Household's Risk preferences, Vulnerability to poverty and Subjective well-being in The Case of Vietnam

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Abstract

Frequent exposure to shocks and the lack of proper coping mechanisms can have a substantial impact on households. This dissertation explores the three prominent features of household behaviors in the context of rural Vietnam where shocks are prevalent: risk preferences, vulnerability to poverty, and subjective well-being. The dissertation contains two core chapters.

The first main chapter, Chapter3, examines the validity of various elicitation methods of risk preferences. The methods include 4 hypothetical questions and 3 experimental tasks, in which, we utilize a set of 3 hypothetical questions from a Vietnamese household survey (VARHS). We conducted a field survey and experiment with a random sample of 350 households in 2019 in rural areas of two provinces. The finding of the chapter indicates that most of the participants have no difficulty in understanding the questions and giving rational choices. Most elicitation methods provide evidence that respondents are, on average, risk-averse. Elicitation methods in the study satisfy at least one of the validity tests. Respondents appear less risk-averse in the self-assessment method than other methods. Therefore, comparing risk preferences elicited from the survey and experimental methods should be done with caution. Next, we find that the self-assessment method has limited validity since it has the least or no relation with other measures and observed behaviors. The result is different from other studies that support the use of self-assessment of risk attitude (e.g., Dohmen et al. (2011) and so could reflect the differences between developed and developing countries. Lastly, the Multiple Price List (MPL) and loss-gain questions are dominant methods in predicting household and individual behaviors, either hypothetical or experimental. Among hypothetical questions from the VARHS, we, therefore, prefer to use the MPL and loss-gain questions in

measuring risk attitude. However, the loss-gain questions should be used with caution because people show more loss-averse in the incentivized situation than in the theoretical one.

The second main chapter, Chapter 4, assesses the relationship between vulnerability to poverty and subjective well-being, using four-wave panel data covering the period 2012–2018. To estimate the vulnerability to poverty of households, we employ an extended Vulnerability as Expected poverty (VEP) approach that is based on the three-level model from Mina and Imai (2017). Our findings show that around 20 percent of the panel households are classified as vulnerable at least once in any of the periods covered. Households are more vulnerable to unobservable idiosyncratic shocks than to unobservable covariate shocks. These results are consistent with Mina and Imai (2017) and once again lend support to the observation that idiosyncratic shocks might not be insured perfectly by village-level mutual help. In addition, households who live in the mountainous area and Central Coast, have a higher risk of falling into poverty than households living in other regions. To examine the relationship between poverty risk and happiness, we employed a Fixed Effect model to deal with the endogeneity of vulnerability. We find a significant and strong relationship between vulnerability to poverty and depression score (CES-D), but not between vulnerability to poverty and life satisfaction.

The findings of the dissertation emphasize the importance of appropriate and supportive systems of social protection and adequate safety nets for vulnerable households, especially for minor ethnicity groups in the mountainous areas. Some suggested policies, such as improving the attractiveness of weather insurance products, expansion of the provision of health insurance coverage, and improvement of health care services might be worth exploring.

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WTTR	Willingness to take risk
MPL	Multiple Price List
EUT	Expected Utility Theory
CRRA	Constant Relative Risk Aversion
VARHS	Vietnam Access to Resources Household Survey
NRD	New Rural Development program
CES-D	Center for Epidemiologic Studies Depression Scale
VEP	Vulnerability as Expected Poverty
VEU	Vulnerability as low expected utility

CHAPTER 1

INTRODUCTION

1.1.Introduction to the Dissertation: Rationale of the Study

Vietnam has experienced remarkable economic growth and poverty reduction since the implementation of the Doi Moi (Restoration) reform policies in 1986. The country has transformed from one of the world's poorest nations into a lower middle-income country. GDP per *capita* has increased by 2.7 times between 2002 and 2018 and more than 45 million people have been lifted out of poverty (World Bank, 2018)[1].

However, Vietnam is still facing numerous challenges. The slow speed and a lack of sustainability in poverty reduction has led to the vast majority of Vietnamese remaining poor. Moreover, large differences in poverty rates between regions and between ethnicities remain a challenging issue. Most of the poor are from rural areas and belong to ethnic minorities. Although ethnic groups comprise only 15 percent of the country's population, as of 2017, they represent 86 percent of the poor population. Most of Vietnam's poorest households live in the highlands and mountainous regions. In particular, the Midlands and Northern Mountains and the Central Highlands regions account for 20 percent of the total population, yet they are home to 56% of the country's poor. On the other hand, the Red River Delta and Southeast regions are home to nearly 40 percent of the population, but only six percent of the poor population (World Bank, 2018).

[1] The poverty headcount ratio evaluated at US$1.90 international poverty line (2011PPP) decreased from 37% to 1.8% in the same period (World Development Indicators, 2022, https://databank.worldbank.org/source/world-development-indicators, accessed on 07/22/2022).

Agriculture, the major source of earnings for nearly two thirds of the rural population, is strongly affected by climate change. According to the World Bank, Vietnam is among the five countries[2] in the world that are most vulnerable to climate change. Water and air pollution and rising temperatures have significant effect on the productivity of key sectors and on human health. Moreover, these widespread exposures to shocks are uninsured. The development of the nation's social safety net is incomplete. Coverage of health insurance is spreading slowly. Some vital types of insurance for farmers, such as weather and crop insurance, are not yet fully developed.

The unpredictable nature of the above shocks and the lack of proper coping mechanisms make it difficult for households to smooth consumption. Therefore those shocks can have a substantial impact on household welfare, attitudes toward risk, and emotional and physical well-being. In this context, this dissertation explores household risk preferences, vulnerability to poverty and effect of vulnerability on household well-being. In this section, we explain the motivation for the two core studies reported in Chapters 2 and 3 of the dissertation. Section 1.2 describes the objectives and contributions of the two studies in detail. Finally, Section 1.3 presents a roadmap of the dissertation.

Motivation and Objectives of Chapter 2 on validity of risk preferences measures

The extent to which people are willing to take risk represent their *risk preference*. Risk preferences are an important determinant of a variety of household activities and are also associated with poverty and vulnerability. Meanwhile, methods to measure risk preference are called *elicitation methods*. If people, for instance farmers, are (extremely)

[2] https://climateknowledgeportal.worldbank.org/country/vietnam

averse to the risk, they may be reluctant to try new varieties of seeds; or to apply new technology that could increase their productivity; or to engage in profitable investment (Bezabih and Sarr, 2012). Therefore, risk-aversion may explain, in part, why some people remain poor. An understanding of the risk preferences of individuals can reveal the underlying reason for many of their seemingly decisions and be useful for recommending policies in the areas, such as risks and poverty reduction, productivity improvement, and social safety net. In that light, finding a method to accurately measure individual attitude towards risk is crucial in explaining their persistent poverty.

The findings of tests that examine the validity of various methods of measuring risk preferences in the literature are inconclusive. In some studies, responses of the respondents are inconsistent between 'hypothetical methods' - where the subjects are asked by the interviewer to choose a particular answer corresponding to the payoff in a hypothetical setting - and 'the experimental methods' in which the subjects participate in the field experiment where the subjects typically receive the cash based on their choice in the experimental settings which would similar to the choices made in everyday life (Binswanger, 1980; Holt and Laury, 2002).

Some studies, checking for correlation among elicitation methods, have found significant correlation between the responses to hypothetical and experimental methods (Dohmen et al., 2011; Armin et al., 2016). Other studies have found the relationship to be less strong (Deck et al., 2014; Vieider et al., 2015), while some studies have found no relationship among elicitation methods (e.g., Anderson and Mellor, 2009; Loomes and Ganna, 2014). Regarding the validity of self-assessment of risk attitude method, estimating the risk attitude of the subjects based on the survey questions asking about

their own self-assessment of risk preferences [3], several studies have found evidence of close associations between the outcomes of the method based on self-assessment and the one based on experimental methods that are designed to capture actual behaviors of the subjects (Dohmen et al., 2011; Jaeger et al., 2010; Hardeweg et al., 2013; and Anderson and Mellor, 2008) while other studies find no significant association (Harrison et al., 2015a; and Galizzi and Miraldo, 2012).

Regarding the case of Vietnam, to the best of my knowledge, Nielsen et al. (2013) is the only study that examines consistency of risk preference across a wide range of elicitation methods. While that study examines response consistency and correlations among elicitation methods, it does not examine the explanatory power of risk preference measures with respect to observed economic behaviors. Also, elicitation methods in the study (e.g., the multiple price list task) do not involve loss so that the study can only compute the risk aversion parameter but not the loss aversion one.

In Vietnam, the Vietnam Access to Resources Household Survey (VARHS), a longitudinal data set for 12 rural provinces of Vietnam, is the only survey that contain information on individuals' attitudes toward risk since 2012. A concern is whether the hypothetical elicitation questions in VARHS are valid, in the sense of whether they accurately predict the actual behavior of an individual in real life. In response to the above concerns, Chapter 2 of this dissertation investigates the validity of various elicitation

[3] In this method, subjects rate their own degree of risk attitude based on a self-report scale from 0 (=completely avoid risk) to 10 (=totally enjoy risk). This method is used widely in some large representative surveys such as the German Socio-Economic Panel (GSOEP) survey, the UK Household Longitudinal Survey (UKHLS) and the Italian National survey. The method can assess risk attitude in general situation or in specific domains (sports, finance, employment, health and education).

methods, including a set of hypothetical questions from the VARHS. We conduct a field survey and experiment with a random sample of 350 households in 2019 in rural areas of two provinces in Vietnam.

Chapter 2 aims to answer the main and sub-research questions listed below:

What is the most reliable elicitation method to measure the risk preference of vulnerable farmers in developing countries among different elicitation methods commonly used in the literature, namely,

(i) self-assessment based on hypothetical questions,

(ii) lottery tasks (hypothetical settings),

(iii) loss-gain tasks (hypothetical or experimental settings),

(iv) Multiple Price List tasks (hypothetical or experimental) and

(v) real investment tasks (experimental)?

Here, reliability is defined by consistency across different elicitation methods and the ability of each elicitation method to predict the actual risk preference of the individuals, inferred by the performance of experimental measures and household risk-taking behaviors identified by survey questions. So the sub-research questions are:

For internal consistency:

- Do the subjects understand the questions? How many subjects give irrational responses?
- Are the responses consistent within subjects across elicitation methods?
- Are measures significantly correlated with each other?

For behavioral relevance and predictive ability:

- Do the responses given in the hypothetical measures predict actual risk-taking behavior in the experimental measures?
- Does risk preference, determined using elicitation methods, predict observed individual and household behaviors?

1.1.1. Motivation for and objectives of Chapter 3, study of the impact of poverty risk on subjective well-being

People who live in unstable circumstances with unpredictable shocks and a lack of appropriate coping mechanisms face a substantial income fluctuation. Living in such a situation can also affect an individual's emotional and physical condition. This exposure to poverty risk leads us to the concept of vulnerability to income poverty. A useful guiding definition from World Bank (2001) can be summarized as: *vulnerability to income poverty is the risk of a household falling below the income poverty line in the future.*

Few studies have examined the impact of vulnerability to poverty on happiness. One of the most recent studies is Caria and Falco (2018), which investigates the relationship between vulnerability to income poverty and worker happiness in the urban labour market in Ghana. That study finds a strong negative relationship between vulnerability to income poverty and worker happiness. Another study, Dang et al. (2020) further explores this relationship in its examination of adaptation to vulnerability and life satisfaction in the Russian Federation, using rich panel data over the period 2002–2017. The study found no evidence of adaption to vulnerability in the interest of life satisfaction and subjective wealth.

The goal of the study reported in Chapter 3 is to investigate the relationship between the risk of poverty and subjective well-being. Our hypothesis is that individuals living in poverty risk are less satisfied with life and more depressed than those not in poverty risk. We begin by measuring vulnerability by applying multilevel analysis based on Mina and Imai (2017), and then employ the Fixed effect model to examine the impact of vulnerability on happiness. Our analysis is based on four-wave longitudinal VARHS household survey data, which is well suited to the examination of the hypothesis.

1.2.Main contribution and findings

1.2.1. Main contributions and findings of the study reported in Chapter 2

The study reported in Chapter 2 found that most of the participants had no difficulty in understanding the questions and making rational choices.

Our internal consistency test showed that in the Multiple Price List task, 75% of the subjects are consistent or nearly consistent when making choice between hypothetical and experimental situations. However, more of the subjects (more than half of the sample) gave inconsistent responses to experimental and hypothetical questions related to loss aversion. This may have been because losses provoke more caution than gains, so the subjects were more cautious and loss-averse in the experiments (Kahneman and Tversky,1970); Gal and Ruker, 2018) . In the correlation test, the strongest correlation was between questions with the same design, for example the MPL and loss-gain tasks. In the investment scenario there was also strong association with other methods such as MPL and loss-gain. Self-assessment and hypothetical lottery found least relation (or no relation) with other measures.

The results of our OLS regressions of the behavioral relevance test indicate that responses from hypothetical MPL and loss-gain questions significantly predict experimental behaviors, while responses from the self-assessment and lottery have very little or no explanatory power. The results are similar to those of predictions of individual and household behavior. In terms of numbers of predicted behaviors, the explanatory power of the hypothetical measures is stronger than that of the experimental-based measures in the MPL task. In particular, responses to the hypothetical MPL predicted 04/06 observed behaviors, but responses to the experimental MPL predicted only 02/06.

The findings reported in this chapter contribute to existing knowledge regarding validity of risk preferences methods and provide insights that should be useful in the future research using hypothetical elicitation questions from the VARHS survey. In the Conclusion chapter, we summarize those results and report some valuable lessons from our experience during the field survey and experiments.

1.2.2. Main contributions and findings of Chapter 3

The exploration in Chapter 3 of the relationship between vulnerability to poverty and subjective well-being contributes to knowledge of the following aspects that have not been fully addressed in previous studies. One contribution is the use of a composite index, the Center for Epidemiologic Studies Depression (CES-D) Scale, which is a more comprehensive measure of subjective well-being than the widely used self-rating life satisfaction measure. The CES-D index is constructed based on the responses to ten questions related to both the physical and mental health of an individual.

