Behavioral responses to risk in rural China

Jyotsna Jalan [a], Martin Ravallion [b, *]

[a] *Indian Statistical Institute, Delhi, India*
[b] *Policy Research Department, The World Bank, 1818 H Street N.W., Washington, DC 20433, USA*

Abstract

We study portfolio and other behavioral responses to idiosyncratic risk in household panel data for rural China. One quarter of wealth is held in unproductive liquid forms. However, only a small share of this appears to be a precaution against income risk. We estimate that eliminating income risk would reduce the share of wealth held in liquid form by less than one percentage point. Furthermore, this effect is largely confined to middle income groups; high-income households do not, it seems, need to hold unproductive precautionary wealth, and the poor probably cannot afford to do so. We find no evidence that income risk discourages schooling, but it does appear to inhibit the temporary out migration of labor.

JEL classification: D91; Q12
Keywords: Insurance; Precautionary wealth; Poverty; Rural China

1. Introduction

As a stylized fact, there is great uncertainty about incomes and health in underdeveloped rural economies, and the instruments to insure against those risks are weak or absent. At the same time, there is pervasive poverty. Are these features of poor rural economies causally connected? In particular, does risk promote forms of rational behavior that help perpetuate poverty?

One way that risk might create poverty is by inducing poor credit-constrained households to hold high levels of relatively unproductive liquid wealth.[1] If borrowing is not an option when there is a sudden drop in income, then liquid wealth will be needed to protect consumption. Famously, Keynes (1973, p.170) identified a "precautionary motive" as "...the desire for security as to the future cash equivalent of a certain proportion of total resources". Somewhat less famously, he also believed that India was "...a country impoverished by a preference for liquidity", which stifled the "growth of real wealth" (Keynes, 1973, p. 337).[2]

The idea that (rational) portfolio behavior in the presence of uninsured risk can help perpetuate poverty appears to be longstanding. It can be found in relatively early writings on finance and development (such as Patrick, 1966) as well as recent discussions (World Bank, 1998), and it emerges in more formal terms in the Bencivenga and Smith (1991) model of endogenous growth with multiple assets. The idea has also been seen to strengthen the case for public efforts to promote better institutions for financial intermediation in poor rural economies.

The plausibility of the claim that precautionary portfolio behavior can cause poverty is, not self-evident. One can readily agree that there are benefits to poor people from self-insurance; they are likely to be more credit constrained, and (possibly) more averse to risk and more exposed to it. However, there are costs, too, and arguably the poor will not be able to afford to hold a large share of their wealth in unproductive forms. Poverty is surely a strong inducement to assuring that one's own resources are not idle. Adequate insurance may still be possible by holding only moderately liquid but still relatively productive forms of wealth.

This paper aims to contribute to knowledge about behavioral responses to risk in poor rural economies and the role this might play in perpetuating poverty. Formal economic models of saving behavior have only recently begun to systematically incorporate uncertainty.[3] A new body of microeconometric work using data

[1] Strictly, borrowing constraints are not necessary for precautionary saving. If the marginal utility of current consumption is a convex function of consumption, then (by Jensen's inequality) a mean-preserving increase in uncertainty about future incomes will increase the marginal utility of future consumption; current savings will rise to preserve intertemporal equilibrium even without borrowing constraints (see, for example, Gersovitz, 1988). Such a model does not, however, explain an effect on the composition of wealth holdings; higher risk will encourage higher saving, but it can be in any form. Nor is precautionary saving the only way in which risk can create poverty. Another is via effects on production decisions; for example, outmoded agricultural technologies may persist because they are less risky (see, for example, Morduch, 1995).

[2] It is unclear why Keynes thought that this was such an important cause of poverty in India. In his biography of Keynes, Skidelsky (1983, p. 176) writes that, "although he was to write and advise extensively on Indian affairs, the furthest east he ever got was Egypt; the only Indians he ever met were at Cambridge or London; the only books he ever read on India were specialized tomes on finance".

[3] Contributions include Zeldes (1989), Caballero (1990), Carroll (1994, 1997), Deaton (1991, 1992) and Kimball (1990).

from underdeveloped agrarian economies has looked for effects of rainfall variability and other income risks on the flow of consumption or savings (including asset transactions), or on growth rates of consumption.[4] However, as Keynes argued and has since been formalized in theories of demand for money balances when the future interest rate is uncertain (following Tobin, 1958), it is the stock of their liquid wealth that protects people from risk, not the flow into wealth as such.

Instead of looking for effects of risk on the flows of savings or consumption, we look for portfolio effects. We test whether those households facing higher idiosyncratic risk to their incomes tend to hold a higher share of their wealth in unproductive liquid form than one would expect given their permanent income and other characteristics. We also test for effects of risk on schooling and migration.

The setting for our empirical work is rural areas of southwest and southern China.[5] Our data cover a period (1985–1990) after reforms began that entailed abandoning the old commune system of agricultural production in favor of allowing individual farmers the freedom to make their own production choices. Previous research found considerable vulnerability to idiosyncratic risk in this setting (Jalan and Ravallion, 1999a). So, an aggregate (village- or area-wide) measure of risk, such as rainfall, is unlikely to provide a good estimate of individual income risk. Here, we use instead the household-specific income process over time to identify income risk, following Carroll and Samwick (1997). We extend this method by controlling for any persistence in the errors of the income process.

We find that the share of wealth held in liquid form has a severely skewed and kurtotic distribution, and that this non-normality persists after controlling for a broad set of household characteristics. With such heavy tails in the distribution, standard estimation methods found in the literature will not be robust. To assure that our analysis of responses to risk is robust to the non-normality, we apply recent advances in quantile regression methods.

We also allow for two other sources of risk that we expect to be important in this setting, namely the variability of food grain yields on the household's own farm and a measure of health risk. Transport and transaction costs in this setting could mean that risks to own-farm food output matter independently of their implications for overall income risk. Health risk could also be a motive for

[4] For surveys of research on risk and savings in developing countries, see Gersovitz (1988), Alderman and Paxson (1994) and Besley (1995). Studies of the effect of income risk or variability on savings behavior in poor rural economies include Paxson (1992), Rosenzweig and Binswanger (1993), Rosenzweig and Wolpin (1993), Alderman (1996), Dercon (1998) and Fafchamps et al. (1998). Carroll and Samwick (1997) review research on precautionary saving in developed countries.

[5] For a comprehensive overview of what is currently known about household savings behavior in China, see Kraay (2000).

precautionary saving. Hubbard et al. (1994) did not find evidence that health risk increased savings using data for the U.S. With greater health risks, and fewer options for private health insurance, this might be a more important motive in our setting.

There is a further issue of how "liquid wealth" should be defined in a poor rural economy. Our interest is in unproductive liquid assets. Here, one might focus solely on money balances (cash in hand). However, a food grain stock can also be a good hedge, as has been recognized in the literature.[6] So, we define liquid wealth as grain stock plus cash in hand.[7] In defining total wealth, we exclude land, which is mainly allocated administratively in rural China; since the market is very thin, valuation is impossible. Non-liquid wealth includes bank deposits, farm capital, livestock, housing and consumer durables.

Besides holding liquid wealth, we examine two other ways in which households might protect themselves from risk in this setting, namely by not sending their children to school and by temporary out migration of family labor (which, though restricted in the past, is becoming more common in China). One could make theoretical arguments either way about how risk affects these variables. Consider labor export. Greater income uncertainty might encourage out migration as a risk diversification strategy (as argued in, for example, Rosenzweig, 1988). However, the opposite outcome is possible when factor markets are imperfect. Agricultural land is not privately owned in China but is administratively allocated according to criteria such as the household's labor force. Out migration of labor risks the loss of land entitlement and the food security this brings. In these circumstances, it can be argued that the greater the riskiness of farm incomes, the greater the incentive to assure that the administrative land allocation is secure, and hence the less likely there will be out migration. Additionally, when rural labor markets are thin, risk can discourage migration due to concerns about possible labor shortage on the farm. This is plausible in rural China, given that farm labor markets are also thin or non-existent. Thus, a labor surplus on average is not sufficient for out migration —the family will also take account of the possible risk to the household's consumption.

