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Understanding farmers' valuation of agricultural insurance

Evidence from Viet Nam

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Abstract: We employ a novel approach to investigate the reasons for a low demand for agricultural insurance. We confirm that farmers systematically undervalue agricultural insurance. First, we find that private transfers, mainly from family members, explain under-valuation of agricultural insurance. Second, membership of a farmer's union, interpreted as a form of social capital or pro-active behaviour, explains the differential between willingness to pay (WTP) and the predicted economic value of insurance. Third, we help answer the puzzle why the most risk averse are least likely to take up agricultural insurance. We find that over-confidence holds a positive and significant relationship with WTP for agricultural insurance and interpret this as evidence that, within the context of implementation challenges and likely concerns about insurer viability, only the most confident are likely to purchase insurance. These results hold across a range of robustness checks.

Keywords: Insurance, agriculture, risk, expected utility theory, willingness to pay
JEL classification: D81, D91, D84, G22, O13, Q14

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1 Introduction

Uninsured production shocks for farmers contribute to chronic poverty when assets are damaged and agricultural yields disappoint. Households, thrust into poverty by such shocks, often choose between asset depletion or consumption reduction, and often find it difficult to recover and restart the long process of accumulating productive assets (Carter et al., 2014; Mahul and Skees, 2007). Furthermore, the absence of agricultural insurance means many farmers adopt low-risk, low-return investment strategies. Rosenzweig and Binswanger (1993) provide an estimate of the possible gains from insurance, estimating that a one-standard-deviation decrease in weather risk (measured by the standard deviation of the timing of the rainy season) would raise average profits by up to 35 per cent among farmers in the lowest wealth quartile.

Proposed as a formal financial instrument for risk management, area yield agricultural insurance has been introduced in several developing countries such as India, Brazil, Ethiopia, Kenya, Malawi, and Viet Nam over the last 30 years. To address concerns over moral hazard and adverse selection, yield-based agricultural insurance firms provide indemnity payments based on area rainfall or area agricultural yield indices (Jensen et al., 2014; De Bock et al., 2010; Hess et al. 2005).[1] However, uptake has been disappointing. Exceptional cases such as regional initiatives in India (Cole et al., 2014) and Malawi (Gine and Yang, 2009) indicate uptake ranging between 15–30 per cent, while the case of Viet Nam is more representative of low-income countries where data from the Viet Nam Access to Resources Household Survey (VARHS) suggests less than 1 per cent penetration. In many instances, low levels of demand undermine the long-term sustainability of agricultural insurance schemes (Cole et al., 2014; Smith and Watts, 2009).

According to classical expected utility theory, an individual should obtain actuarially fair full insurance coverage (Ehrlich and Becker, 1972) to protect against damaging losses. For risk averse farmers, it is optimal to take out insurance, with the level of insurance determined by the level of risk aversion, and yet in practice we have seen low rates of uptake. This observation led Clarke (2011) to note two empirical puzzles. First, why has the demand for these products been so low, especially for households operating with pervasive weather and environmental risks. The second empirical puzzle is the observation that demand is particularly low for the most risk averse (Cole et al., 2013 and Gine et al., 2008). Jurkovikova (2016) wonders why many people for whom insurance is worth purchasing do not, while others who do not need protection have purchased coverage.

An extensive literature employs contingent valuation methods (CVM), such as willingness to pay questions, and membership profiles to explain insurance demand. The evidence suggests that socio-economic factors such as wealth, education and financial illiteracy, risk aversion, financial liquidity, informal arrangements as well as insurance scheme particulars such as basis risk, price and previous experience of pay-outs are important in explaining demand for insurance (Dercon et al., 2014; Cole et al., 2014; McIntosh et al., 2013; Mobarak and Rosenzweig, 2013; Liu and Myers, 2012; Gine and Yang 2009; Gine et al., 2008; Chantarat et al., 2009; Cole et al. 2014 and Cai et al. 2009).

[1] The concept of agricultural insurance, based on a pre-determined index, has been explored by a number of studies such as Hazell et al. (2010), De Bock et al. (2010) Carter et al. (2014), Kaczala and Wisniewska (2015) and Mahul and Stutley (2010).

Behavioural deviations from the classical predictions of insurance demand may also help explain under-purchase, over-purchase or wrong purchase of insurance products (Zelizer, 1978; Kunreuther, 1996; Kunreuther and Pauly, 2006; Jurkovicova, 2016). There is a limitation to human knowledge and dynamic computation that can hinder customer's ability to act 'rationally' in accordance with the predictions of standard classical or neo-classical economic models (Jurkovicova, 2016). Such 'irrationality' need not be wrong and, as suggested in Ariely (2007), irrational behaviours are neither random nor senseless but can be systematic and predictable. Behavioural factors that can affect the demand for insurance include present bias, over-confidence and gambler's fallacy, trust, status quo bias, choice aversion and limited attention.[2] However, the particular behavioural constraints that may explain low demand for agricultural index insurance remain largely unexplored in the literature. One exception is trust. The systematic review by Cole et al. (2012) highlights trust as an important factor for the purchase of index insurance, while a similar finding for formal bank products has been documented (Honohan and King, 2012).

This paper provides evidence on how Vietnamese farmers value agricultural insurance and how their self-reported Willingness to Pay (WTP) valuation deviates from their predicted valuation derived from expected utility theory. Employing survey data on von Neumann-Morgenstern (VNM) preferences over wealth outcomes and on recent agricultural losses due to weather and disease, we estimate the rational economic value of agricultural insurance for farming households using Constant Relative Risk Aversion (CRRA) utility function. The CRRA utility function uses the coefficient of Relative Risk Aversion (RRA) derived from a Becker-DeGroot-Marschak (BDM) bidding game played in the VARHS data. We examine whether a significant differential exists between the farmer's valuation of insurance, captured by their self-reported willingness to pay, and the value of insurance implied by theory. We assess the heterogeneous effects of gender, age, education, and other socio-economic and demographic characteristics on the valuation differential and the role played by behavioural biases. Our hypotheses are that (i) there exists a significant differential between the value of insurance predicted by expected utility theory and the farmer's self-elicited valuation of insurance, (ii) various socioeconomic and demographic characteristics explain this valuation differential, (iii) availability of risk coping measures such as borrowings, receipt of public and private transfers and social capital acts as a substitute implying lower valuation of insurance by farmers and (iv) behavioural biases can help predict the valuation deviation in accordance with the predictions from the literature. This paper employs the Viet Nam VARHS panel dataset from 2008 to 2016 collected every two years.

We find that three quarters of households report their willingness to pay as zero. While this is in response to a hypothetical agricultural insurance scheme, rather than one with details, a glossy brochure and a well-trained salesperson, low demand is pervasive as evidenced by enrolment rates in agricultural insurance for households in our panel of 0.34 per cent. We find evidence that recent losses due to agricultural shocks and natural disasters do not explain low valuation of agricultural insurance. Having losses greater than 5 per cent of agricultural output, actually increases the likelihood of reporting a zero willingness to pay, while controlling for other variables, recent losses are not significantly related to household willingness to pay for agricultural insurance. This suggests that past losses do not inform self-reported valuations of insurance.

We find evidence to support our first hypothesis that a differential exists between self-reported WTP for agricultural insurance and the predicted economic value of this insurance. Our evidence

[2] In related work Jurkovicova (2016) found systematic gender differences in the decision to purchase insurance. Factors such as emotional tension, advice from friends, advertisement, information campaigns, and fear of financial loss are more prominent amongst females as compared to males in making an insurance choice.

shows that farmers are systematically undervaluing agricultural insurance and suggests that this finding is an important contribution to the literature.

We investigate the determinants of this differential and have three main results. First, we find that private transfers, such as from internal or overseas migrants (family members, friends and neighbours), are negatively related to both WTP and the differential between WTP and predicted economic value of insurance. It is possible that having access to remittances in times of need reduces the demand for insurance. Having a stream of remittances can mean that cash flow at household level reduces the demand for formal insurance and the data suggests this is the more important mechanism at play. The evidence suggests that the latter channel is dominant with regular additions to cash flow through private transfers reducing household demand for agricultural insurance.

Second, we find that membership of a farmer's union is positively related to the differential between reported WTP and the predicted economic value of insurance, and this result holds for a range of robustness checks. Farmer's union members self-report improved access to agricultural inputs or technology, credit and insurance, education or training and market access as benefits, and yet membership is also likely to indicate higher levels of social capital, as argued by Newman and Kinghan (2015).

Third, over-confidence, measured by the log of how much a household would bid to engage in a hypothetical gamble, holds a positive and significant relationship with WTP. This result was unexpected, since our expectation was that a respondent depicting over-confidence would be likely to under-value insurance, deeming it unnecessary. Instead, our interpretation of this result is that a level of over-confidence may be needed to believe that agricultural insurance will pay out when you have had a loss. This may be due to perceived unviability of previous agricultural schemes in Viet Nam, perceived problematic claims processes and/or lack of confidence in the yield calculations of the insurer. We interpret this as an explanation for Clarke's (2011) empirical puzzle for why risk averse farmers are the least likely to take up agricultural insurance.

Our regressions control for a broad set of household characteristics, and time- and household-fixed effects are employed to control for unobservables. This approach is important because there are statistical differences between those who answer the WTP question and households who do not, and between households who play the BDM game and those who do not. Despite these differences, we do find that households who play the BDM game do not have higher WTP for agricultural insurance.[3]

We pay particular attention to how we deal with non-responses in the data. While our main findings come with certain decisions about non-responses, our results are unaffected by the assumptions we make. Section 5.4, and appendices B and C, provide a comprehensive set of robustness checks. First, we assume for our main results that households who fail to answer the BDM game at any point in time (35 per cent of sample) are not infinitely risk averse and would have participated in the gamble had the starting bid of loss been lower than 2,000 VND. We calculate RRA for these households taking the starting bid of the game as 1,000 VND. However, we additionally conduct robustness checks using alternative starting bids and by omitting households with non-responses. Second, informed by empirical studies that suggest that RRA can be considered constant over time (Brunnermeir and Nagel, 2008 and Chiappori and Paiella, 2011), for households that played the game at least once, we assign the mean value of RRAs calculated from available data for all years.

3 The difference of means for WTP between the household who play the BDM game once, and the households who never play the game is statistically insignificant. Only 6 per cent refuse to provide a willingness to pay response.

As the main results could be influenced by this approach, we also conduct our entire analysis in two alternative ways; using actual BDM game observations and means only for missing years, and separately by dropping all observations when the BDM game was not played (no starting bid assumption for those who failed to play the game). Third, in our main analysis we drop the 6 per cent of non-responses to the WTP question, but we also consider these to be the same as not interested or zero valuation. Fourth, we conduct the analysis only on years the behavioural bias questions were asked, dropping two of the five waves of data.

Additional robustness checks relate to the length of loss period we employ in the calculation of economic value of insurance and the type of utility function assumed. In our main specification we use current year and all historical data available on losses to calculate our economic value of insurance. In Section 5.3 we restrict the analysis to agricultural losses in the current and previous year. And finally, we test the sensitivity of our results to the choice of the utility function when ascertaining the economic value of agricultural insurance for each farmer. We present robustness checks using both the CARA and DARA utility functions. We find that our main results are consistently found under each of the above approaches.

Predictably, the design of insurance products, not directly considered in this paper, can also play a role in low demand. For example, the existence of high basis risk due to poor design of insurance can be one of the important factors behind the low up-take of agricultural insurance. Jensen et al. (2014a, b), De Bock et al. (2010), and Carter et al. (2014) assert that imperfect correlation of indices (used for constructing the terms of agricultural insurance) with the key welfare measure of farmers (agricultural produce or income) means insurance products offer limited security against agricultural shocks. This was recognized by the seminal study by Miranda (1991) who acknowledged that the more highly correlated individual yield is to area-yield, the greater will be the hedging against covariate shocks in area-based index insurance.

The rest of this paper is divided into background, conceptual framework and estimation strategy and results. Key policy implications are discussed in the conclusion.

2 Background

Viet Nam ranks sixth in the list of countries with agricultural losses suffered due to natural disasters and crop disease (Dao and Tai, 2014), and with nearly 50 per cent of the workforce employed in farming, Viet Nam is seemingly well placed to be a leader in agricultural insurance.

