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Abstract

This paper considers the various strategies rural households employ to avoid consumption shortfalls caused by realizations of adverse income shocks. First, we develop an ex post theoretical model within an inter-temporal utility maximizing framework which we use to explain households' decisions to insure against idiosyncratic risk and save to protect against uninsurable spatially covariant risk. In the theoretical model we show that the latter can take a variety of different asset forms depending on the absolute level of risk aversion of the household and the variability in asset returns. Second, using household level panel data from Vietnam we test the extent to which households' smooth consumption over time and how this depends on the presence of insurance and saving instruments. Third, we consider savings and liquid asset holdings as a form of self-insurance or precautionary savings against spatially covariant shocks. Overall, our results suggest that households deplete their stock of total liquid assets in the event of exposure to both exogenous and idiosyncratic income shocks. The ability of households to cope is also dependent on their receipt of public and private transfers in the event of an exogenous natural shock with insurance claims serving to alleviate the depletion of livestock holdings in the event of insurable idiosyncratic income shocks. These results are particularly pronounced for low and middle wealth groups.

Key Words: Insurance, precautionary savings, risk-coping, income shocks
JEL Codes: D14, D91, O12, O16

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1. Introduction

Vulnerability to shocks is a dominant feature of household livelihoods in developing economies. A fundamental problem facing rural households is how to maintain satisfactory levels of consumption in the face of adverse income shocks. These shocks can affect a household's welfare by negatively impacting on household income, existing household wealth and the health of household members. This paper considers the various strategies rural households employ to avoid consumption shortfalls caused by realizations of adverse income shocks. We categorize shocks as either idiosyncratic or spatially covariant (for example, a flood which affects all households in a particular location), with the former insurable in formal financial markets, and the latter non-insurable, thereby creating a theoretical motive for precautionary saving. We first develop an ex post theoretical model within an inter-temporal utility maximizing framework which we use to explain households' decisions to insure against idiosyncratic risk and save to protect against uninsurable spatially covariant risk. In the theoretical model we show that the latter can take a variety of different asset forms depending on the absolute level of risk aversion of the household and the variability in asset returns. Second, using panel data from rural households in Vietnam, we test the extent to which households' smooth consumption over time and how this depends on the presence of insurance and savings instruments. Third, we consider savings stocks in the form of liquid assets (livestock holdings, grain stores, savings and borrowings) as a form of self-insurance or risk-coping strategy against spatially covariant shocks. To our knowledge this is the first empirical study to incorporate both formal insurance and savings instruments together within a development context.

For many poor farmers in developing countries, risk remains a serious cause of poverty and ruin (Fafchamps, 2009). The precise nature of the realized risk or shock incurred has implications for a household's ability to cope and its consequences (Dercon, 2002). The literature typically distinguishes individual (idiosyncratic) shocks from common (spatially covariant) shocks whereby the former affect an individual household or income earner only (for example, injury, illness, death, divorce, etc.), while the latter may have regional or even country-wide effects (for example, natural disasters, price shocks). We explicitly distinguish between the terms 'shocks' and 'risk' whereby a shock can be unanticipated by the recipient household and once suffered, the household engages in risk-coping strategies (whether anticipated or not). Put differently, this paper examines the consequences of risk on household behaviour *ex post*. The literature has found that spatially covariant shocks, and, in particular, weather related events such as rainfall, can negatively impact on human welfare. For example, Alderman et al (2006) found that detrimental weather can impact on the nutrition and height of children while Jacoby and Skoufias (1997) found that weather related events can affect school attendance and enrolment.[1] There is also much evidence to support the detrimental effect that the occurrence of idiosyncratic shocks can have on a household with many finding evidence in support of the dominance of idiosyncratic shocks (Morduch, 2004; Townsend, 1994; Udry, 1991). Shocks can also be categorized by their frequency and the magnitude of their impact. Dercon (2002) finds that relatively small but frequent shocks are easier to deal with than large,

[1] In contrast, Deaton (1997) finds that covariant shocks for certain villages explain little of the variation in household income within villages in Cote d'Ivoire.

infrequent adverse shocks, while Alderman (1998) finds that consumption smoothing is more difficult with successive shocks than with single shocks. In addition, some shocks may have persistent effects (for example, health problems).

In addition to having an impact on a household's ability to cope, the nature of the shock is also important for understanding the strategies households use to cope with its adverse consequences. Idiosyncratic shocks can be insured informally at a community level, or, if available, via formal insurance contracts with a third-party insurer. Recent literature suggests that the lack of formal insurance, both in terms of market availability and actual take-up, is one of the key drivers of persistent levels of poverty in developing countries (Morduch, 2002). This lack of formal insurance together with a lack of other formal means to smooth the consumption of low-income households is a central feature of livelihoods in the developing world. Spatially covariant shocks are more difficult to insure collectively and formal insurance contracts are extremely rare for reasons of moral hazard and adverse selection. Consequently, households in risky environments develop sophisticated strategies to reduce the impact of shocks (Dercon, 2002). Alderman and Paxson (1994) distinguish between risk-management and risk-coping strategies whereby the former attempt to affect *ex ante* how risky the income generating process is ('income smoothing') while the latter deal with the consequences *ex post* of income risk ('consumption smoothing'). A considerable body of literature on savings and consumption smoothing explores the concept of precautionary savings (Zeldes, 1989; Kimball, 1990; Deaton, 1991, 1992; Udry, 1994). The evidence suggests that in rural populations where credit constraints are binding, inefficient savings behaviour is likely to occur.[2] The savings of many poor households appear to be a pre-emptive response to income shocks, which would not entail the optimal allocation of risk, rather than a long term investment decision. Despite the empirical challenges in distinguishing precautionary motives from inter-temporal or bequest motives, evidence supports significant inefficient saving behaviour which violates the permanent-income hypothesis.

In this paper, our primary hypothesis proposes that in the absence of formal insurance contracts for spatially covariant risk transfer, a risk-averse household engages in precautionary savings strategies to buffer against forms of spatially covariant risk while formally insuring against forms of idiosyncratic risk. We attempt to theoretically isolate the precautionary savings component of household savings levels. In addition to accumulating savings stores for precautionary (and other inter-temporal) motives, evidence also suggests that risk-averse households accumulate other forms of liquid assets for self-insurance purposes. Under severe credit constraints households may be forced to sell productive assets to smooth consumption. Rosenzweig and Wolpin (1993) provide evidence that farmers sell bullocks when faced with an unfavourable crisis in Icrisat villages in India. Fafchamps et al (1998) find that livestock transactions in the West African semi-arid tropics are responsive to income fluctuations while Lim and Townsend (1998) find that the most effective approach to risk-coping at the household level is by self-insurance through in-kind saving (for example, building up grain reserves and drawing them down as required). In addition to forms of household savings (for example, formal savings instruments, informal

[2] Udry (1994) found evidence of precautionary savings in rural villages of northern Nigeria where he showed that these households saved significantly in anticipation of transitory shocks. Deaton (1992) found that significant savings were made in anticipation of income shocks in Cote d'Ivoire.

savings and ROSCAs), this paper also considers other forms of asset accumulation in the form of livestock holdings and crop stores as precautionary saving strategies against spatially covariant risk, as well as borrowing.

Our application to panel data from Vietnam provides us with a unique opportunity to incorporate formal insurance and precautionary savings into the analysis. Our data come from the Vietnamese Access to Resources Household Survey for 2006, 2008 and 2010 and include detailed information on households' financial resources, access to and purchase of formal insurance, and the incidence of idiosyncratic and spatially covariant shocks. Given that formal financial markets (including insurance markets) are more developed in Vietnam relative to other developing economies, our prior is that households successfully insure away risks or accumulate sufficient precautionary savings to facilitate consumption smoothing in the face of adverse income shocks. If, however, risk-coping mechanisms are insufficient and full recovery from shocks is not achieved in spite of rural Vietnam's relatively well developed financial markets, it is doubtful that recovery can be achieved in less endowed regions of the developing world.

We first identify which households have not achieved consumption smoothing across the timeframe under consideration. We find that 'consumption smoothing' is more difficult for households suffering income shocks, but this shortfall is reduced with crop stores, livestock holdings and income levels. Though subject to selection bias, insured households' record no significant shortfalls in consumption over time while uninsured households' suffer consistent shortfalls. We then estimate a reduced form fixed effects model to ascertain if liquid assets are depleted in response to spatially covariant shocks providing evidence that they serve precautionary savings purposes. The model also considers the role of public and private transfers as well as insurance claims in buffering against adverse idiosyncratic and spatially covariant shocks. Our results suggest that total liquid asset holdings are depleted in the event of both idiosyncratic (insurable) shocks and exogenous spatially covariant natural (uninsurable) shocks. Public and private transfers together with formal insurance claims appear to be emerging as important risk coping mechanisms in the face of spatially covariant natural and idiosyncratic shocks respectively.

The remainder of the paper is organised as follows; Section 2 details the conceptual framework used for the analysis while Section 3 outlines the empirical approach; Section 4 describes the data; Section 5 discusses the empirical findings and Section 6 concludes.

2. Conceptual Framework

In this section, we develop a simple two-period model incorporating both spatially covariant and idiosyncratic risk that captures, in a stylized manner, the formal insurance and savings (including precautionary savings or self-insurance) decisions made by rural Vietnamese households (and elsewhere) in the anticipation of shocks. Households can purchase formal insurance and accumulate precautionary savings and assets in order to forearm themselves in the face of income and wealth variability. Households will then employ dissaving, selling of real assets and activation of insurance contracts as corresponding risk-coping mechanisms in response to realizations of spatially covariant and idiosyncratic risk. Formal insurance decisions are modelled separately from savings decisions and it is explicitly assumed that the idiosyncratic household risk under consideration is completely transferable while the spatially covariant risk is not. The primary goal of this model is to determine the optimal risk-management portfolio for the household when liquid assets and savings instruments, together with formal insurance instruments, are available. It is assumed for the purposes of this model that credit constraints are not binding thereby facilitating negative asset values. As already noted by Dionne and Eeckhoudt (1984) and Gollier (1994), it does not hold that for non actuarial premia, formal insurance is always more efficient than asset accumulation/savings and these competing objectives are empirically analyzed within the context of a household in a developing economy.