Now, consider schooling. Again, the effect of income risk could go either way. On the one hand, keeping kids in school may expose the family to higher risk of family labor shortage, but (on the other hand) better educated children could be

[6] See, for example, Patrick (1966). There is recent supportive evidence on the precautionary role of food grain stocks from Park's (1995) surveys in poor areas of northwest China.

[7] One could also argue that livestock might be reasonably liquid as well. While we acknowledge that livestock like chickens, pigs, etc. can be easily tradeable, these are all productive assets unlike cash and grain holdings. Hence, we exclude the seemingly easily tradeable assets like livestock from our definition of non-productive liquid assets.

expected to directly reduce future income risk. It has been argued that income risk discourages investment in human capital, and there is some supportive evidence (Jacoby and Skoufias, 1997, find seasonal effects on schooling of income risk in semi-arid areas of India). However, there is also scope for substitution in children's time allocation whereby the family's need for child labor in response to an income or health shock can be satisfied, at least in part, by reducing children's leisure rather than schooling; there is evidence that substitution between schooling and child labor is much less than one-for-one in rural Bangladesh (Ravallion and Wodon, 2000).

Section 2 examines how one might expect demand for precautionary wealth to vary with initial wealth. Section 3 outlines our method of testing for risk effects on liquid wealth holding. Section 4 describes our data, while Section 5 presents our results. Conclusions are found in Section 6.

2. A model of precautionary wealth

We begin by considering a simple theoretical model of a farm-household's choice between holding liquid wealth and investing in a risky production activity. The model will lead us to question any presumption that it will tend to be the poor who hold unproductive liquid assets as a precaution against uninsured risk. This will help motivate our empirical investigation.

Consider a household facing a two-period decision on how to allocate its initial wealth W between current consumption, investing an amount K in a risky production activity, and holding an amount M of an unproductive but secure liquid asset. Utility at any date is a strictly increasing and concave function of consumption at that date, and goes to minus infinity as consumption goes to zero. Utility in the first period is $U(W-K-M)$. Output in the second period is $F(K,\xi)$ where F is increasing and concave in K but also depends on the realization of a random variable ξ. The value of $F(K,\xi)$ exceeds K for at least some values of ξ. $F(K,\xi)$ is also assumed to fall to zero (a total crop failure, for example) for some values of ξ irrespective of the value of K. These conditions assure that there will be positive investment in the risky activity, but that at least some liquid wealth will also be held as insurance (for otherwise, there is a positive probability of zero consumption, which gives infinite disutility). The choice of K and M maximizes expected utility:

$$U(W-K-M)+E_{\xi}U[F(K,\xi)+M] \tag{1}$$

Since our assumptions imply interior solutions for K and M, these must satisfy:

$$\begin{aligned} U'(W-K-M) &= E_{\xi}U'[F(K,\xi)+M] \\ &= E_{\xi}U'[F(K,\xi)+M]F_K(K,\xi) \end{aligned} \tag{2}$$

The choice of M and K will depend on W and the properties of the distribution of ξ. On differentiating Eq. (2) with respect to W and exploiting the second-order conditions, it is readily verified that M will be a strictly increasing function of W if and only if:

$$E_{\xi}\left[U'(F+M)F_{KK}+U''(F+M)(F_K-1)F_K\right]<0 \tag{3}$$

A sufficient condition is that $F_K > 1$ for all ξ. This must hold for some ξ since $F(K) > K$, but it may not hold at all values. Nonetheless, the inequality in Eq. (3) is not a strong assumption, and it implies that it will be the poorest (in terms of W) who hold the lowest amount of liquid wealth at any given level of risk. So, this model must make one immediately skeptical of any claim that precautionary liquidity preference is largely confined to the poor.

To give a tractable example with an explicit solution for this model, suppose that there are two possible outcomes in the second period: either the investment fails to produce anything or it succeeds, with a rate of return $r > 0$. Suppose also that individuals hold logarithmic utility functions. Then, M and K maximize:

$$\ln(W-K-M)+p\ln M+(1-p)\ln\left[(1+r)K+M\right]$$

where p is the (positive) probability of failure. It is readily verified that the solution for M is $p(1+1/r)W/2$, which is strictly increasing in both W and p and decreasing in r. Notice that not only do the poorest (in terms of W) hold the lowest amount of liquid wealth at any given level of risk and rate of return, but their demand for this form of wealth is least responsive to risk (in that case, $\partial M/\partial p$ is increasing in W). Total wealth carried over is $W/2$ and the share of it held in liquid form $(M/(M+K))$ is $p(1+1/r)/4$. For example, with a 25% rate of return and a 20% chance of failure, one quarter of wealth will be held in liquid form.

This model can be extended in a number of ways. One could easily introduce transaction costs that are decreasing in M, implying both a "transactions motive" and "precautionary motive" for liquidity. Heterogeneity can be introduced by allowing for household characteristics that influence either the utility function or the production function. Introducing human capital into the production function such that better education increases the returns to investment can readily yield solutions in which poorly educated households tend to hold the less productive form of wealth. At high levels of initial wealth, one might also conjecture that the above model would become less relevant since more efficient means of insurance will probably become available.

To sketch an extended version of the above model, which incorporates an alternative insurance instrument, let us assume that crop insurance is offered to any farmer who is willing to pay some positive minimum premium in the first period, sufficient to cover a fixed administrative cost and the insurer's expected payout in the second period. Beyond some critical initial wealth (sufficient to afford the crop insurance), this option will start to be the preferred method of insurance because its payouts are state contingent. Thus, one can expect that demand for liquid wealth as insurance will initially rise with wealth, but then fall after some point.

3. Method of testing for precautionary responses to risk

To implement an empirical test for precautionary behavior, we must find a measure of the income risk facing the household. Here, we follow Carroll and Samwick (1997) in basing that measure on the estimated innovation errors from an income process of the following form:

$$\ln Y_{it} = \alpha + X'_{it}\beta + \epsilon_{it} \quad (4)$$

where Y_{it} is the income of household i in time t, and X_{it} is a vector of exogenous variables. The error structure is assumed to be:

$$\epsilon_{it} = \eta_i + \nu_{it} \quad (5)$$

where η_i is a random individual component with mean zero and variance σ_η^2.

In the standard error component model, the errors are only correlated over time through the individual specific effect η_i, i.e. the ν_{it}s are assumed to be independent and identically distributed. However, for a variable like income, it is quite possible that an unobserved shock in the current period will affect the behavioral relationship in at least the next period if not further. The persistence in the errors of the income process over time implies that simply using the variance of the estimated ν_{it}s as the income uncertainty measure will understate the total income risk. In order to estimate precautionary savings, we need the variance of an i.i.d process.

We assume instead that the random variable ν_{it} is an AR(1) process:

$$\nu_{it} = \rho\nu_{it-1} + \omega_{it} \quad (6)$$

where ρ (with $|\rho| < 1$) is the serial correlation coefficient and ω_{it} is a random i.i.d. error with mean zero and variance σ_ω^2. Ignoring the serial correlation will still give consistent estimates of the regression coefficients, but the standard errors will be biased, which will bias our estimate for income uncertainty. Appendix A discusses our method of estimating ρ. The explanatory variables are assumed to be orthogonal to η_i and ω_{it}, i.e.:

$$E(X'_{it}\eta_i) = E(X'_{it}\omega_{it}) = E(\eta'_i\omega_{it}) = 0 \quad (7)$$

Having estimated Eq. (4), we construct a measure of household-specific income uncertainty as the variance of the estimated innovation errors in Eq. (6):

$$\hat{\sigma}_{i,y}^2 = \sum_{t=1}^{T} (\omega_{it} - \overline{\omega})^2 / T \tag{8}$$

We also measure household permanent income by:

$$\ln \hat{Y}_i^{\mathrm{p}} = \sum_{t=1}^{T} \ln \hat{Y}_{it} / T \tag{9}$$

where $\hat{Y}_{it}$ is the predicted income for household i at date t.[8]

To test for portfolio effects of income risk, we estimate an equation of the form:

$$S_{it} = Z_{it}'\pi + \gamma \ln \hat{Y}_i^{\mathrm{p}} + \theta \left[\hat{\sigma}_{i,y}^2 / \hat{Y}_i^{\mathrm{p}} \right] + \mathrm{e}_{it} \tag{10}$$

where S_{it} is the share of total wealth held in unproductive liquid form (we call this the "liquid wealth share"), Z_{it} is a vector of exogenous variables (in terms of the theoretical model above, $S = M/(K+M)$). If households hold higher shares of their wealth in liquid form when they face higher risk, then θ will be positive. Notice that in testing for precautionary wealth, we control for permanent income and other household characteristics that influence demand for liquid assets, such as for transaction purposes, or via effects on utility or production functions. We adopt the same specification as Eq. (10) for other behavioral responses to risk, as discussed in the Section 1.