Historical efforts to introduce agricultural insurance in Viet Nam have been unsuccessful. Introduced back in 1982 when the Bao Viet company started operating in Vu Ban and Nam Ninh provinces, the first agricultural insurance scheme in Viet Nam gradually expanded to 16 more provinces, but the company incurred huge losses and the services stopped in 1999 (Mahul and Stutley, 2010). In the same year, another insurance product for pig feeding was introduced by a non-government organisation called GRET, but it was discontinued due to mismanagement and sustainability issues (Roth and McCord, 2008). In 2001, Groupama Viet Nam, operated by an experienced French company, obtained a licence for agricultural insurance in the Mekong Delta region, specifically for livestock, crops, farm physical assets and equipment, accidents of agricultural workers and civil liability, and shrimp farming. In 2003, Groupama incurred heavy losses for five agricultural products in the southern region and did not prosper in Viet Nam because of low revenue, poor take-up and high compensation rates.

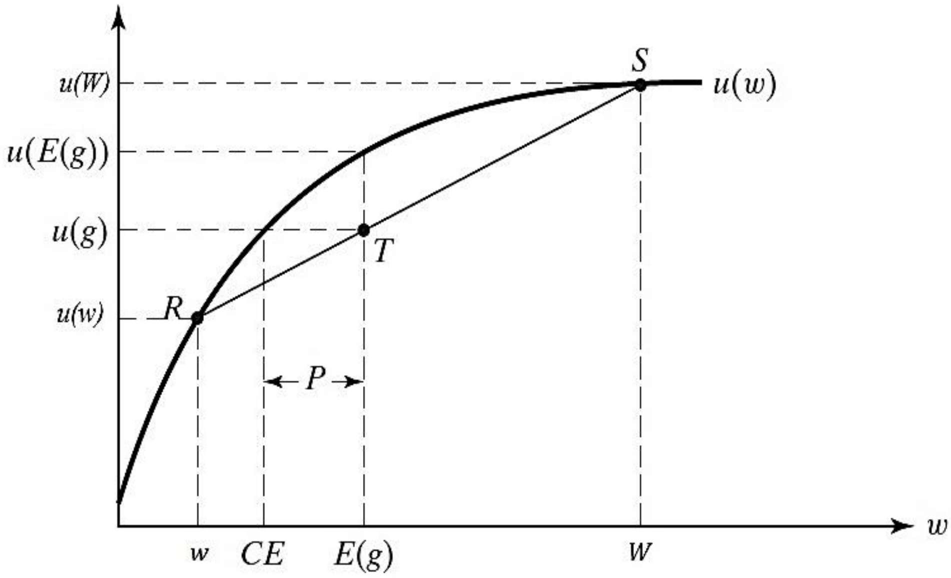
The most recent agricultural insurance scheme that started in Viet Nam came into existence after the 2011 parliamentary decision no. 315/QD-TTg established a pilot of agricultural insurance for rice farmers, aquaculture, poultry, and livestock. The insurance for rice is designed on the basis of area yield index and is yet to graduate as a universal risk managing instrument against covariate losses. Under the decision, the state will support 100 per cent of insurance fees for poor farmers engaged in agricultural production and 80 per cent of insurance fees for nearly poor farmers. By 2014, the programme failed to reach scale, only accounting for 3 per cent of eligible households, and while the State and its various Ministries actively engaged press agencies to support take-up, very few farmers voluntarily purchased the insurance without full or partial subsidies. Implementation issues documented by Thang (2014) suggested that some crop losses were not covered under the insurance simply because the commune-based average yield insurance failed to take heterogeneity in productivity across large communes into consideration.

3 Conceptual framework and methodology

3.1 Conceptual framework

To estimate the theoretically derived economic value of agricultural insurance for a farmer, we rely on standard VNM utility function and expected utility theory. We compare this estimated value of actuarially fair insurance for the farmer with their self-elicited Willingness to Pay (WTP) and arrive at a differential, described as under- or over-valuation of insurance. The predicted value for farmers is taken as the risk premium/cost of risk implied by the VNM iso-elastic utility function; a function we reasonably assume is strictly concave in agricultural production. Strict concavity implies risk aversion where a consumer, a farmer in our setting, always prefers the certain outcome compared to a fair gamble. In other words, a farmer would prefer to receive the expected value of the gamble with certainty, rather than accepting the inherent risk associated with the participation in the gamble itself. Figure 1 below diagrammatically presents this concept and it can be concluded that for a gamble $g \equiv (\varphi \circ w, (1-\varphi) \circ (W))$ whenever $u(E(g))>u(g)$, the farmer is said to be risk averse, where 'φ' is the probability of loss 'L', such that '$L=W-w$'.

Figure 1: Concave utility function showing VNM Preferences over wealth 'w'



Source: Author's illustration based on the standard concave utility function.

The individual would prefer *E(g)* with certainty rather than the gamble '*g*', where *E(g)* in time period '*t*' is the abscissa of the convex combination of individual utilities *u(W)* and *u(w)* associated with the good (*W*) and bad states (*w*), represented as:

$$u(g)_t = \varphi . u(w) + (1 - \varphi). u(W) \quad \textbf{(1)}$$

Here, 'φ' is the probability of a bad state incurring an amount of loss given by '*L*', resulting in agricultural production level '*w*'.[4] We use the VARHS's individually reported value of crops and retrospective means of monetary losses due to natural disaster (floods, land-slides, typhoon, storms, and droughts) and agricultural shocks (pest infestation and crop disease) to infer '*w*' and '*L*'.[5] The probability of loss 'φ' is calculated by taking the proportion of years (out of five survey years), when the productivity of rice in a commune falls below the average mean productivity of rice in that commune over the surveyed years.[6,7] Therefore, if a commune reports two occasions when the productivity of rice fell below the average productivity for the surveyed periods, we assign the probability of loss for the households in that commune as 0.4.[8] We use this method

[4] The data reports farm area for the three most important crops only. We use this measure to standardise the values of crops and associated losses. Thus, the unit of 'w', 'W' and 'L' is VND/sq. metres, where VND is Vietnamese Dong; the local currency of Viet Nam.

[5] The missing values reported for agricultural losses imply no agricultural activity in the household in that period. We derive the value of agricultural loss 'L' as the mean of agricultural losses; calculated retrospectively for each household using all information on agricultural losses incurred in current as well as previous periods.

[6] We estimate probability of loss with respect to fall in productivity of rice because rice is the most important crop cultivated in the communes. The average days worked for rice by households is reported as 72 being greater than 53 days devoted for all other crops. Further, out of 10,745 households involved in agriculture, 77 per cent of the households cultivate some amount of rice (8,331 households).

[7] The data uses values reported from the commune survey undertaken as part of the VARHS.

[8] There are five survey years (2008, 2010, 2012, 2014 and 2016), hence φ =2/5 or φ =0.4. In some periods, the average productivity of rice was not reported for all the communes in the data. For example, out of 470 communes in 2008, average productivity of rice was not reported for 71 communes. Similarly, the value remained missing for 97

because, for the simplest form of agricultural area based index insurance, the process of receiving payments in the event of loss is based on this principle.

A risk-averse person would be willing to pay some amount called the cost of risk or risk premium, '*P'* in Figure 1, to obtain the expected utility of gamble *'g'* but with certainty. Jehle and Reny (2011) define '*P*' as the willingness to pay of an individual to avoid risk. We consider this '*P*' the economic valuation of insurance and use the class of standard iso-elastic utility function to calculate it. Equation 2 describes the Constant Relative Risk Aversion (CRRA) utility function (Arrow 1963, 1971).

$$U(w) = \frac{w^{1-\rho}}{1-\rho} \quad (2)$$

The key assumption of CRRA utility functions is that as wealth increases, the percentage of investment in risky assets remains constant. This implies that the level of risk aversion is measured as *relative risk aversion* (RRA) expressed as $-w * \frac{U''(w)}{U'(w)}$ and captured by the parameter 'ρ' in equation 2. We prefer the iso-elastic utility function over exponential utility function such as Constant Absolute Risk Aversion (CARA), as shown in equation 3.

$$U(w) = 1 - e^{-bw} \quad (3)$$

The choice of CRRA utility function is made over CARA, despite the analytical convenience of the latter because the predictions of CARA are counter-intuitive and contradicted by empirical studies (Alpanda and Woglom, 2007).[9] Also, a strand of asset pricing literature suggests that CRRA utility functions imply a stationary aggregate wealth to consumption ratio; which does not suffice for CARA utility functions because in CARA the optimal consumption is linear, not proportional in wealth, thus making the ratio non-stationary (Merton, 1992). Nevertheless, we present robustness checks using CARA utility function. In addition, a consumer's absolute risk aversion might decrease with increasing wealth; implying a Decreasing Absolute Risk Aversion (DARA), and hence an additional robustness check using a logarithmic utility function, as shown in equation 4, is performed. Equation 4 implies DARA because it satisfies the positively skewed nature of DARA functions.[10]

$$U(w) = \log(w) \quad (4)$$

3.2 Estimation of the coefficient of Relative Risk Aversion (RRA)

To derive utility with a CRRA utility function, we first estimated the value of the parameter 'ρ' (constant of RRA) in equation 2. A strength of this paper is that instead of parameterizing it on the basis of existing studies, we estimate this directly for each farmer through a Becker-DeGroot-Marschak (BDM) bidding game (Clemen and Reilly, 2001; Dacey, 2003). This is an incentive compatible game as shown in Figure 2 below, where the decision problem is such that; a gamble is played by an individual for some amount '*X*' with probability of winning being 0.5 with an equal

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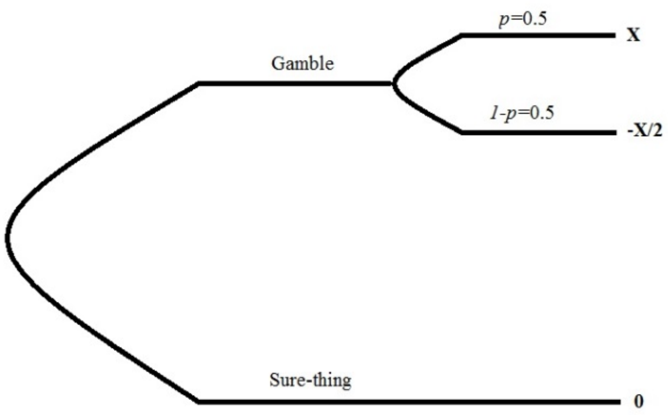
communes out of 472 in 2010, 65 communes out of 471 in 2012, 116 communes out of 488 in 2014, and 90 commune out of 482 in 2016. For these communes, the mean productivity of rice for the whole sample is then calculated by considering only the number of years when the average productivity data was reported.

[9] CARA counter-intuitively assumes that with increase in wealth, the absolute amount of investment in risky assets remains constant.

[10] It requires to meet the following necessary but not sufficient inequality: $u'''(X) = \frac{2}{X^3} (> 0)$

probability of loss which can be any proportion of the amount '*X*'.[11] The sure thing gives a pay-off of zero and it is the outcome associated with the individual's decision not to play the game.

Figure 2: A Becker-DeGroot-Marschak game



Source: Author's illustration based on the standard BDM game outcomes.

Following the method suggested by Dacey (2003), we assume that the decision maker has a CARA utility function, having the functional form as $U(X) = 1 - e^{-bX}$.[12] Here, the parameter '*b*' is called the constant of Absolute Risk Aversion (ARA)[13] and it has got the following relationship with *RRA*:

$$RRA = ARA * X \quad (5.1)$$

since,
$$ARA = \frac{-U''(X)}{U'(X)} \quad (5.2)$$

multiplying (5.2) with '*X*' would produce *RRA (ρ)* as shown in equation (5.1), which we can use in estimating the risk premium/cost of risk from the CRRA utility function, as shown in equation (2).

Returning to the BDM gamble, a person would be indifferent between the sure thing and playing the gamble if and only if:

$$0.5U(X) + 0.5U\left(-\frac{X}{2}\right) = U(0) \quad (6.1)$$

which becomes;

[11] Considered (X/2) in Figure 2, but it can be any amount such as (X/3), (X/4), (5X/3), etc.

[12] Here, we consider CARA because the final winning amount associated with each bid of loss in the BDM game does not change and is fixed at 6,000 VND. Thus, absolute risk aversion is quite representative of the riskiness of individuals. However, the CARA function would have not been suitable if the winning amount was changing with every successive bets, since that situation would have changed the attitudes of people relatively and not in absolute terms.