Adapting a theoretical approach developed by Ventura and Eisenhauer (2005) we model a representative household with a wealth endowment W and a thrice differentiable state independent utility function U, where $U^{'}(W) > 0$, $U^{''}(W) < 0$ and $U^{'''}(W) > 0$. To determine in a stylized way the factors affecting the households' optimal level of insurance and saving (including precautionary saving), we consider the following two-period model in which future income and wealth is a linear function of current wealth but the slope $\tilde{\alpha}$ and intercept $\tilde{\gamma}$ are uncertain. To maximize utility from total wealth, the household selects a level of insurance coverage $I \in [0,1]$, and savings A. The household's expected utility problem is therefore:

$$Max\ U_{I\epsilon[0,1],A} = U(W - A) + \beta EU(\tilde{\alpha}W + A(1 + \tilde{r}) - \tilde{\gamma} + I\tilde{\gamma} - I\theta E\big[\widetilde{\gamma}\big]) \qquad (1)$$

where $\widetilde{\alpha}$ is a random variable representing an exogenous spatially covariant wealth shock (for example, floods, drought, crop disease) with mean $\alpha < 1$ and variance σ_{α}^2, and $\widetilde{\gamma}$ represents an idiosyncratic shock (for example, divorce or illness/death of household member), with probability distribution $(\gamma_1 p_1, \gamma_2 p_2, \dots, \gamma_n p_n)$ with each $\gamma_n \geq 0$ for all losses and with $E[\tilde{\gamma}] = \gamma$. The spatially covariant multiplicative shock $\widetilde{\alpha}$ captures the fact that natural shocks (for example, floods, drought etc) together with economic shocks could deplete the households' wealth holdings over time. The idiosyncratic shock $\tilde{\gamma}$ attempts to capture in a stylized fashion, the various household income shocks during the family life cycle. In this simplified set-up time preferences and the risk free interest rate are assumed to cancel each other out so that the inter-temporal motive for insurance and saving is captured only by the difference between current and expected future wealth. We also impose a mean preserving spread as per Ventura (2007) to ensure that second period expected future wealth remains constant to eliminate any additional inter-temporal motive to save. Insurance against the idiosyncratic shock $\tilde{\gamma}$, is modelled with reference to Gollier (1994), Briys (1986) and Dionne (2000) whereby households have the opportunity to purchase formal insurance contracts which consist of a generalized indemnity function $D(.)$ such that the household receives payment $D(\tilde{\gamma})$ in the event of a realized idiosyncratic loss $\tilde{\gamma}$. It is assumed that the premium per unit coverage for a given indemnity function $D(.)$ takes the form $\pi = \theta E[D(\tilde{\gamma})]$ where $\theta \geq 1$ is a loading factor. Letting $D(\gamma) \cong I\gamma$ implies a premium rate $\pi = I\theta E[\tilde{\gamma}]$. Note that $I = 1$ represents full insurance coverage for the idiosyncratic risk while $I = 0$ indicates full self-insurance where all idiosyncratic and spatially covariant risk is borne in full by the household. It is also assumed that insurance premium per unit coverage, $\pi = E[D(\tilde{\gamma})]$, where $\theta = 1$, is actuarially fairly priced. The First Order Conditions with respect to each control variable are derived as follows:

$$I\colon\ \ \beta EU'(\tilde{\alpha}W + A(1+\tilde{r}) - \tilde{\gamma} + I\tilde{\gamma} - I\theta E[\tilde{\gamma}])(\tilde{\gamma} - \theta E[\widetilde{\gamma}]) = 0 \tag{2}$$
$$A\colon\ \ U'(W - A) = \beta(1+\tilde{r})EU'(\tilde{\alpha}W + A(1+\tilde{r}) - \tilde{\gamma} + I\tilde{\gamma} - I\theta E[\tilde{\gamma}]) \tag{3}$$

where $\tilde{r}$ represents stochastic returns to savings which may vary with spatially covariant shocks. Equation (2) states that the expectation of the marginal insurable risk variable $(\tilde{\gamma} - \theta E[\tilde{\gamma}])$ times the marginal utility of wealth is zero at the optimum. This reflects the basic insurance analytical result that if a household is risk averse, then full insurance will be demanded, thereby transferring all idiosyncratic risk to a risk neutral insurer, if (and only if) markets are complete and pricing is actuarially fair. In other words $I = 1$ if (and only if) the loading factor, $\theta = 1$. Equation (3) reflects the theoretical result that assuming the idiosyncratic risk has been insured away in full $(I = 1)$, the precautionary saving component of A is undertaken in response to the remaining variance of future wealth σ_α^2 given the related assumptions above.[3]

In order to obtain an approximation for the level of the precautionary savings component within A within this stylized model, we Taylor expand marginal utility from equation (3) around wealth W and solve for A. After some algebraic manipulation and simplification (setting $\beta(1+\tilde{r}) = 1$ to eliminate impatience as a motive for saving, setting $I = 1$ for full insurance coverage and $\theta = 1$ for actuarially fair pricing), we obtain the following approximation for savings A (see Appendix for full details):

$$A \cong \frac{2\varphi W^2\sigma_\alpha^2 + 2W(\alpha-1)[\varphi W(\alpha-1)-1] - 2W(\alpha-1) - \gamma[2\varphi W(\alpha-1) - \varphi\gamma - 2]}{4 - 2\varphi W(\alpha-1) + 2\varphi\gamma} \tag{4}$$

where φ is the coefficient of absolute prudence. The first term on the right hand side of equation (4) can be interpreted as the precautionary savings component of A and is directly proportional to income uncertainty as represented by the variance of the spatially covariant risk, σ_α^2. The remaining terms can be thought of as the combined effect of bequest and inter-temporal motives (Ventura and Eisenhauer, 2005). Noteworthy too is that the insurance premium for idiosyncratic risk, γ, has a negative effect on the overall savings level of the household.

There is ample evidence that households across the developing world accumulate savings and liquid assets as a form of precautionary saving (Fafchamps, 2009; Deaton, 1992; Deaton, 1991). We follow the theoretical approach taken by Fafchamps et al (1998) and Newman et al (2011), only here the analysis focuses in a generalized way on the inter-temporal allocation of total savings A between savings stocks (including formal and informal savings, gold, ROSCAs), crop stores (for example, rice and other crops), livestock holdings and forms of borrowings (including formal and informal loans). We impose that savings can occur in a safe form with a positive rate of return as per Deaton (1991). By normalizing A to 1, assuming normal asset returns, CARA preferences and including a riskless asset with return r_0 (for example, return to formal

[3] Recall, also, that we have assumed that the covariant risk $\tilde{\alpha}$ cannot be transferred to a risk neutral insurer.

savings), a household concurrently solves the following portfolio mean-variance allocation problem (see Connor et al (2010), page 18 for details):[4]

$$Max_{P_A}\left(1 - P_A^{'}1^n\right)r_0 + P_A^{'}\mu - \frac{1}{2}\lambda P_A^{'}CP_A \qquad (5)$$

where P_A is a vector of portfolio weights, n is the number of portfolio assets, μ is a vector of asset returns, λ is the co-efficient of absolute risk aversion and C is the assets return variance-covariance matrix. A closed form solution to equation (5) is given by:

$$P_A = \frac{1}{\lambda}C^{-1}(\mu - 1^n r_0) \qquad (6)$$

where the portfolio weights P_A do not sum to 1, instead the holding in the riskless asset is implied by the unit sum condition. Equation (6) illustrates that at the optimum a risk-averse household will apply positive portfolio weighting in direct proportion to those assets having higher excess return over the risk-free rate and reduced portfolio weighting to those assets with higher variances and co-variances of returns.

3. Empirical Considerations

The theoretical predictions from Section 2 can be summarized in the following way: First, equation (2) predicts that the insurance coverage rate is $I = 1$ under the standard assumptions of complete insurance markets and actuarially fairly priced contracts. Here, a risk-averse household will fully insure the idiosyncratic portion of the risk it faces. Second, equation (4) predicts that the household precautionary saves to buffer against the remaining spatially covariant risk whereby the precautionary savings component of total savings A is a direct function of total wealth, W, the variance of the spatially covariant risk σ_α^2, and the coefficient of absolute prudence φ.

The first and second theoretical predictions can be empirically tested by first determining whether households manage to smooth consumption over time, in particular, in the face of an adverse income shock (both idiosyncratic and spatially covariant) and in the presence of savings and formal insurance.[5] Our identification strategy is as follows: In the first step we estimate a standard household consumption equation for period $t1$.

$$C_{t1} = X_{t1}'\beta_{t1} + \epsilon_{t1} \qquad (7)$$

[4] In this simplified set-up we implement a myopic investment strategy for the household. Samuelson (1969) shows that if an investor has constant relative risk aversion and returns are (i.i.d) through time, then dynamic portfolio optimization has a myopic solution.

[5] As the dataset available represents a three year panel, we are effectively capturing a short run consumption response to income shocks. We would therefore expect the consumption response to be larger and the wealth/savings response to be smaller for those poorer households and the reverse for wealthier households. Note also that due to the limited three year timeframe under consideration we empirically treat all shocks as transitory in nature, while controlling for any persistence – with the one exception being the death of a family income earner. A longer panel dataset would facilitate an empirical long run analysis of household consumption response to both permanent and transitory income shocks.

where C_{t1} represents total household food consumption expenditures in period $t1$, X'_{t1} is a vector of standard consumption explanatory variables including income, wealth measures and other relevant household socio-economic characteristics such as age and education level of the household head, and ϵ_{t1} is a statistical noise term.[6] This model is estimated using OLS.

In the second step we use the estimated beta coefficients from equation (7) to predict household consumption in period $t2$ using observed data on X in period $t2$. Income reported lost in the period $t2$ due to adverse shocks is added back in order to capture the true ceteris paribus predicted level of consumption.

$$\hat{C}_{t2} = X'_{t2}\hat{\beta}_{t1} \tag{8}$$

If households manage to smooth consumption then this estimated level of consumption for period $t2$, which takes into account changes in observable consumption determinants captured in X (adjusted for income shocks) should be the same as the actual observed level of consumption C_{t2} in period $t2$. The third step is therefore to test the following hypothesis:

$$H_0: \hat{C}_{t2} = C_{t2} \tag{9}$$

Failure to reject this hypothesis will provide evidence of consumption smoothing. This test is performed across different household groupings according to the category of shocks suffered, whether savings or formal insurance are present and household income levels.

The second aspect of our empirical investigation explores the mechanism of consumption smoothing invoked by the household. Our theoretical model predicts that a household will allocate its total savings over asset classes as a function of excess returns over the risk-free rate $\mu - 1^n r_0$, the coefficient of absolute risk aversion λ^{-1} and the variance covariance of asset returns C^{-1} (see equation (6)). As such we can expect households to allocate total savings (including any precautionary component) across a range of different assets to buffer against unexpected income shocks. The extent to which they draw down on different types of assets in the event of different types of income shocks is an interesting empirical question to explore.

Identifying a causal relationship between the occurrence of an adverse income shock and the depletion of the stock of liquid assets is complicated given that the effect of the shock may be difficult to separate from other factors that may deplete household liquid assets. For example, households that suffer the death of a family member may have already begun depleting liquid asset stocks if that household member required medical treatment for some time in advance of his or her death. If the shock is exogenous, however, this relationship can be identified using a panel fixed-effects approach under certain identification assumptions. Our data facilitate the disaggregation of overall shocks into their exogenous (spatially covariant) and

[6] Household food consumption expenditures represents the total monetary value ('000 VND) of a selected number of food items consumed during the last four weeks prior to each survey date (adjusted to 2010 present values). The expenditure values each year also include food items exchanged, home-produced or received for free. We are unable to separately quantify these components from the data.

idiosyncratic components. Exogenous spatially covariant shocks are further disaggregated into 1) economic (for example, crop price changes, key input price changes/shortages) and 2) natural (for example, floods, typhoons, droughts etc) components while our raw data motivate the classification of idiosyncratic shocks are classified as 3) insurable (for example, illness, injury or death of household member) and 4) uninsurable (for example, crime/theft, divorce, family disputes etc).[7] By their nature, idiosyncratic shocks may be correlated with unobserved household characteristics that affect a household's financial decision making. Our data lean toward estimation approaches within the context of a natural experiment with certain important characteristics, namely the existence of multiple treatment groups and multiple treatment events in the form of income shocks across time. We select to use household fixed-effects estimation as it represents a generalized difference-in-differences approach and accommodates the fact that there is more than one treatment group (for example, households can suffer both spatially covariant and idiosyncratic income shocks) and more than one treatment time period (households can suffer any income shock in any/all time period(s) under consideration). We obtain our fixed-effects estimates by regressing the outcome variable (each household liquid asset level) on the income shock variables, after controlling for year and household fixed effects. The full household level fixed effects model we estimate is given by:

$$\begin{aligned} a_{it} = \; & \beta_0 + \beta_1 dNat_{it} + \beta_2 dEcon_{it} + \beta_3 dIdioI_{it} + \beta_4 dIdioU_{it} + \beta_5 dIns_{it} \\ & + \beta_6 dTrans_{it} + \beta_7 dIdioI_{it} * dIns_{it} + \beta_8 dNat_{it} * dTrans_{it} + \boldsymbol{Z'_{it}}\beta_9 \\ & + \tau_t + u_i + \epsilon_{it} \end{aligned} \tag{10}$$

where $A_{it} = \sum_{i=1}^{n} a_{it}$ represents the aggregate household liquid asset value under consideration (all disaggregated a_{it} are adjusted to 2010 present values), $dNat_{it}$, $dEcon_{it}$, $dIdioI_{it}$ and $dIdioU_{it}$ are dummy variables indicating spatially covariant natural and economic and idiosyncratic insurable and uninsurable shocks respectively, $\boldsymbol{Z_{it}}$ represents a vector of time variant household characteristics (including wealth levels which act as a proxy for time variant household risk aversion under our assumed CARA risk preferences), τ_t represent time dummies, u_i is a household specific fixed effect and ϵ_{it} is the household random error term. We assume that the variance of the spatially covariant risk facing each household, $\sigma_{i\alpha}^2$, is subsumed within the household fixed effect u_i together with any regional differences which control for insurance supply side variations and asset pricing variations across regions (including variance/co-variances of asset returns) while the time dummies τ_t control for average changes in asset values over time.[8] Our identifying assumption is that we control for all time variant household characteristics within the empirical model while all household time invariant characteristics are subsumed within the household specific fixed effect.