The household income variable is undoubtedly measured with error. The estimated coefficient on the income risk variable in Eq. (10) will be unaffected under two assumptions on the income measurement error. Suppose that the true income variable is given by $\ln Y_{it}^* = \ln Y_{it} + \mu_i$, where μ_i is the time-invariant individual specific measurement error in income, which is uncorrelated with the other regressors in the model. Under this assumption, the model is:

$$\ln Y_{it} = \alpha + X_{it}' \beta + \eta_i + \mu_i + \nu_{it} \tag{11}$$

This leaves the error term ν_{it} unchanged, so our measure of risk is also unchanged. Alternatively, suppose the measurement error is an independent and identically distributed random variable, that is, $\ln Y_{it}^* = \ln Y_{it} + \chi_{it}$ where $\chi_{it} \sim \mathrm{IID}(0, \sigma_\chi^2)$, then the income regression is:

$$\ln Y_{it} = \alpha + X_{it}' \beta + \eta_i + \chi_{it} + \nu_{it} \tag{12}$$

[8] Carroll (1997) and Carroll and Samwick (1997) have decomposed total income risk into household-specific permanent and transient components. We choose not to do this decomposition because we have only six observations per household to estimate the two parameters.

The estimated income shock residual is $\chi_{it} + \nu_{it}$ and the income risk variable is now given by:

$$\hat{\sigma}_{yi}^2 = \sum_{t=1}^{T} (\omega_{it} - \overline{\omega})^2 / T + \sigma_\chi^2 \tag{13}$$

The presence of an i.i.d. measurement error in income adds a constant (σ_χ^2) to the income risk measure of all households. This will not affect the estimated coefficients on income risk in our regressions for portfolio and other behavioral responses.

There may also be heteroskedasticity across households in the distribution of omitted income determinants known to the household. This will mean that our risk measure includes both the true risk and the variance in omitted variables. On the one hand, the error in measured risk will attenuate its regression coefficient; on the other hand, since the error is known to the household, there will also be an endogeneity bias. The two sources of bias will work in the opposite direction as long as known income variability has the same direction of effect on behavior as does risk. Indeed, it can be readily shown that the two sources of bias in an OLS estimate will cancel out exactly in the special case in which the variance in the (known) omitted variables is uncorrelated (across households) with the true measure of risk and the two have the same effect on behavior. However, the latter condition seems unlikely to hold, so we cannot rule out bias due to heteroskedasticity.

One could estimate Eq. (10) using a standard random effects estimator, as in Kazarosian (1997).[9] However, it is likely that extreme values are present in wealth data making the error distribution heavy tailed. We use, instead, least absolute deviation (LAD) procedures that are less sensitive to extreme values.[10] Our estimating equation is:

$$S_{it} = \text{Quant}_\delta\left(S_{it} \mid Z_{it}, \hat{Y}_i^{\text{P}}, \hat{\sigma}_{i,y}^2\right) + e_{\delta it} \tag{14}$$

where

$$\text{Quant}_\delta\left(S_{it} \mid Z_{it}, \hat{Y}_i^{\text{P}}, \hat{\sigma}_{i,y}^2\right) = Z_{it}'\pi_\delta + \gamma_\delta \ln \hat{Y}_i^{\text{P}} + \theta_\delta\left[\hat{\sigma}_{i,y}^2 / \hat{Y}_i^{P}\right] \tag{15}$$

which is the δth conditional quantile of S_{it} given the explanatory variables. The LAD estimator is asymptotically normal, facilitating standard asymptotic inference

[9] There is the question of whether the risk variables are proxying for unobserved household specific fixed effects. Ideally, one would have liked to test for fixed effects but, in our case, the variables of interest are all time-invariant (the risk and the permanent income measures), which are not identified under a fixed-effects specification. However, the wealth regression is sufficiently well specified at both household and geography levels to give us some confidence that the risk variables are not substituting for unobserved household heterogeneity.

[10] See Buchinsky (1998) for a survey on quantile regression methods.

procedures. The standard errors of the parameter estimates are calculated using bootstrapping techniques and so are robust to any general kind of heteroskedasticity that may be present. We test whether the errors from a random-effects estimation are non-normal. If the null hypothesis of the errors being normally distributed is rejected, we estimate Eq. (10) using quantile regression methods. We also test for heterogeneity in wealth-holding behavior by stratifying Eq. (10) by income group.

4. Data

We use panel data formed from the Rural Household Surveys (RHS) of China's State Statistical Bureau. We use a sample of 6108 households over the 6-year period 1985–1990 from four contiguous provinces in southern China, namely Guangdong, Guangxi, Guizhou and Yunnan. The latter three provinces make up one of the poorest regions in China, while Guangdong is a relatively prosperous coastal province. Financial intermediation in rural areas is also better developed in Guangdong, as is evident in our data, from the fact that the sample mean of deposits per capita in Guangdong is about four times higher than in the rest of the sample.[11] The differences between Guangdong and the other three provinces in these and other respects are so marked that our tests will often separate out Guangdong.

The RHS is a well-designed and executed budget survey of a random sample of households drawn from a sample frame spanning rural China (including small–medium towns),and with unusual effort made to reduce non-sampling errors.[12] Sampled households keep a daily record of all transactions, as well as log books on production. Interviewing assistants visit each sampled household every 2 weeks to check on their progress and collect the data. Checks are made at the county statistical office, with return visits to the households when necessary. The household data are collated with geographic data at the village, county and the province levels.[13] All nominal values have been normalized by 1985 prices.

The computerized data are annual. So, we cannot identify intra-year income risk. In a rural economy, one naturally expects there to be seasonality, and (less obviously, but arguably) the extent of risk this induces will vary from place to

[11] Mean deposits in 1990 prices are 77.2 yuan per capita in Guangdong versus 21.0, 8.3 and 30.3 in Guangxi, Guixhou and Yunnan, respectively.

[12] Chen and Ravallion (1996) describe how the survey was done.

[13] See Jalan and Ravallion (1998) for details on the geographic data.

place. With these data, however, we cannot assess whether there is a precautionary savings response to seasonal income risk.[14]

The income variable includes imputed values for in-kind income from various sources (household production, which includes farming, forestry, animal husbandry, handicrafts, etc.). It does not include borrowings from (or loans to) informal and/or formal sources.

For the reasons discussed in Section 1, we define wealth as the sum of cash in hand, grain stock, deposits, value of productive farm assets, housing materials and consumer durables, but we exclude land. "Unproductive liquid wealth" is defined as cash-in-hand and grain holdings of the household. Treating grain as unproductive is questionable if its price is increasing over time, sufficient to cover storage cost.[15] In this period and region, the relative price of grain was quite stable from year-to-year.[16] However, some grain could well have been held in anticipation of seasonal price changes, on which we do not have data.

We test for effects of risk on school enrollment rates. We consider the number of students between the ages 6–17 and 12–17 years as ratios of the corresponding numbers of children in those age groups. We are unable to identify primary and secondary school enrollment rates at the household level because we do not know the level at which the students are enrolled; we only have information on their age and whether they are students or not.[17] Since we do not have data on days of school attendance, we cannot identify any risk effects on the daily attendance rate conditional on enrollment.