[13] It is also called the Arrow-Pratt measure of absolute risk aversion named after Kenneth Arrow and John W. Pratt.

$$0.5(1-e^{-bX})+0.5\left(1-e^{b\frac{X}{2}}\right)=1-e^{-b*0} \qquad \textbf{6.2)}$$

this reduces to;

$$0.5(1-e^{-bX})+0.5\left(1-e^{b\frac{X}{2}}\right)=0 \qquad \textbf{(6.3)}$$

$$e^{-bX}+e^{b\frac{X}{2}}=2 \qquad \textbf{(6.4)}$$

assuming *k*=*bX*

$$e^{-k}+e^{\frac{k}{2}}=2 \qquad \textbf{(6.5)}$$[14]

We derive the roots of equation (6.5) and after solving for the value of '*k*', and substituting the value of '*X*', we solve for the ARA, i.e. '*b*'. Once we have the parameter '*b*', we can follow the step from equation (5.1) and multiply it with the value of '*X*' to obtain *RRA*.[15] This value of *RRA* can then be treated as the measure of relative risk aversion and can be used as parameter 'ρ' in equation (2). In the VARHS data, the BDM game is played in 2010, 2012 and 2014 surveys, where the respondents are asked to play a game in which the winning amount (*X*) is fixed to 6,000 Vietnamese Dong (VND) ('*p*'=0.5) and the loss amounts are fixed to 2,000, 3,000, 4,000, 5,000, 6,000, and 7,000 VND for subsequent rounds. We consider the highest bid of loss amount up to which the respondent stays in the game and calculate *RRA* at that amount with the method as mentioned above (5.1-6.5). The results of the BDM game show that 35 per cent of the households never participate in the game and reject the game in the first bid across all waves, i.e. at the loss amount of 2,000 VND. We make an assumption that these respondents are not infinitely risk-averse and would have participated in the gamble had the starting bid of loss been any lower than 2,000 VND. Therefore, we calculate RRA for these households taking the starting bid as 1,000 VND for the gamble. Robustness checks using starting bids of 1,500 VND and 500 VND are also conducted to capture any sensitivity to this assumption.

For households that play the game at least once, we assign the mean value of RRAs calculated from available data for all years, informed by empirical studies that suggest that RRA can be considered constant over time (Brunnermeir and Nagel, 2008 and Chiappori and Paiella, 2011).[16] We take this approach also due to the fact that of the 65 per cent of all households in the panel who play the game at least once, 63 per cent play the game on one occasion, 31 per cent on two occasions and 6 per cent on three occasions. As the main results could be influenced by this approach, we also conduct our entire analysis in two alternative ways; using actual BDM game observations and means for missing years for households who played at least once and using a smaller sample of only actual BDM observations, thus excluding observations where the assumption of lower starting bid of 1,000VND is required.

[14] Here, the equation would change with changing amounts of losses. This equation holds when the loss is (1/2) proportion of the winning amount 'X'. If winning amount was 6,000, then the loss amount here would be 3,000. If the loss amount was 2,000, then this equation would be: $e^{-k}+e^{\frac{k}{3}}=2$, because the loss amount has changed to (1/3) proportion of X.

[15] These are shown in Table 1. Essentially, these values of RRA are also the roots for 'k', since k=bX, where b=ARA.

[16] Our data shows that where we have repeated observations of the BDM game, 68 per cent of households stayed within plus or minus 1,000 VND and 91 per cent within plus or minus 2,000 VND. The game had eight possible answers.

The values of respective RRAs calculated are shown by value of starting bid of loss in Table 1 and it can be seen that relative risk aversion decreases with increasing amounts of losses associated with the gamble, thus implying a less risk averse attitude of people who participate in the gamble for these increasing stakes.

Table 1: Relative Risk Aversion calculated from the BDM game

Starting Bid of Loss (VND)	Relative Risk Aversion
1,000	4.11
2,000	1.82
3,000	0.96
4,000	0.49
5,000	0.19
6,000	0
7,000	-0.14

Source: Author calculation based on the VARHS data.

We find that those who play the BDM game are systemically different from those who do not, suggesting that decisions to play the game are non-random. However, we do have at least one response for 65 per cent of households, and in our subsequent econometric analysis we employ a range of observable controls, and time and household fixed effects to control for unobservable differences.

3.3 Econometric specifications

With the calculation of 'ρ' for an iso-elastic utility function implying CRRA, we estimate risk premium/cost of risk (represented as '*P*' in Figure 1), and identify our primary dependent variable as the difference between the self-elicited '*WTP*' and the respective '*P*' from CRRA utility function. Equation 7 lists the potential explanations of this differential.

$$(WTP - P)_i = \delta_i(demographic\ factors, social\ capital, financial\ status, risk - coping\ strategies,\ behavioural\ factors) \quad (7)$$

The functional form, as stated above, is taken as a reduced form regression equation with the econometric specification, as shown in equation 8.

$$(Differential)_{it} = \alpha + (\boldsymbol{DEMO})_{it}\gamma + (\boldsymbol{FinActivity})_{it}\delta + \beta(\boldsymbol{SocCap})_{it} + (\boldsymbol{RiskCoping})_{i}\rho + (\boldsymbol{Behav})_{it}\sigma + \boldsymbol{\theta}_i + \boldsymbol{\tau}_t + \varepsilon_{it} \quad (8)$$

DEMO is the vector of demographic variables such as age, education, log of net total income, and household status of being poor as designated by MOLISA (Ministry of Labour - Invalids and Social Affair). The vector *FinActivity* includes the set of controls such as household borrowing, insurance status, as well as public or private money transfers. We also take a measure of farm investment by considering the log of total investment in pesticides by the household. The control *SocCap* represents household membership in a farmer union. The vector *RiskCoping* controls for the risk-coping activities which households undertake to cope with shocks (idiosyncratic or co-variate in nature). We consider variables such as sale of land, borrowings from formal and informal sources, use of savings, and inactivity (doing nothing) as the measures of risk responses. The use of these variables helps understand how such activities influence insurance demand. Finally, *Behav* represents the vector of behavioural factors that we consider as per the available information in the VARHS data-set. The behavioural biases that we consider here are: first, over-confidence bias using the gamble amounts elicited for a lottery of winning 2 million VND; and second, trust using the response of people on the belief that people are honest and can be trusted. The information for these behavioural biases is available only for 2010, 2012 and 2014; therefore, we assign the mean values of these responses to 2008 and 2016 in order to deal with the missing information.[17]

The regression equation is estimated controlling for household level fixed effects 'θ_i' and time fixed effects as shown by 'τ_t'. The use of fixed effects estimation and inclusion of time-varying control variables deals with concerns about endogeneity due to omitted variable bias, unobserved heterogeneity as well as any measurement error in the surveyed variables. The standard errors are clustered at commune level. Empirical results are discussed in Section 5.

Already mentioned in this section, are robustness related to the choice of the utility function when ascertaining the economic value of agricultural insurance for each farmer, and three alternative ways of dealing with non-responses to the BDM game. To further validate our results, we assess how sensitive our results are to approaches dealing with non-responses to the WTP question and for the two missing years of years of behavioural bias data. In our main analysis we drop the 6 per cent of non-responses to the WTP question, but we also consider these to be the same as zero valuation/not interested. In addition, we focus only on existing years for the behavioural bias data. In Section 5 we present the key robustness checks, but further checks are available in appendices B and C.

4 Descriptive statistics

The dataset used in this study comes from Viet Nam Access to Resources Household Survey (VARHS) for 2008, 2010, 2012, 2014 and 2016. The five years of panel represents an unbalanced data-set of around 2,200 households in 2008 and 2010 and around 2,700 households in 2012, 2014 and 2016 giving us a well-balanced panel of 2,131 households. Our analysis is based on the full sample for all households present in the surveys, thus giving approximately 12,000 observations for the five-year time period.

4.1 Willingness to pay

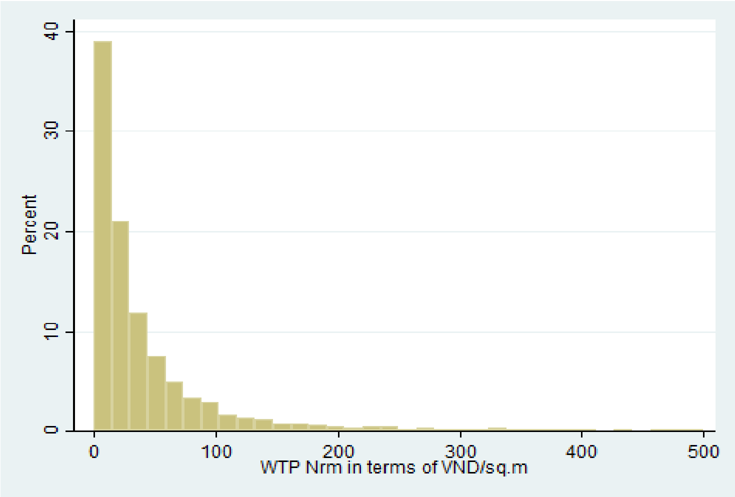
The measure of individually reported WTP in VARHS survey was recorded using an open-ended contingent valuation framework.[18] Individuals were asked to state VND amounts that they would like to pay if an agricultural insurance against the damage of crops was available to them. The respondents gave their values as either zero, not interested, or any other amount which they deemed worth paying for agricultural insurance. We treat the response 'not interested' as the same as paying zero amount. The insurance here did not actually exist but was rather hypothetical, therefore the question did not contain any further details such as the coverage options or details about the conditions of payment. The stated amounts were in absolute currency form without any bidding framework or closed bounds. It is worth noting that this paper does not disentangle any errors in WTP directly, which might have resulted from the reporting or strategic bias as suggested in Arrow et al. (2001).

[17] There are no missing values for our behavioural variables in the years the question was asked.

[18] Appendix A provides full details of all the variables used in this paper.

When we treat the not interested response as zero, it is observed that 76 per cent of households in the data have zero WTP.[19] In order to improve understanding of the WTP distribution, Figure 3 shows the values of WTP near zero with the upper limit being fixed at 500 VND/sq.m and lower limit assigned as greater than zero (excluding the zero response).[20] As the graphs shows, majority responses are concentrated in the region from zero to 200 VND/sq.m, containing 98.86 per cent of the total responses.

Figure 3: WTP responses from 0 to 500 VND/sq.m (excluding the 0 response)



Source: Author illustration based on the recordings of the VARHS data.

Further, the zero (or not interested) responses for WTP are reported in Table 2. These high zero responses raise a concern over the validity of the WTP measure in accordance to the conclusion of the Federal Panel headed by Kenneth Arrow in 1993. The Federal Panel suggested that a high level of non-response in WTP is indicative of unreliability in the WTP measure. However, the non-response in the present case is representative of the low demand of farmers insurance recorded in the VARHS data, as shown in Table 3. We purport that the large number of those with zero valuation of agricultural, many of whom claimed not to be interested, are providing valid estimates of their valuation of agricultural insurance.

Table 2: WTP responses given as zero/not interested

Year	Zero Responses for WTP	Observations	Percent
2008	1,324	1,831	72.31
2010	1,246	1,972	63.18
2012	2,049	2,734	74.95
2014	2,213	2,704	81.84
2016	2,202	2,663	82.69
Overall	9,034	11,904	75.89

Source: Author calculation based on the VARHS data.

[19] Not Interested is different from a normal missing value because out of the total sample size of 12,678 households, 701 values were reported as missing (5.53 per cent) while others were either a positive WTP (23.21 per cent), zero WTP (1.04 per cent) or not interested response (70.22 per cent).

[20] In order to make the willingness to pay measure comparable to the value of crops we use value of crops reported as VND/sq.m.

Table 3: Household membership in the Farmers Insurance

Year	Membership	Observations	Percent
2008	20	1,835	1.09
2010	15	2,230	0.67
2012	0	2,487	0.00
2014	0	1,758	0.00
2016	1	2,417	0.04
Overall	36	10,742	0.34

Source: Author calculation based on the VARHS data.

We find evidence that increasing agricultural losses do not tend to decrease the zero valuation of insurance. This is shown in Table 4, where the valuation of insurance as zero is actually higher for households that suffer losses above 5 per cent.[21]

Table 4: Distribution of zero valuation of WTP as per the extent of loss

Year	(WTP=0|Loss<=5%)	(WTP=0|Loss>5%)	Observations
2008	72.40%	72.19%	1,831
2010	58.48%	69.21%	1,972
2012	69.33%	84.74%	2,734
2014	78.95%	87.75%	2,704
2016	77.40%	92.15%	2,663
Overall	72.35%	81.75%	11,904

Source: Author calculation based on the VARHS data.

We find that there are statistically significant differences between those who fail to answer the WTP question (6 per cent), and those who do answer (94 per cent). In our main results, we simply exclude missing non-responses.