A second contribution, in our estimation of vulnerability to poverty, is our adoption of the extended Vulnerability as Expected Poverty (VEP) approach by using

multi-level model analysis, in order to overcome the econometric issues in measurement of poverty risk because the multi-level model takes into account the existence of the data hierarchies of household surveys by allowing for residual components at each level in the hierarchy. Moreover, multi-level model makes it possible to identify the source of vulnerability by decomposing the unexplained variance of household income into a lower level (household) and a higher level (community). Third, we use the fixed effect model in our examination of the impact of poverty risk on happiness. Moreover, we attempt to use instruments to deal with reverse causality issue that have not been done in previous studies. The instruments include number of firms in neighboring villages and active participation of commune in the New Rural Development program. Furthermore, our study examines the relationship in another study context, rural areas, whereas previous studies explored the relationship in the context of urban area with workers (Caria and Falco, 2018; and Dang et al., 2020). This is also the first study in Vietnam to investigate the relationship.

Our results show that in any of the periods covered, around 20 per cent of the panel households are classified as vulnerable at least once. More importantly, only 10.51 per cent of panel households are classified as vulnerable to unobservable covariate shocks, while around 18.43 per cent are classified as vulnerable to unobservable idiosyncratic shocks. Looking more deeply into our categorization of poverty and vulnerability to poverty, we observe that the chronic and the transitory poor, and even the never poor, are more vulnerable to unobservable idiosyncratic shocks than to unobservable covariate shocks. These results are consistent with those of Mina and Imai (2017) and Gaiha and Imai (2008), and hence, once again imply that idiosyncratic shocks might not be insured

perfectly by village-level mutual help or mutual support between relatives , or social network as informal mutual assistance.

We find that households living in areas affected by natural disaster, for instance those living in the East Northern Mountain and Central Coast of Vietnam, also have higher risk of falling into poverty than households living in another regions. This is also confirmed by the results of our OLS regression on the determinants of vulnerability. Less educated household head, non-Vietnamese ethnicity, and lack of access to road, infrastructure and utility are also associated with higher vulnerability.

In examining the relationship between poverty risk and happiness, we find a significant and strong relationship between vulnerability to poverty and depression score (CES-D), but not with life satisfaction. A one percent point increase in the risk of poverty is associated with a 2.6 unit increase in the CES-D score. The association is more strongly related to idiosyncratic shocks than covariate shocks. Examining the different poor groups, we observe that poverty risk has a stronger and more significant effect on the CES-D score for the never-poor than for the transition and always-poor groups. In particular, a one percentage point increase in the risk of poverty is linked with a 7.8 unit increase in CES-D score for the poor, but only a 3.4 unit increase in CES-D score for the transition poor.

1.3. Roadmap to the Dissertation

This dissertation has three remaining chapters. Chapter 2 examines the validity of risk preference measures. Chapter 3 investigates the impact of vulnerability to poverty on subjective well-being. Finally, Chapter 4 summarizes the main findings and

identifies some policy implications of the findings of each of the main chapters and indicates some possible extensions of this research.

CHAPTER 2

VALIDITY OF RISK PREFERENCES MEASURES

2.1. Introduction

Risk is inherent in any economic decision-making. In some certain areas, risks are higher and more challenging to deal with such as for the poor in natural disaster-prone areas and in agricultural activities whose earnings depend heavily on the weather.

The extent to which people are willing to take risk represent their *risk preferences*. Differences in risk preferences across individuals or households have been implicated for behaviors such as ineffective investment and unhealthy habits. Reducing the risk of shocks is a primary focus of many policies, and estimates of risk aversion is critical for policy prescriptions in determining the appropriate level of risk reduction and in helping people, especially the poor, to cope with shocks in daily life.

Therefore, figuring out ways to accurately measure this important parameter can shed light on the sources of the vast differences in individual preferences and their role in fundamental economic choices. Economists and psychologists have developed a variety of methodologies to elicit and assess individual risk attitudes. Some noteworthy elicitation methods are the Multiple Price List (MPL, or pairwise choice lotteries)[4] by Holt and Laury (2002); the Becker-Degroot-Marschak (BDM) procedure (Bohm et al., 1997; James, 2007; Burfurd et al., 2018); the Eckel and Grossman (B/EG) (Eckel and Grossman, 2000; Charness

[4] In this task, a respondent works through a menu of paired lottery choices, s/he can be expected to switch at some point from one side to the other. The switching point is assumed to be indicative of the individual's risk attitude. Detail of the MPL task in this study is presented in Section 2.3 about elicitation methods of risk preferences

et al., 2013); the framed incremental tasks by Gneezy and Potters (1997); and the self-assessment of risk attitude (Dohmen et al., 2011; Falk et al., 2018; Dohmen et al., 2018; Sepahvand et al., 2021). In general, methods for measuring risk preferences can be divided into two main categories: incentivized games with real financial consequences and survey measures. Incentivized games are the tasks in which subjects evaluate and make choices among risky alternatives, usually between two alternatives such as the popular Multiple Price List and then receiving the real payoff depending on their choice. Survey measure contains two main types of questions. The first survey type are hypothetical questions where subjects also make choices among risky options but they do not receive real consequences after making decisions. The second survey type are self-rating questions that subjects report their perceptions of their own risk tolerance or report the likelihood of engaging in specific behaviors such as in health, financial investment and doing business.

Existing studies have examined the validity and reliability of a wide variety of different types of risk preference measures (Maart and Syster (2014), Charness and Viceisza (2016), Crosetto and Antonio (2016)), in various contexts (Einav et al., 2012; Rieger., 2015) and subjects such as students (Cleave et al., 2013; Charness et al., 2020), farmers (Takeshima and Yamauchi, 2012; Jin et al., 2017; Brauw and Eozenou, 2014; and Iyer et al., 2020), and firm owners (Meyer et al., 1961; Cooper and Krista, 2013). Nevertheless, the findings of tests that examine the validity of various methods of measuring risk preferences in the literature are inconclusive.

In some studies, responses of the respondents are inconsistent between 'hypothetical methods' - where the subjects are asked by the interviewer to choose a particular answer corresponding to the payoff in a hypothetical setting - and 'the experimental methods' in which the subjects participate in the field experiment where the subjects typically receive the cash

based on their choice in the experimental settings which would similar to the choices made in everyday life (Binswanger, 1980; Holt and Laury, 2002). One well-known pioneering study, Binswanger (1980) finds evidence that interview-based methods are highly unstable and more biased than experimental methods through conducting a survey of 240 households and an experiment in semi-arid, tropical areas of India. Before conducting the experiment, the research team implemented a interviewed-based survey and find that the most serious inconsistencies occurred in two neighboring villages, and the risk-aversion distribution coefficients differed markedly in more than 20% of individual cases. That difference is the result of the interview technique that is subject to severe interviewer bias. The study then compares the results between interview-based method and experiment-based method by looking at the distributions of risk-aversion coefficients at low stake (Rs.50) and high stake (Rs.500). Their findings show that the interview results classify more than 50% of individuals as severely risk-averse and close to 15% as neutral. This is in sharp contrast to the experimental results for the same households. These findings bring evidence that interview-based methods are biased and highly instable relative to experimental methods.

Another well-known study by Holt and Laury (2002) uses the Multiple Price List. The authors conducted an experiment using this technique under both real and hypothetical conditions in a sample of undergraduate business students. Their main conclusions are that increasing the stakes do not alter behavior in hypothetical payoff treatments. Subjects are much more risk averse with increasing real-payoff level than with comparable hypothetical payoffs.

Holzmeister and Stefan (2021) assess heterogeneity of revealed risk preferences across elicitation methods, then examine their relationship with subjects' perceived riskiness of choices. The study uses four risk preference elicitation tasks: (1) the "bomb" risk elicitation task, (2) the certainty equivalent method, (3) a multiple choice list, and (4) a single choice list.

After completion of deciding on any of the four tasks, subjects were asked to evaluate the riskiness of their decision (risk perception) and their confidence about the specific choice they made based on the ranking from 1 (not at all risky/not confident) to 7 (very risky/confident). There are a total of 198 German participants who are bachelor and master students from various fields of study. By comparing implied parameter intervals CRRA, the authors assess an individual measure of preference stability. The study found there is substantial variation in revealed risk preferences. Based on the overlap of the CRRA parameter intervals, on average, subjects show stable risk preferences in less than half of the pairwise comparisons of elicitation methods. Although varying risk attitudes characterize the observed behaviour, participants are well aware of the risk level associated with their decisions. Since participants deliberately make their choices, their behaviour cannot be interpreted as inconsistent.

While checking for correlation among methodologies to elicit individual risk attitudes (hereafter, elicitation methods), some studies have found a significant correlation between hypothetical and experimental responses (Dohmen et al., 2011; Falk et al., 2016; and Josef et al., 2016). On the other hands, other studies found the relationship to be less strong (Wölbert and Arno, 2013; Deck et al., 2014; Vieider et al., 2015; and Attanasi et al., 2016).

While assess the across-methods variation by checking the correlations among them, some studies found no relationship among elicitation methods (e.g., Anderson and Mellor, 2009; Dave et al., 2010; Lévy-Garbou et al., 2012; and Loomes and Ganna, 2014). For instance, Anderson and Mellor (2009) examine the stability of risk preference within undergraduate students by comparing measures obtained from two elicitation methods: a lottery choice task from Holt and Laury (2002) with real monetary rewards; and survey questions involving

hypothetical gambles[5]. The authors find that risk preferences are not stable across the two elicitation methods. Risk preference defined from the survey question has no significant association with risk preference defined from the lottery choice task. Loomes and Ganna (2014) investigate the relationship among three elicitation methods: the choice list procedure (or called multiple price list method); the ranking procedure, a variant of a procedure used in Binswanger (1980), presents a set of lotteries with different payoffs and asks the respondent to identify which lottery he prefers the most; and the allocation procedure provides the subjects with a budget and allows him/her to allocate it between different possible states of the world. The results of the study show that significant differences in responses across the three methods.

Regarding the survey method of self-assessment of risk attitude[6], several studies have found evidence of close associations between the outcomes of the method based on self-assessment and the one based on experimental methods that are designed to capture actual

[5] The detail of the question is "*Suppose that you are the only income earner in your family. Your doctor recommends that you move because of allergies and you have to choose between two possible jobs. The first would guarantee you an annual income for life that is equal to your parents' current total family income. The second is possibly better paying, but the income is less certain. There is a 5050 chance the second job would double your total lifetime income and a 5050 chance that it would cut it by a third. Which job would you take the first job, or the second job?*"

[6] In this method, subjects rate their own degree of risk attitude based on a self-report scale from 0 (=completely avoid risk) to 10 (=totally enjoy risk). This method is used widely in some large representative surveys such as the German Socio-Economic Panel (GSOEP) survey, the UK Household Longitudinal Survey (UKHLS) and the Italian National survey. The method can assess risk attitude in general situation or in specific domains (sports, finance, employment, health and education).

behaviors of the subjects (Dohmen et al., 2011; Jaeger et al., 2010; Hardeweg et al., 2013; and Anderson and Mellor, 2008).

Dohmen et al, (2011) pioneered the validation of the survey measures with a lottery experiment. The elicitation methods used in the study include a set of self-assessment survey measures taken from a panel survey of households in Germany, a hypothetical investment task and an experimental MPL for a sample of 450 adults aged 16 and older in Germany in 2005. The results indicate that the responses given in the survey did predict actual risk-taking behavior such as being self-employed, smoking and migrating and even outperforms the lottery measure, domain-specific measures and the hypothetical lottery question. Following Dohmen et al. (2011), other studies adds to the evidence for behavioral relevance of the self-assessment method such as (Jaeger et al., 2010; Hardeweg et al., 2013). With respect to other real-life behaviors such as healthcare habits (e.g., smoking, not doing exercises), some studies find a significant relation between smoking behavior and risk preferences from survey measures (Reynolds, 2006; Anderson and Mellor, 2009) while other studies find no significant association (Harrison et al., 2005; Harrison et al., 2010; Harrison et al., 2015a; and Galizzi and Miraldo, 2017); technology adoption (Liu and Huang, 2013); causal relationship between risk attitude and self-employment (Skriabikova et al., 2014).

A growing body of literature has concentrated on experimental studies on risk preferences in Vietnam, especially in rural area where many poor people live and experience frequent shocks. Some studies combine experiments with survey household data and explore the relationship between risk preferences and household behaviours as well as changes of risk attitude under shocks.

One of the well-known studies in Vietnam, **Tanaka et al. (2010)** link data from an experiment of risk and time preferences and household survey data (VHLSS 2002) and assess

the relationship between individual risk and time preferences and economic circumstances. The experiment method was a multiple price list involving both gain and losses. It was implemented in 142 rural villages in the Mekong Delta (in the south) and 137 rural villages in the Red River Delta (in the north). To deal with the endogeneity issue of the preferences, ability to work of household head and rainfall are used as instruments. The study applies the prospect theory to compute the three parameters: risk aversion, nonlinear weighting of probabilities and loss aversion. The results indicate that more educated and older respondents tend to be more risk averse. Respondents from the South are more loss averse and non-Chinese ethnic is more loss averse than ethnic Chinese. Household income is not significantly associated with risk preference but significantly correlated with patience (shown by lower interest rate). Moreover, respondents, who live in wealthy villages, are less risk averse and more patient.

Vieider et al. (2019) compare risk preferences between Vietnamese farmers and students in the West by using the same large number of experiments that are also utilized in the West. The study also examines the relationship between risk preferences and economic well-being. Experimental measures of risk preferences are decisions task to elicit certainty equivalent. The respondents face choices between amounts of money that could be obtained for sure and risky allocations that involve some probabilities for different amounts. Parameters of risk preferences are obtained under both the prospect theory and expected utility. The sample contains 207 farmers in the Vietnamese villages in An Giang province that is close to the border with Cambodia. The study shows a strong negative correlation between risk aversion and income while no correlation with other measures of economic well-being, such as wealth. Vietnamese farmers are more risk-tolerant than Western subjects. Vietnamese farmers are significantly less risk-averse than American (or Western) students. However, Vietnamese farmers are slightly more risk averse than Vietnamese students.

Other studies examine how individual risk attitudes change under shocks. **Gloede et al. (2015)** assess the influence of the experience of shocks on individual risk attitude by conducting a household survey in rural provinces of Northeast Thailand and Vietnam in 2010 (three provinces/country). In which, a self-assessment survey question measures risk attitude. The results indicate that experience of adverse shocks is associated with a higher degree of risk aversion. There are four main findings regarding shock categories. First, specific areas in each country may suffer more shocks and have a higher frequency than other areas. Second, it is crucial to understand the number of shocks and their intensity. Third, shocks can happen at household level or commune/village level. More shocks occur at the household level in Vietnam, while more shocks occur at the commune/village level in Thailand. Lastly, unexpected shocks have bigger impact. For instance, in Thailand, agricultural shocks matter more, while in Vietnam shocks, that occur at household level, are more critical.