Given our theoretical prediction that risk-averse households fully insure the idiosyncratic portion of their risk, our model includes the binary variable $dIns_{it}$ which indicates whether the household made any insurance claims during the time period and an interaction term, $dIdioI_{it} * dIns_{it}$. This interaction term captures the

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[7] We treat all rural Vietnamese households within our sample as price takers and control for shadow wages through the household income measure. All price shocks are assumed exogenous within this context.

[8] We assume CARA over CRRA risk preferences as maximizing expected utility of the former approximates maximizing mean-variance utility which is required for equation (5)

effect on household liquid asset levels of those households suffering an idiosyncratic and insurable shock *and* making an insurance claim – while controlling for average differences across these households through the level terms, $dIdioI_{it}$ and $dIns_{it}$. Our hypothesis predicts that the estimated coefficients on both level and interaction terms should be significant with the interaction term signaling the degree to which insurance serves to ease the depletion of the liquid asset under financial stress. Our analysis is further extended to consider the extent to which other risk-coping strategies may serve to lessen the depletion of liquid assets. We consider public and private transfers through the dummy variable $dTrans_{it}$ as an alternative way to smooth the path of consumption in the face of an adverse income shock.[9] Government aid programs may also act as an important safety net for those households suffering spatially covariant natural shocks and this effect is captured through the interaction term $dNat_{it}*dTrans_{it}$. If external transfers help to lessen the depletion of liquid asset holdings in the event of an adverse natural shock we would expect the coefficient on this interaction term to be positive and statistically significant.

4. Data

The data are taken from the Vietnam Access to Resources Household Survey (VARHS) for 2006, 2008 and 2010 (CIEM et al, 2007; 2009; 2011 Forthcoming). This survey was carried out in rural areas of 12 provinces of Vietnam in the summer of each year producing a balanced panel of 2,045 households spread over 161 districts and 456 communes.[10] The survey was conducted during the same three month period each year to ensure consistency and facilitating reasonable comparisons across time. The VARHS explores issues surrounding Vietnamese rural households' access to resources and the constraints that these households face in managing their livelihoods. Along with detailed demographic information on household members, the survey includes sections on household assets, savings, credit (both formal and informal), formal insurance, shocks and risk-coping, informal safety nets and the structure of social capital. The full set of explanatory variables used in this analysis is described in Table 1.

[INSERT TABLE 1 ABOUT HERE]

In this paper, we are interested in using the empirical model given in equation (10) to test the responsiveness of each household's liquid asset class under consideration to exposure to spatially covariant and idiosyncratic shocks. Before doing so we present a range of summary statistics that help to provide further motivation for our core research questions. Households are asked to rank the shocks suffered in order of importance and to provide an associated monetary loss in terms of Vietnamese Dong (VND). Table 2a provides a more detailed breakdown of income shocks and their sub-categories while Table 2b considers a disaggregation across wealth groups.

[INSERT TABLE 2a AND 2b ABOUT HERE]

[9] Anecdotal evidence suggests that the Vietnamese government provides assistance via transfer payments to households severely affected by natural disasters. We cannot directly identify from the raw data, the purpose behind any transfer income.

[10] The survey was developed by the Development Economics Research Group, Department of Economics, University of Copenhagen and the Institute of Labour Studies and Social Affairs, Hanoi Vietnam.

We find that that 56 per cent of households suffered an adverse income shock between 2006 and 2008 while 50 per cent suffered an income shock between 2008 and 2010. At a disaggregated level, in 2008 we find that 13 per cent of households suffered an idiosyncratic shock *only* while 73 per cent suffered an exogenous spatially covariant shock *only* thus providing some support toward the dominance of spatially covariant over idiosyncratic shocks. In 2010, spatially covariant shocks also dominate idiosyncratic shocks by 71 per cent to 13 per cent, respectively. In 2008, 45 per cent of households report that they fully recovered from the income shocks with recovery less likely where households experience both spatially covariant and idiosyncratic shocks.[11] In 2010, 53 per cent of households report that they fully recover from shocks. Disaggregating the household shock recovery data across wealth groups (Table 2b) reveals that in 2008, 47 per cent of households in the highest wealth group recovered from adverse income shocks compared with 41 per cent from the lowest wealth group. In 2010, the corresponding proportion of households that recovered was 62 and 44 per cent, respectively. These recovery data suggest that while income shocks are problematic for households across each wealth group, recovery is more difficult for poorer households.

These summary statistics help further motivate the central questions of this paper concerning household risk-coping mechanisms and their effectiveness. To further aid our understanding of households' risk coping strategies we estimate a simple probit model of the determinants of household recovery from shocks. We consider whether the household holds liquid assets in the form of savings, livestock, crops stores and loans together with other relevant wealth controls. The results are presented in the Appendix (Table A1). Although all shocks captured within the survey are transitory by definition (with the exception of the death of a household member), if the household is affected by a succession of transitory shocks these could have a persistent effect across the short timeframe under consideration. We control for the persistence of shocks by including the total number of shocks suffered by the household.[12] As expected, the total number of shocks suffered has a negative effect on the likelihood of recovery in both the 2008 and 2010 cross-sections. Having voluntary insurance has a positive and significant influence on the likelihood of recovery in both 2008 and 2010.[13] We find that households suffering from an idiosyncratic shock are less likely to recover while those suffering spatially covariant natural shocks are more likely to recover. This result is evident in both 2008 and 2010 and suggests that external factors (for example, government transfers) may help to alleviate the adverse impacts of natural shocks for these households. This issue is explored further in the empirical section. We find that households with savings and livestock holdings are more likely to recover in 2008 although this relationship is not evident in 2010. Successful recovery from prior shocks does not significantly impact on the likelihood of recovery from current income shocks in both years. This descriptive analysis allows us to profile the households that recover from shocks and reveals that insurance and liquid assets may be important risk coping instruments.

[11] Households are asked whether they have fully recovered from the effects of the adverse shock(s) suffered during the current timeframe and this measure is therefore subjective.
[12] We also included a dummy variable representing a shock from the death of a family member which was statistically insignificant and so was excluded.
[13] We also disaggregate the recovery profile by wealth groups and find that voluntary insurance has a positive effect on recovery across all groups. Results available on request.

Tables 3a to 3c describe the liquid asset holdings of households and how they are accumulated or depleted for households that experience shocks. As revealed in Table 3a we find that the proportion of households with savings increased between 2006 and 2010 from 61 per cent to 72 per cent of households.[14] The proportion of households with other types of liquid asset holdings is relatively similar in each year while the proportion of households with loans fell between 2006 and 2010.

[INSERT TABLES 3a, 3b AND 3c ABOUT HERE]

Table 3b details the change in the average value of different types of liquid asset holdings of households between 2006 and 2008 disaggregated by whether the household experienced a shock or not. Table 3c details these changes between 2008 and 2010. Households that suffered a shock between 2006 and 2008 reduced their savings by an average of 1 million VND while households that did not suffer a shock increased their savings levels. In contrast, between 2008 and 2010, all households increase their savings levels on average, but households suffering from shocks increase their stock of savings by less than those not suffering. We also find that the amount of loans outstanding increases for households that suffer shocks which suggests that households may turn to credit in times of financial stress.

The household shock recovery profile presented in Table A1 suggests that formal insurance protects against idiosyncratic risk as is consistent with our theoretical predictions. In recent years, the Vietnamese formal insurance sector has experienced substantial growth in terms of market penetration.[15] The raw data reveal that although no insurance products are available to the VARHS participants against spatially covariant risks, insurance for forms of idiosyncratic risk is held by 61 per cent of households in 2010 (see Table 4). Of the 61 per cent of households holding formal insurance, 84 per cent of these hold voluntary insurance contracts. Among the categories of formal insurance listed in the survey, health insurance schemes (12 per cent) and education insurance (15 per cent) schemes have the highest participation rates. In contrast, no households in our sample hold fire insurance. Moreover, insurance against spatially covariant risk (for example, rainfall insurance) is not available to households in our sample.

[INSERT TABLE 4 ABOUT HERE]

We also estimate a simple probit model of voluntary insurance participation as a guide to the profile of households holding voluntary insurance in both 2008 and 2010. The results are presented in the Appendix (Table A2). Although subject to potential endogeneity bias with respect to unobserved heterogeneous risk aversion (and other factors), the results suggest that educated households are more likely to hold formal insurance. Household wealth, which proxies risk aversion, also has a positive effect, while the size of the household is also positively associated with the likelihood of having insurance. The impact of income shocks, expressed as the total number of shocks suffered in the period, decreases the likelihood of insurance purchase in 2008 only while savings stocks increase the likelihood of purchase in both periods. Overall, observations from the raw insurance data suggest that although 61 per cent of

[14] In 2008 only 52 per cent of households had savings which may reflect that difficult year that many rural households in Vietnam had in 2008 due to the food price crisis and inflation which followed.
[15] The Knowledge Centre forecast formal insurance market growth of 12% between 2007 and 2011.

households hold insurance (with 84 per cent of these holding voluntary instruments) for idiosyncratic risk, other forms of risk-coping such as saving and borrowing remain important.

5. Empirical Results

In order to test the theoretical predictions developed in Section 2 our empirical strategy is two-fold. First, we focus on consumption responses to adverse shocks to gain an understanding of the extent to which households manage to smooth their consumption over time and whether this relates to their holdings of liquid assets and formal insurance. Second, we examine the depletion of household liquid assets in response to adverse income shocks to determine whether these assets serve precautionary or self-insurance purposes. Taken together, these steps should help us to gain a clearer understanding of the important risk-coping strategies within rural Vietnam and their effectiveness.

5.1 Consumption Smoothing

On the basis of subjective responses to coping with income shocks, 54 per cent of households indicate reducing consumption is the most important risk-coping mechanism. In addition, 25 per cent of households report that they increase borrowings and sell assets. In contrast, our theoretical model predicts that households will fully insure against idiosyncratic risk and will use precautionary savings to buffer against spatially covariant shocks. As such, we predict that households should smooth consumption over time regardless of whether they suffer an income shock or not.[16] To test whether this is the case, first, a consumption function for 2006 is estimated, the results of which are presented in Table A3 of the Appendix. Second, the estimated coefficients are used to predict consumption for 2008 using the observed data on the explanatory variables for 2008.[17] Third, t-tests of the difference between actual levels of consumption in 2008 and the predicted consumption values are conducted. These tests are conducted at median rather than mean values to alleviate any extreme value distortions. Failure to reject the null hypothesis provides evidence of consumption smoothing. Significantly positive (negative) t-statistics indicate that the estimated value is significantly lower (higher) than the actual suggesting that actual observed consumption is higher (lower) than expected. The same consumption smoothing analysis is then conducted between 2008 and 2010. Tables 5a and 5b detail the results of the t-tests across different household groupings according to income levels, category of shocks, the presence of formal insurance and other liquid savings instruments.

[INSERT TABLES 5a AND 5b ABOUT HERE]

[16] As per Alderman and Paxson (1994), we distinguish between ex ante and ex post risk reduction. Insurance and precautionary savings are ex post risk management instruments and are used to help households to smooth consumption over time. In contrast, ex ante risk reduction means undertaking activities that reduce the probability of the shock occurring (e.g. safer investments) and can be considered as ‘income smoothing’ activities.