We also test for risk effects on the temporary out migration of family labor. This is a potentially important route out of poverty in this setting, although historically labor mobility has been highly restricted in China. Our measure of temporary out migration is the "labor export ratio", defined as the proportion of adult household members (over 18) who are working out of the township (a local administrative unit comprising many villages) for up to 6 months of the last year (in which case, they are still counted as part of the household in the RHS).

There is a concern about the possible endogeneity of the income risk measure in our regressions for the labor export ratio. Our regressions already include a number of the likely non-risk determinants of out migration. However, if some

[14] It cannot be presumed that there will be such a response. Using sub-annual data for semi-arid areas of India, Chaudhuri and Paxson (1993) find no evidence that consumption is affected by seasonal income changes, as distinct from annual changes that do have a significant effect.

[15] Some of the food grain stock is also productive as future seeds, but this is likely to be a small proportion.

[16] Taking a simple average over the four provinces, the median selling price of grain in the data set in 1985 prices (deflated by the rural CPI) was 0.36 yuan per kg in 1985, 0.38 in 1986, 0.39 in 1987, 0.40 in 1988 and 1989 and 0.38 in 1990 (based on Chen and Ravallion, 1996).

[17] Our samples for the schooling regressions are restricted to households with children in the relevant age groups.

omitted variable results in a worker leaving temporarily, then income will fall and this will increase the value of our risk measure based on the variance of the residuals in the income regression. We will return to this possibility when interpreting our results.

In estimating Eq. (4), the vector X_{it} includes age and age^2 of the household head, household composition, education levels of the household members, occupational dummy variables, both on their own and interacted with age, land holding and its squared value, geographic variables including features of the topography of the communities in which the household resides (say, whether or not the village is in the plains, or hills, or the coastal area, whether it is a minority area, etc.), as well as socio-economic characteristics of the county in which the village of the household is located in (for example, proportion of illiterates in the 15^+ population in the county, the infant mortality rate, access to roads, etc.). A time trend is also included in the model. Table 1 gives the income regression.

For identification of Eq. (10), we follow Kazarosian (1997) in excluding occupation characteristics, which are assumed to only affect wealth-holding behavior through their effect on permanent income and the income risk measure. Thus, the vector Z includes all those variables in X except the occupation dummies and their interactions with age. We test robustness to this identification assumption by including the occupation dummies in Z.

Our income risk variable will clearly not capture all the risks that matter to households in this setting. Given transaction costs, grain yield uncertainty may well matter independently of its effect on income risk. Health risk is also likely to have an independent effect. So, we also include two other risk variables, which are observed in the data. The first is food grain yield risk measured by the variance of the residuals in a regression of grain yield against the same set of variables used in the income regression. The second is a measure of medical risk, namely the variance of the residuals from household expenditure on medicine, medical articles, and medical treatment regressed on the same set of variables used in explaining incomes. In both cases, we also allow for serial correlation of the errors, similar to our measure of income risk discussed in Section 3, and in both cases, we normalize by the corresponding means.

Table 2 gives descriptive statistics. In addition to the overall sample means, we give a regional breakdown between Guangdong and the other three provinces, and we give a breakdown by quintiles of households ranked by predicted permanent income per person. Fig. 1 gives the empirical density functions for the liquid wealth share and total wealth.

On average, 26.5% of (non-land) wealth is held as cash or grain.[18] The proportion is lower in Guangdong than the other provinces, and Guangdong has a

[18] Productive assets accounted for 16.5% of wealth, housing 44.5%, consumer durables 10.3%, and deposits 2.2%.

Table 1
Income regression

Explanatory variable	Coefficient	*t*-ratio
Household size (log)	−0.27303	−7.3600
Household size^2 (log)	−0.04901	−4.2480
Cultivated land per capita	0.03134	21.2980
Cultivated land per capita^2	−0.00061	−14.0010
Age of household head	0.29680	80.2400
Age^2 of household head	−0.00482	−46.9470
Age^3 of household head	0.00002	28.2790
Whether farming is main occupation	3.35105	39.8220
Whether industry is main occupation	3.14028	14.7190
Whether working in the government is the main occupation	3.47023	9.6050
Proportion of preschool children in household	−0.39332	−20.4190
Proportion of kids aged 6–11 years	−0.22498	−11.8300
Proportion of kids aged 12–14 years	−0.06495	−2.9560
Proportion of kids aged 15–17 years	0.05507	2.7170
Proportion of illiterates in household	0.07191	3.9900
Proportion of primary school educated in household	0.13976	8.6180
Proportion of secondary school educated in household	0.27382	14.8210
Plains (dummy)	0.15825	17.7020
Hills (dummy)	0.07614	10.8100
Coast (dummy)	0.07333	3.9940
Minority area (dummy)	−0.03594	−4.7330
Revolutionary base area (dummy)	−0.03471	−1.6550
Border area (dummy)	−0.00063	−0.0820
Medical personnel per capita in county	0.01189	12.6010
Cultivated area which is irrigated	0.29761	11.1320
Cultivated area on which fertilizer is used	0.37616	13.8290
Roads per capita in county	0.00011	8.3760
Infant mortality rate in county	−0.00075	−2.5390
Illiterates in 15^+ population	−0.00149	−3.1790
Time trend	−0.01594	−9.9310
Constant	0.46976	22.4610
R^2	0.6848	

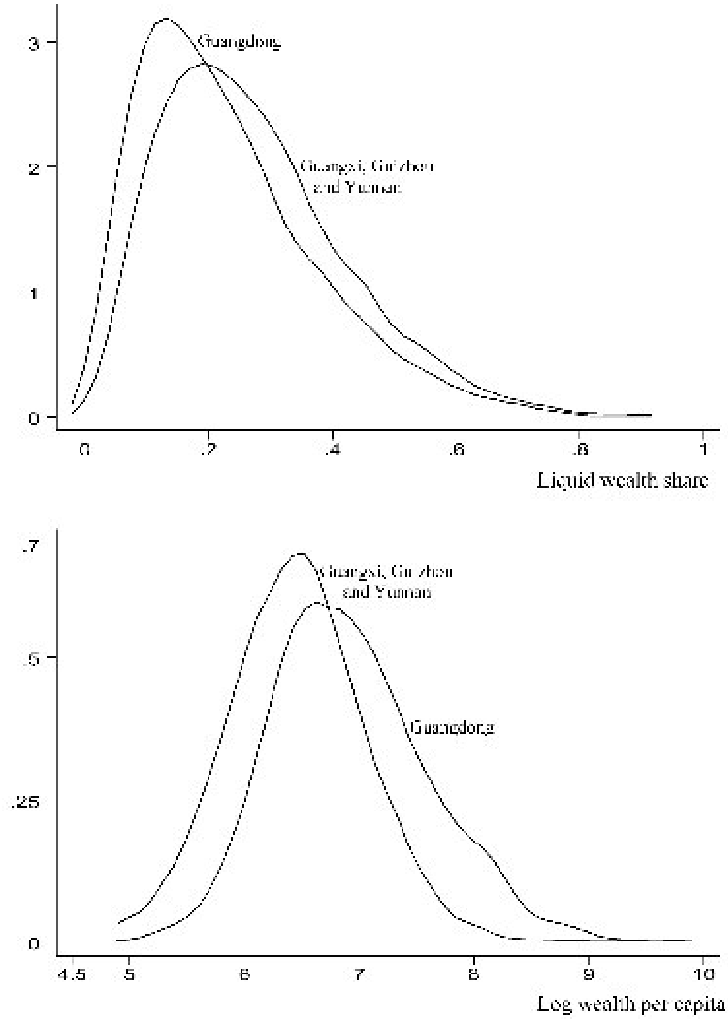
The model is estimated using random effects panel data techniques, with a serially dependent error term. The modified Durbin–Watson statistic for the income regression underlying the estimate of the income risk variable is 1.6487 and the first-order serial correlation coefficient is 0.2686. The model also includes interactions between the occupation, age, age^2, age^3. All the variables in the model have been transformed according to the Prais–Winsten transformation to correct for first-order serial correlation.

narrower dispersion of liquid wealth shares (Fig. 1). Guangdong also has higher mean wealth and lower mean income risk by our measure (Table 2). It is unclear whether these differences result from differences in the extent of both economic and financial development, though it is a plausible conjecture. Our estimates of Eq. (10) will throw further light on this issue.