A similar study on the impact of shocks on risk attitude is implemented by **Reynaud and Aubert (2020)**. However, the study focuses on a specific type of shock. Particularly, the study evaluates the impact of experiencing a flood in the past five years on risk preferences in Vietnam. The duration of the impact of flood is divided into three periods: precise, medium and long-term. The study combines experimental data of risk attitude (lottery choice, loss and gain domains) with actual data on flooding experiences (occurrence, injuries and financial and health cost) and expectations about flooding in the future and social factors (social networks, aid from various sources). The prospect theory framework is applied. The experimental measures of risk attitude include the Ordered Lottery Selection (OLS) procedure based on Eckel and Grossman (2002) and Binswanger (1998). Particularly, participants choose the lottery they prefer from a set of lotteries with a 50/50 chance of winning a low payoff or a high payoff. The study finds that flood experience is significantly associated with higher risk

aversion in the loss domain but has no significant impact in the gain domain. In addition, a higher expectation of the effects of flood in the future is related to more risk-taking.

On the other hand, **Nguyen and Leung (2010)** examine the impact of working in a risky occupation on risk attitude by combining a field experiment and a Vietnam household survey data (VNLSS 2002). The chosen risky occupation is fishing, so the subject is the fisher. The context of the study is rural villages in the Mekong Delta and the Red River Delta. The used elicitation method is the multiple price list under the prospect theory framework. Rainfall level in 2002 is used as an instrument to address the endogeneity issue of income. The study's key findings are that fishers are less risk averse than others. The authors stated that "*fishers are less afraid of income variation than income loss." and "It is possible that being faced with uncertainty on an almost daily basis makes fisher less averse to risk.*"

Nguyen et al. (2016) investigate the effect of risk aversion, loss aversion and time preference on trust and trustworthiness, and how is it different between the north and the south of Vietnam. The experiments include a risk elicitation task, a time preference elicitation task, and a trust game that are performed in sequence. The field experiment is implemented in four villages in the north and four villages in the south of the country. There are 166 participants in total. The participants are also the household heads asked during the 2002 Vietnam Household Living Standard survey. The findings show that risk aversion, loss aversion and present bias do not affect the amount sent by the trustors. The decisions of trustors are positively influenced by the expectation of a higher return from the trustee. However, subjects from the South have higher time discounting, increasing this amount, and probability weighting decrease with subjects from the North. Trustee behaviour does not get affected by time discounting and loss aversion. Nevertheless, trustees, who are more risk-averse and less present-biased, return a higher share of their wealth to the trustor. Participants in the North have more pessimistic

expectations of others' trustworthiness and behave less reciprocally than participants in the South.

The studies in Vietnam presented thus far provide important insights into the role of risk preference and utilize various elicitation methods. However, such studies do not assess risk preference across methods or investigate validity of the elicitation methods. To the best of my knowledge, Nielsen et al. (2013) is the only study that examines the consistency of risk preference across a wide range of elicitation methods. The study is conducted in a province in marginal upland environment in northwestern Vietnam and uses eight hypothetical methods categorized into four groups: self-assessment based on Dohmen et al. (2011), financial risk tolerance, income and wealth-related measures (income series, inheritance series), and agricultural product-related measure (maize price series, maize yield series, rice price series and rice yield series). In addition, an experiment, the Multiple Price List game based on Holt and Laury (2002), was implemented. The study found inconsistencies in the responses between income and inheritance series responses. For example, 25.6% of respondents in the most risk averse category in the income series are in the least risk averse category in the inheritance series. Regarding the distribution of self-assessment scale and financial risk tolerance results, the findings indicate that these methods elicit lower level of risk aversion than the other methods. Regarding the correlation among methods, correlation between the maize and rice series and the other methods (e.g., multiple price list, self-assessment measures and financial risk tolerance) are weak and several correlations are not statistically significant. Correlation between MPL and other methods is weak though statistically significant. On the other hand, correlations between some assessment methods, especially in the same group, are strong, for instance, between the survey method of financial risk tolerance and self-assessment method (0.728); Income series and inheritance series (0.4); Maize yield series and maize price series (0.528); Rice yield series and maize yield series (0.672); Despite of statistically significant

correlations between most of the various risk preference measures, magnitude of the correlations are weak, including the correlation between self-assessment scale and multiple price list (0,19).

Although Nielsen et al. (2013) used various interview techniques and methods to measure risk attitude and examine responses consistency and correlations among elicitation methods, the study does not examine the explanatory power of risk preference measures with respect to observed economic behavior. Also, elicitation methods in the study (e.g., the multiple price list task) do not involve loss so that the study can only compute the risk aversion parameter but not the loss aversion parameter.

On the other hand, integrating questions of risk preferences in household survey becomes more important for current empirical analysis. In Vietnam, the Vietnam Access to Resources Household Survey (VARHS), a longitudinal data set for 12 rural provinces of Vietnam, is the only big survey that contain information on individuals' attitudes toward risk since 2012. The survey was conducted every two years since 2002, covering more than 2000 households. However, our concern is that whether hypothetical elicitation questions in VARHS accurately predict the actual behavior of an individual in real life. Knowing this will be helpful for future use of the researchers. Moreover, we have not found any studies that implement validity tests for the questions in VARHS. This gives us an opportunity to examine the validity of those questions.

Therefore, with the above concerns, the goal of this chapter is to investigate the validity of various elicitation methods, including the VARHS ones, with focus on internal consistency, predictive validity and behavioral relevance test. The main and sub-research questions in this chapter are listed below:

What is the most reliable elicitation method to measure the risk preference of vulnerable farmers in developing countries among different elicitation methods commonly used in the literature, namely,

(i) self-assessment based on hypothetical questions,

(ii) lottery tasks (hypothetical settings),

(iii) loss-gain tasks (hypothetical or experimental settings),

(iv) Multiple Price List tasks (hypothetical or experimental) and

(v) real investment tasks (experimental)?

Here the reliability is defined by consistency across different elicitation methods and the ability of each elicitation method to predict the actual risk preference of the individuals, inferred by the performance of experimental measures and household risk-taking behaviors identified by survey questions. So sub-research questions are:

For internal consistency:

- Do the subjects understand the questions? How many subjects give irrational responses?
- Are the responses consistent within subjects across elicitation methods?
- Are measures significantly correlated with each other?

For behavioral relevance and predictive ability:

- Do the responses given in the hypothetical measures predict actual risk-taking behavior in the experimental measures?
- Does risk preference, determined using elicitation methods, predict observed individual and household behaviors?

In order to answer the above research questions, we conducted field survey and experiment with a random sample of 350 households in 2019. The context of our study is rural area of two provinces in Vietnam, namely Long An and Kien Giang with the main income source from agriculture. Our elicitation methods include eight hypothetical methods and three experiments. The hypothetical elicitation methods contain a set of self-assessment questions that adopted from Dohmen et al., (2011) and the set of questions taken from the Vietnam Access to Resources Household Survey. The experimental methods include three tasks in which two tasks are modified from the equivalent hypothetical questions in the VARHS survey and another task is Investment game. Participants receive real payment in the experiment. In addition, while some studies have adopted the prospect theory (e.g., Tanaka et al., 2010; Nguyen et al., 2016; and Reynaud, 2020), our study focuses on the expected utility in order to simplify the questionnaires we use so that they can be easily understood by subjects.

Our findings show that most of our participants (94% of the sample) have no difficulty in understanding the questions and give rational choices. We have summarized and driven some helpful lessons from our experiences during field survey given non-student participants in our study who have limited education and numeracy.

For internal consistency test, our findings show that in Multiple Price List (MPL) task, 75% of subject are consistent or nearly consistent when making choice between hypothetical and experimental situation. However, many more people (more than half of the sample) show inconsistent responses between experiment and hypothetical questions for loss aversion. This can be because losses loom larger than gains and hence people become more cautious and loss-averse in experiments (Daniel Kahneman and Amos Tversky (1970), Gal and Ruker (2018)) . In the correlation test, the strongest correlation is between questions that have the same design such as the MPL and loss-gain tasks. The investment scenario also shows strong association

with other methods like MPL and loss-gain. Self-assessment and hypothetical lottery have the least or no relation with other measures.

For behavioral relevance test, results from our OLS regressions present that responses from hypothetical MPL and loss-gain questions significantly predict experimental behaviors while responses from the self-assessment and lottery have very least or no explanatory power. The results are similar in predicting individual and household behaviors. In terms of numbers of predicted behaviors, the explanatory power of the hypothetical measures is relatively stronger than the experimental-based measures in MPL task. In particular, response from hypothetical MPL can predict 04/06 observed behavior in comparison with 02/06 from response of experimental MPL.

From the findings, we have some main observations and suggestions. First, unlike other studies on supporting the use of self-assessment of risk attitude in survey such as Dohmen et al., (2011), we find that self-assessment, both in general and in specific context have limited validity as it has the least or no relation with other measures. Second, the Multiple Price List and loss-gain questions are dominant methods in predicting household behaviors and individual behaviors, either in hypothetical or experimental setting. Validity of lottery question are limited and unstable throughout the tests. Among hypothetical questions from the VARHS survey, we, therefore, prefer to use the MPL and loss-gain questions in measuring risk attitude. However, the loss-gain questions should be used with caution or it is better to substitute or complement by an experiment to measure loss-aversion because people show more loss-averse in incentivized situation than in theoretical one.

The remaining part of the chapter proceeds as follows. Section 2 is concerned with the theoretical background of validity test. Section 3 begins by laying out the the research design, and describes elicitation methods used for this study. Section 4 analyses the results of internal

consistency test. Section 5 presents and discusses the findings of the research, focusing on behavioral relevance and explanatory power validity. Section 6 concludes.

2.2. Theoretical background of validity test

In empirical research, validity of a measurement instrument is crucial to the reduction of measurement error of a behavior or phenomenon (Drost (2011), Kimberlin and Winterstein (2008). When researchers measure behaviors, they are concerned with whether they are measuring what they intended to measure. It is not clear, for example, whether a single question such as "Do you often feel happy?" measures the happiness of a person; and whether a response to the question, "Do you like or dislike risky activities?" accurately reflects the person's attitude toward risk.

The literature of validity test has identified various dimensions of validity (Nanda et al., (2000) and Drost (2011)). In general, we summarize here five major types of validity tests that researchers need to consider and how we can apply them in the validity of elicitation methods of risk preferences in our study.

First, translation validity or validity by expert is a qualitative measure based on a subjective judgment by the researcher himself or herself or the opinion of an expert in the field. Most of the elicitation methods have been well-developed and well-used in the literature and so proving itself theoretically and empirically by experts of the field. However, basing only on the experts' opinions is not enough, more validity tests need to be considered as below.

Second, concurrent validity refers to the degree of response between one measurement method of interest and one or more external ones. Ideally, the external method is considered as the standard measure of the behavior. This validity strategy is particularly observed in situations where a new instrument poses some advantages over the standard one, such as friendly use, reduced time, effort or expense of administration (Kimberlin and Winterstein

(2008)). In our study, by using multiple elicitation methods, including the traditional one such as the Multiple Price List and the most recently used one such as self-assessment method of risk attitude, we are able to compare and assess the responses among different methods and thus examine this concurrent validity.

Third, internal validity: Internal validity refers to the internal consistency within the context of a study (Trochim, 2006). In measures of risk preferences, the internal validity test is seeking answer for the question that do all measurement methods of attitude towards risk produce the same results in the study context? Some ways to implement internal validity such as visualizations (histograms, bar charts) or one-way or two-way tabulations to observe and have a broad picture of how consistent the responses within subjects are among elicitation methods; And using correlation matrix among hypothetical and experimental tasks to assess if there is a significant correlation among them.

Fourth, behavioral relevance validity: If there is a significant correlation between the two variables, we would like to know whether the relationship is a predictive one given other controls and to make sure there are no confounding factors in research design. Behavioral relevance validity is seeking answer for the question whether the responses given in the hypothetical tasks do in fact predict actual risk-taking behavior in the experiments?

Fifth, predictive validity test refers to the ability of a test to predict a future event or observed economic behavior. The predictive validity test is seeking answer for the questions that whether responses from elicitation methods predict some household behaviors such as crop diversification and seeding time adjustment or individual behaviors such as smoking and drinking?

Our study focuses on internal validity test, behavioral relevance validity and predictive test. In the next part, we briefly describe our research design to collect data as well as detailed of elicitation methods using in the study.

2.3. Research design and Elicitation methods of risk preferences

2.3.1 Research design and Data description

Characteristics of survey area

The field survey and experiment were conducted in rural area of two provinces, Kien Giang and Long An, located in the Mekong Delta region of southern Vietnam. Kien Giang is known for fishing, shrimp growing and rice farming with 22 percent of its population live in urban areas. Long An is situated in an advantageous position in the Southern Key Economic Region of Vietnam. It serves as a bridge between the big city – Ho Chi Minh City in the north and 12 provinces in the Mekong Delta in the south. Due to its low-lying geography, Long An has some areas subject to flooding during the rainy season and is susceptible to sea level rise caused by climate change. Another climate issue is salt water intrusion, alum and high temperature that result in death of many people while working in the field the whole day. Kien Giang is subdivided into 13 district-level sub-divisions and two cities. Long An Province has 15 administrative units (districts) that include a total of 166 communes. Major economic activities are rice production, growing crops such as jackfruit and Melaleuca tree (Long An)[7]. In the past years, the two provinces had experienced major shocks such as saltwater intrusion (Kien Giang) and flooding (Long An).

The two provinces share similar geographical and economic characteristics and are suitable places to examine the impact of shocks on daily decisions of people and their attitude

[7] that is commonly known as paperbarks or tea-trees and has economic value for producing fencing and oils such as tea tree oil: https://en.wikipedia.org/wiki/Melaleuca

towards risk. Long An is also one of 12 provinces in the household survey VARHS. We also select the same communes in Long An as in the VARHS. (Please see the Appendix for the detailed time line of survey implementation and some pictures at the field).

During the survey time, about 25 households were interviewed in each of 06 rural villages in 02 communes in Kien Giang province and 25 households in each of 08 rural villages in 02 communes in Long An province. The households were randomly chosen from a complete population list of the villages by systematic sampling. Systematic sampling is a probability method in which researchers select members of the population at a regular interval determined in advance. In our case, the commune leaders provide us a list of household heads in each village by alphabetical order. We choose to sample every 20^{th} or 30^{rd} household in each village.

Field survey procedure

From January to May of 2019, we had conducted the field survey and risk experiments with a random sample of 350 households that is representative for the rural population in these areas. More specifically, our sample is representative of the village reality of Southern Vietnam, although we cannot claim representativeness outside of this specific subject pool. We cooperated with the Southern Institute of Social Sciences (SISS)[8] in organization of the field trip, including training enumerators, contacting local authorities, logistics and implementation of pilot and real survey. Our research team included eight enumerators, four supervisors and one local guide in each commune.