[17] As discussed previously, for the estimated consumption calculation, income earned during 2008 is adjusted for the 2008 realized shock amount in order to generate a more accurate consumption prediction based on ceteris paribus effects. This adjustment is also applied in generating the estimated consumption calculation in 2010.

The first group we consider are households that did not experience any shocks and we use 2008 for the baseline analysis. The results of the t-tests (row 1 of Table 5a) indicate that actual consumption is significantly larger than estimated consumption indicating that households that suffered no income shocks consume even more than predicted using the 2006 model. The second row of Table 5a compares the actual and predicted consumption levels of households that suffered any classification of 'severe' income shock in 2008 (either exogenous or idiosyncratic or both). We find a significant negative difference indicating that these households consume less than predicted and so do not manage to smooth consumption across the timeframe under consideration. While our 2006 consumption model may not perfectly predict 2008 consumption levels, it does suggest that finding actual consumption levels that are significantly less than the levels predicted using our model may even under-estimate the extent of the fall in consumption as a result of the shock as compared with other households. It is also worth noting that the consumption model is a cross-sectional analysis using actual household income rather than permanent income which empirically results in marginal propensity to consume (MPC) estimates that are smaller in magnitude than the permanent income hypothesis (PIH) predicts.[18]

We disaggregate households that suffer any 'severe' shock into those that have no formal voluntary insurance and households that have formal voluntary insurance. We find no significant difference between actual and estimated consumption levels for households with formal insurance, while those with no insurance consume significantly less than predicted. Although this result may suggest that formal insurance is an important mechanism for smoothing consumption when faced with a 'severe' income shock it may simply be capturing the fact that the consumption smoothing households have better planning capacities as evidenced by their selecting to purchase formal insurance. We cannot, however, disentangle these effects using our approach. We also consider the consumption smoothing capabilities of households suffering a 'severe' shock across various levels of liquid asset holdings. We consider savings, livestock and crop stores and divide households into those with above and below median levels in each case. For savings and livestock holdings, our results suggest that while consumption smoothing is problematic for households with above *and* below median asset values, the differential is slightly reduced with above median asset holdings. Crop stores appear to be significantly correlated with consumption smoothing in 2008. Focussing now on income groups, our results indicate that households with below median income levels do not manage to consumption smooth when faced with a 'severe' income shock while households with above median incomes also record lower actual consumption levels, but to a slightly lesser extent. Overall, only insurance and crop stores appear to significantly assist households with consumption smoothing in the face of any 'severe' income shock and only the insurance result is preserved across both the 2008 and 2010 cross-sections (see also row 2 of Table 5b).

Idiosyncratic shocks, both insurable and uninsurable, do not cause significant reductions in actual consumption over predicted levels (row 4 of Table 5a), however

[18] The general consumption function was also estimated across household income quintiles and the MPC estimates in all cases are of a similar magnitude to the main estimation. This provides support for the PIH constant MPC theory (notwithstanding that these results are extremely small in magnitude, possibly due to their cross-sectional nature and the fact that the consumption amount is a monthly measure). Results are available upon request.

significant reductions in consumption are reported in 2010 (row 4 of Table 5b). As before, we find those households holding no formal insurance record significant shortfalls between actual and predicted consumption amounts while households holding formal insurance record no significant differences.[19] This positive relationship between insurance and consumption is also evident in 2010 (row 4 of Table 4b). We now consider whether the presence of savings instruments, livestock holdings and crop stores influence consumption smoothing in the face of idiosyncratic shocks and we find no significant pattern in 2008. Surprisingly, households with below and above median income levels suffering an idiosyncratic shock suffer no significant reductions in consumption in 2008 while significant reductions are recorded in 2010. However, in the latter case income appears to cushion consumption shortfalls.

There is little evidence to suggest that insurance has any relationship with the consumption smoothing abilities of households that experience exogenous spatially covariant shocks (row 3 of Table 5a). This helps support to our hypothesis that formal insurance has no effect when coping with exogenous spatially covariant shocks. We find that in both 2008 and 2010, across all categories of liquid assets, there is no clear pattern emerging regarding the effectiveness of assets in consumption smoothing in the face of exogenous spatially covariant shocks. We also find contradicting patterns with crop stores and savings whereby households with below median savings consume significantly more than predicted. One possible explanation is that where natural disasters occur in farming communities the government often steps in to provide financial assistance to the poorest of those affected. Our results suggest that, if this is the case, this support may, in fact, lead to higher consumption levels than would have been the case, even in the absence of the natural disaster.

Overall, our results suggest that the ability of households in rural Vietnam to cope when faced with any category of adverse income shock is highly correlated with whether they have formal insurance while the magnitude of consumption shortfalls may also be alleviated to a small extent by savings instruments (for example, crop stores, savings) and income levels. Faced with idiosyncratic shocks, there is no consistent pattern regarding the effectiveness of savings instruments while formal insurance appears to significantly and consistently assist with consumption smoothing. These inconsistencies regarding the effectiveness of savings instruments may arise due to the fact that risk materializes over time which may also cause a households' ability to cope with the adverse consequences of an income shock to change over time. Our results are also suggestive of incomplete formal insurance markets for idiosyncratic risk.[20] Consumption responses to exogenous spatially covariant shocks do not appear to be correlated with formal insurance. These results, while inconclusive, suggest that existing risk-coping mechanisms are failing to smooth consumption for many households. This provides us with an important motivation for the second part of our empirical investigation, namely to explore household risk-coping mechanisms in more detail.

[19] We treat this result with caution due to the aforementioned selection bias, but also given that the number of observations is extremely small (19).

[20] These market imperfections may also be indicative of other factors, for example lack of trust in formal institutions, prohibitive costs of acquiring knowledge about insurance products, peer effects, premium pricing etc. A more detailed investigation into these potential effects is beyond the current scope of this paper.

5.2 Total Liquid Assets

We now turn our attention away from consumption responses toward asset responses in the face of income shocks which is the central theme of our analysis (of which formal insurance is an important component). To explore this aspect of risk coping we estimate the model presented in Equation (10). For each asset class under consideration (total liquid assets, savings, livestock, crop stores and loans), we use fixed effects estimation to regress the level of household asset holdings (expressed in million VND) in each year against our measures of exogenous spatially covariant and idiosyncratic shocks together with income controls, wealth controls and household composition changes. All value variables expressed are adjusted to 2010 present values. Income shocks are disaggregated by exogenous natural and economic and idiosyncratic, insurable and uninsurable. We also include a dummy variable to control for external public and private transfers together with a dummy variable to control for actual formal insurance claims. We focus explicitly on whether the household made voluntary insurance claims (health or life) as these specific claims closely align with our category of idiosyncratic insurable shocks.

First, we determine whether households suffering any type of income shock experience a statistically significant reduction in asset levels. Second, we disaggregate the income shock measure into its exogenous and idiosyncratic components to explore how each specific category of shock influences asset levels over time. Third, we interact insurance claims and transfers with the incidence of shocks to establish whether they help to reduce the impact of shocks on asset depletion. We also disaggregate our results by wealth group to establish the extent to which the poor are particularly vulnerable. Controls for income, household size, gender of household head, age of the household head and age squared (to capture any lifecycle effects), wealth (net of liquid assets), recovery from prior shocks (to control for persistence) and time dummies (to control for average changes in asset values over time) are included.

We first consider whether a household's stock of total liquid assets (including all savings, livestock and crops stores) is responsive to adverse income shocks. The results are presented in Table 6.

[INSERT TABLE 6 ABOUT HERE]

Column (1) reveals that shocks have a negative impact on the accumulation of total liquid assets. Insurance claims and external transfers have no significant effect. Disaggregating the income shock into its exogenous and idiosyncratic components (Column 2) we find that both types of shock have a negative impact on the value of liquid asset. A further breakdown of the type of shock (Columns 3 and 4) reveals that while both exogenous economic and idiosyncratic insurable shocks are serving to deplete total liquid asset values over time, the idiosyncratic insurable shocks have less of an impact. We find that total liquid asset levels respond negatively and significantly to exogenous economic shocks providing some evidence in support of our primary hypothesis that household total liquid assets may serve precautionary savings purposes.[21] Interacting formal insurance claims with idiosyncratic insurable

[21] We cannot disentangle the precise amount of total liquid assets which was originally intended to serve precautionary savings purposes from the amount serving other inter-temporal purposes.

shocks (Column 5) and interacting external transfers with exogenous natural shocks (Column 6) has no significant effect on the level of liquid assets.

In relation to our control variables we find that household lifecycle effects are significant in the direction that we expect while income and wealth are positive and significant. Disaggregating our sample into three wealth groups and funning the model separately for each group we find that exogenous economic shocks are important for the highest wealth group while idiosyncratic insurable shocks are more problematic for the lowest wealth group.[22]

5.3 Livestock Holdings

To understand whether livestock serves as a buffer against adverse shocks we estimate a fixed effects regression of livestock holdings values against our exogenous spatially covariant and idiosyncratic shock measures. The results are presented in Table 7.

[INSERT TABLE 7 ABOUT HERE]

There is no evidence to suggest that livestock acts as a buffer against overall income shocks (Column 1). Disaggregating income shocks into their exogenous and idiosyncratic components we find a negative and significant relationship between idiosyncratic shocks and the value of livestock holdings (Column 2). There is no evidence to suggest, however, that livestock acts as a buffer against spatially covariant shocks. These findings support the partial equilibrium effects discussed in Fafchamps et al (1998) whereby if livestock markets are not perfectly integrated then it is difficult for this asset class to act as a buffer stock in the case of exogenous spatially covariant shocks. In such closed market situations, net sales of livestock must sum to zero at the commune/village level. Idiosyncratic insurable shocks, on the other hand, facilitate the use of livestock as a risk-coping mechanism and we see some evidence that this is the case (Column 4). Turning our attention to formal insurance effects, we find that insurance claims are negatively related to total livestock values (Columns 1 to 4). The interaction between whether the households makes an insurance claim with whether the household suffered an idiosyncratic insurable shocks has a positive and significant effect on total livestock values. This suggests that while households suffering an idiosyncratic insurable shock and making formal insurance claims deplete their livestock holdings on average, households suffering from such shocks *and* claiming formal insurance do so to a lesser extent. In fact, the magnitude of the coefficient on the interaction term almost cancels out the negative effect of idiosyncratic shocks. This indicates that while households who suffer idiosyncratic insurable income shocks rely on livestock to act as a buffer, those that make insurance claims do not. When the sample is disaggregated by wealth group we find that our results are consistent across the lowest and middle wealth groups.[23] We find no evidence that external transfers act in any way to preserve livestock holdings.

Overall, our results provide some support for the hypothesis that livestock plays an important role in consumption smoothing where idiosyncratic insurable shocks occur but not for exogenous spatially covariant shocks (Rosenzweig and Wolpin (1993) find

[22] The results of the separate regressions for different wealth groups are not presented in Table 6 due to space constraints but are available on request.
[23] These results are not shown for ease of illustration but are available from the authors upon request.

a similar result). We also some evidence that insurance plays an important role in eliminating the need for households to deplete livestock holdings in the event of an idiosyncratic insurable shock.

5.4 Financial Savings

We estimate a similar model of the responsiveness of a household's total stock of savings to exogenous spatially covariant and idiosyncratic shocks. We also consider a disaggregation of the total stock of savings into formal savings (with financial institutions), informal savings and cash/gold stores to determine whether households demonstrate preferences to preserve certain savings stocks in the event of different categories of shock. The results pertaining to total savings stocks are presented in Table 8.