Table 2
Descriptive statistics

Variable	Full sample	Stratified by region		Stratified by estimated permanent income per person				
		Guangdong	Guangxi, Guizhou and Yunnan	Bottom quintile	20th–40th percentile	40th–60th percentile	60th–80th percentile	Top quintile
Liquid wealth share (cash and grain)	0.2649	0.2304	0.2746	0.2864	0.2776	0.2731	0.2625	0.2246
	(0.152)	(0.145)	(0.153)	(0.160)	(0.1512)	(0.1510)	(0.146)	(0.146)
Log of (non-land) wealth per capita	6.5322	6.9265	6.4203	5.8954	6.2768	6.4927	6.7462	7.2498
	(0.707)	(0.685)	(0.672)	(0.579)	(0.515)	(0.505)	(0.493)	(0.606)
School enrollment rate	0.5508	0.5613	0.5478	0.5238	0.5654	0.5542	0.5615	0.5491
	(0.445)	(0.442)	(0.445)	(0.423)	(0.430)	(0.449)	(0.452)	(0.467)
Income risk (X1000)	0.2148	0.1369	0.2369	0.3446	0.2428	0.2057	0.1591	0.1217
	(0.240)	(0.163)	(0.253)	(0.315)	(0.257)	(0.208)	(0.171)	(0.140)
Yield risk	57.1207	44.9769	60.5663	28.6210	108.3974	35.2745	38.5520	74.6603
	(919.89)	(355.054)	(1024.94)	(113.169)	(1963.256)	(165.256)	(223.035)	(527.503)
Medical risk	20.4164	42.8038	14.0643	9.2793	11.0484	18.5444	23.2944	39.9149
	(97.391)	(178.846)	(54.028)	(30.172)	(37.773)	(73.287)	(95.714)	(173.069)
Log predicted permanent income	5.9770	6.3409	5.8737	5.5019	5.7724	5.9539	6.1473	6.5091
	(0.363)	(0.326)	(0.302)	(0.140)	(0.057)	(0.051)	(0.065)	(0.224)

Standard deviations are in parentheses.



Note: Non-parametric densities estimated using the Epanechnikov kernel and Silverman's recommended bandwith. Vertical axis in top panel scaled by 100.

Fig. 1. Empirical densities for liquid wealth share and total wealth.

There is only a slight decrease in the liquid wealth share as permanent income increases. The income risk measure (by contrast) falls steeply as permanent income increases (Table 2).

The behavior of the medical risk measure in Table 2 makes us suspicious about how good a measure this is. The much higher value in Guangdong is clearly not because the Guangdongese face higher medical risk. Similarly, the higher values at higher levels of permanent income are not because the health of richer people is more uncertain. Our measure is probably picking up an income effect (even though we have normalized the variance by mean medical spending). While we do not think that a better measure is possible with the data available, these results make us cautious in interpreting the results for the effects of health risk.

5. Results

It is evident from Fig. 1 that liquid wealth share has a highly skewed distribution, and that both it and log wealth are kurtotic. We computed skewness and kurtosis measures for all our dependent variables and found that they are all non-normal.[19] The case for using the more robust LAD estimator for these data is thus compelling. For the labor export ratio, there is also a strong a priori case for a non-normal error term given the censoring. Out migration of labor is rare in all but one of the provinces, namely Guangdong; excluding this province, the average proportion of adults out of the village on work was only 0.7%. However, in Guangdong, the sample mean of the labor export ratio (proportion of adults working outside the township) was 5.8% (with a standard deviation of 14.6). So, we confined that part of the analysis to Guangdong.

5.1. Determinants of the liquid wealth share

Our LAD estimates of Eq. (10) are given in column 1 of Table 3. We find that higher income uncertainty results in a higher share of wealth being held in unproductive liquid forms. The regression coefficient on the income risk measure implies that eliminating all such risk would reduce the percentage share of wealth held as cash or grain by 0.66%, from 26.5% (Table 2) to 25.8%. So, while the income risk effect is highly significant, it is quantitatively small.

Recalling our concerns about the health risk measure, and noting that both this variable and the measure of farm yield risk are insignificant in our estimate of Eq.

[19] For the full sample, the skewness and kurtosis measures for the residuals from a random effects regression of liquid wealth share on Z were 0.878 and 4.244, respectively and the associated chi-square normality test has a p-value of less than 0.0001 (under the null of normality, the skewness measure should be zero and the kurtosis measure 3). For the regression of log wealth per capita on Z, they were -1.244 and 11.319, again strongly rejecting normality. Similarly, for the school enrollment rate, the skewness measure is -0.517, the kurtosis measure is 6.276, and the p-value of the chi-square normality test is less than 0.0001. We get very similar patterns for the other categorizations analyzed in the paper.

(10) (column 1, Table 3), we also re-estimated the model dropping both the medical risk and farm yield risk. The results were quite similar to column 1 of Table 3. The coefficient on income risk rose slightly, from 0.0309 to 0.0320, and was still highly significant (t-ratio = 5.91). Other coefficients and their standard errors were very similar to Table 3.

The results were similarly robust to adding the occupational variables to the test equation, leaving the interaction effects as the only variables in X that are not in Z. The coefficient on income risk was then 0.0319 (t-ratio = 6.18); other coefficients and their standard errors were affected little.

Aside from income risk, we find a number of other factors influencing portfolio behavior. There is an inverted U relationship between the liquid wealth share and permanent income, with the predicted liquid wealth share peaking at a log permanent income of 5.90, which is close to the mean (Table 2, last row). So, the fact that the poor tend to hold a higher share of their wealth in liquid form (Table 2) is due to other factors correlated with income. Education is clearly one such factor. It can be seen from Table 3 that there are strong effects of education (the omitted proportion of household members with post-secondary schooling). Consider two households, one of which has only illiterate members, while everyone in the other household has secondary schooling. Otherwise, they are identical. Then, our model predicts that the share of wealth held in unproductive liquid forms will be 8.6 percentage points higher for the illiterate household. This difference dwarfs the effect of eliminating all income risk.

There is also a strong demographic effect on portfolio behavior. The liquid wealth share falls as household size increases, up to a size of four, and rises after that. There may well be scale economies in demand for liquid wealth up to some point. Younger households tend to hold more liquid wealth, possibly because they are more disposed toward engaging in the emerging opportunities for money-based market transactions in this setting.

Some of the geographic effects are notable. The liquid wealth share is significantly lower in the plains and coastal areas, and higher in the hills and mountains (the latter being the left-out dummy variable). Farm productivity tends naturally to be lower and more risky in the hills and mountains. Similarly, agricultural development (as measured by irrigation usage) results in significantly lower share of wealth held in liquid form.

There is more than one possible interpretation of these geographic effects. They can be interpreted as differences arising from external effects of agricultural development in an area on the returns to private investment.[20] The geographic effects might well be picking up a precautionary wealth effect of covariate risk; the significantly higher share of wealth held in liquid forms in the mountains is suggestive of covariate risk. However, these effects might also reflect any effects

[20] For a deeper analysis of such effects, see Jalan and Ravallion (1999b).