One month before the real survey and experiments, we provided three-day trainings and pilot survey for enumerators, including rehearsal and discussions of possible situations at the field. Besides, research coordinators contacted local government officials in each research site.

[8] SISS belongs to the Vietnam Academy of Social Sciences that have been experiencing numbers of projects in development issues, particularly in the South of Vietnam.

In each household, we had interviewed a household representative member face-to-face. The interview lasted about 1.5 hours. The interview contains two main parts: survey and experiment parts. The survey part consists of collecting detailed demographic information, applying hypothetical elicitation methods, and asking about risk perceptions and scenarios. The experiment part includes three main tasks with some similar elicitation methods as in the survey part. However, subjects are paid in this section depending on their choice. In order to prevent spillover effect in thinking process, the time gap when subjects answered the hypothetical question and the experimental questions are about 45 minutes.

Experimental set up

After completion of the survey part, subjects participated in a paid experiment. To help subjects understand the questions clearly, the enumerators read the questions aloud and used examples, pictures and red and black token to explain about 50:50 probability. The experiment consists of three main tasks that are equivalent to 11 questions. We use 11 chips to represent for 11 questions and put them in a bag. Before starting the interview, subjects were informed that after they complete both the survey and experiment parts, they would receive a fixed participation fee at 90,000 VND. In addition, they might lose or gain some amount of money aside the participation fee depending on their choice in the experiment. After completing all 11 questions, subjects would pick a chip from 11 chips in a bag without looking at it. The chip a subject pick would identify which question in the experiment is used to calculate final payment of the subject. The enumerator checked subject's answers in that question then a field supervisor would come and give each subject final payout. The average survey and experimental earning for three games was about 196,242 VND (about 19 USD), equivalent to about 06 to 09 days' wages for casual unskilled labor such as harvesting and construction work.

Data description

Table 2- 2 presents a selection of key summary statistics for our sample. Most of individuals are household heads or spouses. Their main income source is from agricultural activities. The average individual is 48.3 years old and has about 6 years of formal education. All subjects had completed at least primary school, hence were able to read and understand the questions. Female accounts for about 30% of the sample. 97% of sampled individuals are married.

2.3.2. Elicitation methods of risk preferences

In this section, we describe elicitation methods of risk preferences using in the study. Elicitation methods are used in both hypothetical and experimental setting (**Table 2- 1***).*

The study utilizes a set of hypothetical questions from the Vietnam Access to Resources Household Survey (VARHS)[9]. Unlike other household datasets in Vietnam, the VARHS contain information on individuals' attitudes toward risk. Particularly, hypothetical lottery and loss-gain task are included in three waves, 2010, 2012, 2014. Hypothetical multiple price list is added to the questionnaire in 2016 and 2018. In addition to the hypothetical elicitation questions from the VARHS, the study includes a set of self-assessment questions adopted from Dohmen et al., (2011). Participants receive no payment in hypothetical tasks. Experimental tasks contain loss-gain, multiple price list and real investment tasks.

Detailed description of each elicitation methods is presented below and with the following main definitions:

Definition of risk: In behavioral economics, risk is defined as the probability of an outcome occurring is known (Corr and Anke, 2018). In this study, risk is understood as

[9] The VARHS are longitudinal datasets constructed biannually by the University of Copenhagen (Denmark) in collaboration with the Centre Institute of Economic Management (CIEM), the Institute for Labor Studies and Social Affairs (ILSSA), and the Institute of Policy and Strategy for Agriculture and Rural Development (IPSARD). The surveys were implemented in rural areas of 12 provinces of Vietnam.

uncertain events that occur in daily life. For example, smoking or inhaling polluted air will cause some respiratory diseases in short-term or cancers in long-term. Or buying a land at low-price this year and can sell it at high-price next year in order to get profit.

Definition of taking risk*?* Taking risk is making a decision or choice eventhough you do not know in advance whether the result is good or not. For instance, buying a dimond ring but you detect it is a fake one later; Trying a new food but getting food poison.

Hypothetical self-assessment willingness-to-take-risk (WTTR)

The self-assessment questions are based on the German Socio-Economic Panel Study conducted by the German Institute for Economic Research (DIW Berlin) and has been widely used to analyze risk preferences (Dohmen et al., (2011)).

Participants look at a Likert scale with integers ranging from zero (= completely unwilling to take risks) to 10 (=completely willing to take risks) and select the integer that best matches their own willingness to take risk. The self-rating questions include evaluating their willingness to take risk in general and in four different activities including agriculture, non-agriculture (doing business), healthcare and education of children.

Most of participants are more toward the risk-preferring side. Particularly, about 50% of them choose the points that are higher than five. This is the same across different domains, including agriculture, healthcare and education of children. Only in non-agriculture activities such as doing business, people tend to select the score below five. About 20-30% of the subjects choose score "5" in these questions (**Figure 2- 3**).

Hypothetical lottery questions

In this task, subjects imagine they are given the chance of joining a state-run lottery where only ten people can enter and one person will win the prize. Subjects are asked how

much they would you be willing to pay for a 1 in 10 chance of winning a prize of 2,000,000 VND (=100 USD) and 20,000,000 VND (=1,000 USD), respectively. We name this task as lottery2 and lottery20. Responses of participants are considered as reservation prices. The lottery task originally comes from a study by Hartog et al. (2002)[10].

Figure 2- 4 shows the distributions of responses of subjects in both situations. Most of participants are willing to pay less than 300,000 VND and hence their responses are accumulated at the corner of the figure. About 20% of participants are not willing to buy the lottery in either 2 million VND or 20 million VND. From our interview experience, these zero-responses bring mixed implications. They may truly reveal strong risk aversion. Alternatively, they may not provide comprehensive information about risk attitude of a person as some of participants have never play lottery and because of variety of reasons related to moral objection.

About 60% of subjects would like to pay from 10,000 VND to less than 60,000 VND in both situations. Very few subjects would like to pay at considerably high amount (above 200,000 VND). On average, subjects are willingness to pay about 43,000 VND and 264,000VND to have chance to win 2 million and 20 million VND, respectively. Following Hartog et al. (2002) to compute risk preference parameter without specifying a utility function, we obtain the Arrow-Pratt measure of absolute risk aversion (ARA)[11].

Multiple Price List (MPL)

The Multiple Price List is based on Holt and Laury (2002). The task has both hypothetical and experimental setting.

[10] The questions appear widely in some national surveys such as the Brabant survey in Netherlands in 1993, the Bank of Italy Survey of Household Income and Wealth (SHIW) and the Japanese Household Panel survey on Consumer Preferences and Satisfaction in 2011-2012.

[11] Please find details of risk preferences computation in lottery2 and lottery20 in the ***Appendix 2- 4***

The hypothetical MPL task from VARHS provides respondents with pair choices of safe and risky options. In the safe option, they receive a fixed amount of money at 2 million VND certainly[12]. The risky option involves equal chance and hence varies the payoff. In all choices, Risky option B yield higher expected value than that in Safe option A (**Table 2- 3**) Notably, the hypothetical MPL includes instructions to guide subjects after each of their choice. For instance, after subject makes decision in the first row, depending on their choice in the first row, enumerator would decide to ask for their decision in the next row or another row and so some rows might be skipped. Because of that, no subjects have irrational responses.

The experimental MPL has a similar structure with the hypothetical MPL in VARHS but the safe and risky options are 20 times lower in value than the hypothetical one (**Table 2-4**). Moreover, different with the hypothetical MPL, subjects deliberately make their decisions in all rows without guiding from the enumerators and so no row is skipped. Therefore, they may have inconsistent answers.

We assess a subject's risk attitude based on the point at which subjects switched from the risky option to the safe one. Following Holt and Laury (2002), we compute their degree of risk aversion based on the expected utility theory. The expected utility theory (EUT) predicts that individuals assess lotteries as if by taking the sum of the utility of the outcomes weighted by the probabilities. When subjects choose between two different lotteries, L_1 and L_2 with equivalent outcomes of x1 and x2 and probability for each outcome is p_1 and p_2, respectively:

$$L = (x_1, p_1;\ x_2, p_2)\ \text{ then we have:}$$

$$\text{Expected utility (EU)} = p_1 U(x_1) + p_2 U(x_2)$$

[12] 20,000 VND = 1 USD

Assuming U(x) is a constant relative risk aversion (CRRA) utility function: $U = \frac{x^{1-r}}{1-r}$

Where r is a measure of risk aversion: r = 0 (risk neutral); r < 0 (risk loving); r > 0 (risk averse)

To illustrate, if the subject switch from Risky option (B) to Safe option (A) in row 2 in the hypothetical MPL in **Table 2-3**, his/her risk preference can be computed as follows:

In row 1, since Risky option (B) is chosen, expected utility from choosing Risky option (B) is larger or at least equal to expected utility from Safe option (A):

$$U(2{,}000{,}000) \leq 0.5U(1{,}5000{,}000) + 0.5\,U(4{,}000{,}000)$$

Or

$$\frac{2{,}000{,}000^{1-r}}{1-r} \leq 0.5 \times \frac{1{,}500{,}000^{1-r}}{1-r} + 0.5 \times \frac{4{,}000{,}000^{1-r}}{1-r}$$

Assuming that the equality holds, we obtain the lowest possible value for r or r = 0.31

In row 2, since subject switch to Safe option (A), the expected utility from choosing Risky option (B) is smaller or at least equal to expected utility from Safe option (A):

$$U(2{,}000{,}000) \geq 0.5U(2{,}000{,}000) + 0.5\,U(4{,}000{,}000)$$

Or

$$\frac{2{,}000{,}000^{1-r}}{1-r} \geq 0.5 \times \frac{2{,}000{,}000^{1-r}}{1-r} + 0.5 \times \frac{4{,}000{,}000^{1-r}}{1-r}$$

Assuming that the equality holds, we obtain the highest possible value for r or r = 1

We therefore having the two inequalities, solving the two inequalities for the extreme cases, we can obtain the interval of the risk aversion parameter in $0.31 \leq r < 1$.

For subjects who switch at the end, the range is bounded only one side.

Table 2- 5 and **Table 2- 6** present the range of risk aversion parameters (r) from MPL task in hypothetical and experimental situations, respectively. In both settings, more than 20% of sampled individuals always choose safe option A. Subjects tend to be more risk-prone in the

hypothetical task. 36.29% of the subjects always choose risky option B in hypothetical MPL while only 18.57% of them in the real MPL. In general, subjects are more likely to be risk-averse in the incentivized task than in the hypothetical one. As for inconsistent responses, hypothetically, subjects follow a given instruction in each choice; hence, there are no inconsistent answers in hypothetical task. In experiment, 4.29% of participants (15 of them), gives inconsistent answers in the real MPL. We exclude these inconsistent subjects in the validity tests.

Loss-gain questions

The loss-gain questions come from Gächter et al. (2006). The task is both in hypothetical and experimental setting. This is a simple lottery choice task with low stakes, where a rejection to play a lottery with positive expected value arguably reflects loss aversion rather than risk aversion (Gächter et al., 2021).

The hypothetical tasks, that are also the same as the ones in VARHS survey, provide six questions. Each question includes both gaining and losing awards with equal chance. The winning amount is unchanged at VND 6,000 and the loss varies from VND 2,000 to VND 7,000. For each question, the respondents can reject or accept the lottery.

In the experiment, the questions are similar to the hypothetical question but the payoff is five times higher. There are five questions of both gaining and losing awards with equal chance. In each choice, the winning amount is unchanged at VND 30,000 and the loss varies from VND 5,000 to VND 25,000 with the interval of 5,000 VND.

The level of loss-averse attitude of a person can be evaluated through the numbers of options that person accepts. A subject is less loss-averse when s/he accepts more options.

Table 2- 7 and **Table 2- 8** show details of payoff, expected value and distributions of responses in hypothetical and experimental loss-gain questions, respectively. In both hypothetical and experimental scenarios, nearly 35% of subjects do not accept any options. Subjects are more likely to accept the options in hypothetical task than in the experiment. About 45% of respondents accept at least once in the hypothetical game while about 35% of participants accept at least once in the experimental scenario. Irrational responses, that are reverse or multiple switching in answers, are similar in both situations. Four participants (1.14%) give irrational responses in hypothetical task and five of participants (1.43%) response irrationally in the experiment.

To compute the loss-aversion parameter (λ), we apply a similar approach as in the MPL questions with assuming expected utility theory to be true and using a constant relative risk aversion (CRRA) utility function. Following (Tanaka and Munro 2014), we estimate the loss-aversion (λ) by using the utility function $U(x) = -\lambda\frac{(-x)^{1-r}}{1-r}$ for losses, in which the mean of the risk aversion parameter (r) obtained from the MPL tasks. We equate the expected utilities between two lotteries. The loss aversion parameter is determined when subject changes from Accept to Refuse a lottery.

To illustrate, in **Table 2- 7** for hypothetical loss-gain questions, if a participant accepts the lottery at row 1 and rejects the lottery at row 2 then we have:

At row 1, the utility of accepting is bigger or at least equal to utility of refusing the lottery:

$$\text{U (accept)} \geq \text{U (refuse)}, \text{or}$$

$$0.5\text{U (2,000)} + 0.5\ \text{U(6,000)} \geq \text{U (refuse)}$$

Or

$$0.5\ (-\lambda)\ \frac{2000^{1-r}}{1-r} + 0.5\ \frac{6000^{1-r}}{1-r} \geq 0 \qquad (1)$$

At row 2, the utility of refusing is bigger or at least equal to utility of accepting the lottery:

$$U(\text{refuse}) \geq U(\text{accept}), \text{or}$$

$$U(\text{refuse}) \geq 0.5U(3{,}000) + 0.5\,U(6{,}000)$$

Or

$$0 \geq 0.5\,(-\lambda)\,\frac{3000^{1-r}}{1-r} + 0.5\,\frac{6000^{1-r}}{1-r} \qquad (2)$$

Solving (1) and (2) the two inequalities for the extreme cases, we can obtain the interval of the loss-aversion parameter:

$$\lambda = \left(\frac{6000}{3000}\right)^{1-r}$$

By solving at the extreme case where U (refuse) = U (accept), we can obtain the general formula for estimating loss-aversion parameter in each lottery as below:

$$\lambda = \left(\frac{gain\ from\ the\ lottery}{loss\ from\ the\ lottery}\right)^{1-r}$$

Where r is the midpoint value from the risk-aversion intervals of subjects in the MPL tasks. Depending on the risk-aversion, we can get different intervals for loss-aversion λ. For subjects who accept all the lotteries or refuse all the lotteries, the range of loss-aversion is bounded only one side.