[INSERT TABLE 8 ABOUT HERE]

We find that the occurrence of an income shock depletes a household's stock of total savings over time (Column 1). Disaggregating income shocks by type we find that while both exogenous spatially covariant and idiosyncratic shocks are important (Column 2), spatially covariant natural shocks have the greatest impact (Columns 3 & 4). Also of note is the average negative effect on savings of households in receipt of external transfers which suggests that these households are experiencing some financial difficulty. Although total savings stocks are depleted on average by households suffering natural shocks and by those households in receipt of cash transfers, when transfers are interacted with natural shocks (Column 6) we find that those households in receipt of transfers do so to a lesser extent. We interpret this result as providing some evidence regarding the importance of external transfers in times of natural disaster, notwithstanding that the magnitude of this assistance appears not to fully compensate for the total financial loss incurred by the household. Households suffering idiosyncratic insurable shocks save less as do households claiming formal insurance. There is no evidence, however, that insurance claims serve as a buffer to preserve savings stocks in times of financial stress (Column 5).[24] When disaggregated by wealth group we find that our model fits best for the highest wealth group.[25] Overall, we have some evidence that total savings serve precautionary savings purposes due to their responsiveness to spatially covariant natural shocks.[26] External transfers also emerge as a potentially important risk-coping mechanism.

[INSERT TABLE 8 ABOUT HERE]

Disaggregating total savings into its various components also reveals some interesting findings, particularly for cash/gold held at home (see Table 8a). We find that both natural disasters and idiosyncratic insurable shocks deplete households' stock of cash/gold held at home. As for the total stock of saving, we find that transfers feature significantly as a risk-coping mechanism in the face of natural disasters although there is still a shortfall in terms of financial loss for the household. Insurance claims do not serve to ease the depletion of cash/gold in the face of idiosyncratic insurable shocks. This complimentarity between insurance and savings instruments suggests that

[24] We find no evidence that insurance claims assist with natural disasters.

[25] Result not presented but available on request.

[26] As before, we cannot disentangle the precautionary component of total savings from other inter-temporal or bequest components.

insurance markets may be incomplete. We find no significant evidence that either formal or informal savings serve as important risk-coping mechanisms for the household.[27]

5.5 Crop storage

Crop stores in the form of rice, maize, potatoes etc., may also act as a form of precautionary saving.[28] Results of the impact of exogenous spatially covariant and idiosyncratic on the store of crops are presented in Table 9.

[INSERT TABLE 9 ABOUT HERE]

The results indicate that total crop stores are not responsive to idiosyncratic or spatially covariant shocks (Column 1). This result is robust to the disaggregation of spatially covariant and idiosyncratic shocks into their constituent components. Disaggregating by wealth group we find that for middle wealth groups (Column 3), exogenous economic shocks together with idiosyncratic uninsurable shocks serve to deplete household crop stores. Given that exogenous economic shocks include price falls then it is not surprising that households may need to sell more crops to their local intermediary in the event of such a shock. For households that suffered an idiosyncratic uninsurable shock, risk-coping may simply require that more harvest is domestically consumed to offset the financial loss incurred. Exogenous natural shocks deplete the crop stores of households in the highest wealth group (Column 4).

Overall, we find some evidence that crop stores are drawn down in times of financial stress from uninsurable exogenous and idiosyncratic losses and thus appear to serve precautionary savings purposes. Given that anecdotal evidence suggests that rural Vietnamese households do not have the means to store large quantities of their crops (due to the small scale of their production and a lack of storage facilities), it is not surprising that we find no evidence that crop stores are used a risk-coping mechanism for the poor.

5.6 Household Borrowing

Finally, we turn our attention to rural credit markets (both informal and formal) and test whether the existence of credit instruments (or negative assets) serves as a risk-coping mechanism for rural Vietnamese households. According to Dercon (2002), credit and insurance markets in developing economies are typically absent or incomplete, either for good theoretical reasons or as a result of bad policy (for surveys, see Bell (1988) or Besley (1994, 1995)). Typically, consumption loans are also rare. We use a fixed effects estimation to regress the total outstanding household loan amounts against measures of spatially covariant and idiosyncratic shocks to determine whether the household resorts to borrowing to facilitate consumption smoothing when faced with adverse income shocks. The results are presented in Table 10.

[INSERT TABLE 10 ABOUT HERE]

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[27] The results for formal and informal savings are not presented but are available on request.

[28] Park (2005) finds that the joint nature of production and savings decisions limits the income loss associated with risk-coping, and the desire to store grain can explain why subsistence households are frequently net purchasers but rarely net sellers of grain.

We find that total household loan amounts are positively and significantly responsive to adverse income shocks, indicating that households increase borrowing in times of financial hardship (Column 1). We disaggregate income shocks into their constituent components and find that both exogenous and idiosyncratic shocks are associated with higher levels of borrowing (Column 2). A further disaggregation of income shocks suggests that all types of shocks significantly increase household borrowing (Columns 3 and 4). It appears that rural Vietnamese households resort to increasing their borrowings in times of financial stress. We do not find any evidence that formal insurance claims or external transfers help to ease households' debt burden.

Recovery from previous income shocks serves to reduce the outstanding loan amount of the household and this result is robust to all classifications of income shock and associated interaction terms. Lifecycle effects also appear dominant whereby a curvilinear relationship exists between household loans outstanding and the age of the household head. Disaggregating by wealth group we find that the reliance on credit in times of financial hardship is most characteristic of wealthier households who are more likely to have access to credit than poorer households.[29]

6. Conclusion

In this paper, we examine the consequences of risk on households ex post behaviour by examining both the consumption and asset depletion responses of households to the incidence of adverse income shocks. We begin by developing a theoretical model which predicts that in the presence of complete insurance markets households will insure against idiosyncratic risk and precautionary save to protect against uninsurable spatially covariant risk. We test the hypotheses proposed by our model using a unique panel dataset of rural Vietnamese households for the period 2006 to 2010. Vietnam represents an interesting illustrative case study given the recent development of formal rural financial markets, which has significantly increased access to formal financial products by rural households, coupled with a high incidence level of adverse income shocks. To our knowledge this is the first empirical case study which has considered the ex post responses of households to negative income shocks where information on both formal insurance and savings instruments is available.

We begin by analysing the extent to which households manage to smooth consumption over time. We categorize shocks as idiosyncratic and exogenous spatially covariant shocks with the former insurable in formal financial markets and the latter non-insurable, thereby creating a theoretical motive for precautionary saving. Our results suggest that the ability of households in rural Vietnam to cope when faced with adverse income shocks is highly correlated with their level of total liquid assets and their levels of income and wealth.

We follow our consumption smoothing analysis by examining whether liquid asset holdings in the form of savings stocks, livestock holdings, crop stores and borrowings are directly responsive to adverse shocks thereby serving precautionary savings purposes. A key component of our analysis focuses on the distinctive role of formal insurance claims in smoothing household consumption in the face of adverse

[29] The disaggregation by wealth group is not presented due to space constraints but the results are available on request.

idiosyncratic insurable income shocks. We also consider whether external transfers act as an important risk-coping mechanism in the face of spatially covariant natural shocks.

Overall, our results suggest that households deplete their total stock of liquid assets in response to exogenous economic shocks and idiosyncratic insurable shocks. Financial savings, particularly cash and gold held at home act as important buffers in the face of spatially covariant natural shocks. Idiosyncratic shocks also impact on the stock of total savings but to a lesser extent than for exogenous shocks. This is consistent with our hypothesis that households insure against idiosyncratic risk but require precautionary savings to smooth consumption in the event of spatially covariant uninsurable losses. Insurance markets appear to play an important role in easing the depletion of livestock holdings in response to idiosyncratic shocks while external transfers are important for risk-coping in the face of natural disasters. We also find evidence, however, that insurance markets do not fully cover idiosyncratic risks. This is evidenced by savings (especially cash/gold stores) playing an important role in consumption smoothing in the event of idiosyncratic shocks, even when controlling for insurance claims. Borrowing is increased when households are faced with idiosyncratic and spatially covariant shocks, particularly for wealthy households.

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Tables

Table 1: Explanatory Variables and descriptions

Explanatory Variable	*Description*
Exogenous: Spatially Covariant Natural Shock	Dummy variable indicating whether the household has suffered a spatially covariant natural income shock. Shocks include floods, landslides, typhoons, storms, droughts, pest infestation, crop disease and avian flu.
Exogenous: Economic Shock	Dummy variable indicating whether the household has suffered an exogenous economic shock. Shocks include changes in crop price, changes in key input prices, changes in prices of food or other essential commodities consumed.
Idiosyncratic: Insurable Shock	Dummy variable indicating whether the household has suffered an idiosyncratic insurable income shock. Shocks include illness, injury or death of a family member.
Idiosyncratic: Uninsurable Shock	Dummy variable indicating whether the household has suffered an idiosyncratic uninsurable income shock. Shocks include unemployment, unsuccessful investment, loss of land, crime/robbery/theft, divorce, family disputes.
Transfers	Dummy variable indicating whether the household has received external income transfers from government and/or family members/relatives (public/private sources).
Insurance Claim	Dummy variable indicating whether the household has made an insurance claim and received funds in compensation. Claims are restricted to health and life insurance.
Income	Household income – includes income from non-farm activities and income from the sale of assets. Excludes insurance premium paid. (2010 mean = 80991 VND, 2010 std deviation=130050 VND)
Household Size	Total number of household members.
Education of Household Head	1 "Cannot read and write" 2 "Can read & write but did not finish primary school" 3 "Finished primary school" 4 "Finished lower secondary school" 5 "Finished upper secondary school" 6 "Third Level"
Gender of Household Head	Dummy variable (1 Male, 0 Female).
Age of Household Head	Measured in years.
Wealth	Total household wealth constructed using fixed asset values (land), liquid asset values (livestock, savings, crop stores), housing values , equipment and machinery and consumer durables. Liquid Asset values are excluded for the purposes of the analysis. (2010 mean = 351658 VND, 2010 std deviation=1365008 VND)
Recovered from Prior Shocks	Dummy variable indicating whether the household has recovered from a prior income shock in the previous time period.

Table 2a: Household Shocks and Recovery Statistics

	2008	*2008*	*2010*	*2010*
Shock	% Households	% Recovered	% Households	% Recovered
Any Shock	56%	45%	50%	53%
Spatially covariant only	73%	48%	71%	57%
Idiosyncratic only	13%	49%	13%	38%
Both	13%	30%	16%	60%

Table 2b: Income Shocks, Recovery and Voluntary Insurance coverage

	2008	*2008*	*2008*	*2010*	*2010*	*2010*
	Wealth Group 1 (Lowest)	Wealth Group 2 (Mid)	Wealth Group 3 (High)	Wealth Group 1 (Lowest)	Wealth Group 2 (Mid)	Wealth Group 3 (High)
Shock	57%	61%	51%	50%	55%	47%
Recovered	41%	49%	47%	44%	52%	62%
Insured	32%	41%	59%	30%	52%	69%

Table 3a: Household Liquid Asset Holdings by % of Households

	Savings	*Livestock*	*Crops*	*Loans*
2006	61%	77%	71%	54%
2008	52%	68%	69%	41%
2010	72%	69%	69%	45%

Table 3b: Household average asset changes between 2006 and 2008 ('000 VND)

	Save	*Save*	*Live*	*Live*	*Crops*	*Crop*	*Loan*	*Loan*
	No Shock	Shock	No Shock	Shock	No Shock	Shock	No Shock	Shock
Change	3,482	-1,078	5,755	8,053	1,890	3,787	23	3,906

Table 3c: Household average asset changes between 2008 and 2010 ('000 VND)

	Save	*Save*	*Live*	*Live*	*Crops*	*Crop*	*Loan*	*Loan*
	No Shock	Shock	No Shock	Shock	No Shock	Shock	No Shock	Shock
Change	7,923	3,715	-1,054	-1,903	-2,902	-1,859	-1,718	2,103

Table 4: Household Insurance in 2010

	Total	*Volunt.*	*Farm*	*Fire*	*Life*	*Social*	*Health*	*Educat.*	*Other*
% with ins.	61%	84%	1%	0%	9%	8%	12%	15%	61%
% claiming	20%	20%	0%	0%	2%	9%	11%	92%	0%