Table 3
Quantile regressions for wealth holding and school enrollment

	Liquid wealth share	*t*-statistic	Log of wealth per capita	*t*-statistic	School enrollment rates (6–17 years)	*t*-statistic	School enrollment rates (12–17 years)	*t*-statistic
Risk variables								
Income risk (/1000)	0.0309	5.164	0.1710	10.906	−0.0096	−0.656	0.0305	1.949
Yield risk (×1000)	0.0014	1.055	0.0105	4.733	0.0045	0.924	−0.0026	−0.242
Medical risk (×1000)	−0.0140	−1.280	0.0210	0.592	−0.0470	−1.399	−0.0948	−1.856
Other variables								
Permanent income (log)	0.5099	7.368	0.2441	1.304	1.2964	9.211	0.4172	2.066
Permanent income^2 (log)	−0.0432	−7.766	0.0888	5.715	−0.0966	−8.608	−0.0281	−1.719
Household size (log)	−0.0317	−2.215	−0.1059	−2.321	0.2662	3.211	0.3997	2.270
Household size (log)^2	0.0124	2.893	0.0189	1.317	−0.1267	−5.358	−0.1758	−3.591
Age of household head	−0.0055	−2.032	−0.0049	−0.993	0.0166	1.623	0.0019	0.117
Age^2 of household head (×100)	0.0136	2.299	0.0037	0.355	−0.0240	−1.138	0.0137	0.409
Age^3 of household head (×100)	0.0010	−2.509	0.0003	0.364	0.0009	0.638	−0.0002	−0.904
Proportion of preschool kids in household	0.0592	6.151	−0.2470	−8.779	−0.4430	−15.610	−0.6097	−9.572
Proportion of kids 6–11 years in household	0.0538	5.807	−0.1576	−6.713	−0.6335	−28.219	−0.7005	−21.627
Proportion of kids 12–14 years in household	0.0221	1.975	−0.0893	−3.447	−0.4897	−20.597	−0.7224	−19.074
Proportion of kids 15–17 years in household	−0.0049	−0.453	−0.0477	−1.599	−0.9351	−38.119	−1.2886	−40.037
Proportion of illiterates in household	0.0626	7.547	−0.1051	−3.878	−0.6905	−22.586	−1.1323	−32.235

Proportion of primary school educated	0.0385	6.137	−0.0965	−4.109	−0.5329	−25.747	−0.9399	−34.503
Proportion of secondary school educated	−0.0233	−3.963	−0.0102	−0.350	−0.3701	−15.244	−0.7020	−24.030
Cultivated land per capita	0.0231	7.216	0.0818	11.628	−0.0250	−3.295	−0.0260	−1.722
Cultivated land per capita^2	−0.0012	−2.057	−0.0061	−6.164	0.0006	0.270	0.0013	0.309
Geographic variables								
Plains (dummy)	−0.0118	−3.986	0.0671	7.383	−0.0118	−1.621	0.0014	0.148
Hills (dummy)	0.0040	1.313	0.0516	7.869	−0.0043	−0.681	−0.0082	−1.060
Coast (dummy)	−0.0476	−9.577	−0.0112	−0.659	−0.0049	−0.408	−0.0586	−2.026
Minority area (dummy)	−0.0070	−3.089	0.0392	6.758	−0.0009	−0.129	0.0013	0.164
Revolutionary base area (dummy)	−0.0245	−3.859	−0.0284	−1.543	−0.0234	−2.245	0.0295	1.569
Border area (dummy)	0.0246	6.762	−0.0014	−0.132	−0.0306	−3.170	−0.0451	−3.940
Medical personnel per capita	0.0007	3.316	−0.0030	−3.901	−0.0008	−1.463	−0.0018	−2.446
Irrigation usage on cultivated area	−0.0426	−6.792	0.1554	8.390	−0.0597	−3.278	−0.0657	−2.467
Fertilizer usage on cultivated area	0.0098	1.782	−0.1355	−8.990	−0.0540	−2.645	−0.0806	−2.046
Roads per capita (×100)	0.0021	6.332	−0.0096	−9.070	−0.0024	−3.047	0.0017	1.462
Infant mortality rate	0.0003	3.438	0.0024	10.355	0.0007	3.956	0.0004	1.363
Illiterates in the 15$^+$ population (×100)	0.0097	0.734	−0.2200	−6.213	−0.0720	−2.056	−0.0012	−2.858
Time trend	0.0223	43.440	0.0105	7.006	−0.0099	−7.760	−0.0138	−5.487
Constant	−1.3246	−6.006	2.0576	3.494	−3.1338	−6.848	0.0729	0.107

of non-farm rural development on the transactions demand for money. That is a plausible interpretation of why we find that higher road density results in a higher share of wealth held in liquid form. There is a highly significant positive trend in the liquid wealth ratio. This might also reflect a rising transactions demand for money balances, as the economy becomes more market oriented.

5.2. Effects of risk on wealth, schooling and out migration

The second column of Table 3 gives the regression for total wealth. Here, we also find a significant effect of income risk, which accounts for 3.7% of total wealth. So, there are two effects of risk, one through the portfolio effect (on the liquid wealth share) and one through an effect on total wealth. Combining the two, it is readily verified from Tables 2 and 3 that income risk accounts for about 6.8% of liquid wealth (more precisely, the change in the log of liquid wealth if income risk vanished is −0.0676). Roughly half of this (3.1%) is due to the portfolio effect; the rest (3.7%) being due to the total wealth effect. A 6.8% reduction in liquid wealth holding is equivalent to 13.4% of 1 year's mean permanent income. These results were also robust to the specification changes discussed above.

It is not clear why we are finding an effect of income risk on total wealth. The answer may be that some of the "non-liquid" components of total wealth also have precautionary value. Within the village or nearby, a household might fairly readily sell (or exchange for food grain) a productive asset such as a bullock,[21] or even a consumer durable such as a bicycle. However, most of these other wealth components are clearly productive, so arguably any precautionary value they have would not come at a cost to prospects of escaping poverty.

There is also a positive effect of grain yield risk on total wealth, though the contribution of yield risk is small, accounting for 0.06% of wealth. We find no effects of either the grain yield risk or medical risk on either the composition of the portfolio or on total non-land wealth.

We find no effects of income risk on school enrollments (column 3, Table 3). Our dependent variable may however be too aggregated to reveal this effect; possibly, if we had data on days of attendance, an effect might be found. In the last column of Table 3, we give results for the enrollment rate of the 12–17 age group. Again, there is no sign that risk decreases schooling; indeed, the coefficient on income risk is positive and significant at the 5% level.

Table 4 gives our results for family labor export (recall that this regression is only run for the Guangdong sample). For this regression, we used a censored-conditional quantile estimator (Powell, 1984); we estimate this model at the 85% quantile given that the dependent variable is so heavily censored (as discussed

[21] On the role of livestock as insurance in poor rural economies, see Binswanger and McIntire (1987), Rosenzweig and Wolpin (1993), Dercon (1998) and Fafchamps et al. (1998).

Table 4
Censored regression for out migration of labor

		t-statistic
Risk variables		
Income risk (/1000)	−0.1870	−4.295
Yield risk (×1000)	−0.0189	−0.846
Medical risk (×1000)	0.0472	2.249
Other variables		
Permanent income (log)	1.8590	2.020
Permanent income^2	−0.1341	−1.895
Household size (log)	0.0786	0.532
Household size^2	0.0124	0.316
Age of household head	0.0062	0.218
Age^2 of household head	0.0001	0.138
Age^3 of household head	0.0000	−0.449
Proportion of preschool kids in household	−0.3124	−3.630
Proportion of kids 6–11 years in household	−0.2290	−3.369
Proportion of kids 12–14 years in household	0.0056	0.077
Proportion of kids 15–17 in household	0.0194	0.220
Proportion of illiterate members in household	0.1372	2.613
Proportion of primary school educated in household	0.1539	2.918
Proportion of secondary school educated in household	0.3576	7.987
Cultivated land per capita	−0.3091	−8.603
Cultivate land per capita^2	0.0549	5.458
Plains (dummy)	−0.0962	−3.277
Hills (dummy)	0.0651	2.645
Coast (dummy)	−0.0482	−1.820
Revolutionary base area (dummy)	−0.0635	−2.590
Border area (dummy)	−0.0230	−0.711
Medical personnel per capita in the county	−0.0121	−4.026
Cultivated area which is irrigated in the county	0.4019	4.429
Cultivated area on which fertilizers are used	−0.5136	−8.174
Roads per capita in the county	0.0001	1.707
Infant mortality in the county	0.0031	2.289
Illiterates in the 15^+ population in the county	−0.0109	−12.588
Time trend	0.0319	7.305
Constant	−6.4215	−2.071

The above regressions are for Guangdong province only. Censored conditional quantile regression methods have been used (conditional quantile at 0.85) due to heavy censoring of the data.

above). We find a sizable negative effect of income risk on out migration. Eliminating all income risk would increase the mean by 5.5% to 8.8%. Income risk appears then to be an important impediment to the temporary out migration of labor. We find no effect of farm yield risk, but a small positive effect of our measure of health risk.