4.2 Data description

Table 5 summarizes the information directly associated with the CRRA utility function and provides information regarding the variables from Figure 1. The average value of Mean Loss (L)[22] calculated from the data is 930 VND/sq.m (US$0.04 approx.)[23], with an estimated probability of loss (φ) being almost half at 0.47. With this associated probability of loss, the average expected value of crops (shown as *E(g)* in Figure 1) is estimated around 4,506 VND/sq.m (US$0.20 approx.). This lies between the bad state (shown as *w* in Figure 1) and good state (shown as *W* Figure 1) outcome and is greater than the average certainty equivalent (shown as *CE* in Figure 1) value of 4,413 VND/sq.m (US$0.19 approx.). The difference between the average expected value of crops and CE gives average risk premium (shown as *P* Figure 1) of 110 VND/sq.m (0.005US$ approx.).[24] Further, the average *RRA* associated with respective utilities of good and bad state

[21] The trend persists for the distribution of losses above or below 10 per cent.

[22] The mean of losses is calculated retrospectively for each household. In case if previous year's value of losses is not available, the mean is assigned as the current year's loss incurred by the household, as the missing value of loss in any year is associated with no agricultural production in that period.

[23] 1VND=0.000004 US$ (26th April, 2018).

[24] Calculation of risk premium can yield negative values in the extreme case when people have negative RRA. Here, negative RRA implies that an individual will pay positive amount to remain in the gamble (uncertain environment) thus depicting risk-loving nature. Since there were some households in the sample who showed negative RRAs, their risk premium is taken as zero. Due to these changes that were made in the data, the Mean(Risk Premium) is no longer found to be exactly equal to Mean(Expected Income) - Mean(Certainty Equivalent) = 4,506 - 4,413 = 93 but is reported as 110 VND.

outcomes is found as 1.92, lying between the relative risk aversion's of the first losing bid of 1,000 VND (*RRA* of 4.11) and the final losing bid of 7,000 VND (*RRA* of -0.14).

Table 5: Data description of variables used in VNM utility function

Variables	Observations	Mean	Std.Dev.	Min	Max
Bad State Value (*w*)	10,423	4.099	10.51	0	700
Good State Value (*W*)	10,423	4.839	17.26	0	836.7
Mean Loss (*L*)	11,517	0.930	17.0	0	833
Loss Probability (φ)	12,461	0.473	0.244	0	1
Expected Value (*E(g)*)	10,271	4.506	13.70	0	700
Certainty Equivalent (*CE*)	10,100	4.413	12.19	0.000269	700
Risk Premium (P)	10,962	0.110	3.968	0	367.4
RRA (*ρ*)	12,495	1.922	1.592	-0.143	4.11
Bad State Utility (*u(w)*)	10,232	252.8	1538	-71.51	50,033
Good State Utility (*u(W)*)	10,232	316.9	2559	-71.51	146,667

Notes: w, W, L, E(g), and CE reported as '000VND/sq.m.

Source: Author calculation based on the VARHS data.

Table 6 shows the descriptive statistics of variables used to estimate regression equation 8.

Table 6: Descriptive statistics

Variable	Observations	Mean	Std.Dev.	Min	Max
Differential	10,329	-0.080	4.122	-367.42	29.41
Net Total Income	12,677	87,332	124,816	0	4,522,582
Pesticide Invest.	10,410	1833	7516	0	261,000
Educational Grade	12,673	6.99	3.69	0	12
Age	12,668	52.93	14.36	13	99
Designated as Poor	12,677	0.137	0.344	0	1
Farmer Union	11,004	0.458	0.498	0	1
Risk Coping 1: Borrow	12,678	0.036	0.188	0	1
Risk Coping 2: Sold land	12,678	0.003	0.0547	0	1
Risk Coping 3: Use Saving	12,678	0.058	0.233	0	1
Risk Coping 4: Did Nothing	12,678	0.181	0.385	0	1
Private Transfer Receipt	11,751	0.574	0.494	0	1
Public Transfer Receipt	11,751	0.500	0.500	0	1
Borrowing Activity	12,677	0.390	0.488	0	1
Any Insurance	12,677	0.893	0.309	0	1
Savings Activity	11,553	0.829	0.377	0	1

Notes: Monetary Values expressed in 000'VND. Differential expressed in '000VND/sq.m.

Source: Authors' calculation based on the VARHS data.

The differential calculated between the WTP and Risk premium (P) shows a negative mean value of minus 80. The mean value of annual net total income of households is estimated around 87 million VND (US$3,858 approx.). The average educational grade measured on a 12-point grading system (up to end of secondary education) is around 7. The average age of the household head is 53 years, after adjusting for outliers. It is reported that almost 45 per cent of household have membership of a farmer's union and average household investment on pesticide is reported around 1.8 million VND (US$80 approx.).

For self-reported risk coping strategies, almost 5.8 per cent of household's report use of savings in dealing with an income shock that occurred in last two years.[25] This is higher than the 3.6 per cent cases when household resorted to borrowings in the event of an income shock. The sale of

[25] Income shock here refers to any event related to losses due to natural disasters, agricultural shocks, avian flu, change in crop price, shortage or change in price for key agricultural inputs, change in prices of food, unemployment, unsuccessful employment, loss of land, crime, divorce or abandonment, serious illness, injury or death or any other shock not included in the above.

land due to an income shock is very small and is reported by only 0.3 per cent of the sample. In terms of receiving private transfers from children, relatives, and other friends not staying in the household but residing elsewhere, almost 57 per cent of household report doing so. On the other hand, public transfers in the form of government social security programmes and emergence benefits, unions, pensions, etc. is reported by 50 per cent of the households. For the financial activity variables, around 89 per cent of household's report of having some kind of insurance, 83 per cent households report to indulge in savings activity, whereas 39 per cent of the household's report borrowings activity. The unusually high insurance proportion of households in Viet Nam, as compared to any other developing country can be credited to the government's focus on achieving Universal Health Coverage (UHC) for households through the provision of different forms of free medical insurance for children, ethnic minority and the poor.[26]

Our behavioural variables are available for only 2010, 2012, and 2014 and are summarized in Table 7. To preserve the sample size and conduct analysis for the entire time frame of VARHS, the two missing years are given the mean values calculated from available years. Having done so, the binary variable that was previously recorded as 1 if the respondent believed that most people are honest and can be trusted (and zero otherwise) is transformed into an intensity measure from zero to 1.[27] The mean value of this variable being 0.84 shows that the majority of people consider others to be trustworthy. This variable is considered an imperfect proxy measure for trust in formal financial institutions. The other factor considered for the analysis is the gamble value that people report for playing a gamble for a prize of 2 million VND with 10 per cent chance of winning. We interpret this variable as a measure of over-confidence in winning a lottery; admittedly a lottery with attractive odds.

Table 7: Behavioural factors

Variable	Observations	Mean	Std.Dev.	Min	Max
Trust	12,614	0.84	0.31	0	1
Gamble Value	12,614	3.169	12.96	0	300

Notes: Values for the gamble are expressed in 000'VND.

Source: Authors' calculation based on the VARHS data.

5 Results

5.1 The differential between WTP and the risk-premium

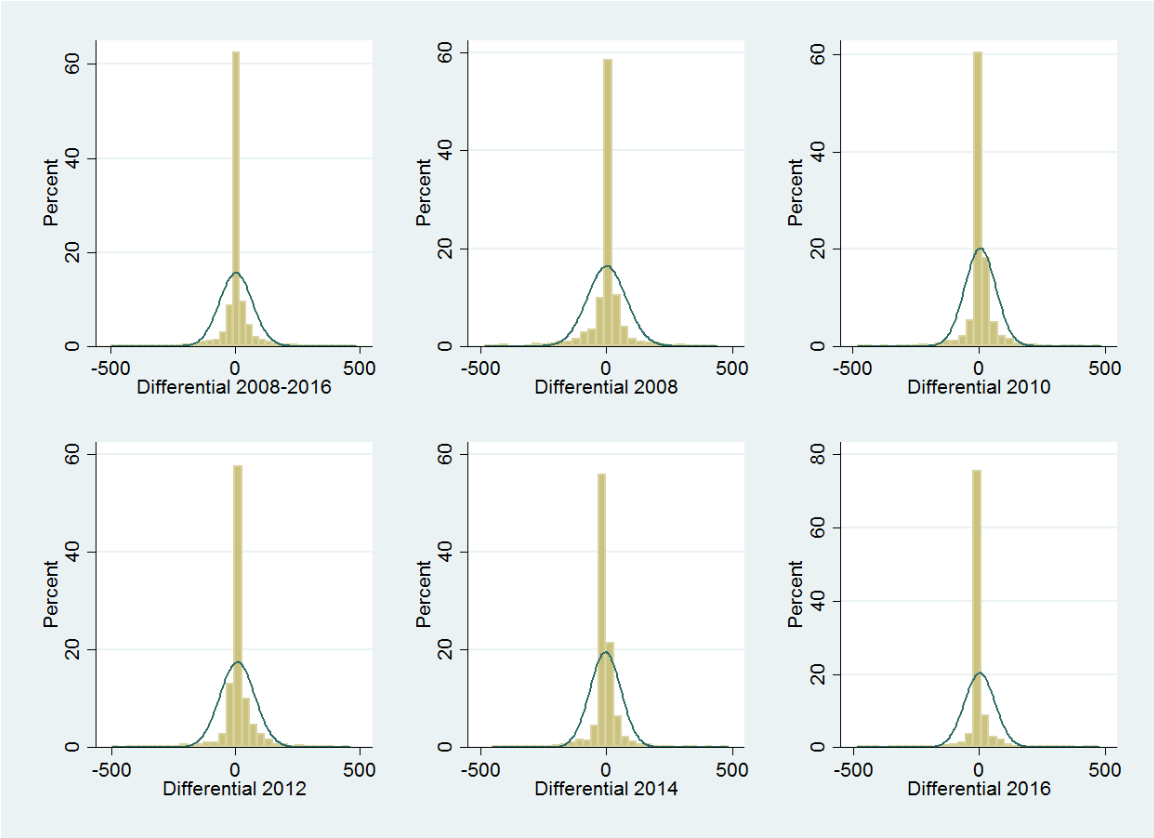
The first hypothesis stated relates to the significance of the differential between WTP of households and implied risk-premium from CRRA utility function. Figure 4 shows the distribution of this differential across the surveyed periods for pooled as well as individual surveys. Although the actual range of the estimated differential is from -367,000 VND to +30,000 VND, the graph for the pooled survey from 2008 to 2016 contain 69.20 per cent of the differential values falling in the range of -500 to +500 VND (See Figure 4). The remainder 29.09 per cent values are the

[26] Of the total 10,742 responses for the insurance information in all surveyed years, approximately 62 per cent of household have medical insurance (amongst options such as health insurance, free health insurance for the poor, and free health insurance for children), 27 per cent households have vehicle insurance and around 25 per cent households possess education insurance.

[27] The resulting intensity of this variable from 0 to 1 is a measure of how strongly a respondents believes that people can be trusted. It is an increasing scale.

differential equal to zero, while around 1.71 per cent are extreme values above and below the range of -500 to +500 VND.

Figure 4: The distribution of the differential between WTP and risk-premium



Note: These graphs contain 69.20 per cent of the data, with the remaining observations made up of zero values (29.09%) and extreme values outside the rate -500 to +500 VND (1.71%).

Source: Author's illustration from the estimates of the differential calculated on the VARHS data.

Inspection of these graphs suggests that approximately 58.2 per cent of the values of the differential concentrate around zero (-50 to +50 VND/sq.m.). The results of the t-tests confirm that there is a statistically significant difference between average WTP and average risk-premium. The risk-premium for this test uses CRRA utility function and we find that average WTP is systematically lower than the derived economic value of agricultural insurance. The results for this test are shown in Table 8. A negative differential was expected, given that the overall zero valuation of WTP is close to 76 per cent. The differential between WTP and the economic value of insurance is significant at the 10 per cent level and this result is robust to different lower bound BDM game assumptions and functional forms for utility.

Table 8: Difference of means of WTP and risk premium

Functional Form	WTP	Risk Premium	Differential	P-value
CRRA	32.82	113.21	-80.39*	0.05
CRRA1500	32.82	109.05	-76.23*	0.06
CRRA500	32.82	119.87	-87.05**	0.03
DARA	32.75	123.21	-90.46**	0.04
CARA	35.44	221.76	-186.32**	0.02

Notes: WTP and Risk Premium expressed as VND/sq.m.

Source: Authors' calculation based on the VARHS data.

5.2 Understanding the differential

As discussed in Section 3.3 we employ a reduced-form fixed-effect panel regression to investigate the importance of socio-economic and demographic factors (hypotheses 2), existing risk coping mechanisms (hypotheses 3) and behavioural factors (hypotheses 4). First, we assess differences in means for the explanatory variables, categorized on the basis of households who value insurance less than their estimated risk premium versus household who value insurance more than their estimated risk premiums, referred to as under-valuation and over-valuation (see Table 9).