Table 2- 9 and **Table 2- 10** presented interval of loss-aversion parameters across different risk coefficients for hypothetical and experimental loss-gain task, respectively. In both theoretically and empirically, when r > 1, specifically when r = 2.91 and r = 1.96, the parameter of loss-aversion increases across numbers of accepted questions while r < 1, r = 0.66 and r = 0.31 and r =0, the inverse is true. In other words, the loss-aversion component affects the risk attitude of an individual. When a person is more loss-averse or having low λ, they are more likely to be risk-averse.

Investment Task

The Investment task is pioneered by Gneezy and Potters (1997)[13]. In this task, subjects imagine they just won 100,000 VND (about 5 $USD) in a lottery. In fact, they receive this amount as endowment. Right after winning the lottery, they receive a financial offer that they can set a part or the entire winning prize to invest. There is the chance to double the money. However, there is also equally likely that they could lose half of the amount invested. The participants need to consider and decide how much they would like to invest among five options: 0 (no invest), 20000, 40000, 60000, 80000 or 100000 VND (invest all). In this Investment game, about 67% of participants choose to invest less than or equal 40,000 VND. The average amount subjects would like to invest is about 40,000 VND.

The amount, that subject decided to invest, is used as the measure of risk preferences. We compute an interval CRRA parameter and its midpoint for an individual by using the investment choice of each individual together with their initial wealth level before the investment. In this case, the initial wealth level equals the initial endowment of 100,000 VND. Specifically, a given investment choice implies that the expected utility from this option must be equal or greater than the expected utility from the next largest, and next smallest possible investment choice. Solving these two conditions using the individual's utility function and substituting the wealth level, we can get the upper and lower bound values for CRRA parameter. The resulting parameter ranges can be referred to the curvature of the lifetime utility function and can be seen in **Table 2- 11**. The CRRA lies between 0.56 and 4.91 and majority of subjects (about 28%) are very risk-averse with CRRA bigger than 4.91.

[13] It is then refined in Charness and Gneezy (2002) and hence, originally called as the CPG method. The CGP method has been widely used in the literature thanks to its relative simplicity (Haigh and List, 2005, (Charness, Gneezy, and Imas 2013)).

2.4.Validity tests and findings

In this section, we examine the consistency of responses within subjects among elicitation methods and the correlations among all of the methods. We first examine how many subjects understand the questions? How many of them give irrational responses? Irrational individuals are the one who have multiple or reverse switching between options. For example, they have rejected to toss the coin to have equal chance to "lose 2,000 VND, gain 6,000 VND" in one option. However, they accept to toss the coin to "lose 3,000 VND, gain 6,000 VND" in the next option.

Inconsistent individuals

Respondents may make inconsistent or irrational decisions in each elicitation methods such as switching more than once in the MPL task. Among 350 subjects, 21 of them give irrational responses, equivalent to about 6% of total sample. Out of 21, 15 subjects give irrational responses in experimental MPL, 5 in experimental loss-gain and 4 in hypothetical loss-gain task (**Figure 2- 2**). Hence, subjects have more challenges in understanding the experiment tasks more than the hypothetical ones, especially tasks involving choosing between options and requiring probability explanation from enumerators such as MPL and loss-gain tasks. We check for the different between consistent and inconsistent subjects and have found no significant differences between them in terms of education, cognitive ability, education and gender (**Table 2- 12**). Overall, most of subjects (94% of the sample) understand the questions and give rational choices.

2.4.1. Internal consistency

Validity of internal consistency is to answer the two research questions:

Are responses consistent within subjects across elicitation methods?

Are measures significantly correlated with each other?

Internal consistency between hypothetical and experimental MPL

Table 2- 13 presents internal consistency of responses within subjects between hypothetical and experimental MPL in terms of the CRRA midpoint. About 20% of participants in each method have a CRRA less than 0.31 and nearly 25% of them have a CRRA larger than 2.91. Subjects are categorized in three groups based on their midpoint CRRA in each situation

(C) *Consistent in risk-aversion*: subjects are in the same range of CRRA that are highlighted in gray and bold in the table; In other words, they show the same degree of risk attitude in both questions. Particularly, 155 subjects, equivalent to nearly half of participants stay consistent between hypothetical and experimental tasks.

(NC) *Nearly consistent in risk-aversion*: Subjects are in one CRRA interval in one task and in the next CRRA interval in the other task. Alternatively, their CRRA interval in each task is next to each other. For instance, subjects have CRRA midpoint of 0.31 ($r < 0.31$) in hypothetical MPL and have CRRA midpoint of 0.66 ($0.31 \leq r < 1$) in experimental MPL. About 2% of subjects are almost consistent.

(IC) *Inconsistent in risk-aversion*: Subjects who respond contrast between two tasks. For instance, they may show highly risk averse ($r > 2.91$) in the real MPL while being much less risk averse ($r < 0$) in the hypothetical MPL. These subjects concentrate at the top-right and bottom-left corners of the table. They account for nearly 25% of the sample.

In short, most of subjects (75%) are consistent or nearly consistent between the two tasks. Based on this classification, **Figure 2-5** summarizes the consistency degree within subjects in the MPL tasks.

Internal consistency between MPL and loss-gain tasks

In Section 1.3.2, we have identified loss-aversion interval for each individual in each hypothetical and experimental loss-gain task by using their equivalent risk preferences from hypothetical and experimental MPL tasks, respectively. If an individual has the same risk preferences in both hypothetical and experimental MPL task, they may have the same loss-aversion interval. If the risk preferences are different in both cases, we would like to examine whether his/her loss-aversion intervals are overlapped in both cases.

Figure 2- 6 shows distribution of individual responses between numbers of accepted options in the loss-gain tasks and their associated risk preference in the MPL task. The left-sided figure is for hypothetical situation while the right-sided figure is for the experimental case.

In general, the figure shows a relatively clear pattern in which a more risk-averse person, who has higher value of risk-aversion parameter (r) in the MPL task, is having low numbers of accepted option. In other words, they are less likely to accept the loss-gain game. Subjects, who always choose safe option A in the MPL task, mostly reject or have only one or two accepted options as observed with light blue column. Particularly 22% of them in the real task and nearly 20% of them in the hypothetical task. Similarly, the trend is reverse when subjects are less risk-averse (r is smaller than 1) in the MPL task. They tend to have higher numbers of accepted options and their distributions skew to the left of the figure. There are some discrepancies though it is small. For instance, about 1.5% of subjects with r = 2.91 or highly risk-averse but accepted all the options in the experimental loss-gain task.

Internal consistency between hypothetical and experimental loss-gain tasks

A subject is considered as consistent between the two loss-gain tasks when their two loss intervals from hypothetical and experimental tasks are overlapped. And if the intervals are

not overlapped, they are inconsistent in revealing their loss preferences. We obtained the two intervals of loss-aversion for each individual in Section 2.3.2.

To examine that, we exclude 21 irrational subjects who have multiple or reverse switching. We also do not include 107 subjects who always choose safe option A in either or both of the MPL tasks since their risk parameter interval is unidentified[14]. In which, 48 of them always select safe option in both MPL task while 59 participants always choose A in one of the MPL task.

In the end, 222 subjects have two specific intervals of loss-aversion parameters, 134 of them (60%) do not have overlapped interval while 88 of them (40%) have the overlapped interval. We continue to categorize the participants further by looking more closely at their two loss-aversion intervals:

(C_L) *Consistent in loss-aversion*: subjects whose two loss-aversion intervals are overlapped;

(NC_L) *Nearly consistent in loss-aversion*: subjects have the two loss-aversion intervals that are next to each other or the two intervals have only one common point.

(IC_L) *Inconsistent in loss-aversion*: subjects have the two loss-aversion intervals that are not overlapped and not next to each other. Depending on the gap or distance between two loss-intervals, we have different degree of inconsistency: (VIC_L) Subjects are *very inconsistent* if the gap is very big or the two intervals are very far away from each other, particularly the gap is larger or equal to 1; (IC_L) The individuals are *inconsistent* if the gap is

[14] We call these individuals as "NA" group from MPL tasks. Classification of their loss-aversion degree is presented in detail in the Appendix.

from 0.12 to 1; (SIC_L) And the individuals are *slightly inconsistent* if the gap is smaller than 0.12.

Moreover, even within the consistent loss-aversion group, we can see some of them are more consistent than others in terms of their risk-aversion. **Figure 2- 7** shows the degree of consistency in loss-aversion across the degree of risk-aversion. Notably, nearly 19% of participants are both consistent in MPL and loss-gain task while about 9% of them are consistent in the loss-gain task but being inconsistent in the MPL tasks.

Correlation among Self-assessment methods

Table 2- 14 shows significant correlations among self-rating questions. The correlation rate varies from 0.21 to 0.63. The strongest relationship is between WTTR in general and in agriculture with the magnitude of 0.63. This can be understandable since most of participants are farmers and their daily life activities and decisions are based on agriculture activities. Besides, the lowest correlation is between WTTR in education of children and in healthcare (0.21). WTTR in non-agricultural activities has the lowest relationship with other WTTR questions, particularly about 20-30%.

A considerable proportion of people (20-30%) choose the middle score. A number of reasons why they choose it can be their true preferences, no interest or no understanding of the questions. We are concerned whether they choose it because they may not understand the question. We hypothesis participants who are less educated and get low cognitive score would tend to choose "5". In order to examine this, we run a probit regression of "whether the answer is 5" on other variables of participants' characteristics such as age, gender, education and cognitive ability and other controls. However, the results show that less educated people are more likely to select "5" only in the general case. Age, gender and cognitive level do not have significant impact on their answers.

Correlations among elicitation methods

Table 2- 15 presents correlation among elicitation methods. We find no significant correlations between most of self-assessment methods with other elicitation methods in the study. Similarly, the lottery2 and lottery20 do not have a significant connection with most of the methods, except for hypothetical loss-gain task. The magnitude is considerably high, at 0.26 and 0.23 for lottery 2 and lottery20, respectively.

Second, for methods that have similar design such as lottery, MPL and loss-gain tasks, the relation is substantially high and significant. Specifically, there is a highly significant and positive correlation between lottery2 and lottery20. The magnitude is 0.85. There is a considerably significant correlation between hypothetical and its counter one from the experiment. The degree of correlation in most cases are more than half. For instance, in the MPL task, the correlation between hypothetical and real numbers of safe options chosen is 0.52. While in the loss-gain task, the correlation between hypothetical and experimental ones is relatively low (0.38). The observed correlation might be explained by the fack that people might not perceive or feel the loss in the hypothetical case as clear as in the experimental case. In the loss-gain experiment, respondents are aware that the loss would be deduced from their endowment (in this case, the participation fee) and so we observed that respondents took longer time to think and consider before having a final decision in the loss-gain experiment.

In investment task in column (4), the real amount invested has strong and significant connections with other response in the loss-gain and MPL tasks. The strongest relation is with experimental loss-gain (0.52) and experimental MPL (-0.58). A negative relationship between the amount invested and real MPL task indicates that higher amount invested from investment game is linked with fewer safe options chosen in the real MPL. In other words, people who have more numbers of safe options chosen in real MPL task or more risk-averse, also tend to invest less in the investment game.

Looking at the relationship between MPL and loss-gain task in columns (5), (6), (7) and (8), the correlation is also high and significant. The negative sign shows that more safe options chosen in MPL task is associated with less accepted options in the loss-gain one. The strongest association is between the experimental MPL and loss-gain tasks (0.66).

To conclude, in internal validity test, the strongest correlation is between hypothetical and experimental tasks with the same design such as MPL and loss-gain and between MPL and loss-gain task. The investment scenario also shows strong association with other methods like MPL, loss-gain. Self-assessment and hypothetical lottery have the least or no relation with other measures. A possible explanation for the result may be that people's perception about 'risk' in the self-assessment is quite different from the 'risk' in the MPL or loss-gain tasks. In the latter, the risk is only defined by the two choices (50%-50%) and by monetary gains/losses. The term 'risk' in agriculture (or other dimensions in real life) people would perceive is much more complex than what the MPL/loss-gain tasks would capture

2.4.2. Behavioral relevance validity

We have seen significant correlations among some measures in Section 1.4.1. In this section, we examine behavioral relevance validity, that is do the responses of subjects in hypothetical situation reflect what they behave in the experiment with real payment? This relationship can be expressed by the following regression:

$$Responses\ from\ experimental\ tasks = \alpha + \beta*(Responses\ from\ hypothetical\ tasks) + controls + \varepsilon$$

Table 2- 16 presents OLS regression of each hypothetical measures on a particular experimental measure and a set of controls[15]. All risk measures are standardized. The results

[15] Control variables are age, gender, education, ethnicity, religion, household income (log), numbers of children, organizational membership (e.g., women group, youth group and farmers association), dummies for province id, and enumerator id. Robust standard errors that allow for clustering at the village level are reported in brackets below the coefficient estimates in each regression.

show that self-assessment WTTR and the lottery tasks (low and high stake) show weak or no significant relation to all experimental behaviors. The weak relationship is between WTTR in agriculture and investment. This finding is different from that of Dohmen et al. (2011).

Meanwhile, hypothetical MPL and loss-gain tasks are the most significantly relevant predictor in predicting actual risk-taking behaviors in all three experiments. The coefficients are significant at any conventional level, indicating that the responses given in the hypothetical measures do predict behaviors in experiment. The sign of coefficients also as expected. For instance, in regression (6) and column (1), negative sign of coefficients indicates that when a subject accepted more options in the hypothetical loss-gain tasks, or less loss-averse, they also choose more risky options in the MPL task in the experiment and so have lower risk-averse coefficient.

Moreover, the magnitude of relationship is economically significant. In addition, this magnitude is stronger between tasks that have the same structure design. Hypothetical MPL is the best indicator for the real MPL and hypothetical responses in loss-gain task is the best indicator for its real one. For example, in regression (5), a one-standard-deviation increase in numbers of safe option chosen in hypothetical MPL is associated with a 0.4 one-standard-deviation increase in that in the MPL task. This is a little bit higher compared to the magnitude with respect to loss-gain. The impact of a one-standard deviation increases in numbers of safe options chosen in hypothetical MPL is linked with 0.3 one-standard-deviation decrease in the numbers of accepted options in the loss-gain. In predicting real amount invested, both responses in hypothetical MPL and loss-gain tasks are significantly well-predicted the amount invested in investment game. A one-standard-deviation increase in hypothetical numbers of accepted options in the loss-gain task goes with a 0.2 one-standard-deviation increase in amount invested.