As noted in Section 4, there is the possibility of a correlation between our measure of income risk and the error term in our regression for out migration. The correlation arises from omitted exogenous shocks that simultaneously result in out migration and an unexpected change in income. This would impact an upward bias in our estimate of the effect of income risk on migration. So, an unbiased estimate would yield an even larger negative effect of risk on migration. While we cannot correct for the bias, its likely direction strengthens our conclusion.

There are a number of other factors influencing out migration. It is less likely in younger families. It increases with average education in the family up to secondary, but then falls. It is also higher for households living in counties with a better educated population, suggesting a spillover effect. It falls as land holding increases up to a high level (the turning point is at 2.82 mu per person, which is almost three standard deviations above the mean of 1.00.) Migration is more likely from the mountains than the plains, but more likely from the hills than the mountains. Also, there is a strong positive trend.

5.3. Stratifications by permanent income and region

Table 5 gives the stratification of Eq. (10) by quintiles of permanent income. We do not reproduce all the regression coefficients (though they are available on request), but only those related to the three risk measures.

We find an inverted U relationship between income and the size of the portfolio response to income risk. The significant effect of income risk on the liquidity of portfolios that is evident in the full sample does not hold among either the poorest

Table 5
Stratifications by permanent income and region

	Income risk (/1000)	Yield risk (×1000)	Medical risk (×1000)
Dependent variable: ratio of liquid to total wealth			
Bottom quintile	0.0118 (1.139)	0.0329 (2.116)	−0.0419 (−0.439)
20th–40th percentile	0.0282 (3.050)	0.0013 (4.622)	0.0795 (1.775)
40th–60th percentile	0.0344 (3.287)	0.0371 (4.640)	−0.0420 (−1.609)
60th–80th percentile	0.0279 (1.647)	0.0137 (2.069)	−0.0860 (−5.040)
Top quintile	0.0073 (0.433)	0.0116 (2.435)	0.0253 (2.607)
Guangdong	−0.0071 (−0.462)	0.0144 (2.458)	0.0067 (0.403)
Guangxi, Guizhou, Yunnan	0.0343 (6.754)	0.0003 (1.948)	−0.0284 (−1.490)
Dependent variable: log of wealth per capita			
Bottom quintile	−0.0006 (−0.029)	0.1601 (2.183)	0.5786 (3.266)
20th–40th percentile	0.1599 (4.677)	0.0100 (2.707)	−0.2708 (−1.898)
40th–60th percentile	0.1033 (3.047)	0.0108 (0.160)	−0.1067 (−1.558)
60th–80th percentile	0.2607 (4.298)	0.0796 (4.048)	0.1702 (2.683)
Top quintile	−0.0625 (−0.748)	0.0538 (1.831)	0.0847 (1.234)
Guangdong	0.3045 (4.824)	0.0001 (0.003)	0.0335 (0.713)
Guangxi, Guizhou, Yunnan	0.1704 (9.569)	0.0034 (2.407)	0.0199 (0.266)

Numbers in parentheses are t-statistics.

quintile, or the richest quintile. However, it is found among the middle three quintiles, peaking in the middle quintile.

Low precautionary demand for liquid wealth by the relatively well off suggests that they either have access to more efficient forms of insurance, or lower demand for insurance generally. For the poor, low demand for this type of insurance could reflect how costly it is to current consumption, or it may reflect prospects for external assistance in bad times.

The effect of income risk on total wealth also has an inverted U relationship with permanent income (Table 5, lower panel). There is no significant effect for either the bottom quintile or the top quintile. So, we find no evidence that income risk leads the poorest quintile of households to hold higher levels of wealth; the effects we find for the sample as a whole are driven entirely by the portfolio behavior of middle income groups.

There is also evidence of an effect of grain yield risk on total wealth holding for the poorest two quintiles (as well as the aforementioned effect on the share held as cash and grain). We also find evidence of an effect of the medical risk variable for the poorest quintile (Table 5).

Table 5 also gives Eq. (10) separately for Guangdong versus the other three provinces. We see that the income risk effect on the share of wealth held as cash and grain does not hold in Guangdong, but does in the other provinces as a whole. The risk effect on total wealth is found in both regions (lower two rows, Table 5), and the size of this effect is stronger for Guangdong. Note, however, that our measure of income risk is also lower on average in Guangdong (Table 2), such that the share of total wealth attributed to the precautionary motive is about the same (4.2% in Guangdong and 4.0% in the other provinces). So, the key regional difference is in the extent to which income risk is reflected in portfolio behavior. The geographic difference in portfolio behavior in response to income risk is consistent with the difference in the extent of financial market development (Section 4).

6. Conclusions

We have studied portfolio and other behavioral responses to idiosyncratic risk in rural areas of southwest and southern China—a setting in which credit and insurance markets are poorly developed, and yet there is pervasive uncertainty about future incomes and health. In keeping with past empirical work on precautionary wealth, we extract a measure of income risk from a first-stage income regression estimated on household panel data and then use this measure of risk as a regressor in attempting to explain liquid wealth holdings. We have extended past methods by allowing for serial dependence in income shocks and by using quantile regression methods that will be more robust to the evident non-normality in the data on liquid wealth holdings. We have also tested for risk effects on schooling and migration.

Our results suggest that wealth is held in unproductive liquid forms to protect against idiosyncratic income risk. However, the effect we get is small; even if all income risk were eliminated, the mean share of wealth held in liquid forms would fall only slightly, from 26.5% to 25.8%. We find that there is an inverted U relationship between the precautionary wealth effect and permanent income, such that neither the poorest quintile nor the richest appear to hold liquid wealth because of income risk; it is the middle income groups that do so. We suspect that the rich do not need to hold precautionary liquid wealth, and the poor cannot afford to do so.

We find some evidence that liquid wealth is also held as a precaution against risk to food grain yields (independently of income risk). We find no clear signs of a precautionary response to health risk, though our measure (based on unexplained fluctuations in medical spending) may be contaminated by income effects on medical spending when sickness occurs.

Schooling and (hence) future incomes appear to be protected from both income and health risk. However, greater uncertainty about incomes does appear to constrain the temporary out migration of family labor. This effect is sizable; in one province in our data set where there is some out migration, eliminating income risk would increase the proportion of the adults temporarily working out of the local area from 6% to 10%. Our finding that income risk attenuates out migration suggests that the prospects for risk diversification through migration are outweighed by other factors in this setting. A seemingly plausible explanation is that income risk at home makes it more important to assure that the labor and land inputs to the family farm are secure, given that labor markets are thin and land is subject to administrative re-allocation.

Acknowledgements

Our thanks go to staff of China's State Statistical Bureau for their assistance. Helpful comments were received from Shubham Chaudhuri, Paul Glewwe, Dominique van de Walle and two anonymous referees. The financial support of the World Bank's Research Committee (under RPO 678-69) is gratefully acknowledged. The hospitality of the ARQADE Université des Sciences Sociales, Toulouse, is also gratefully acknowledged. These are the views of the authors and should not be attributed to the World Bank.