Before controlling for other factors, we find a negative and significant difference for education level indicating that higher educated households overvalue insurance as compared to households who have less educated heads. We find that those with other types of insurance, those who have borrowed recently, members of farmer's union and those who trust others are more likely to overvalue agricultural insurance. On the other hand, households with older heads, engaging in more risk-coping activities (such as borrowing or savings) and have higher rate of public and private transfers are more likely to undervalue agricultural insurance.

Table 9: Difference of means for explanatory variables for valuation negative vs positive

Variable	Negative	Positive	Difference	P-Value
Net Total Income	88,741,487.24	88,680,763.94	60,723.30	0.98
Educational Grade	6.86	7.39	-0.53***	0.00
Age	53.26	51.78	1.48***	0.00
Farmer Union	0.46	0.57	-0.11***	0.00
Designated as Poor	0.15	0.10	0.05***	0.00
Pesticide Invest.	1,411,348.12	2,366,578.40	-955,230.27***	0.00
Risk Coping 1: Borrow	0.04	0.03	0.01**	0.01
Risk Coping 2: Sold land	0.00	0.00	-0.00	0.83
Risk Coping 3: Use Saving	0.07	0.06	0.01	0.22
Risk Coping: Did Nothing	0.22	0.19	0.03***	0.00
Private Transfer Receipt	0.59	0.50	0.08***	0.00
Public Transfer Receipt	0.53	0.47	0.06***	0.00
Borrowing Activity	0.39	0.47	-0.08***	0.00
Any Insurance	0.94	0.96	-0.02***	0.00
Savings Activity	0.85	0.85	-0.00	0.86
Trust	0.83	0.85	-0.02***	0.00
Gamble Value	3,538.75	2,534.68	1,004.07***	0.00

Notes: Monetary values expressed in 000'VND. Gamble value expressed as VND.

Source: Author calculation based on the VARHS data.

The results for the fixed-effects regression for equation 8 are shown in Table 10.[28] In addition to the differential, we also present the findings for WTP (column 2) and the risk premium using the CRRA utility function (column 3). When interpreting the results for the differential in column 1, it is worth noting that the value of the differential ranges from negative to positive, therefore positive coefficients of the regression results should be interpreted as the likelihood towards over valuation of insurance with respect to the risk premium implied by CRRA utility functions.

Education is positively related to WTP in our main specification. This result is significant at the 10 per cent level of significance when household- and time-fixed effects are included. Higher education levels mean households value agricultural insurance more highly through one, or a combination of, greater understanding of insurance, greater confidence in formal financial

[28] Eleven extreme values out of 9,640 observations are excluded from the dependent variable of differential. This forms 0.0011 per cent of the data.

institutions or involvement with early adopting social groups.[29] However, the coefficient for education is sensitive (i.e. not robust) to the exact specification and lower bound of risk aversion.

Private transfers such as from non-household based family members, friends and neighbours (including internal or overseas migrants) are negatively related at the 10 per cent level to both WTP and the differential between reported WTP and predicted economic value and this result holds for different versions of functional forms for utility and assumptions about the non-responses. This finding may be for one of two reasons. First, it is possible that having access to remittances in times of need reduces the demand for insurance. Second, having a stream of remittances can mean that cash flow at household level reduces the demand for formal insurance. Examining the reasons for the receipt of these payments, we conclude that private transfers can be interpreted as ongoing financial support rather than one-off shock responses. The most cited purpose is 'no specific reason' (39%), with wedding/funeral/celebration (18%), child support (11%), medical expenses (10%) and educational expenses (5%). Hence, it appears that regular addition to cash flow, in the form of private transfers, reduces household demand for formal insurance.

Membership of a farmer's union in Viet Nam has been interpreted by some as a form of social capital (Newman and Kinghan, 2015) but membership is likely to indicate pro-active behaviour by farmers who wish to access technology, information and collective purchasing options. The data shows that 55 per cent state that membership provided with access to agricultural inputs or technology, 11 per cent to credit and insurance, 7 per cent to education or training, and 3 per cent to market access. We find that membership of a farmer's union is positively related to both willingness to pay and differential between reported WTP and predicted economic value of insurance (both at the 10% significance level) in our main results. However, only the relationship with the differential holds for all our robustness checks.

We find no robust evidence that risk coping mechanisms are related to WTP or the differential between WTP and the risk premium. None of our four measures of risk coping mechanisms show consistent relationships with our dependent variables.[30] This result may be related to the conditional nature of the variable employed as respondents are only asked what mechanism they use if they report having a recent shock. As a result, we cannot completely rule out the relevance of this channel in agricultural insurance demand.

[29] Other mechanisms could also be imagined such as how education may altering risk perceptions or access to alternative risk management strategies.

[30] Borrowing as a risk-coping activity is found to be significant for differential in our main specification but not for a range of alternative specifications.

Table 10: Main regression results

Variables	(1) Differential	(2) WTP	(3) Risk Premium
Log of Net Total Income	15.711*	28.754	-25.762
	(8.832)	(23.463)	(24.932)
Educational Grade Obtained	10.102	14.731*	0.669
	(6.985)	(7.831)	(6.076)
Age of Household Head	-1.726	-1.141	1.018
	(1.845)	(1.904)	(1.618)
Designated as Poor	-30.945*	-41.278*	162.380
	(16.884)	(24.456)	(155.710)
Farmer Union Membership	57.249*	48.389*	5.396
	(30.912)	(28.208)	(11.332)
Log of Pesticide Investment	4.165	1.034	-2.942
	(2.659)	(1.942)	(1.918)
Risk Coping 1: Borrow	-59.766*	-11.487	80.624**
	(31.822)	(11.641)	(40.012)
Risk Coping 2: Sold land	-14.752	-35.244	-36.773
	(27.101)	(26.356)	(26.541)
Risk Coping 3: Use Savings	7.265	-5.403	42.401
	(23.550)	(24.433)	(32.995)
Risk Coping 4: Did Nothing	23.379	40.664	64.159
	(26.399)	(30.633)	(72.357)
Private Transfer Receipt	-59.656*	-69.194**	29.642
	(31.961)	(33.367)	(24.006)
Public Transfer Receipt	-46.285	-56.321	-12.544
	(42.662)	(42.898)	(33.090)
Borrowing Activity	31.773	41.327	-41.034*
	(22.488)	(25.426)	(22.845)
Any Insurance	13.175	59.585	-7.714
	(20.923)	(41.046)	(16.537)
Trust	-8.781	-25.377	
	(20.582)	(16.520)	
Log Gamble Value	4.260	6.215*	
	(2.925)	(3.264)	
Mean Loss		-0.024	
		(0.241)	
Constant	-417.395**	-648.940	533.271
	(178.941)	(488.634)	(351.159)
Observations	8,033	8,365	8,386
R-squared	0.012	0.014	0.004
Number of UID	2,403	2,424	2,418
Household FE	Yes	Yes	Yes
Commune Controls	Yes	Yes	Yes
Time FE	Yes	Yes	Yes

Notes: Standard Errors clustered at commune level, shown in brackets.

*** p<0.01, ** p<0.05, * p<0.1

For variables in logs, all values reported as zero replaced by 1 to avoid missing observations

Relative Risk Aversion used as a regressor for WTP but omitted in the results.

Source: Author calculation using VARHS data on Stata14.

While income is related to the differential in our main specification, this relationship is sensitive to the functional form we assume for utility and whether or not we assume lower bounds for those who refuse to play the BDM game (See appendix C). The absence of any conclusive relationship between income and demand for insurance may suggests that social capital and behavioural factors may be limiting factors for agricultural demand even as incomes gradually rise in developing countries. In similar fashion, the significance of the relationship between whether a household is considered poor or not by MOLISA is not robust to our various specifications and assumptions about non-responses.

The data allows us to explore two behavioural factors; trust and over-confidence. As it can be seen for Table 10, for the WTP, the measure for over-confidence (represented by the log of gamble value) holds a positive and significant coefficient in our main specification. The direction of this result was unexpected, since our expectation was that a respondent depicting over-confidence would be likely to under-value insurance, deeming it unnecessary. Instead, our interpretation of this result is that a level of over-confidence may be needed to believe agricultural insurance will pay out when you have a claim. This may be due to perceived unviability of previous agricultural schemes in Viet Nam, perceived problematic claims processes and/or lack of confidence in the yield calculations on behalf of the insurer. We interrogate this result further and find that the relationship with WTP is robust across all, assumptions about the lower bound for risk aversion and approaches to non-responses, varying between 5 per cent and 10 per cent significance.

We find no robust evidence of a relationship between trust and WTP or the differential for any specifications across the three dependent variables. Results are insignificant for regressions conducted using risk premium as the dependent variable.

5.3 Alternating loss periods in risk premium calculation

In the regressions shown in Table 10, the calculation of risk-premium from CRRA utility function considers '*L*' as the mean of agricultural losses calculated retrospectively, including current year and responses in previous time periods. Long term panel data might help ascertain what length of time for losses has the most effect on WTP for insurance. While this is an interesting question, in the absence of such data, we assess, what is the impact on our findings of restricting the loss period to the immediate past – current period and previous year. This alternative approach alters the value of '*L*' in the iso-elastic utility function setup, thus changing the calculation of the risk premium and subsequently the differential between WTP and risk premium. Table 11 shows our main results hold in terms of direction, magnitude and significance.

We present in the appendices additional robustness checks regarding our assumptions about non-responses for the BDM game, WTP, and the behavioural measures. Appendix B provides the full set of econometric specifications for our main results (Table 11) and our main results with truncated loss period (current and previous year). Appendix C provides four further robustness checks as follows. First, we omit households who never participated in the BDM game. Second, we use actual observations and means in years a household did not play the game (instead of means for all years). Third, we redo the analysis combining the previous two approaches. Fourth, rather than dropping the 6 per cent of households who do not provide an answer to the WTP question, we assume that non-responses are zero valuation/not interested.[31] Fifth, we conduct analysis for behavioural factors by considering only the years when responses for behavioural factors were recorded. For each robustness checks, our main results are found to be consistent in significance and direction.

[31] Please note that an attachment to this paper, which provides further robustness checks that combine in different ways the different assumptions, is available on request from the authors.

Table 11: Regression results using differential and risk-premium estimated from recent losses (Current and last period)

Variables	(1) Differential	(2) WTP	(3) Risk Premium
Log of Net Total Income	20.847**	18.754	-11.318
	(10.599)	(13.924)	(30.037)
Educational Grade Obtained	8.481	14.232*	1.436
	(7.344)	(7.629)	(12.498)
Age of Household Head	-2.234	-1.512	1.207
	(2.253)	(1.892)	(2.384)
Designated as Poor	-36.246*	-44.481	236.077
	(19.027)	(27.141)	(226.340)
Farmer Union Membership	59.896*	52.167*	18.862
	(34.519)	(29.703)	(25.556)
Log of Pesticide Investment	4.167	1.230	-1.893
	(2.763)	(2.073)	(2.434)
Risk Coping 1: Borrow	-103.695**	-7.977	137.382**
	(48.184)	(12.038)	(55.749)
Risk Coping 2: Sold land	-2.016	-33.032	-80.424
	(33.765)	(24.883)	(53.813)
Risk Coping 3: Use Savings	8.873	-23.492	66.043
	(25.549)	(37.993)	(63.606)
Risk Coping 4: Did Nothing	18.291	35.025	83.007
	(27.795)	(27.776)	(104.042)
Private Transfer Receipt	-55.073*	-65.828**	86.962
	(32.788)	(32.557)	(73.519)
Public Transfer Receipt	-50.317	-51.700	-6.264
	(43.692)	(42.559)	(50.892)
Borrowing Activity	32.183	38.783	-84.855*
	(25.731)	(24.076)	(46.905)
Any Insurance	19.704	62.053	-12.531
	(23.006)	(44.598)	(17.773)
Trust	0.955	-29.816*	86.951
	(29.186)	(17.429)	(81.640)
Log Gamble Value	3.318	5.670*	9.212**
	(3.028)	(3.013)	(4.114)
Mean Loss		0.037	
		(0.083)	
Constant	-494.509**	-484.363	161.336
	(216.220)	(306.369)	(412.875)
Observations	7,936	8,000	8,287
R-squared	7,936	8,000	8,287
Number of UID	0.012	0.013	0.004
Household FE	Yes	Yes	Yes
Commune Controls	Yes	Yes	Yes
Time FE	Yes	Yes	Yes

Notes: Standard Errors clustered at commune level, shown in brackets.

