reported risk attitudes. Robust standard errors are clustered at the household level and reported in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table A4.— INDIVIDUAL MIGRATION DECISION: FULL SPECIFICATION

	Migrated last year					Ever migrated		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
wtRisk	0.014*** (0.0018)	0.005*** (0.0019)	0.005*** (0.0019)	0.005*** (0.0019)	0.030*** (0.0025)	0.014*** (0.0027)	0.014*** (0.0028)	0.014*** (0.0028)
Male dummy		0.060*** (0.0064)	0.081*** (0.0145)	0.086*** (0.0147)		0.135*** (0.0087)	0.132*** (0.0178)	0.132*** (0.0179)
Age		-0.021*** (0.0040)	-0.005 (0.0051)	-0.004 (0.0053)		-0.020*** (0.0046)	0.005 (0.0059)	0.003 (0.0060)
Age squared*100		0.015*** (0.0044)	0.001 (0.0055)	-0.000 (0.0056)		0.009* (0.0052)	-0.015** (0.0063)	-0.013** (0.0063)
Years of education		0.001 (0.0014)	0.001 (0.0014)	0.001 (0.0014)		0.002 (0.0020)	0.002 (0.0020)	0.002 (0.0020)
Married		-0.032 (0.0274)	-0.044 (0.0289)	-0.055* (0.0286)		-0.013 (0.0291)	-0.032 (0.0305)	-0.035 (0.0310)
Order of birth			-0.002 (0.0028)	-0.003 (0.0027)			-0.002 (0.0043)	-0.002 (0.0043)
# of siblings			0.002 (0.0027)	0.001 (0.0027)			0.003 (0.0040)	0.003 (0.0040)
# of children			-0.002 (0.0059)	0.001 (0.0057)			-0.008 (0.0079)	-0.005 (0.0080)
# HH members below age 16				0.009 (0.0059)				0.008 (0.0083)
# HH members in work force				-0.005 (0.0040)				-0.011* (0.0059)
# HH members above age 60				-0.004 (0.0094)				0.009 (0.0130)
Ln (p.c. house value)				-0.002 (0.0034)				0.002 (0.0049)
Relationship with HH head dummies			X	X			X	X
County fixed effects	X	X	X	X	X	X	X	X
Observations	6,332	6,332	6,103	5,992	6,280	6,280	6,052	5,946
R-squared	0.187	0.288	0.305	0.310	0.148	0.273	0.288	0.292

Note. The table reports estimates from LPM regressions of a dummy for individual migration status on individual willingness to take risk (*wtRisk*) and other controls. The migration status dummy equals one if the individual migrated for working reasons in the year before the interview (columns 1–4) or has ever migrated for working reasons (columns 5–8). The *wtRisk* variable measures individual willingness to take risks (decreasing with risk aversion) and has mean of 2.57 and a standard deviation of 2.36. The basic individual controls are age, age squared, a dummy for male, years of education, and a dummy for married; the additional individual controls are: relation with HH head dummies, order of birth, number of siblings, and number of children; and the household controls are household size and structure (number of family members under 16, in the work force, and older than 60); and per capita house value (in logs). All regressions include 82 county fixed effects. The sample includes all individuals in the labour force (i.e. aged between 16 and 60 and not currently in school or disabled) who live in households in which more than one member in the labour force has reported risk attitudes. Robust standard errors are clustered at the household level and reported in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A5.— CHANGES IN SELF-REPORTED WILLINGNESS TO TAKE RISKS (2009-2011 RUMIC-RHS WAVES)

	Change in Δ wtRisk 2009-2011				wtRisk 2011			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A								
Migration in 2010	0.037 (0.232)	0.120 (0.239)	0.106 (0.245)	0.108 (0.244)	0.151 (0.192)	-0.059 (0.196)	-0.088 (0.201)	-0.093 (0.201)
Observations	2,906	2,906	2,813	2,791	2,906	2,906	2,813	2,791
Panel B								
Migration only in 2010	-0.121 (0.303)	-0.027 (0.307)	-0.032 (0.316)	-0.013 (0.315)	0.056 (0.261)	-0.164 (0.263)	-0.192 (0.270)	-0.199 (0.269)
Migration in 2008 and 2010	0.195 (0.319)	0.267 (0.325)	0.242 (0.333)	0.227 (0.331)	0.246 (0.257)	0.045 (0.255)	0.015 (0.261)	0.011 (0.261)
Observations	2,906	2,906	2,813	2,791	2,906	2,906	2,813	2,791
wtRisk 2009					X	X	X	X
Basic individual controls		X	X	X		X	X	X
Additional individual controls			X	X			X	X
Household controls				X				X
County fixed effects	X	X	X	X	X	X	X	X

Note. This table tests the relationship between changes in self-reported risk attitudes between 2009 and 2011 and migration experience in 2010. In columns 1-4, the dependent variable is the change in self-reported willingness to take risks between the 2009 and the 2011 waves, while in columns 5-8 the dependent variable is self-reported willingness to take risks in 2011. In Panel A, the main regressor of interest is an indicator for the individual being recorded as migrant in year 2010. In Panel B, the main regressors of interest are an indicator for the individual having migrated only in 2010 and an indicator for having migrated in both 2008 and 2010. In Panel B, willingness to take risks reported in 2009 is always included in the controls. The basic individual controls are age, age squared, a dummy for male, years of education, and a dummy for married; the additional individual controls are: relation with HH head dummies, order of birth, number of siblings, and number of children; and the household controls are household size and structure (number of family members under 16, in the work force, and older than 60); and per capita house value (in logs). All regressions include 82 county fixed effects. The sample includes all individuals in our estimating sample who also reported risk attitudes in the 2011 wave. Robust standard errors are clustered at the household level and reported in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A6.— MIGRATION DURATION AND RISK ATTITUDES (RUMiC URBAN SURVEYS)

	OLS	Fixed Effects
	(1)	(2)
Years since first migration	0.006	-0.002
	(0.004)	(0.007)
Individual controls	X	X
Year and city dummies	X	X
Individual fixed effects		X
Observations	22,208	22,208
R-squared	0.132	0.013

Note. This table tests the relationship between attitude toward risks and the length of migration experience. It reports estimates of wtRisk on years since first migration for a sample of migrants living in urban areas. Individual controls are age, age squared, a dummy for male, years of education, a dummy for married and the number of cities the individual has migrated to. OLS estimates are presented in column 1 while estimates including individual fixed effects are presented in column 2. The sample is an unbalanced panel of rural-urban migrants living in urban areas coming from six waves (from 2008 to 2013) of the urban module of the RUMiC Survey. Robust standard errors are clustered at the household level and reported in brackets. *** p<0.01, ** p<0.05, * p<0.1.