Appendix A. Estimating the residual autoregression coefficient

We first test the null hypothesis that $\rho = 0$ using the Bhargava et al. (1982) generalized Durbin–Watson statistic (d_ρ). The test statistic is:

$$d_\rho = \sum_{i=1}^{N}\sum_{t=2}^{T}\left(\hat{\nu}_{it} - \hat{\nu}_{it-1}\right)^2 \Big/ \sum_{i=1}^{N}\sum_{t=1}^{T}\hat{\nu}_{it}^2$$

Provided we reject the null that $\rho = 0$, we transform the usual AR(1) model into a serially uncorrelated regression with independent observations using the Prais–Winsten transformation. Thus, the transformed regression disturbances are:

$$\epsilon^{*} = (I_N \otimes C)\epsilon = (I_N \otimes Ce_T)\eta + (I_N \otimes C)\nu$$

where e_T is a T vector of ones, $\eta' = (\eta_1, \eta_2, \ldots, \eta_N)$, and $\nu' = (\nu_{11}, \ldots, \nu_{1T}, \ldots, \nu_{NI}, \ldots, \nu_{NT})$. The C matrix is given by:

$$C = \begin{bmatrix} (1-\rho^2)^{1/2} & 0 & 0 & \ldots & 0 & 0 & 0 \\ -\rho & 1 & 0 & \ldots & 0 & 0 & 0 \\ . & . & . & \ldots & . & . & \\ . & . & . & \ldots & . & . & . \\ 0 & 0 & 0 & \ldots & -\rho & 1 & 0 \\ 0 & 0 & 0 & \ldots & 0 & -\rho & 1 \end{bmatrix}$$

We get an estimate of ρ using the relationship $\rho_d = 1 - d_p/2$ and the fact that:[22]

$$E(\rho_d) = 1 - \frac{(1-\rho)(T-1)}{\left[T - \frac{1+\rho}{1-\rho} + \frac{2\rho(1-\rho^T)}{T(1-\rho)^2}\right]}$$

which can be solved by standard nonlinear numerical methods.

References

Alderman, H., 1996. Saving and economic shocks in rural Pakistan. Journal of Development Economics 51, 343–366.

Alderman, H., Paxson, C., 1994. Do the poor insure? A synthesis of the literature on risk and consumption in developing countries. In: Economics in a Changing World: Proceedings of the Tenth World Congress of the International Economic Association, Moscow, vol. 4, St. Martin's Press, New York.

Baltagi, B.H., Li, Q., 1991. A transformation that will circumvent the problem of autocorrelation in an error-component model. Journal of Econometrics 48, 385–393.

Bencivenga, V.R., Smith, B.D., 1991. Financial intermediation and endogenous growth. Review of Economic Studies 58, 195–209.

Besley, T., 1995. Savings, credit and insurance. In: Behrman, J., Srinivasan, T.N. (Eds.), Handbook of Development Economics, vol. 3. North-Holland, Amsterdam.

Bhargava, A., Franzini, L., Narendranathan, W., 1982. Serial correlation and fixed effects model. Review of Economic Studies 49, 533–549.

Binswanger, H., McIntire, J., 1987. Behavioral and material determinants of production relations in land-abundant tropical agriculture. Economic Development and Cultural Change 36, 73–99.

[22] See Baltagi and Li (1991) and Wansbeek and Kapteyn (1982, 1983) for further details on this transformation.

Buchinsky, M., 1998. Recent advances in quantile regression models: a practical guideline for empirical research. Journal of Human Resources 33, 88–126.

Caballero, R.J., 1990. Consumption puzzles and precautionary savings. Journal of Monetary Economics 25, 113–136.

Carroll, C.D., 1994. How does future income affect current consumption? Quarterly Journal of Economics 109, 111–147.

Carroll, C.D., 1997. Buffer stock saving and the life cycle/permanent income hypothesis. Quarterly Journal of Economics 112 (1), 1–57.

Carroll, C.D., Samwick, A.A., 1997. The nature of precautionary wealth. Journal of Monetary Economics 40, 41–73.

Chaudhuri, S., Paxson, C., 1993. Consumption smoothing and income seasonality in rural India. Discussion Paper 173, Research Program in Development Studies, Princeton University.

Chen, S., Ravallion, M., 1996. Data in transition: assessing rural living standards in southern China. China Economic Review 7, 23–56.

Deaton, A., 1991. Saving and liquidity constraints. Econometrica 59, 1121–1142.

Deaton, A., 1992. Understanding Consumption. Oxford Univ. Press, Oxford.

Dercon, S., 1998. Wealth, risk and activity choice: cattle in western Tanzania. Journal of Development Economics 55, 1–42.

Fafchamps, M., Udry, C., Czukas, K., 1998. Drought and saving in west Africa: are livestock a buffer stock? Journal of Development Economics 55, 273–306.

Gersovitz, M., 1988. Savings and development. In: Chenery, H., Srinivasan, T.N. (Eds.), Handbook of Development Economics, vol. 1. North-Holland, Amsterdam.

Hubbard, R.G., Skinner, J., Zeldes, S.P., 1994. The importance of precautionary motives for explaining individual and aggregate saving. Carnegie-Rochester Conference Series on Public Policy 40, 59–126.

Jacoby, H.G., Skoufias, E., 1997. Risk, financial markets and human capital in a developing country. Review of Economic Studies 64, 311–335.

Jalan, J., Ravallion, M., 1998. Are there dynamic gains from a poor-area development Program? Journal of Public Economics 67, 65–85.

Jalan, J., Ravallion, M., 1999a. Are the poor less well insured? Evidence on vulnerability to income risk in rural China. Journal of Development Economics 58, 61–81.

Jalan, J., Ravallion, M., 1999. Geographic poverty traps? Mimeo, Development Research Group, World Bank.

Kazarosian, M., 1997. Precautionary savings—a panel study. Review of Economics and Statistics 79, 241–247.

Keynes, J.M., 1973. The General Theory of Employment, Interest and Money. Macmillan Press for the Royal Economic Society, London.

Kimball, M.S., 1990. Precautionary saving in the small and the large. Econometrica 58, 53–73.

Kraay, A., 2000. Household savings in China. Mimeo, World Bank Economic Review 14, 545–570.

Morduch, J., 1995. Income smoothing and consumption smoothing. Journal of Economic Perspectives 9 (3), 103–114.

Park, A., 1995. Household grain management and precautionary saving in China's poor areas. Mimeo, Food Research Institute, Stanford University.

Patrick, H.T., 1966. Financial development and economic growth in underdeveloped countries. Economic Development and Cultural Change 14 (2), 174–189.

Paxson, C., 1992. Using weather variability to estimate the response of savings to transitory income in Thailand. American Economic Review 82, 15–34.

Powell, J.L., 1984. Least absolute deviations estimation for the censored regression model. Journal of Econometrics 25, 303–325.

Ravallion, M., Wodon, Q., 2000. Does child labor displace schooling? Evidence on behavioral responses to an enrollment subsidy. Economic Journal 110, C158–C175.

Rosenzweig, M.R., 1988. Labor markets in low-income countries. In: Chenery, H., Srinivasan, T.N. (Eds.), Handbook of Development Economics, vol. 1. North-Holland, Amsterdam.

Rosenzweig, M.R., Binswanger, H., 1993. Wealth, weather risk and the composition and profitability of agricultural investments. Economic Journal 103, 56–78.

Rosenzweig, M.R., Wolpin, K.I., 1993. Credit market constraints, consumption smoothing, and the accumulation of durable production assets in low-income countries: investments in bullocks in India. Journal of Political Economy 101, 223–245.

Skidelsky, R., 1983. John Maynard Keynes: Hopes Betrayed 1883–1920. Macmillan, London.

Tobin, J., 1958. Liquidity preference as behavior towards risk. Review of Economic Studies 67, 65–86.

Wansbeek, T., Kapteyn, A., 1982. A simple way to obtain the spectral decomposition of variance components models for balanced data. Communications in Statistics A11, 2105–2112.

Wansbeek, T., Kapteyn, A., 1983. A note on spectral decomposition and maximum likelihood estimation of ANOVA models with balanced data. Statistics and Probability Letters 1, 213–215.

World Bank, 1998. World Development Report. Oxford Univ. Press, New York.

Zeldes, S.P., 1989. Optimal consumption with stochastic income: deviations from certainty equivalence. Quarterly Journal of Economics 104, 275–298.