*** p<0.01, ** p<0.05, * p<0.1

For variables in logs, all values reported as zero replaced by 1 to avoid missing observations

Relative Risk Aversion used as a regressor for WTP but omitted in the results.

Source: Author calculation using VARHS data on Stata14.

5.4 Robustness checks

In this section, we present a reduced set of robustness results for the main analysis. We first consider different functional forms to calculate the differential, in addition to the CRRA utility function. We re-estimate the main specification with the risk premium implied by DARA and CARA utility function, as discussed in section 3.2.

As a further check for the consistency of relative risk aversion used in the CRRA utility function, we alternate our assumption of considering the starting losing bid of the BDM game for people who did not participate in the first round but chose to stay out of the game. Therefore, further to considering the starting losing bid of 1,000 VND for these household, we estimate the relative risk aversion by considering additional options such as 1,500 VND and 500 VND. This is done to test the sensitivity of our assumption. Thus, this leads to estimation of two new risk-premiums and subsequently two new differentials, represented by CRRA1,500 and CRRA500 in Table 12.

Table 12: Robustness results using different functional forms and starting bids for BDM game

Variables	Differential CRRA1500	Differential CRRA500	Differential DARA	Differential CARA
Log of Net Total Income	14.357*	16.726*	4.051	15.834
	(8.678)	(8.894)	(8.959)	(10.088)
Educational Grade Obtained	10.270	10.125	9.828	11.278
	(6.966)	(7.015)	(6.982)	(7.904)
Age of Household Head	-1.834	-1.321	-1.811	-1.770
	(1.837)	(1.851)	(1.834)	(1.848)
Designated as Poor	-30.864*	-32.107*	-34.320**	-24.024
	(16.854)	(17.037)	(16.990)	(16.807)
Farmer Union Membership	56.343*	56.585*	52.633*	64.265*
	(30.853)	(30.969)	(30.352)	(36.319)
Log of Pesticide Investment	4.033	4.262	2.836	-0.280
	(2.650)	(2.663)	(2.618)	(2.265)
Risk Coping 1: Borrow	-54.028*	-62.067*	-36.265*	-97.324**
	(28.187)	(32.477)	(18.506)	(46.799)
Risk Coping 2: Sold land	-18.789	-10.830	-39.447	-16.212
	(25.992)	(29.039)	(30.818)	(32.436)
Risk Coping 3: Use Savings	8.836	4.385	-0.507	17.904
	(22.649)	(24.462)	(23.488)	(21.856)
Risk Coping 4: Did Nothing	22.693	23.052	21.694	25.942
	(26.243)	(26.629)	(26.064)	(24.976)
Private Transfer Receipt	-60.226*	-59.651*	-63.254**	-64.801*
	(31.906)	(31.971)	(32.066)	(33.123)
Public Transfer Receipt	-44.597	-47.398	-35.047	-39.333
	(42.581)	(42.681)	(42.690)	(47.562)
Borrowing Activity	31.810	30.950	29.387	24.706
	(22.318)	(22.559)	(22.197)	(23.357)
Any Insurance	13.947	13.728	16.901	12.213
	(20.623)	(20.967)	(20.080)	(23.597)
Trust	-10.410	-9.300	-24.720	-23.702
	(19.905)	(20.495)	(16.713)	(21.742)
Log Gamble Value	4.394	4.194	4.127	4.052
	(2.902)	(2.937)	(2.986)	(3.131)
Constant	-380.122**	-466.631**	-173.240	-357.772*
	(176.134)	(184.669)	(183.062)	(193.991)
Observations	8,033	8,033	8,051	7,319
R-squared	0.012	0.012	0.012	0.013
Number of UID	2,403	2,403	2,408	2,285
Household FE	Yes	Yes	Yes	Yes
Commune Controls	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

Notes: Standard Errors clustered at commune level, shown in brackets. *** p<0.01, ** p<0.05, * p<0.1.
For variables in logs, all values reported as zero replaced by 1 to avoid missing observations. CRRA1500: Differential calculated from CRRA function using starting bid of 1500 VND for BDM game for estimating RRA. CRRA500: Differential calculated from CRRA function using starting bid of 500 VND for BDM game for estimating RRA. DARA: Differential calculated from DARA utility function. CARA: Differential calculated from CARA utility function using starting bid of 1000 VND for estimating ARA.

Source: Author calculation using VARHS data on Stata14.

5.5 Welfare implications of agricultural losses on household consumption

To assess the underlying welfare rationale for agricultural insurance, we examine the relationship between agricultural shocks and consumption reduction in the household. Table 13 below shows estimates derived from a linear probability model using fixed effects. The dependent variable in the regression takes value 1 when the household reports of reducing consumption as a risk-coping mechanism when stuck by an income shock.[32] The results indicate a statistically significant and positive relationship between agricultural losses with reduction of household consumption due to an income shock, and this result is robust to different specifications.[33] The small effect size is consistent with the earlier findings that average losses are small relative to average production; being around 20 per cent (see Table 5).

Table 13: Likelihood of reducing consumption due to income shock

Variables	(1) Reduce Consumption	(2) Reduce Consumption	(3) Reduce Consumption
Log of Agri. Loss	0.020***	0.020***	0.020***
	(0.001)	(0.001)	(0.001)
Educational Grade Obtained		-0.006**	-0.008***
		(0.003)	(0.003)
Age of Household Head		-0.002	-0.002
		(0.002)	(0.002)
Farmer Union Membership		-0.005	0.008
		(0.014)	(0.016)
Private Transfer Receipt			0.010
			(0.012)
Public Transfer Receipt			0.035**
			(0.014)
Borrowing Activity			0.039***
			(0.013)
Any Insurance			0.011
			(0.019)
Savings Activity			-0.029*
			(0.017)
Constant	0.136***	0.240***	0.195**
	(0.028)	(0.079)	(0.093)
Observations	9,713	8,555	7,166
R-squared	0.246	0.248	0.261
Number of UID	2,555	2,446	2,379
Household FE	Yes	Yes	Yes
Commune FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes

Notes: Standard Errors clustered at commune level, shown in brackets.

*** p<0.01, ** p<0.05, * p<0.1

For variables in logs, all values reported as zero replaced by 1 to avoid missing observations

Loss taken as current reported losses due to natural or agricultural shock.

Reduce Consumption: Binary variable taken as 1 if a household reports reducing consumption when faced by income shock.

Source: Author calculation using VARHS data on Stata14.

[32] Out of the total sample of 12,678 households, around 20 per cent of the households report to have reduced consumption when affected by an income shock.

[33] The proportion of reducing consumption is 53 per cent when a household reports positive loss due to agricultural shock or natural disaster.

6 Conclusion

The prevalence of weather- and disease-related shocks for farmers across Viet Nam and our confirmation that production losses for farmers lead to reductions in household consumption, brings to the fore the question why area yield insurance, which protects farmers from covariate shocks, has failed to achieve scale. To help solve the puzzle of low demand for agricultural insurance, we investigate first the determinants of self-reported WTP and second, the differential between WTP and the predicted economic value of insurance to each farmer based on expected utility theory.

We find that private transfers substitute for agricultural insurance demand. This reflects the findings from Kenya where mobile money accelerated the process of private transfers from family, friends and neighbours and led to consumption smoothing (Jack and Suri, 2014). The phenomenon of increased and speedy private transfers, which is likely to accelerate further, with improved financial technologies and increased migration, agricultural insurance will continue to be challenging to market and bring to scale.

We find that social capital (or pro-social behaviour) in the form of farmer union membership are important to encourage farmers to engage in formal risk management technologies such as agricultural insurance. Our evidence suggests that insurance providers in the process of rollout are more likely to achieve success by working through existing farming networks.

Insurance is not rare in Viet Nam, with 95 per cent of the sample holding some form of insurance. It is interesting to note that many of these insurance contracts involve some form of subsidies or mandatory purchase. We note that the most recent attempt to establish agricultural insurance included subsidies for poor farmers and yet even within the context of a supportive state-led communication strategy, take-up disappointed. We find that income is not systematically related to WTP or the differential; suggesting that purchasing power is not the determining factor in agricultural insurance demand. This result can inform debates around whether subsidies for agricultural insurance might be effective.

Our analysis shows that the behavioural characteristic of over-confidence is important in the valuation of insurance and we consider this finding within the context of the likely perceived unviability of previous agricultural schemes in Viet Nam, perceived problematic claims processes and/or lack of confidence in the yield calculations of the insurer. Financial education, improved claims processes and the overall reputation of the sector maybe central to the medium-term prospects for agricultural insurance take-up. Each of these have specific implications for providers, and insurance regulators who often struggle to mediate the interaction between customers and insurance firms successfully for mutual welfare gains.

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Appendix A

The description of important variables used in the study are as follows:

1) Willingness to Pay: This measure records the absolute monetary value given for the Willingness to Pay for agricultural households in the survey. The exact question asked in the survey: If insurance against loss or damage of crop were available, how much would you be willing to pay for it? List in 000 VND/per year/household.

2) Value of crops: The exact wording for the question is: In last 12 months. What is total value of output produced? The reported value in '000VND is assigned to the Bad state value of crops.

3) Good State Value of Crops: The value of crops is derived by summing the value of crops produced and the value of reported loss.

4) Loss: This is the amount of loss reported, conditional on suffering from a natural disaster (floods, droughts, typhoons) or agricultural shock (pest infestation and crop disease).

5) Mean Loss: The main analysis of the paper derives mean losses by taking the average of reported loss in the current period and all preceding survey rounds.

6) Probability of Loss in the Commune: Calculated by taking proportion of the number of years (out of total surveyed years), when the productivity of rice in a commune falls below the average mean productivity of rice in that commune.

7) Average Mean Productivity of Rice: It is reported in the data in different units of weight (kg, quintal, ton) per hectare for summer and autumn. The study takes the mean productivity over both seasons of production.

8) Expected Value: This is the expected value of crops for a household. It is calculate using expected utility framework over good and bad state value of crops with associated probabilities.

9) Certainty Equivalent: The expected value of crops which a risk-averse household should accept to avoid the inherent probability of involved in agriculture.

10) Risk-Premium: Estimated by taking the difference between the expected value of crops and the certainty equivalent. Hence, it can be interpreted as the value which a household foregoes to avoid the gamble. The value as per the expected utility theory is the willingness to pay for actuarially fair insurance by a rational consumer.

11) Differential: It is estimated by taking the difference between the WTP and the risk premium.

12) Net Total Income: This is net total income reported by the household for last 12 months from sources such as wage/salary, agricultural activity, common property uses, non-farm, non-wage economic activity, rental income, land/real estate, other assets, sales of assets, private transfers, public transfers, and other sources.

13) Pesticide Investment: This is the amount of investment which a household makes in using pesticide for as an agricultural input in past 12 months of the survey.

14) Educational Grade: This captures the grade which the household head completed. The grades are as per the 12-grade system. The highest grade is secondary school.

15) Age: Derived from the year of birth of household head.

16) Farmer Union: This is a binary variable taking the value as 1 if any member of the household belongs to farmer's union.

17) Risk Coping: The four variables under this category are of binary nature and take the value as 1 if a household engages in borrowing, sale of land or use of savings in order to cope up with an income shock in following the last VARHS survey (approximately two years). Here, the value recorded is conditional on household saying yes to the previous question whether a household suffered from an income shock. Income shock means getting affected by the occurrence of natural disasters, agricultural shocks, avian flu, change in crop price, shortage or change in price for key agricultural inputs, change in prices of food, unemployment, unsuccessful employment, loss of land, crime, divorce or abandonment, serious illness, injury or death or any other shock not included in the above.

18) Transfer Receipt (Private/Public): This is a binary variable taking the value as 1 if the household received any money or goods from persons who are not members of their household such as relatives living elsewhere friends or neighbours (Private Transfers) or from public institutions, e.g. insurance money or social assistance (Public Transfers).

19) Borrowing Activity: This is a binary variable taking the value as 1 if the household borrowed money or goods (including seeds or fertilisers) from any source from the period following the last VARHS survey (approximately two years).

20) Any Insurance: This is a binary variable taking the value as 1 if a household possesses any kind of insurance amongst the options such as: farmer' insurance, fire insurance, life insurance, voluntary social insurance, compulsory social insurance, health insurance, free health insurance for children/poor, education insurance, vehicle insurance, or any other forms of insurance.

21) Trust: This is a binary variable taking the value as 1 if the respondent agrees to the following question: Most people are basically honest and can be trusted.

22) Gamble Value: This is recorded as the monetary value which the respondent gives to the following question: How much would you be willing to pay for a 1 in 10 chance of winning a prize of 2,000,000 VND?