In general, **Table 2- 17** summarizes the results of behavioral relevance validity. This section confirms the validity of behavioral relevance of hypothetical MPL and loss-gain task in comparison with other methods include self-assessment and lottery tasks.

2.4.3. Validity of Predictive power in household and individual behaviors

The above section has brought some evidence on behavioral relevance between hypothetical and experimental measures. In this section, we investigate whether the measurement of risk preferences have the explanatory power with respect to household and individual decisions in real life. The following regression presents the relationship between risk preference and real-world behaviors:

$$Real\ world\ behaviors = \alpha + \beta*(Responses\ from\ elicitation\ methods) + controls + \varepsilon$$

Our survey area has been exposed to severe conditions and climate change. Drought, saline intrusion and flooding are common shocks that affect households every year. Livelihood of people depends heavily on agricultural activities, and so farming daily decisions are highly associated with daily weather. Some of their choices such as choices of crop, seeding time, irrigation investment is no doubt facing risks.

In the field survey, we asked the respondents about the changes they have made in the past 10 years "*In the past 10 years, does your family have any big adjustment or changes in agricultural activities and living*? (*1) Adjust seed sowing time, for instance, change the sowing time, shorten crop season; (2) Diversify types of crops and animals. For example, rotations, planting or changing varieties of plants; (3) Invest in irrigation system; and do not have any changes.* We also asked them the reasons why they have made those changes and the most common response is about unexpected climate changes and disasters (67% of participants), followed by increasing yield and income (62%) and diversifying income sources (30%).

From responses of this question, we have chosen the real-world behaviors including household decisions on crop and animal diversification, investment in irrigation system and seeding time adjustment, as well as implementing all of three activities at the same time. In addition, we estimate the impact on risky individual habits including drinking and smoking.

Separate probit regression models are estimated in **Table 2- 18** for each behavior as outcome and each elicitation method as control variable of interest. Outcome variables are binary. In every regression, the controls include gender, age, education, household wealth, household net income (log), religion, ethnicity, numbers of children, household size, group membership, dummies for communes and enumerator. Robust standard errors that allow for clustering at the village level are reported in brackets below the coefficient estimates.

All risk measures are standardized. Reported coefficients are probit marginal effects estimates, evaluated at the means of independent variables. Therefore, the coefficients show the impact of a one-standard-deviation change in the corresponding measure of risk preferences. We also report the unconditional probability in the last row of the table for each corresponding risky behavior. We exclude irrational people, who have logically inconsistent responses, from the sample.

Table 2- 19 summarizes the predictive power of all elicitation methods with household and individual behaviors. In general, most of measures predict at least one of the behaviors. Particularly, the MPL and loss-gain task are dominant methods in predicting household behaviors and individual behaviors, respectively. While the self-assessment and investment tasks have the least explanatory power.

Second, among all behaviors, crop diversification is more predictable than other activities. Five of eight measures significantly predict crop diversification. The next predictable behaviors are smoking and irrigation investment. While doing all of three household activities

and drinking receive the least predictive power. In short, farming activities in a household are more related to risk preferences than individual behaviors.

The sign of coefficients is as expected in most regressions. For example, in case of investment in irrigation, negative sign of the coefficients from MPL question indicate that a more risk-averse person is unlikely invest in irrigation system. In the loss-gain task, positive sign indicates that when individuals are less loss-averse, equivalent to higher numbers of accepted options, they are more likely invest in the irrigation system.

Third, the marginal effects of some measures are also sizeable relative to the unconditional probabilities, showing the economic significance of the risk attitude measures. In addition, the explanatory power of the hypothetical measures is relatively stronger than the experimental measures in terms of numbers of predicted behaviors, especially with the tasks that have the same structure design such as MPL and loss-gain tasks. The marginal effect of both measures is economically significant. However, when predicting a behavior, the experimental has relatively bigger magnitude and at higher significant level. In case of diversification of crop and animal, only hypothetical tasks are significantly correlated with this household behavior. In case of irrigation investment, a one-standard-deviation increase in risk coefficient from hypothetical MPL is associated with a 12% decrease in the likelihood of irrigation investment. This impact magnitude is a little lower than its counter measure-experimental MPL (17.1%).

2.5. Issue of multiple hypothesis testing

In the above sections, we perform a number of regressions in order to compare various measures of risk preferences with regard to multiple outcomes. As a result, this is likely to involve the issue of multiple hypothesis testing or the probability that at least one of the true null hypotheses will be falsely rejected using randomization inference. There are several

approaches to deal with this issue: the traditional and conservatives Bonferroni correction, the Benjamini-Hochberg procedure and the Romano-Wolf Multiple Hypothesis correction that is newly updated in 2019.

The Bonferroni correction and Benjamini-Hochberg procedure assume that the individual tests are independent of each other. However, this is not the case in our data since there are correlation among measures. In some cases, the correlation is even strong (more than 50%). Therefore, we apply the Romano-Wolf Multiple Hypothesis correction is developed by Clarke et al., (2020). This method is considered as more powerful than earlier ones such as Bonferroni and Holm corrections. It considers the dependence structure of the test statistics by resampling from the original data. The **Table 2-20** provides detail of the Romano-Wolf step-down adjusted p-values with the number of resamples are 10000. The first column is original model P-value and the third column show adjusted Romano-Wolf P value. There are no changes in adjusted P-value compared to the model P-value, indicating validity of our results.

2.6. Conclusions and discussions

This chapter examines the validity of various elicitation methods in the context of rural area in two provinces in Vietnam. We conduct a field survey and an experiment for 350 households. The elicitation methods include 4 hypothetical questions and 3 experimental tasks, in which, we utilize a set of 3 hypothetical questions from a Vietnamese household survey (VARHS). We provide more comprehensive validity test of elicitation methods compared to other existing studies in Vietnam (e.g., Nelson et al., 2013). This study is also the first to investigate the validity of hypothetical elicitation questions in a household survey of Vietnam.

Most of participants (94% of the sample) have no difficulty in understanding the questions and give rational choices. Among the participants who provided inconsistent

responses, there were the ones who tend to take more time and have more challenges in understanding the experiments tasks more than the hypothetical ones, particularly the MPL and loss-gain tasks. We have summarized and drawn some helpful lessons from our experiences during field survey in presenting and designing experimental questions more clearly and effectively given subjects have limited education and numeracy in the conclusion chapter.

Most elicitation methods (except for the self-assessment method) provide evidence that respondents are, on average, risk averse. The finding that most respondents are risk averse supports other studies (e.g., Tanaka et al., 2010; Nielson et al., 2013; and Hold and Laury, 2012). The mean CRRA from the MPL in our study, 1.1, is higher than other studies, such as 0.68 in northern Vietnam (Tanaka et al., 2010) and 0.63 in marginal upland area in northwestern Vietnam (Nielson et al., 2013). The degrees of risk aversion are slightly lower in the MPL (both in hypothetical and experimental setting) than in the investment task. In the MPL, the mean CRRA is 1.12 (SD 1.07) for hypothetical setting and is 1.09 (SD 1.13) for experimental setting while the mean midpoint of the CRRA interval in the investment task is 2.51 (SD 1.76). It is encouraging to understand the high degree of risk preferences in this study in the context of living environment for the poor and vulnerable households. High risk preference may come from the fact of frequent exposure to shocks and risks, particularly the survey area in Long has experienced flooding during the rainy season and is susceptible to sea level rise caused by climate change and survey area in Long An has experienced salt water intrusion and alum that affect rice productivity or high temperature that might cause serious illness or death of household members. A number of researches have also revealed that shocks has a detrimental effect on risk aversion and loss aversion (Gloede et al., 2015; Reynaud and Aubert, 2020; Nguyen and Leung, 2010). Gloede et al. (2015) assess the influence of the experience of shocks on individual risk attitude by conducting a household survey in rural provinces of Northeast Thailand and Vietnam in 2010. Their results indicate that the experience

of adverse shocks is related to a higher degree of risk aversion, even when controlled for a large set of socio-demographic variables. A similar study on the impact of shocks on risk attitude is implemented by Reynaud and Aubert (2020) with the focus on the precise, medium- to long-term, impact on risk preferences of experiencing a flood in the past 5 years in Vietnam. The study finds that experience with being flooded significantly increases risk aversion in the loss domain.

Responses to the general self-assessment scale (mean = 5.86) are similar to those in Nielson et al. (2013). Based on the responses to the same self-assessment scale used in Dohment et al. (2011), we find that Vietnamese farmers reported greater tolerance for risk than typical Germany adults with more than half of the total sample chosen the upper scale. This finding is consistent with Vieider et al. (2019) that Vietnamese farmers are more risk tolerant than Western subjects, and with Charness and Viceisza (2011) that participants in rural Senegal, particularly women, are more risk-tolerant than typical experimental subjects in the western world, including the Dohmen et al. (2011) study.

For internal consistency test, beside checking for subjects' understanding of the question, we also examine the consistency in responses within subjects across elicitation methods as well as correlations between the measures. In MPL task, 75% of subject are consistent or nearly consistent when making choice between hypothetical and experimental situation. However, many more people (more than half of the sample) show inconsistent responses between experiment and hypothetical questions for loss aversion. This can be because losses loom larger than gains and hence people become more cautious and loss-averse in experiments (Tversky and Kahneman, 1989; and Gal and Derek, 2018) . Between MPL and loss-gain tasks, there are little discrepancies (only 1.5% of the sample) between the two tasks. Only about 20% participants have consistent response across all MPL and loss-gain tasks. In

the correlation test, the strongest correlation is observed between questions that have the same design such as the MPL and loss-gain tasks. The investment scenario also shows strong association with other methods like MPL and loss-gain. Self-assessment and hypothetical lottery have the least or no relation with other measures.

For behavioral relevance test, we implement the OLS regression to examine the predictive and explanatory power of the hypothetical measures with the behaviors in experiments after controlling for other factors; and of the elicitation methods with observed individual and household behaviors. We find that responses from hypothetical MPL and loss-gain questions significantly predict experimental behaviors while responses from the self-assessment and lottery have very least or no explanatory power. The results are similar in predicting individual and household behaviors. In terms of numbers of predicted behaviors, the explanatory power of the hypothetical measures is relatively stronger than the experimental-based measures in MPL task. In particular, response from hypothetical MPL can predict 4 out of 6 observed behavior in comparison with 2 out of 6 from response of experimental MPL.

In general, elicitation methods in the study satisfy at least one of the validity tests. From the findings, we have some main observations and suggestions. First, respondents appear less risk averse in the self-assessment method than other methods such as the MPL and investment scenario. Therefore, comparing risk preferences elicited from survey and experimental methods should be done with caution.

Second, we find that self-assessment, both in general and in specific context, have limited validity since it has the least or no relation with other measures and observed behaviors. This finding is similar to those reported by Nielson et al. (2013), Lönnqvist et al. (2015) and Ding et al. (2014). Particularly, in Nielson et al. (2013), the correlation between self-assessment scale and multiple price list is weak (0,19). Ding et al. (2014) found low association among the

hypothetical lottery question, self-assessment question and an experimental lottery. However, the result is different from other studies that support the use of self-assessment of risk attitude in survey, such as Dohmen et al. (2011). A possible explanation for this opposite result might be that our study is different from Dohmen et al. (2011) in some respects[16]. First, subjects in Dohmen et al. (2011) are German adults and subjects in our study are Vietnamese farmers. They may have different life experiences, living and working environments, and personal traits, so their perception of risks may differ. In addition, characteristics of each type of elicitation may have also contributed to the difference in perception about 'risk' even though we had told the respondents a clear definition of risk and risk-taking from the beginning. Notably, people would perceive the term 'risk' in the self-assessment (in general, in agriculture and other dimensions in real life) is much broader and more complex than what MPL/loss-gain tasks would capture. In comparison, the 'risk' in the MPL or loss-gain tasks is only defined by the two choices (50%-50%) and by monetary gains/losses. Second, in terms of elicitation methods, Dohmen et al. (2011) compared the responses between survey method with only one experimental method (the MPL) while our study does not only compare the responses of survey methods with the experimental MPL, but also with two other hypothetical methods (lottery, MPL, and loss-gain tasks) and three experimental tasks (loss-gain and investment tasks). In terms of behavioral relevance, the chosen behaviors in Dohment et al. (2011) are an investment in stocks, active sports, and self-employed that are not common activities for farmers in the context of rural areas in developing countries. In our study, the observed household behaviors are related to agricultural activities. In general, the difference in findings of our research with

[16] though our sample sizes are similar (sample size in Dohmen et al. (2011) and our study are 450 and 350 respondents, respectively)

Dohment et al. (2011) could reflect the differences between developed and developing countries.

Third, the Multiple Price List and loss-gain questions are dominant methods in predicting household and individual behaviors, either hypothetical or experimental. The validity of lottery questions is limited and unstable throughout the tests. Among hypothetical questions from the VARHS survey, we, therefore, prefer to use the MPL and loss-gain questions in measuring risk attitude. However, the loss-gain questions should be used with caution or it is better to be substituted or complemented by an experiment to measure loss-aversion because people show more loss-averse in incentivized situation than in theoretical one.

CHAPTER 3

VULNERABILITY TO POVERTY AND SUBJECTIVE WELL-BEING

3.1. Introduction

Vietnam has achieved considerable economic growth and poverty rate reduction in the past decade. However, the country is still facing a number of challenges, including slow and unsustainable poverty reduction, and large difference in the poverty rate between regions and ethnicities (World Bank, 2018).

Agriculture, major sources of earning for nearly two thirds of the rural population, is strongly affected by climate change. The World Bank Group and Asian Development Bank (2020) summarizes the situation as follow. Vietnam is ranked one of the five countries in the world most vulnerable to natural hazards. Among those hazards, storms, floods, and droughts take place more frequently and they are typical threats for many agricultural areas. Loss of agricultural productivity has been projected for key food and cash crops. Increased average temperature leads to negative health outcomes, especially for poorer communities and outdoor laborers such as farmers who work in the field all day. Moreover, this widespread exposure to shocks is uninsured, and the development of social safety nets is incomplete. Formal insurance such as weather insurance is unavailable, coverage of health insurance is low, and savings opportunities are limited. Without effective adaptation and risk reduction efforts, the above factors all pose threats to sustainable poverty reduction and more generally to the quality of life in rural areas.