Table 5a: Results of sample median tests for the difference between actual and predicted consumption in 2008

	Overall	*No Insur.*	*With Insur.*	*<Med Save*	*>Med Save*	*<Med Live*	*>Med Live*	*<Med Crop*	*>Med Crop*	*<Med Income*	*>Med Income*
No Shock	6.393***										
	(1764)										
Any Shock	-3.67***	-2.63***	-0.12	-3.05***	-2.17**	-2.74***	-2.39**	-5.90***	0.86	-3.56***	-3.14***
	(281)	(153)	(45)	(210)	(61)	(174)	(107)	(192)	(89)	(157)	(124)
Exog: Natural/ Economic	0.29	-1.65*	-0.27	2.07**	1.60	-0.24	1.54	-1.97**	3.50***	1.59	0.66
	(229)	(125)	(34)	(173)	(49)	(137)	(92)	(161)	(68)	(125)	(104)
Idio: Insurable/ Non-insur	-1.03	-2.29***	0.93	-0.10	-0.767	0.32	-1.82**	-0.18	-1.52	-1.40	-0.55
	(112)	(67)	(19)	(82)	(25)	(75)	(38)	(70)	(42)	(64)	(48)

Table 5b: Results of sample median tests for the difference between actual and predicted consumption in 2010

	Overall	*No Insur.*	*With Insur.*	*<Med Save*	*>Med Save*	*<Med Live*	*>Med Live*	*<Med Crop*	*>Med Crop*	*<Med Income*	*>Med Income*
No shock	0.13										
	(1928)										
Shock	-1.03	-1.76*	0.213	-0.73	-0.77**	0.15	-1.98**	-0.54	-2.82**	-4.85***	-1.65*
	(117)	(53)	(23)	(90)	(24)	(83)	(34)	(75)	(42)	(59)	(58)
Exog: Natural/ Economic	-1.77*	-0.81	-1.02	-0.91	-1.81*	-1.55	0.11	-0.95	-1.92*	-3.31***	-2.63***
	(74)	(30)	(17)	(56)	(16)	(48)	(26)	(40)	(34)	(34)	(40)
Idio: Insurable/ Non-insur	-2.89*	-1.00	2.09**	-2.93***	-1.79*	-1.24	-1.80*	-2.36**	-1.69*	-4.78***	-2.506**
	(73)	(37)	(10)	(57)	(14)	(51)	(22)	(49)	(24)	(38)	(35)

Notes for 5a and 5b: A shock is defined as having suffered an income loss of greater than 25 per cent of 2008 and 2010 annual income respectively.
*** indicates significance at the 1% level, ** indicates significance at the 5% level, * indicates significance at the 10% level.
The number of observations are presented in parenthesis.

Table 6: Fixed effects estimates of the impact of income shocks on Total Liquid Asset Holdings

	(1) Levels	*(2) Levels*	*(3) Levels*	*(4) Levels*	*(5) Interaction: Insurance*	*(6) Interaction: Transfers*
Income Shock	-0.1661***					
	(0.0508)					
Exogenous Shock		-0.0986**				
		(0.0497)				
Exogenous:			-0.0365	-0.0343	-0.0329	-0.0055
Natural Shock			(0.0501)	(0.0503)	(0.0503)	(0.0761)
Exogenous:			-0.1854*	-0.1860*	-0.1831*	-0.1852*
Economic Shock			(0.0996)	(0.0996)	(0.0997)	(0.0998)
Idiosyncratic Shock		-0.1601***	-0.1527***			
		(0.0556)	(0.0558)			
Idiosyncratic:				-0.1339**	-0.1551**	-0.1339**
Insurable Shock				(0.0604)	(0.0629)	(0.0604)
Idiosyncratic:				-0.0720	-0.0705	-0.0711
Uninsurable Shock				(0.0961)	(0.0962)	(0.0962)
Transfers	0.0222	0.0244	0.0200	0.0192	0.0198	0.0358
	(0.0431)	(0.0431)	(0.0431)	(0.0431)	(0.0431)	(0.0548)
Transfers*						-0.0413
Natural Shock						(0.0792)
Insurance Claim	-0.0964	-0.0958	-0.0923	-0.0917	-0.1237*	-0.0922
	(0.0720)	(0.0722)	(0.0724)	(0.0723)	(0.0772)	(0.0723)
InsuranceClaim*					0.1587	
Insurable Shock					(0.1748)	
Income	0.0015***	0.0015***	0.0015***	0.0015***	0.0015***	0.0015***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Wealth	0.0369***	0.0377***	0.0375***	0.0373***	0.0382***	0.0373**
	(0.0130)	(0.0129)	(0.0130)	(0.0130)	(0.0130)	(0.0130)
Household Size	0.0397*	0.0403*	0.0407*	0.0402*	0.0402*	0.0403*
	(0.0220)	(0.0220)	(0.0220)	(0.0220)	(0.0221)	(0.0221)
Education Head	0.0128	0.0135	0.0141	0.0140	0.0144	0.0141
	(0.0213)	(0.0213)	(0.0213)	(0.0213)	(0.0213)	(0.0212)
Age Head	0.0443*	0.0426*	0.0427*	0.0427*	0.0427*	0.0428*
	(0.0231)	(0.0232)	(0.0231)	(0.0232)	(0.0231)	(0.0232)
Age Squared Head	-0.0004**	-0.0004**	-0.0004**	-0.0004**	-0.0004**	-0.0004**
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Recovered from	0.0842	0.0537	0.0207	0.0146	0.0129	0.0146
Shock	(0.0543)	(0.0516)	(0.0523)	(0.0524)	(0.0526)	(0.0524)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Constant	7.8827***	7.9036***	7.8867***	7.8860***	7.8819***	7.8744***
	(0.6502)	(0.6531)	(0.6525)	(0.6538)	(0.6512)	(0.6545)
Overall R^2	0.1528	0.1531	0.1538	0.1533	0.1533	0.1533
N	5775	5775	5775	5775	5775	5775
Standard errors	Clustered (H'hold)	Clustered (H'hold)	Clustered (H'hold)	Clustered (H'hold)	Clustered (H'hold)	Clustered (H'hold)

Standard errors are given in parenthesis. *** indicates significance at the 1% level, ** indicates significance at the 5% level, * indicates significance at the 10% level.

Table 7: Fixed effects estimates of the impact of income shocks on Total Livestock Holdings

	(1) *Levels*	*(2)* *Levels*	*(3)* *Levels*	*(4)* *Levels*	*(5)* *Interaction: Insurance*	*(6)* *Interaction: Transfers*
Income Shock	-0.0344					
	(0.0733)					
Exogenous Shock		0.0230				-
		(0.0664)				
Exogenous: Natural Shock			0.0015	0.0007	0.0066	0.1061
			(0.0658)	(0.0658)	(0.0656)	(0.1053)
Exogenous: Economic Shock			0.0496	0.0534	0.0639	0.0572
			(0.1476)	(0.1486)	(0.1488)	(0.1486)
Idiosyncratic Shock		-0.1537*	-0.1551*			
		(0.0824)	(0.0823)			
Idiosyncratic: Insurable Shock				-0.1839**	-0.2657***	-0.1811**
				(0.0914)	(0.0958)	(0.0914)
Idiosyncratic: Uninsurable Shock				-0.0694	-0.0636	-0.0623
				(0.1267)	(0.1264)	(0.1271)
Transfers	0.0226	0.0243	0.0262	0.0264	0.0271	0.0957
	(0.0667)	(0.0667)	(0.0663)	(0.0664)	(0.0431)	(0.0868)
Transfers* Natural Shock						-0.1502
						(0.1178)
Insurance Claim	-0.2794**	-0.2808**	-0.2817**	-0.2811**	-0.3979***	-0.2815**
	(0.1216)	(0.1217)	(0.1217)	(0.1218)	(0.1362)	(0.1217)
InsuranceClaim* Insurable Shock					0.6319**	
					(0.2698)	
Income	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	0.0002
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Wealth	0.0078	0.0096	0.0094	0.0094	0.0138	0.0090
	(0.0215)	(0.0215)	(0.0215)	(0.0215)	(0.0214)	(0.0215)
Household Size	0.0841**	0.0846**	0.0845**	0.0841**	0.0848**	0.0846**
	(0.0358)	(0.0358)	(0.0358)	(0.0358)	(0.0355)	(0.0358)
Education Head	-0.0379	-0.0374	-0.0376	-0.0377	-0.0341	-0.0379
	(0.0356)	(0.0355)	(0.0355)	(0.0355)	(0.0354)	(0.0355)
Age Head	0.0372	0.0339	0.0336	0.0324	0.0303	0.0319
	(0.0293)	(0.0296)	(0.0296)	(0.0298)	(0.0295)	(0.0297)
Age Squared Head	-0.0004	-0.0003	-0.0003	-0.0003	-0.0003	-0.0003
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Recovered from Shock	0.0739	0.0614	0.0723	0.0721	0.0646	0.0710
	(0.0771)	(0.0729)	(0.0721)	(0.0720)	(0.0720)	(0.0720)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Constant	5.7137***	5.7801***	5.7959***	5.8334***	5.847***	5.8023***
	(0.8142)	(0.8200)	(0.8187)	(0.8224)	(0.8169)	(0.8227)
Overall R^2	0.2276	0.2300	0.2295	0.2300	0.2294	0.2291
N	4377	4377	4377	4377	4377	4377
Standard errors	Clustered (H'hold)	Clustered (H'hold)	Clustered (H'hold)	Clustered (H'hold)	Clustered (H'hold)	Clustered (H'hold)

Standard errors are given in parenthesis. *** indicates significance at the 1% level, ** indicates significance at the 5% level, * indicates significance at the 10% level.

Table 8: Fixed effects estimates of the impact of income shocks on Total Savings

	(1) Levels	*(2) Levels*	*(3) Levels*	*(4) Levels*	*(5) Interaction: Insurance*	*(6) Interaction: Transfers*
Income Shock	-0.2427***					
	(0.0703)					
Exogenous Shock		-0.1909***.				-
		(0.0675)				
Exogenous:			-0.1945***	-0.1925***	-0.1927***	-0.3339***
Natural Shock			(0.0654)	(0.0657)	(0.0656)	(0.1016)
Exogenous:			-0.0737	-0.0670	-0.0672	-0.0814
Economic Shock			(0.1497)	(0.1496)	(0.1496)	(0.1486)
Idiosyncratic Shock		-0.1372*	-0.1371*			
		(0.0773)	(0.0772)			
Idiosyncratic:				-0.1557*	-0.1538*	-0.1544*
Insurable Shock				(0.0914)	(0.0853)	(0.0817)
Idiosyncratic:				-0.0008	-0.0008	-0.0010
Uninsurable Shock				(0.1376)	(0.1377)	(0.1374)
Transfers	-0.1334**	-0.1323**	-0.1302**	-0.1325**	-0.1326**	-0.2056***
	(0.0604)	(0.0604)	(0.0603)	(0.0600)	(0.0600)	(0.0729)
Transfers*						0.2063*
Natural Shock						(0.1095)
Insurance Claim	-0.1792**	-0.1782**	-0.1751**	-0.1745**	-0.1719**	-0.1700**
	(0.0873)	(0.0873)	(0.0873)	(0.0873)	(0.0889)	(0.0872)
InsuranceClaim*					-0.0135	
Insurable Shock					(0.2363)	
Income	0.0021***	0.0021***	0.0021***	0.0021***	0.0021***	0.0021***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Wealth	0.0185	0.0192	0.0192	0.0190	0.0190	0.0187
	(0.0204)	(0.0205)	(0.0205)	(0.0205)	(0.0205)	(0.0205)
Household Size	0.0122	0.0119	0.0118	0.0114	0.0112	0.0110
	(0.0307)	(0.0307)	(0.0308)	(0.0307)	(0.0308)	(0.0308)
Education Head	0.0284	0.0296	0.0295	0.0292	0.0292	0.0289
	(0.0283)	(0.0284)	(0.0285)	(0.0284)	(0.0284)	(0.0284)
Age Head	0.0363	0.0337	0.0338	0.0336	0.0336	0.0330
	(0.0354)	(0.0357)	(0.0372)	(0.0355)	(0.0355)	(0.0354)
Age Squared Head	-0.0003	-0.0003	-0.0003	-0.0003	-0.0003	-0.0003
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Recovered from	0.1119	0.0731	0.0719	0.0658	0.0660	0.0613
Shock	(0.0755)	(0.0696)	(0.0681)	(0.0680)	(0.0681)	(0.0680)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Constant	7.8988***	7.9540***	7.9537***	7.9650***	7.9661***	8.0362***
	(1.0276)	(1.0371)	(1.0375)	(1.0327)	(1.0331)	(1.0300)
Overall R^2	0.1974	0.1986	0.1980	0.1974	0.1973	0.1956
N	3791	3791	3791	3791	3791	3791
Standard errors	Clustered (H'hold)	Clustered (H'hold)	Clustered (H'hold)	Clustered (H'hold)	Clustered (H'hold)	Clustered (H'hold)

Standard errors are given in parenthesis. *** indicates significance at the 1% level, ** indicates significance at the 5% level, * indicates significance at the 10% level.