Appendix B

Table B. 1: Different specifications for main results as shown in Table 10

Variables	(1) Differential	(2) Differential	(3) Differential	(4) Differential	(5) WTP	(6) WTP	(7) WTP	(8) WTP	(9) WTP	(10) WTP	(11) Risk Premium	(12) Risk Premium	(13) Risk Premium	(14) Risk Premium
Log of Net Total Income	16.003*	15.615*	15.480*	15.711*	27.443	27.614	26.612	27.171	28.754	11.149	-26.505	-26.238	-25.831	-25.762
	(9.032)	(8.903)	(8.923)	(8.832)	(22.183)	(22.294)	(21.690)	(22.029)	(23.463)	(8.075)	(24.869)	(25.042)	(25.039)	(24.932)
Educational Grade Obtained	9.900	9.830	9.900	10.102	13.650*	13.622*	13.643*	13.884*	14.731*	11.898	1.168	0.849	0.739	0.669
	(6.919)	(6.865)	(6.881)	(6.985)	(7.403)	(7.376)	(7.368)	(7.429)	(7.831)	(7.777)	(6.309)	(6.101)	(6.081)	(6.076)
Age of Household Head	-2.063	-2.062	-2.024	-1.726	-1.460	-1.453	-1.424	-1.057	-1.141	-2.123	1.049	0.962	0.924	1.018
	(2.082)	(2.098)	(2.089)	(1.845)	(1.900)	(1.912)	(1.910)	(1.757)	(1.904)	(1.837)	(1.534)	(1.477)	(1.453)	(1.618)
Farmer Union Membership	59.685*	59.695*	58.279*	57.249*	48.432*	48.021*	46.312*	46.702*	48.389*	55.960*	3.749	3.335	4.590	5.396
	(31.177)	(31.012)	(30.428)	(30.912)	(26.981)	(26.795)	(26.244)	(27.098)	(28.208)	(31.756)	(11.393)	(11.368)	(11.318)	(11.332)
Private Transfer Receipt	-59.765*	-59.675*	-60.858*	-59.656*	-64.546**	-64.800**	-66.090**	-65.094**	-69.194**	-58.619*	30.628	27.550	29.277	29.642
	(31.856)	(32.346)	(32.863)	(31.961)	(31.263)	(31.459)	(32.064)	(31.436)	(33.367)	(31.219)	(23.868)	(22.828)	(23.493)	(24.006)
Log Gamble Value	4.728	4.683	4.621	4.260	5.891*	5.943*	5.909*	5.689*	6.215*	5.461*	3.793**	4.019**	4.001**	4.187**
	(3.014)	(3.021)	(3.037)	(2.925)	(3.064)	(3.077)	(3.089)	(3.043)	(3.264)	(3.011)	(1.893)	(1.950)	(1.958)	(2.005)
Log of Pesticide Investment				4.165				1.147	1.034	-2.125				-2.942
				(2.659)				(1.890)	(1.942)	(1.310)				(1.918)
Risk Coping 1: Borrow		-49.015	-60.848*	-59.766*		2.249	-12.359	-10.718	-11.487	-7.733		63.451	80.015**	80.624**
		(31.805)	(31.839)	(31.822)		(11.914)	(11.226)	(11.157)	(11.641)	(14.104)		(41.368)	(40.239)	(40.012)
Risk Coping 2: Sold land		-23.277	-24.791	-14.752		-37.090	-37.019	-30.569	-35.244	-37.179		-38.895	-34.958	-36.773
		(28.410)	(27.877)	(27.101)		(25.527)	(24.616)	(24.766)	(26.356)	(23.344)		(30.024)	(28.602)	(26.541)
Risk Coping 3: Use Savings		1.387	0.950	7.265		-10.400	-10.326	-4.639	-5.403	16.047		40.744	41.598	42.401
		(21.524)	(21.396)	(23.550)		(23.281)	(23.165)	(23.013)	(24.433)	(18.320)		(33.451)	(33.596)	(32.995)
Risk Coping 4: Did Nothing		23.787	22.743	23.379		40.588	39.212	39.627	40.664	23.730		61.199	62.891	64.159
		(26.668)	(26.030)	(26.399)		(29.984)	(29.202)	(30.022)	(30.633)	(25.221)		(70.635)	(71.170)	(72.357)
Public Transfer Receipt				-46.285				-52.721	-56.321	-40.173				-12.544
				(42.662)				(40.351)	(42.898)	(45.369)				(33.090)
Borrowing Activity			30.354	31.773			36.144	38.257	41.327	27.750			-41.615*	-41.034*
			(21.403)	(22.488)			(22.480)	(23.739)	(25.426)	(22.175)			(23.297)	(22.845)
Any Insurance			5.939	13.175			47.355	56.805	59.585	19.905			-8.514	-7.714
			(15.427)	(20.923)			(34.130)	(38.951)	(41.046)	(21.129)			(14.830)	(16.537)
Designated as Poor	-41.570*	-41.280*	-43.803*	-30.945*	-48.422*	-49.431*	-53.679*	-40.183*	-41.278*	-21.806	159.469	156.568	160.184	162.380
	(22.348)	(22.750)	(24.213)	(16.884)	(28.377)	(28.946)	(31.263)	(23.570)	(24.456)	(14.291)	(148.847)	(147.482)	(148.337)	(155.710)
Trust				-8.781				-22.628	-25.377	-26.948				25.348
				(20.582)				(15.472)	(16.520)	(17.682)				(27.756)
Mean Loss									-0.024					
									(0.241)					
Loss										0.169				
										(0.396)				
Constant	-372.783**	-368.719**	-387.063**	-417.395**	-536.945	-550.372	-597.981	-601.220	-648.940	-208.442	521.649	504.795	524.171	533.271
	(162.140)	(163.646)	(169.366)	(178.941)	(422.141)	(429.992)	(457.063)	(460.724)	(488.634)	(156.069)	(363.364)	(355.350)	(359.568)	(351.159)
Observations	8,033	8,033	8,033	8,033	9,061	9,061	9,061	8,985	8,365	7,513	8,386	8,386	8,386	8,386
R-squared	0.010	0.010	0.011	0.012	0.010	0.011	0.012	0.013	0.014	0.012	0.004	0.004	0.004	0.004
Number of UID	2,403	2,403	2,403	2,403	2,642	2,642	2,642	2,620	2,424	2,345	2,418	2,418	2,418	2,418
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Commune Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard Errors clustered at commune level, shown in brackets.

*** p<0.01, ** p<0.05, * p<0.1 For variables in logs, all values reported as zero replaced by 1 to avoid missing observation.

Source: Authors' calculation using VARHS data on Stata14.

Table B. 2: Different Specifications for risk premium estimated from recent losses (Current and last period as shown in Table 11)

Variables	(1) Differential	(2) Differential	(3) Differential	(4) Differential	(5) WTP	(6) WTP	(7) WTP	(8) WTP	(9) WTP	(10) WTP	(11) Risk Premium	(12) Risk Premium	(13) Risk Premium	(14) Risk Premium
Log of Net Total Income	21.667**	20.996**	20.654*	20.847**	27.443	27.614	26.612	27.171	18.754	11.149	-12.653	-12.016	-11.009	-11.318
	(10.747)	(10.632)	(10.578)	(10.599)	(22.183)	(22.294)	(21.690)	(22.029)	(13.924)	(8.075)	(29.920)	(30.041)	(29.977)	(30.037)
Educational Grade Obtained	8.357	8.263	8.305	8.481	13.650*	13.622*	13.643*	13.884*	14.232*	11.898	2.252	1.856	1.700	1.436
	(7.294)	(7.241)	(7.262)	(7.344)	(7.403)	(7.376)	(7.368)	(7.429)	(7.629)	(7.777)	(12.853)	(12.624)	(12.595)	(12.498)
Age of Household Head	-2.633	-2.606	-2.574	-2.234	-1.460	-1.453	-1.424	-1.057	-1.512	-2.123	1.366	1.223	1.146	1.207
	(2.493)	(2.500)	(2.489)	(2.253)	(1.900)	(1.912)	(1.910)	(1.757)	(1.892)	(1.837)	(2.320)	(2.230)	(2.206)	(2.384)
Farmer Union Membership	63.162*	63.197*	61.781*	59.896*	48.432*	48.021*	46.312*	46.702*	52.167*	55.960*	17.102	16.637	19.305	18.862
	(34.609)	(34.366)	(33.573)	(34.519)	(26.981)	(26.795)	(26.244)	(27.098)	(29.703)	(31.756)	(26.398)	(26.335)	(26.456)	(25.556)
Private Transfer Receipt	-56.160*	-55.384*	-56.531*	-55.073*	-64.546**	-64.800**	-66.090**	-65.094**	-65.828**	-58.619*	88.110	83.558	86.790	86.962
	(32.556)	(33.060)	(33.637)	(32.788)	(31.263)	(31.459)	(32.064)	(31.436)	(32.557)	(31.219)	(72.675)	(71.430)	(72.766)	(73.519)
Log Gamble Value	3.857	3.720	3.672	3.318	5.891*	5.943*	5.909*	5.689*	5.670*	5.461*	8.541**	8.885**	8.867**	9.212**
	(3.118)	(3.126)	(3.136)	(3.028)	(3.064)	(3.077)	(3.089)	(3.043)	(3.013)	(3.011)	(3.909)	(3.987)	(3.982)	(4.114)
Log of Pesticide Investment				4.167				1.147	1.230	-2.125				-1.893
				(2.763)				(1.890)	(2.073)	(1.310)				(2.434)
Risk Coping 1: Borrow		-93.219*	-105.360**	-103.695**		2.249	-12.359	-10.718	-7.977	-7.733		103.032*	137.514**	137.382**
		(49.019)	(48.257)	(48.184)		(11.914)	(11.226)	(11.157)	(12.038)	(14.104)		(59.008)	(56.036)	(55.749)
Risk Coping 2: Sold land		-11.195	-12.344	-2.016		-37.090	-37.019	-30.569	-33.032	-37.179		-82.997	-75.438	-80.424
		(34.563)	(34.170)	(33.765)		(25.527)	(24.616)	(24.766)	(24.883)	(23.344)		(59.523)	(55.862)	(53.813)
Risk Coping 3: Use Savings		2.551	2.328	8.873		-10.400	-10.326	-4.639	-23.492	16.047		63.894	64.835	66.043
		(23.315)	(23.258)	(25.549)		(23.281)	(23.165)	(23.013)	(37.993)	(18.320)		(66.504)	(66.627)	(63.606)
Risk Coping 4: Did Nothing		18.888	17.889	18.291		40.588	39.212	39.627	35.025	23.730		76.484	79.743	83.007
		(28.045)	(27.414)	(27.795)		(29.984)	(29.202)	(30.022)	(27.776)	(25.221)		(99.983)	(100.885)	(104.042)
Public Transfer Receipt				-50.317				-52.721	-51.700	-40.173				-6.264
				(43.692)				(40.351)	(42.559)	(45.369)				(50.892)
Borrowing Activity			30.492	32.183			36.144	38.257	38.783	27.750			-85.078*	-84.855*
			(24.617)	(25.731)			(22.480)	(23.739)	(24.076)	(22.175)			(47.378)	(46.905)
Any Insurance			11.397	19.704			47.355	56.805	62.053	19.905			-11.521	-12.531
			(17.187)	(23.006)			(34.130)	(38.951)	(44.598)	(21.129)			(15.888)	(17.773)
Designated as Poor	-49.133**	-48.112**	-50.788**	-36.246*	-48.422*	-49.431*	-53.679*	-40.183*	-44.481	-21.806	232.186	228.172	234.806	236.077
	(23.656)	(24.026)	(25.626)	(19.027)	(28.377)	(28.946)	(31.263)	(23.570)	(27.141)	(14.291)	(215.619)	(213.537)	(215.542)	(226.340)
Trust				0.955				-22.628	-29.816*	-26.948				86.951
				(29.186)				(15.472)	(17.429)	(17.682)				(81.640)
Mean Loss									0.037					
									(0.083)					
Loss										0.169				
										(0.396)				
Constant	-446.547**	-434.866**	-455.096**	-494.509**	-536.945	-550.372	-597.981	-601.220	-484.363	-208.442	189.247	161.550	194.434	161.336
	(198.381)	(201.246)	(209.016)	(216.220)	(422.141)	(429.992)	(457.063)	(460.724)	(306.369)	(156.069)	(427.376)	(418.355)	(418.597)	(412.875)
Observations	7,936	7,936	7,936	7,936	9,061	9,061	9,061	8,985	8,000	7,513	8,287	8,287	8,287	8,287
R-squared	0.009	0.010	0.011	0.012	0.010	0.011	0.012	0.013	0.013	0.012	0.003	0.004	0.004	0.004
Number of UID	2,406	2,406	2,406	2,406	2,642	2,642	2,642	2,620	2,405	2,345	2,430	2,430	2,430	2,430
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Commune Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard Errors clustered at commune level, shown in brackets.