People who live in such unstable circumstances face substantial fluctuations in income. The poor may stay poor and the non-poor may become poor. This leads us to an important concept of vulnerability to income poverty. "*Vulnerability to income poverty is defined as the risk of*

households falling below the income poverty line in the future" (World Bank, 2001). In other words, it can be understood as the risk of poverty. By the definition, vulnerability to poverty is a forward-looking approach, that takes into consideration the current situation of a household, the characteristics of the environment where they live and the shocks they experience in daily life, and then estimates the risk of falling into poverty in the future. Moreover, living under poverty risk without a proper support system can affect individual emotional and physical condition.

How does living under poverty risk affect individual subjective well-being? This important question has seldom been explored in literature on determinants of happiness. One of the most recent such studies, Caria and Falco (2018), investigates the relationship between vulnerability to income poverty and worker happiness in the urban labour market in Ghana, using panel data from the Ghana Urban Household Panel Survey. The vulnerability index used in that study is built upon the work of Chaudhuri et al. (2002) and Chaudhuri (2003), namely the Vulnerability as Expected Poverty (VEP) approach. Their main findings show a strong negative relationship between vulnerability to income poverty and worker happiness.

Dang et al. (2020) further explore the relationship between vulnerability and subjective well-being by examining adaptation to vulnerability and life satisfaction in the Russian Federation,a middle-income transition country, using rich panel data covering the period 2002–2017. The vulnerable index is constructed as the probability of the non-poor at a time t will fall into poverty and the highest level of income level as the vulnerability threshold. Two main variables of interest are one to identify whether an individual suffers from vulnerability and the other to identify how long the individual has lived in vulnerability to poverty (degree of vulnerability). Main outcomes used for the subjective wellbeing indicator are subjective wealth, life satisfaction in general and in economic condition, job, work contract, pay and career. The

study found no adaption to vulnerability for life satisfaction and subjective wealth. Longer vulnerability is associated with more negative subjective welfare.

Our research is closely related to the study by Caria and Falco (2018). We investigate the relationship between vulnerability to poverty and subjective well-being. Our study contributes to the growing literature on the determinants of happiness. Our contribution is a refinement of existing methodology, attending to the following points, which have not been fully addressed in previous studies.

First, a widely used measure of happiness in the literature is based on a question regarding life satisfaction, "*In general, how satisfied are you with life*?" with the response in a ranked hierarchy. However, this question does not capture all aspects of subjective well-being, and in fact there has been criticism regarding the accuracy of that approach to capturing well-being (Bertrand and Mullainathan 2005). In our study, in addition to life satisfaction, we also use a depression index, namely the Center for Epidemiologic Studies Depression (CES-D) Scale, that is a more comprehensive measure of subjective well-being. The CES-D index is constructed from answers of 10 questions covering both physical and mental individual health.

Second, several methods have been proposed to measure vulnerability to poverty (Ligon and Schechter, 2004). One of the common methods is the Vulnerability as Expected Poverty (VEP) from Chaudhuri (2003). This method is also applied to construct the vulnerability index in happiness model of Caria and Falco (2018). However, this medthod do not take into account the characteristics of household survey data that is hierarchical structure, lower levels (households) are nested within higher levels (villages and communes). Shocks to household, often strongly related to poverty, also occur at both household level and village/commune level. The VEP

approach ignores the effects of all time-invariant commune- and household-level variables, and it does not include the relative impacts of household-specific and community-specific factors. Also, commune characteristics and covariate shocks affect household welfare not only directly, but also indirectly, through household characteristics (Günther and Harttgen, 2009). Thus, the coefficient estimates could be biased (Goldstein, 1999).

In addition, without considering the hierarchical levels of the data when evaluating the impact of shocks on households' income, studies often categorize shocks into idiosyncratic and covariate shocks, but it is not easy to separate the two kinds of shocks clearly. Some shocks may contain both covariate and idiosyncratic components.[17] Some specific community characteristics such as covariate shocks can be assigned from a small number of communes to many more households. This violates the assumption of independent observations and can lead to an overestimation of the impact of commune shocks on household welfare.

To overcome the above econometric issues related to measuring poverty risk in the literature, we employ multi-level analysis based on Mina and Imai (2017). Multilevel models recognize the existence of data hierarchies by allowing for residual components at each level in the hierarchy[18]. By using multilevel model, information at both household and commune levels can be included

[17] For example, a flood reported at commune level but the flood may affect only a certain place in a village and hence households living in that area get impacted and this is their idiosyncratic shocks. While household live in unaffected area of the village have their covariate shocks. Another example is that a death of a household member can happen because of age and so it is idiosyncratic shock, or because of a typhoon and hence it is a covariate shock.

[18] For example, a two-level model which allows for grouping of households within communes would include residuals at the households and communes level. Therefore, the residual variance is partitioned into a between-commune component (the variance of the commune-level residuals) and a within-commune component (the variance of the household-level residuals). The commune effects, represent unobserved commune characteristics that affect household outcomes. It is these unobserved variables which lead to correlation between outcomes for households from the same commune.

simultaneously in the same model without violating the assumption of independent observations, and hence can provide correct standard errors and significance tests (Goldstein, 1999). Moreover, multilevel model helps us to identify the source of vulnerability by decomposing the unexplained variance of household income into a lower level (household) and higher level (community). For the above reasons, using multilevel model affords a deeper understanding of vulnerability situation of a household by informing us of their poverty source.

Third, while past studies have investigated the correlation between poverty risk and happiness, none have examined the causal impact of vulnerability on happiness, due to the complexity of vulnerability measurement as well as the unavailability of suitable instruments.

Therefore, our main goal in this chapter is to examine the relationship between poverty risk and subjective well-being. Our hypothesis is that individuals who live in poverty risk are less satisfied with life and more depressed than those who do not. In order to examine this hypothesis, we begin by measuring vulnerability by applying three-level model analysis based on Mina and Imai (2017). Next, we use the estimated vulnerability index to examine the impact of vulnerability on happiness by employing the Fixed effect model.

Our analysis is based on the four-wave longitudinal the Vietnam Access to Resources Household Survey (VARHS) data. The context of our study is rural area of Vietnam where people mainly depend for their livelihood on agricultural activities and household member works together to generate income. Our study is the first study examines the relationship between vulnerability and happiness in rural context while previous studies explore the relationship in the context of urban area with workers (Caria and Falco, 2018 and Dang et al., 2020). This is also the first study in Vietnam looking into the relationship.

Our results show that around 20 per cent of the panel households are classified as vulnerable at least once in any of the periods covered. More importantly, only 10.51 per cent of panel households are classified as vulnerable to unobservable covariate shocks while around 18.43 per cent are vulnerable to unobservable idiosyncratic shocks. Looking further by categorization of poverty and vulnerability to poverty, we observe that the chronic and the transitory poor, and even the never poor, are more vulnerable to unobservable idiosyncratic shocks than to unobservable covariate shocks. These results are consistent with Mina and Imai (2017) and Gaiha and Imai (2008), and hence, once again imply that idiosyncratic shocks might not be insured perfectly by village-level mutual help or mutual support between relatives , or social network as informal mutual assistance.

We find that households, who live in natural disasters affected area, for instance the ones who locate in the East Northern Mountain and Central Coast of Vietnam, also have higher risk of falling into poverty than households live in another regions. Less educated household head, non-Vietnamese ethnicity, and lack of access to road, infrastructure and utility are also associated with higher vulnerability. These findings supports evidence from previous observations (e.g. Imai et al. (2011); Pham et al., 2021).

In examining the relationship between poverty risk and happiness, we find a significant and strong relationship between vulnerability to poverty and depression score (CES-D), but not between vulnerability to poverty and life satisfaction. 16 percentage point reduction of the risk of poverty, which amounts to entirely offsetting the risk of poverty for the mean individual in our sample, has the same effect on CES-D score as a 70% increase in income. This association is stronger related to idiosyncratic shocks than covariate shocks. Looking at different poor groups, we observe that vulnerability to poverty has stronger and more significant effect on higher CES-

D score to the never-poor than the transition and always-poor groups. In particular, a one percentage point increase in the risk of poverty is linked with a 7.8 unit increase in the CES-D score of the non-poor, but only a 3.4 unit increase in the CES-D score of the transition poor.

Identifying the poverty risk that a household is facing and its effect on their happiness can provide useful information for policy makers in their work to design more effective, forward-looking anti-poverty strategies and improve people's life quality. It also brings important implications for other economies similar to Vietnam.

The rest of the chapter is structured as follows. In section 2, we describe the household survey data used here. Our empirical methodology for examination of the relationship between vulnerability and happiness are explained in section 3. Section 3 also describes measurement of vulnerability in the happiness model. Section 4 presents our main regression results. Section 5 contains a concluding discussion.

3.2. Data description and Measures of subjective well-beings

3.2.1. Data description

Estimating the effect of poverty risk on subjective well-being requires detailed data on demography, income, shocks, and happiness-related questions at the individual, household and commune levels. We rely on a panel data from the Vietnam Access to Resources Household Survey (VARHS) for four waves, 2012, 2014, 2016 and 2018. The datasets are collected every two years in rural areas of 12 provinces throughout Vietnam, covering provinces across 05 regions (Red river delta, North, Central coast, Central highlands, and Mekong river delta).[19]

[19] The VARHS are constructed biannually by the University of Copenhagen (Denmark) in collaboration with the Centre Institute of Economic Management (CIEM), the Institute for Labor Studies and Social Affairs (ILSSA), and the Institute of Policy and Strategy for Agriculture and Rural Development (IPSARD). The 12 provinces are evenly selected throughout Vietnam, including Ha Tay in the Red River Delta; Lao Cai and Phu Tho in the Northeast; Lai Chau and Dien Bien in the Northwest; Nghe An in North Central Coast; Quang Nam

In fact, VARHS is the data set that complements the nationally-representative Viet Nam Household Living Standards Survey (VHLSS)[20] (Tarp, 2017). Many households surveyed in the VARHS have also been surveyed in the VHLSS. The VARHS investigates issues surrounding Vietnamese rural household access to resources and the constraints (land, credit, and labor) that these households face in managing their livelihoods. The VARHS is representative at the provincial level and concentrates on the poor and rural areas. In addition, the VARHS include information that is not available in the VHLSS, such as set of questions about individual happiness.

The VARHS covers all demographic, income and shocks information on the households. In addition, a module for construction of a depression index, namely the CES-D score, was added to the survey in 2016. With the VARHS data, we are able to construct our main variables of interest, including risk of poverty and depression index, together with other necessary controls.

Furthermore, using panel data such as the VARHS has some benefits that time-series and cross-section data do not. The use of VARSH makes it possible to control for individual heterogeneity, since there are numerous invariant individual traits or time-invariant variables that may affect the regression outcomes. Omissions of those variables can lead to biased results. Besides, the use of panel data provides more information, more variability, and is more efficient. With that increased amount of information, parameter estimates are more reliable. Also, data variation can be broken down into variation at different levels, such as between and within households. Having panel data is also useful for the study of dynamics and duration of economic states such as poverty (Baltagi, 2008; and Baltagi, 2021).

and Khanh Hoa in the South Central Coast; Dac Lac, Dac Nong and Lam Dong in the Central Highland; and Long An in the Mekong River Delta.

[20] A national household survey conducted biennially by the General Statistics Office (GSO)

To estimate vulnerability to poverty, we use data at household level, tracing 2,800 households from 466 communes in the VARHS since 2012. Attrition may occur when there are nonresponses from households in one or several waves. Refusal to re-interview, and death of all members of a household are rare reasons given in VARHS (Tarp, 2017)[21]. In fact, the scale of attrition is small over the four waves: the attrition rates between one wave and the next vary between 0.32 per cent and 2.0 per cent. The overall attrition rate from 2012 to 2018 is 3.53 percent. Only limited evidence of systematic patterns of attrition is found in the VARHS (Tarp, 2017).

For the vulnerability-happiness model, since only one adult person in each household, typically the household head, answered the questions about happiness, we examine the relationship between vulnerability and happiness using data at the individual level. The number of individuals dropped slightly from 2012 to 2016 (three percent). In 2018, there was no happiness information for about 400 individuals (15% of the original sample), although the households were still in the sample. Therefore, we do not include those 400 individuals and work with a balanced panel data which traces 2,342 individuals over the period 2012-2018.

Table 3- 1 presents key summary statistics for the sample of interest in 2012. The sample includes individuals between the ages of 23 and 89 whose main income source is from agricultural activities, with 80% of them male and having been married. Ethnicity of about 60% of our sample is Kinh (Vietnamese), the largest of the 54 ethnic groups in Vietnam. About 5% of the sample never went to school, half of them had completed primary or secondary school, and 30% are graduates of a vocational school or university. More than 70% of the sampled individuals live in communes affected by natural disasters such as flood, drought, typhoons and crop infestation every

[21] According to the Institute for Labor Studies and Social Affairs (ILSSA)—the government unit in charge of collecting the data—the common reason for attrition is migration, and according to local authorities, people migrate because of economic necessity or reunion with family members.

year.

3.2.2. Measures of subjective well-being

Our two main outcomes of subjective well-being in this study are life satisfaction and CES-D score. A question on life satisfaction[22] has been included since 2012, measured on a scale from 1 to 4, with higher score implying higher reported level of life satisfaction. **Figure 3- 1** presents distribution of responses regarding degree of life satisfaction. About two-thirds of the responses lie in the upper part of the distribution (score three and four). More than 30% of the sample stated that they were not satisfied with life. Average respondent life satisfaction score of 2.6.

Although life satisfaction has been used consistently in the literature as a measure of subjective well-being, there have been criticisms of the ability of that measure to accurately capture well-being. First, it does not reflect emotional well-being aspect, particularly the emotional quality of the individual's daily experience (Kahneman and Deaton, 2010). Second, using only a single question to measure life satisfaction may give rise to cognitive problems. Respondents who wish to avoid making significant mental effort, may not attempt to recall all the relevant information or by not reading through the whole list of alternative responses. In addition, their responses may correlate with a set of their behavior characteristics. Third, social desirability, in which respondents want to avoid looking bad in front of the interviewers, may influence answers of respondents. For these reasons, responses to life satisfaction questions may contain a high measurement error (Bertrand and Mullainathan, 2005); if so, there is a need for more validity testing. As a

[22] *"In general, how satisfied are you with your current life? 1. Disappointed, 2. Not satisfied, 3. Satisfied, 4. Very satisfied"*

consequence, using only life satisfaction question as a single measure of individual well-being is unlikely to capture happiness level comprehensively.