Table 8a: Fixed effects estimates of the impact of adverse income shocks on Cash/Gold Held at Home

	(1) Levels	*(2) Levels*	*(3) Levels*	*(4) Levels*	*(5) Interaction: Insurance*	*(6) Interaction: Transfers*
Income Shock	-0.2533***					
	(0.0725)					
Exogenous Shock		-0.1736**.				-
		(0.0698)				
Exogenous:			-0.1646**	-0.1602**	-0.1602**	-0.2940***
Natural Shock			(0.0691)	(0.0692)	(0.0692)	(0.1063)
Exogenous:			-0.2077	-0.1923	-0.1921	-0.2087
Economic Shock			(0.1416)	(0.1411)	(0.1411)	(0.1416)
Idiosyncratic Shock		-0.1999**	-0.1980**			
		(0.0817)	(0.0815)			
Idiosyncratic:				-0.2246**	-0.2257**	-0.2219**
Insurable Shock				(0.0883)	(0.0918)	(0.0881)
Idiosyncratic:				-0.0111	-0.0111	-0.0098
Uninsurable Shock				(0.1519)	(0.1520)	(0.1513)
Transfers	-0.2086***	-0.2093***	-0.2102***	-0.2132***	-0.2131***	-0.2764***
	(0.0637)	(0.0636)	(0.0634)	(0.0628)	(0.0628)	(0.0771)
Transfers*						0.1879*
Natural Shock						(0.1167)
Insurance Claim	-0.1663*	-0.1613*	-0.1595*	-0.1583*	-0.1600*	-0.1538*
	(0.0896)	(0.0895)	(0.0895)	(0.0893)	(0.0953)	(0.0894)
InsuranceClaim*					0.0086	
Insurable Shock					(0.2169)	
Net Income	0.0012***	0.0012***	0.0012***	0.0012***	0.0012***	0.0012***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Net Wealth	-0.0109	-0.0100	-0.0101	-0.0104	-0.0104	-0.0106
	(0.0217)	(0.0218)	(0.0218)	(0.0220)	(0.0220)	(0.0220)
Household Size	0.0142	0.0137	0.0137	0.0128	0.0128	0.0129
	(0.0283)	(0.0283)	(0.0283)	(0.0283)	(0.0283)	(0.0283)
Education Head	0.0375	0.0392	0.0389	0.0390	0.0390	0.0378
	(0.0290)	(0.0291)	(0.0290)	(0.0290)	(0.0290)	(0.0290)
Age Head	0.0521	0.0505	0.0503	0.0503	0.0502	0.0492
	(0.0403)	(0.0405)	(0.0404)	(0.0401)	(0.0401)	(0.0399)
Age Squared Head	-0.0005	-0.0005	-0.0005	-0.0005	-0.0005	-0.0005
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Recovered from	0.1611**	0.1229*	0.1190*	0.1084	0.1082	0.1023
Shock	(0.0782)	(0.0782)	(0.0712)	(0.0709)	(0.0709)	(0.0713)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.8696	0.8857	0.9034	0.9067	0.9058	0.9842
	(1.1510)	(1.1510)	(1.1579)	(1.1494)	(1.1490)	(1.1443)
Overall R^2	0.1089	0.1086	0.1084	0.1084	0.1085	0.1087
N	3292	3292	3292	3292	3292	3292
Standard errors	Clustered (H'hold)	Clustered (H'hold)	Clustered (H'hold)	Clustered (H'hold)	Clustered (H'hold)	Clustered (H'hold)

Standard errors are given in parenthesis. *** indicates significance at the 1% level, ** indicates significance at the 5% level, * indicates significance at the 10% level.

Table 9: Fixed effects estimates of the impact of adverse income shocks on Crop Stores

	(1) *Levels*	*(2)* *Lowest Wealth Group Levels*	*(3)* *Middle Wealth Group Levels*	*(4)* *Highest Wealth Group Levels*
Income Shock	-0.0650			
	(0.0411)			
Exogenous:		-0.0561	0.0525	-0.1824**
Natural Shock		(0.0632)	(0.0601)	(0.0795)
Exogenous:		-0.0496	-0.2835**	0.0881
Economic Shock		(0.1731)	(0.1355)	(0.1163)
Idiosyncratic:		-0.1234	0.0456	0.0121
Insurable Shock		(0.0896)	(0.0699)	(0.0969)
Idiosyncratic:		0.2674*	-0.3639***	-0.2239
Uninsurable Shock		(0.1420)	(0.1312)	(0.1515)
Transfers	-0.1220***	-0.1125*	-0.1204*	-0.1252
	(0.0394)	(0.0649)	(0.0661)	(0.0781)
Insurance Claim	0.0101	-0.0533	0.0254	-0.1350
	(0.0602)	(0.1017)	(0.0926)	(0.1123)
Net Income	0.0003	0.0016	0.0006	0.0002
	(0.0002)	(0.0015)	(0.0005)	(0.00002)
Net Wealth	0.0064	0.0619**	0.0013	0.0456*
	(0.0113)	(0.0248)	(0.0199)	(0.0282)
Household Size	0.0574***	0.0704*	0.0680**	0.0350
	(0.0178)	(0.0360)	(0.0274)	(0.0303)
Education Head	0.0216	0.0568**	-0.0022	-0.0210
	(0.0172)	(0.0244)	(0.0314)	(0.0386)
Age Head	-0.0034	-0.0088	0.0346	-0.0116
	(0.0139)	(0.0194)	(0.0422)	(0.0171)
Age Squared Head	0.0001	0.0002	-0.0002	0.0001
	(0.0001)	(0.0002)	(0.0004)	(0.0002)
Recovered from	-0.0235	-0.0154	-0.1120*	-0.0513
Shock	(0.0430)	(0.0720)	(0.0582)	(0.0779)
Time Dummies	Yes	Yes	Yes	Yes
Constant	6.8492***	5.9282***	5.9890***	7.3414***
	(0.4166)	(0.6125)	(1.2021)	(0.5517)
Overall R^2	0.0966	0.0858	0.1109	0.1446
N	4267	1532	1546	1189
Standard errors	Clustered (H'hold)	Clustered (H'hold)	Clustered (H'hold)	Clustered (H'hold)

Standard errors are given in parenthesis. *** indicates significance at the 1% level, ** indicates significance at the 5% level, * indicates significance at the 10% level.

Table 10: Fixed effects estimates of the impact of adverse income shocks on Total Borrowing

	(1) *Levels*	*(2)* *Levels*	*(3)* *Levels*	*(4)* *Levels*	*(5)* *Interaction: Insurance*	*(6)* *Interaction: Transfers*
Income Shock	1.0729*** (0.1610)					
Exogenous Shock		0.8778*** (0.1628)				-
Exogenous: Natural Shock			0.6552*** (0.1635)	0.6548*** (0.1636)	0.6566*** (0.1637)	0.6399** (0.2609)
Exogenous: Economic Shock			0.8995*** (0.3375)	0.8971*** (0.3375)	0.9012*** (0.3377)	0.8967*** (0.3375)
Idiosyncratic Shock		0.9035*** (0.1717)	0.8827*** (0.1716)			
Idiosyncratic: Insurable Shock				0.9009*** (0.1872)	0.8709*** (0.1993)	0.9008*** (0.1872)
Idiosyncratic: Uninsurable Shock				0.5703* (0.3254)	0.5728* (0.3255)	0.5699* (0.3255)
Transfers	0.2355 (0.1460)	0.2224 (0.1464)	0.2348 (0.1468)	0.2351 (0.1469)	0.2360 (0.1468)	0.2268 (0.1872)
Transfers* Natural Shock						0.0213 (0.2871)
Insurance Claim	0.0100 (0.2323)	0.0176 (0.2321)	0.0014 (0.2325)	-0.0022 (0.2328)	-0.0496 (0.2524)	-0.0019 (0.2329)
InsuranceClaim* Insurable Shock					0.2292 (0.5418)	
Net Income	0.0010* (0.0006)	0.0010* (0.0006)	0.0010* (0.0006)	0.0010* (0.0006)	0.0010* (0.0006)	0.0010* (0.0006)
Net Wealth	0.0428 (0.0407)	0.0411 (0.0407)	0.0400 (0.0408)	0.0396 (0.0408)	0.0409 (0.0409)	0.0396 (0.0408)
Household Size	0.0794 (0.0708)	0.0766 (0.0707)	0.0762 (0.0709)	0.0783 (0.0710)	0.0782 (0.0710)	0.0783 (0.0710)
Education Head	0.0244 (0.0620)	0.0217 (0.0620)	0.0194 (0.0622)	0.0192 (0.0621)	0.0199 (0.0621)	0.0192 (0.0621)
Age Head	0.1001 (0.0667)	0.1088* (0.0654)	0.1088* (0.0656)	0.1101* (0.0655)	0.1100* (0.0655)	0.1100* (0.0655)
Age Squared Head	-0.0013** (0.0006)	-0.0014** (0.0006)	-0.0014** (0.0006)	-0.0014** (0.0006)	-0.0014** (0.0006)	-0.0014** (0.0006)
Recovered from Shock	-0.6636*** (0.1804)	-0.5701*** (0.1729)	-0.4535*** (0.1609)	-0.4453** (0.1732)	-0.4480** (0.1734)	-0.4453** (0.1732)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.3507 (1.8494)	1.1492 (1.8102)	1.2196 (1.8191)	1.1815 (1.8187)	1.1723 (1.8184)	1.1881 (1.8203)
Overall R^2	0.0645	0.0648	0.0635	0.0629	0.0633	0.0629
N	6132	6132	6132	6132	6132	6132
Standard errors	Clustered (H'hold)	Clustered (H'hold)	Clustered (H'hold)	Clustered (H'hold)	Clustered (H'hold)	Clustered (H'hold)

Standard errors are given in parenthesis. *** indicates significance at the 1% level, ** indicates significance at the 5% level, * indicates significance at the 10% level.