*** p<0.01, ** p<0.05, * p<0.1   For variables in logs, all values reported as zero replaced by 1 to avoid missing observation.

Source: Author calculation using VARHS data on Stata14.

Appendix C

This appendix presents different robustness checks associated with (i) no starting bid assumption for those who failed to play the game, (ii) the assumption around the calculation of relative risk aversion using actual BDM game observations and means only for missing years, (iii) non-responses to the WTP question when we consider missing values to be the same as not interested or zero valuation (iv) relaxing the assumption regarding the behavioural factors for missing years.

Table C. 1: Main results (as discussed in Table 10) without the assumption of starting bid of 1000 VND (Households who never play the BDM game are excluded)

Variables	(1) Differential	(2) WTP	(3) Risk Premium
Log of Net Total Income	12.066	41.926	-40.685
	(10.754)	(34.590)	(31.749)
Educational Grade Obtained	5.486	13.945*	4.928
	(4.188)	(7.764)	(4.361)
Age of Household Head	-3.037	-2.319	1.456
	(3.180)	(3.514)	(1.630)
Designated as Poor	-20.228	-42.778	227.147
	(17.480)	(39.056)	(220.680)
Farmer Union Membership	70.009*	50.853	15.264
	(41.012)	(42.249)	(14.939)
Log of Pesticide Investment	4.019	0.431	-2.980
	(3.559)	(2.849)	(2.358)
Risk Coping 1: Borrow	-29.602	-11.960	51.100
	(23.656)	(14.876)	(41.965)
Risk Coping 2: Sold land	-35.726	-38.414	-19.467
	(29.554)	(32.298)	(30.292)
Risk Coping 3: Use Savings	7.703	-9.039	55.660
	(25.054)	(30.311)	(45.221)
Risk Coping 4: Did Nothing	7.025	16.058	112.740
	(42.203)	(41.103)	(100.945)
Private Transfer Receipt	-63.881**	-81.538**	30.078
	(29.282)	(35.539)	(27.699)
Public Transfer Receipt	-32.993	-63.541	-21.242
	(38.835)	(49.769)	(39.982)
Borrowing Activity	18.063	31.495	-35.007
	(22.528)	(28.971)	(26.348)
Any Insurance	16.203	71.696	-16.642
	(17.554)	(49.373)	(18.622)
Mean Loss		0.048	
		(0.279)	
Trust	-14.106	-34.971	43.879
	(23.624)	(22.935)	(35.355)
Log Gamble Value	6.364	11.147**	3.451
	(3.870)	(4.844)	(2.241)
Constant	-259.764	-951.905	748.191
	(219.123)	(738.202)	(488.074)
Observations	6,280	5,541	6,591
R-squared	0.011	0.016	0.006
Number of UID	1,973	1,606	1,997
Household FE	Yes	Yes	Yes
Commune Controls	Yes	Yes	Yes
Time FE	Yes	Yes	Yes

Notes: Standard Errors clustered at commune level, shown in brackets. *** p<0.01, ** p<0.05, * p<0.1

For variables in logs, all values reported as zero replaced by 1 to avoid missing observations

Relative Risk Aversion used as a regressor for WTP but omitted in the results.

Source: Authors' calculation using VARHS data on Stata14.

Table C. 2: Results derived using the alternate approach taking Relative risk aversion as observed values for households who play the gamble and means only in the years when the Gamble was not played. This is different from the earlier approach because there the RRA was always taken as the mean across all the years.

Variables	(1) Differential	(2) WTP	(3) Risk Premium
Log of Net Total Income	17.369*	28.648	-26.025
	(9.134)	(23.380)	(25.010)
Educational Grade Obtained	11.022	14.801*	-1.666
	(7.063)	(7.865)	(6.085)
Age of Household Head	-1.645	-1.145	0.838
	(1.850)	(1.902)	(1.628)
Designated as Poor	-31.736*	-41.490*	162.286
	(16.934)	(24.578)	(155.725)
Farmer Union Membership	55.902*	48.409*	7.267
	(30.255)	(28.203)	(11.347)
Log of Pesticide Investment	3.976	1.042	-3.331
	(2.834)	(1.942)	(2.052)
Risk Coping 1: Borrow	-93.084**	-11.424	111.291**
	(40.270)	(11.700)	(46.358)
Risk Coping 2: Sold land	-19.575	-36.420	-31.991
	(26.293)	(26.488)	(27.882)
Risk Coping 3: Use Savings	-0.033	-5.321	49.202
	(21.360)	(24.356)	(33.068)
Risk Coping 4: Did Nothing	20.365	40.765	66.903
	(26.090)	(30.666)	(72.395)
Private Transfer Receipt	-59.452*	-69.373**	30.416
	(32.161)	(33.385)	(24.197)
Public Transfer Receipt	-36.597	-56.133	-20.284
	(42.707)	(42.855)	(32.926)
Borrowing Activity	33.920	41.213	-40.306*
	(22.774)	(25.393)	(23.513)
Any Insurance	9.671	58.998	3.499
	(20.155)	(40.659)	(17.056)
Trust	-18.028	-24.899	33.514
	(23.726)	(16.416)	(30.336)
Log Gamble Value	3.755	6.295*	4.027*
	(3.061)	(3.310)	(2.137)
Relative Risk Aversion		31.630	
		(33.709)	
Mean Loss		-0.021	
		(0.242)	
Constant	-445.631**	-709.330	549.702
	(180.938)	(537.303)	(353.176)
Observations	8,033	8,365	8,386
R-square	0.012	0.014	0.004
Number of UID	2,403	2,424	2,418
Household FE	Yes	Yes	Yes
Commune Controls	Yes	Yes	Yes
Time FE	Yes	Yes	Yes

Notes: Standard Errors clustered at commune level, shown in brackets.

*** p<0.01, ** p<0.05, * p<0.1

For variables in logs, all values reported as zero replaced by 1 to avoid missing observations

Source: Author calculation using VARHS data on Stata14.

Table C. 3: Results similar to the results in Table D.2 (alternate approach of taking observed RRA and means RRA for missing years) without the assumption of starting bid of 1000 VND (Households who never play the BDM game are excluded)

Variables	(1) Differential	(2) WTP	(3) Risk Premium
Log of Net Total Income	14.189	41.729	-41.013
	(11.018)	(34.439)	(31.863)
Educational Grade Obtained	6.638	14.075*	1.893
	(4.244)	(7.878)	(4.402)
Age of Household Head	-2.891	-2.319	1.166
	(3.192)	(3.514)	(1.647)
Designated as Poor	-21.763	-43.205	227.684
	(17.452)	(39.376)	(220.763)
Farmer Union Membership	68.510*	50.915	17.620
	(40.259)	(42.242)	(14.970)
Log of Pesticide Investment	3.737	0.446	-3.408
	(3.775)	(2.850)	(2.537)
Risk Coping 1: Borrow	-75.068*	-11.855	92.326*
	(40.925)	(14.976)	(52.618)
Risk Coping 2: Sold land	-43.390	-40.007	-13.127
	(30.324)	(32.153)	(32.094)
Risk Coping 3: Use Savings	-2.215	-8.882	65.089
	(24.023)	(30.234)	(45.274)
Risk Coping 4: Did Nothing	3.035	16.233	116.098
	(41.917)	(41.203)	(100.971)
Private Transfer Receipt	-63.558**	-81.867**	30.988
	(29.747)	(35.655)	(27.973)
Public Transfer Receipt	-20.509	-63.208	-31.266
	(39.136)	(49.638)	(39.697)
Borrowing Activity	20.698	31.307	-34.100
	(23.739)	(28.885)	(27.374)
Any Insurance	11.439	70.793	-3.046
	(16.723)	(48.773)	(19.589)
Trust	-26.197	-34.198	54.373
	(28.674)	(22.684)	(38.957)
Log Gamble Value	5.711	11.260**	3.289
	(4.024)	(4.898)	(2.433)
Relative Risk Aversion		35.509	
		(34.794)	
Mean Loss		0.051	
		(0.280)	
Constant	-297.097	-980.153	772.109
	(232.179)	(759.867)	(489.626)
Observations	6,280	5,541	6,591
R-square	0.011	0.016	0.006
Number of UID	1,973	1,606	1,997
Household FE	Yes	Yes	Yes
Commune Controls	Yes	Yes	Yes
Time FE	Yes	Yes	Yes

Notes: Standard Errors clustered at commune level, shown in brackets.

*** p<0.01, ** p<0.05, * p<0.1

For variables in logs, all values reported as zero replaced by 1 to avoid missing observations

Source: Author calculation using VARHS data on Stata14.

Table C. 4: Results estimated for the assumption for non-response in WTP. All missing WTPs (6 per cent) are assumed to be not interested/zero valuation. Results here include assumption for starting bid of 1000 VND.

Variables	(1) Differential	(2) WTP	(3) Risk Premium
Log of Net Total Income	31.223**	30.574	-25.762
	(14.835)	(22.954)	(24.932)
Educational Grade Obtained	8.726	12.449*	0.669
	(6.586)	(7.015)	(6.076)
Age of Household Head	-1.366	-1.059	1.018
	(1.795)	(1.809)	(1.618)
Designated as Poor	-55.907	-45.798	162.380
	(35.652)	(28.604)	(155.710)
Farmer Union Membership	53.521*	45.661*	5.396
	(28.832)	(26.156)	(11.332)
Log of Pesticide Investment	0.758	-0.029	-2.942
	(3.283)	(1.873)	(1.918)
Risk Coping 1: Borrow	-60.370**	-11.486	80.624**
	(30.392)	(11.092)	(40.012)
Risk Coping 2: Sold land	-26.978	-36.302	-36.773
	(33.926)	(27.591)	(26.541)
Risk Coping 3: Use Savings	4.021	-2.896	42.401
	(22.440)	(22.165)	(32.995)
Risk Coping 4: Did Nothing	36.240	40.667	64.159
	(28.270)	(29.865)	(72.357)
Private Transfer Receipt	-68.789**	-69.453**	29.642
	(33.785)	(33.411)	(24.006)
Public Transfer Receipt	-40.915	-49.280	-12.544
	(39.996)	(38.641)	(33.090)
Borrowing Activity	44.625*	43.056*	-41.034*
	(23.595)	(24.678)	(22.845)
Any Insurance	64.217**	71.521**	-7.714
	(31.787)	(35.802)	(16.537)
Trust	-8.897	-25.076	25.348
	(19.966)	(15.905)	(27.756)
Log Gamble Value	4.640	5.574*	4.187**
	(2.964)	(3.060)	(2.005)
Mean Loss		-0.042	
		(0.234)	
Constant	-724.002**	-669.141	533.271
	(302.644)	(466.632)	(351.159)
Observations	8,363	8,700	8,386
R-square	0.013	0.013	0.004
Number of UID	2,414	2,432	2,418
Household FE	Yes	Yes	Yes
Commune Controls	Yes	Yes	Yes
Time FE	Yes	Yes	Yes

Notes: Standard Errors clustered at commune level, shown in brackets.

*** p<0.01, ** p<0.05, * p<0.1

For variables in logs, all values reported as zero replaced by 1 to avoid missing observations

Relative Risk Aversion used as a regressor for WTP but omitted in the results.

Source: Author calculation using VARHS data on Stata14.

Table C. 5: Results estimated on original values for behavioural factors. Here, the results relax the assumption made for taking mean values for behavioural variables in 2008 and 2016.

Variables	(1) Differential	(2) WTP	(3) Risk Premium
Trust	-13.516	-28.560	8.872
	(21.645)	(18.705)	(20.900)
Log of Gamble Value	3.883	6.378*	4.911**
	(3.067)	(3.432)	(2.289)
Constant	83.423	-673.352	-428.152
	(238.662)	(740.930)	(475.456)
Observations	5,292	5,470	5,502
R-squared	0.021	0.025	0.018
Number of UID	2,311	2,341	2,337
Household Controls	Yes	Yes	Yes
Household FE	Yes	Yes	Yes
Commune Controls	Yes	Yes	Yes
Time FE	Yes	Yes	Yes

Notes: Standard Errors clustered at commune level, shown in brackets.

*** p<0.01, ** p<0.05, * p<0.1

For variables in logs, all values reported as zero replaced by 1 to avoid missing observations

Source: Author calculation using VARHS data on Stata14.