Appendix

Table A1: The likelihood of recovery from shock

Dependent variable:	*Recovered from current shock*	
Time	2008	2010
Exogenous: Natural Shock	0.2727*	0.2532
	(0.1614)	(0.1665)
Exogenous: Economic Shock	-0.6319***	0.6989***
	(0.1817)	(0.2186)
Idiosyncratic: Insurable Shock	-0.3965***	-0.3311**
	(0.1500)	(0.1452)
Idiosyncratic: Non-insurable Shock	-0.0266	0.0478
	(0.1661)	(0.0986)
Number of shocks suffered	-0.3324***	-0.1888**
	(0.0810)	(0.0748)
Recovered from prior shock	0.0487	0.0478
	(0.0952)	(0.0986)
% Income Lost	0.0054	-1.8346***
	(0.0062)	(0.3209)
Stock Of Savings Dummy	0.1262*	0.0879
	(0.0928)	(0.0991)
Livestock Dummy	0.2615**	0.1388
	(0.1222)	(0.1143)
Voluntary Insurance Dummy	0.1934**	0.2094**
	(0.0967)	(0.0991)
Borrowings Dummy	0.0278	-0.0328
	(0.0847)	(0.0893)
Crop Stores Dummy	-0.0299	-0.0548
	(0.1191)	(0.1206)
Total Wealth (VND)	0.0465	0.0486*
	(0.0482)	(0.0288)
Income (VND)	0.0002	-0.0002
	(0.0011)	(0.0006)
Age of Household Head	-0.0167	0.0042
	(0.0199)	(0.0237)
Age of Household Head Squared	0.0002	-0.0000
	(0.0002)	(0.0002)
Gender of Household Head (1Male, 0Female)	-0.0628	0.0600
	(0.1078)	(0.1214)
Education Level of Household Head	0.1784***	0.1375**
	(0.0469)	(0.0548)
Size of Household – Number of members	0.0064	
	(0.0248)	
Regional Dummies	Yes	Yes
Constant	-0.3755	0.2731
	(0.6583)	(0.7092)
N	1,147	1023

Note: Robust standard errors are presented in parenthesis. A dummy variable representing a shock from the death of a family member was dropped from both estimations.
*** indicates significance at the 1% level, ** indicates significance at the 5% level, * indicates significance at the 10% level.

Table A2: The likelihood of voluntary insurance purchase

Dependent variable:	*Purchased Voluntary Insurance*	
Time	2008	2010
Exogenous: Natural Shock	0.2996**	0.2099
	(0.1310)	(0.1404)
Exogenous: Economic Shock	0.5389***	-0.0531
	(0.1678)	(0.2201)
Idiosyncratic: Insurable Shock	0.2011	0.0296
	(0.1325)	(0.1352)
Idiosyncratic: Uninsurable Shock	0.1130	0.0410
	(0.1560)	(0.1720)
Number of shocks suffered	-0.2464***	-0.0872
	(0.0844)	(0.0844)
Recovered from prior shock	0.0375	0.0837
	(0.0820)	(0.0885)
Stock Of Savings Dummy	0.2241***	0.3469***
	(0.0690)	(0.0686)
Livestock Dummy	-0.0383	0.0740
	(0.0798)	(0.0746)
Borrowings Dummy	-0.0772	0.1266*
	(0.0644)	(0.0648)
Crop Stores Dummy	-0.0723	0.1097
	(0.0805)	(0.0807)
Total Wealth (VND)	0.1115***	0.1861***
	(0.0194)	(0.0171)
Income (VND)	0.0007**	0.0005**
	(0.0003)	(0.0002)
Age of Household Head	-0.0225	0.0012
	(0.0149)	(0.0159)
Age of Household Head Squared	0.0000	-0.0001
	(0.0001)	(0.0001)
Gender of Household Head (1Male, 0Female)	-0.1453*	0.0524
	(0.0780)	(0.0819)
Education Level of Household Head	0.1891***	0.2193***
	(0.0359)	(0.0392)
Size of Household – Number of members	0.0888***	0.0564***
	(0.0192)	(0.0200)
Regional Dummies	Yes	Yes
Constant	-0.4540	-2.1554***
	(0.4285)	(0.4533)
N	2045	2045

Note: Robust standard errors are presented in parenthesis.
*** indicates significance at the 1% level, ** indicates significance at the 5% level, * indicates significance at the 10% level. A dummy variable representing a shock from the death of a family member was dropped from both estimations.

Table A3: General Consumption Regression

Dependent Variable	*HH Food Expenditure (2006)*	*HH Food Expenditure (2008)*
Income (VND)	0.0025***	0.0022***
	(0.0009)	(0.0005)
Total Wealth (VND)	0.0011***	-0.0001*
	(0.0002)	(0.0001)
Borrowings Outstanding	0.0004	-0.0014*
(VND)	(0.0004)	(0.0008)
Age of Household Head	11.4816***	30.384***
	(3.8165)	(7.3629)
Age Squared of Household	-0.1159***	-0.2728***
Head	(0.0356)	(0.0656)
Gender of Household Head	-67.8519**	40.5599
(0 Female, 1 Male)	(30.6543)	(38.2358)
Education of Household Head	27.5367***	117.086***
	(8.2061)	(16.8068)
Size of Household – Number	41.8074***	72.2591***
of members	(7.9954)	(8.8777)
Constant	-132.8858***	-772.1188***
	(112.0746)	(214.726)
R^2	0.1624	0.1595
N	2044	2045

Note: Robust standard errors are presented in parenthesis.
*** indicates significance at the 1% level, ** indicates significance at the 5% level, * indicates significance at the 10% level.

Derivation of savings level A:
First order condition for savings A from equation (3):
$A\colon U'(W-A)=\beta(1+r)EU'(\tilde{\alpha}W+A(1+\tilde{r})-\tilde{\gamma}+I\tilde{\gamma}-I\theta E[\tilde{\gamma}])$

Rewriting and setting $\beta(1+r)=1$ and $\tilde{r}=0$ for simplicity gives:
$U'(W-A)-EU'(\tilde{\alpha}W+A-(1-I)\tilde{\gamma}-I\theta E[\tilde{\gamma}])=0$

Assuming full insurance coverage for idiosyncratic risk $I=1$ and actuarially fair insurance $\theta=1$ gives:
$U'(W-A)-EU'(\tilde{\alpha}W+A-E[\tilde{\gamma}])=0$

Taking a second order Taylor expansion of $U'(W-A)$ and $EU'(\tilde{\alpha}W+A-E[\tilde{\gamma}])$ about W gives:

$$U'(W)-U''(W)A+\frac{1}{2}U'''(W)A^2 - E\Big[U'(W)+U''(W)(W(\tilde{\alpha}-1)-E[\tilde{\gamma}]+A) + \frac{1}{2}U'''(W)(W(\tilde{\alpha}-1)-E[\tilde{\gamma}]+A)^2\Big]=0$$

Separately expanding $(W(\tilde{\alpha}-1)-E[\tilde{\gamma}]+A)^2$ gives:
$W^2(\tilde{\alpha}-1)^2-2W(\tilde{\alpha}-1)E[\tilde{\gamma}]+2W(\tilde{\alpha}-1)A+E[\tilde{\gamma}]^2+A^2-2E[\tilde{\gamma}]A$

Applying expansion directly into Taylor series approximation gives:

$$U'(W)-U''(W)A+\frac{1}{2}U'''(W)A^2 - E\Big[U'(W)+U''(W)(W(\tilde{\alpha}-1)-E[\tilde{\gamma}]+A)+\frac{1}{2}U'''(W)(W^2(\tilde{\alpha}-1)^2 - 2W(\tilde{\alpha}-1)E[\tilde{\gamma}]+2W(\tilde{\alpha}-1)A+E[\tilde{\gamma}]^2+A^2-2E[\tilde{\gamma}]A)\Big]=0$$

Setting $E[\tilde{\gamma}]=\gamma$ for idiosyncratic risk insurance premium simplifies to:

$$U'(W)-U''(W)A+\frac{1}{2}U'''(W)A^2 - E\Big[U'(W)+U''(W)(W(\tilde{\alpha}-1)-\gamma+A)+\frac{1}{2}U'''(W)(W^2(\tilde{\alpha}-1)^2 - 2W(\tilde{\alpha}-1)\gamma+2W(\tilde{\alpha}-1)A+\gamma^2+A^2-2\gamma A)\Big]=0$$

Expanding the terms within the expectations operator gives:

$$U'(W)-U''(W)A+\frac{1}{2}U'''(W)A^2-U'(W)-U''(W)W(\alpha-1)+U''(W)\gamma-U''(W)A - \frac{1}{2}U'''(W)W^2(\alpha-1)^2+U'''(W)W(\alpha-1)\gamma-U'''(W)W(\alpha-1)A - \frac{1}{2}U'''(W)\gamma^2-\frac{1}{2}U'''(W)A^2+U'''(W)\gamma A=0$$

Simplifying terms, with terms of idiosyncratic risk premium γ in brackets gives

$$-2U''(W)A-U''(W)W(\alpha-1)-\frac{1}{2}U'''(W)W^2(\alpha-1)^2-U'''(W)W(\alpha-1)A + \Big[U''(W)\gamma+U'''(W)W(\alpha-1)\gamma-\frac{1}{2}U'''(W)\gamma^2+U'''(W)\gamma A\Big]=0$$

Which equates to:

$$-2U''(W)A-U''(W)W(\alpha-1)-\frac{1}{2}U'''(W)W^2[(\alpha-1)^2+\sigma_\alpha^2]-U'''(W)W(\alpha-1)A + \Big[U''(W)\gamma+U'''(W)W(\alpha-1)\gamma-\frac{1}{2}U'''(W)\gamma^2+U'''(W)\gamma A\Big]=0$$

Dividing across by U''' gives:

$$-2\frac{U''(W)}{U'''(W)}A-\frac{U''(W)}{U'''(W)}W(\alpha-1)-\frac{1}{2}\frac{U'''(W)}{U'''(W)}W^2[(\alpha-1)^2+\sigma_\alpha^2]-\frac{U'''(W)}{U'''(W)}W(\alpha-1)A$$
$$+\left[\frac{U''(W)}{U'''(W)}\gamma+\frac{U'''(W)}{U'''(W)}W(\alpha-1)\gamma-\frac{1}{2}\frac{U'''(W)}{U'''(W)}\gamma^2+\frac{U'''(W)}{U'''(W)}\gamma A\right]=0$$

Applying the co-efficient of absolute prudence $\varphi=-\frac{U'''(.)}{U''(.)}$ gives:

$$\frac{2A}{\varphi}+\frac{W(\alpha-1)}{\varphi}-\frac{W^2[(\alpha-1)^2+\sigma_\alpha^2]}{2}-W(\alpha-1)A-\frac{\gamma}{\varphi}+W(\alpha-1)\gamma-\frac{\gamma^2}{2}+\gamma A=0$$

Gathering terms of A gives:

$$\frac{2A}{\varphi}-W(\alpha-1)A+\gamma A=\frac{W^2[(\alpha-1)^2+\sigma_\alpha^2]}{2}-\frac{W(\alpha-1)}{\varphi}+\frac{\gamma}{\varphi}-W(\alpha-1)\gamma+\frac{\gamma^2}{2}$$

Isolating A gives:

$$A\left[\frac{4-2\varphi W(\alpha-1)+2\varphi\gamma}{2\varphi}\right]=\frac{2\varphi W^2[(\alpha-1)^2+\sigma_\alpha^2]-2W(\alpha-1)+2\gamma-2\varphi W(\alpha-1)\gamma+\varphi\gamma^2}{2\varphi}$$

Approximating A gives:

$$A\cong\frac{2\varphi W^2[(\alpha-1)^2+\sigma_\alpha^2]-2W(\alpha-1)+2\gamma-2\varphi W(\alpha-1)\gamma+\varphi\gamma^2}{4-2\varphi W(\alpha-1)+2\varphi\gamma}$$

Which equates to:

$$A\cong\frac{2\varphi W^2\sigma_\alpha^2+2\varphi W^2(\alpha-1)^2-2W(\alpha-1)+2\gamma-2\varphi W(\alpha-1)\gamma+\varphi\gamma^2}{4-2\varphi W(\alpha-1)+2\varphi\gamma}$$

Which equates to:

$$A\cong\frac{2\varphi W^2\sigma_\alpha^2+2W(\alpha-1)[\varphi W(\alpha-1)-1]-2W(\alpha-1)-\gamma[2\varphi W(\alpha-1)-\varphi\gamma-2]}{4-2\varphi W(\alpha-1)+2\varphi\gamma}$$

As per equation (4) Section 2.

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