More comprehensive methods would be to use a set of questions that capture both the physical and mental health of a person. Answers to these questions can be used to construct an index to reveal depression level of a person. These questions will increase the possibility that feelings exist in a coherent form, since subjects report feelings that are more consistent with their behavior and past attitudes. One of the most commonly used measures of depression is the Center for Epidemiologic Studies Depression (CES-D) Scale. The original CES-D scale, consisting of 20 items, was developed by Radloff (1977) as a screening tool for measurement of depressive symptoms; a number of epidemiological studies have offered evidence that it strongly predicts clinical diagnoses of depression and anxiety disorders (Weissman et al., 1977). The CES-D was also found reliable and valid by Radloff (1991). Another modified 10-item short-form version of CES-D, developed by Andresen et al. (1994), has been shown to have good psychometric properties in a variety of contexts (Andresen et al., 1994; Boey, 1999; Björgvinsson et al., 2013; Blattman et al., 2016; Kilburn et al., 2018; Eyal and Justine, 2019; and James et al., 2020). In particular, respondents were asked to indicate how often they had certain feelings in the past week, on a 0–3 scale of "never (0 days in a week)"; "sometimes (1–2 days of the week)"; "often (3–4 days of the week)"; and "all the time (5–7 days of the week).' The scale is used as an additive index. A higher CES-D score indicates poorer mental health condition. Furthermore, Thanh et al. (2016) and James et al. (2020) examined the validity of the CES-D-10 in developing countries, evaluating its validity and applicability in low- and middle-income countries in Asia, Africa, the Caribbean and South America.

In the VARHS survey, a module of a 10-item CES-D designed in accordance with the existing literature has been included in the survey since 2016. The CES-D score (depression index) consists of 10 questions about how the subject felt during the past week in terms of various emotional and physical condition (**Table 3- 2**). Answers to questions about negative feelings are scored progressively while answers for questions on positive feeling are scored on a decreasing scale. The resulting depression index is the sum of scores for each question. The possible range of scores is zero to 30, a higher indicating the presence of more symptomatology of depression.

Figure 3- 2 summarizes distributions of depression scores. Average respondent CES-D score was 7. Most respondent has the CES-D score lie between 0 and 19, making up nearly 90% of the sample.

3.3. Empirical methodology

This section begins with a description of the methodology for construction of the vulnerability index that is used as a variable of interest in the central model of happiness. It then proceeds to presentation of our central model for exploration of the effect of income vulnerability on subjective well-being.

3.3.1. Measures of vulnerability using multi-level model

In preparation for our examination of the impact of income vulnerability on subjective well-being, we need to construct a measure of the vulnerability. This section summarizes the main steps in that construction of the vulnerability index.

Vulnerability to poverty is defined as the risk of households or individuals falling below the poverty line in the future (World Bank, 2001) — in other words, the risk of poverty. This definition implies a forward-looking approach: evaluating the current situation of households, the

characteristics of where they live and the shocks they experience in daily life; and then predicting their probability of falling into poverty. Application of this concept makes it possible to determine which poor may stay poor and which non-poor may become poor. This is also an important approach to assessment of the poverty dynamic and of the sustainability of poverty reduction, and identifying the source(s) of poverty risk.

In empirical analysis, *ex-ante* vulnerability measures are often specified as a function of the expected mean and variance of household welfare, in terms of either consumption or income. The mean of the expected consumption is determined by household and community characteristics, whereas the variance in household consumption is determined by (a) the severity and frequency of idiosyncratic and covariate shocks; and (b) the strength of a household's coping mechanisms for insuring consumption against these shocks (Günther and Harttgen,2009).

Literature on quantitative measures of vulnerability to poverty has been growing. In general, measures of vulnerability to poverty are classified into three main approaches, based on their defining elements (Hoddinott and Quisumbing, 2003; Ceriani, 2018). First, vulnerability as uninsured exposure to risk (VER) considers exposure to risks to be the key element of vulnerability, either in terms of lack of insurance to cover poverty risk (Jalan et al., 1999; Cafiero and Renos, 2006; Dercon and Krishnan, 2000; Dutta et al., 2011), or on the basis of an expected downside risk (Glewwe and Paul, 1998; Povel, 2015; and Cafiero et al., 2006) . This approach assesses the impact of shocks on income and hence is considered as *ex-post* approach to measure vulnerability. In this study, we focus on *ex-ante* approach.

The second approach to the measurement of vulnerability, vulnerability as low expected utility (VEU), is also founded on the concept of expected poverty; however, the expected poverty measures are expressed in terms of utility gaps (taken to be the defining element of vulnerability).

The VEU category includes two new vulnerability approaches that have been formulated in terms of expected utility (Ligon and Schechter, 2003; Calvo and Stephan, 2013; Magrini et al., 2018; Vo, 2019; Chen et al., 2021); and reference-dependent utility theory (Günther and Johannes, 2014). However, these approaches are not suitable for our happiness-vulnerability model, as happiness is widely considered as a proxy for utility (Rayo and Gary, 2007; Kimball and Willis, 2006; Benjamin et al., 2012). For that reason, in the happiness model, VEU as an independent variable and happiness as a dependent variable measure the same thing that is utility. As a result, it is impossible to examine the relationship between the two when the outcome variable and the explanatory variable both measure utility.

There are other approaches to the measurement of vulnerability, such as vulnerability by mean risk (VMR) (Gallardo, 2018; Chiwaula et al., 2011; and Angeon et al., 2015) which is based on the mean-risk ordering of uncertain welfare outcomes, vulnerability in terms of a low-mean outcome and the risk of divergence from that mean (Chiwaula and Rudolf, 2011; Gallardo, 2013), vulnerability threshold (Dang et al., 2020). However, these methods usually require an extensive panel data and very rich information about the nature of the shocks. Therefore, it is not suitable in our study given the four waves panel data used here, and the limited information about all types of shocks to households.

The third method, widely adopted in empirical studies, is Vulnerability to Expected Poverty (VEP), which identifies expected poverty as the essential feature of vulnerability to poverty. Among early studies are the work of Pritchett et al. (2000), Chaudhuri et al. (2002) and Chaudhuri (2003). Some noteworthy studies include Christiaensen and Kalanidh (2005), Azam and Imai (2009), Jha and Tu (2010), Jha et al. (2010), Imai et al. (2011), Échevin (2013), and Klasen and Hermann (2015). Imai et al. (2011) is the first study that provides analysis on

vulnerability and poverty dynamics in Vietnam applying the vulnerability as expected poverty approach to measure vulnerability. The study concentrates on ethnic minority groups and specific geographical areas. The analysis is based on panel data constructed from the Vietnam Household Living Standard Survey (VHLSS) in 2002 and 2004. Their results indicate that higher vulnerability translates into poverty over time, specifically a vulnerability in 2002 translates into poverty in 2004. The vulnerability of the poor tends to perpetuate their poverty. In addition, households of ethnic minorities or those living in high mountain areas are both monetarily poorer and more vulnerable than ethnic majority households (Kinh and the Khmer) or those living in other regions. Factors related to poverty and vulnerability include landlessness and lack of education, and lack of access to infrastructure. However, the study cannot distinguish sources of vulnerability to poverty from using the VEP.

A wide range of methodologies have been applied in estimation of the VEP. Some of the most common methodologies to estimate VEP are feasible generalized least square (FGLS) (Vo, 2019) and fixed-effects (Kamanou and Jonathan, 2002; Klasen et al., 2015); The VEP-fixed effect was also applied to the measurement of vulnerability in the happiness model of Caria and Falco (2018). However, these methods of measurement of vulnerability do not take into account of the main characteristic of the household survey data that is hierarchical or clustered structure, i.e. lower levels (households) are nested within higher levels (villages and communes). Shocks to household, often strongly related to poverty, also occur at both household level and village/commune level. Estimate of the VEP based on fixed effect model ignores the effects of all time-invariant commune- and household-level variables, and it does not include the relative impacts of household-specific and community-specific factors. Also, commune characteristics and covariate shocks affect household welfare not only directly, but also indirectly, through household

characteristics (Günther and Harttgen, 2009). Thus, the coefficient estimates could be biased (Goldstein, 1999).

In addition, without considering the hierarchical levels of the data when evaluating the impact of shocks on households' income, studies often categorize shocks into idiosyncratic and covariate shocks, but it is not easy to separate the two kinds of shocks clearly. Some shocks may contain both covariate and idiosyncratic components. Some specific community characteristics such as covariate shocks can be assigned from a small number of communes to many more households. This violates the assumption of independent observations and can lead to an overestimation of the impact of commune shocks on household welfare.

Recently, there is a new method, namely the extended VEP, overcomes the limitations of the VEP by employing multilevel modelling. This method was proposed by Günther and Harttgen (2009) with two-level model and developed by Mina and Imai (2017) with three-level model. By using multilevel model, information at both household and commune levels can be included simultaneously in the same model without violating the assumption of independent observations, thus providing correct standard errors and significance tests (Goldstein, 1999). Multilevel models recognize the existence of the data hierarchies by allowing for residual components at each level in the hierarchy.[23] Moreover, it helps us to know the source of vulnerability by decomposing the unexplained variance of household income in to a lower level (household) and a higher level (community).

[23] For example, a two-level model which allows for grouping of households within communes would include residuals at the households and communes level. Therefore, the residual variance is partitioned into a between-commune component (the variance of the commune-level residuals) and a within-commune component (the variance of the household-level residuals). The commune effects, represent unobserved commune characteristics that affect household outcomes. It is these unobserved variables which lead to correlation between outcomes for households from the same commune.

Given the above advantages of multilevel model over econometric issues in measuring poverty risk , our chosen method in this study is the extended VEP, developed by Mina and Imai (2017). A recent study in Vietnam by Pham et al. (2021) has also applied and developed the three-level model in Mina and Imai (2017) by constructing measures of vulnerability to poverty across multiple dimensions, particularly in both monetary (income) and non-monetary dimensions for households at the regional and national levels. The non-monetary dimensions are obtained from 19 indicators and grouped into six dimensions, including education, health, housing, basic services, durable assets, and economic status. The study uses three-wave panel data from the Vietnam Housing Living Standard Survey (VHLSS) 2010, 2012, and 2014. Their main findings show that households have a higher probability of being totally poor in the monetary dimension than that in non-monetary dimensions. In the monetary dimension, the probability of a household being classified as definitely poor at least once in the next two years is very high (about 60%). In addition, more multidimensionally poor households are more vulnerable to idiosyncratic shocks than to covariate shocks. Around 84 percent of households are vulnerable to unobservable idiosyncratic shocks in the monetary dimension while only around 7.3% are vulnerable to unobservable covariate shocks. Factors found to be influencing poverty and vulnerability in most dimensions include education of household members, members in services and non-farm activities, and agriculture index. The chronically poor in the monetary dimension are more likely to remain poor in the near future. Households of ethnic minorities who live in high mountain areas are both poorer monetarily and more vulnerable than ethnic majority households or those living in other regions.

While the study by Pham et al. (2021) focus solely on measurement of vulnerability, our study aims to construct vulnerability as a variable of interest in our happiness model in order to investigate the impact of poverty risk on happiness. Both studies construct the vulnerability based

on the three-level model from Mina and Imai (2017). However, our study is different from Pham et al. (2021) in a number of respects. First, we use the VARHS data that is complementary for the VHLSS and concentrate more on the poor and rural area of 12 provinces along Vietnam. Moreover, the VARHS provides us a set of questions to measure subjective well-being that are not available in the VHLSS. Second, in three-level model, level 1 (time) and level 2 (household) are the same in both studies whereas level 3 is different. Level 3 in our study is at commune level while Pham et al. (2021) is at province level. It could be argued that covariate shocks at commune level may be stronger and have more direct impact on household's welfare than covariate shocks at the province level.

Third, Pham et al. (2021) use a different definition to classification of poor people (definitely poor and non-poor), particularly the study uses the propensity to poverty for households as "*Definitely poor measured as a proportion of the interval defined by lower and upper bounds of expected deprivation*" instead of using income threshold. Lastly, Pham et al. (2021) construct multidimensional vulnerability to poverty while the scope of our study is limited in terms of measure of vulnerability to income poverty since income has been considered as an important and direct determinant in numbers of studies (e.g. Cuong, 2021). We acknowledge that using multidimensional vulnerability can be an interesting approach and would be a fruitful area for further work in future to see more comprehensive impact of vulnerability on subjective being.

The below part presents the extended VEP, developed by Mina and Imai (2017) applying in our study. Particularly, the applied methodology is three-level linear random coefficient model. The three level are time (t) (level 1), household (i) (level 2) and commune (j) (level 3).

The basic model is expressed as below:

$$\ln y_{ijt} = x_{ijt}^T \beta_1 + x_{ij}^T \beta_2 + x_{jt}^T \beta_3 + Z_{ijt}^T v_j + Z_{ijt}^T u_{ij} + e_{ij} \qquad (3.3)$$

In which, $\ln y_{ijt}$ is log of total income in the past 12 months of household (i)[24] in community (j) at time (t). The model includes two parts.

The fixed part ($x_{ijt}^T, x_{ij}^T, x_{jt}^T$) is a vector of household and commune level explanatory variables = time-variant household-level covariates, time-invariant household-level covariates and commune-level covariates.

The last three terms in equation (3.3) comprise the random part of the model. ($Z_{ijt}^T v_j + Z_{ijt}^T u_{ij}$) capture the unobservable effect at commune level (j) and household level (i) while e_{ij} is level 1 residual, capturing unexplained variance in household income and contains the impact of idiosyncratic shocks and measurement error.

In addition, given the limitation of the random coefficient model that are potential correlations between covariates and an unobservable term at the household or commune level (or the heterogeneity bias), we follow Mina and Imai (2017) in adoption of the method called the 'within-between' formulation based on Bell and Jones (2015) to address the issue of heterogeneity issue. Specifically, the 'within-between' method by Bell and Jones (2015) takes into account the 'within variation' by including a vector of demeaned terms of time-varying covariates in levels 1 and level 3 (time-varying covariates minus time-series mean of time varying covariates) and the 'between variation' by having a vector of time-series means of time-varying covariates.

[24] The recording period is 2012-2018; The total income is household's net income computed from the following sources: wage/salary, agricultural activities, common property resources, non-farm non-wage economic activities, rental income (land/real estate and other assets), sales of assets, private transfers, public transfers and other.

The main steps to obtain household vulnerability to poverty are:

1. Regress equation (3.3) after applying 'within-between' method by Bell and Jones (2015) to obtain predicted value of log of per capita income and three estimated error terms that are variance of household-income at household level, commune-level and time-level.

2. Regress the obtained squared residuals on a set of household and community characteristics. The set of controls are the same as in equation (3.3)

$e_{ijt}^2 = x_{ijt}^T a_1 + x_{ij}^T a_2 + x_{jt}^T a_3$ (3.4) *Time-level*

$u_{0ij}^2 = x_{ij}^T b_2 + x_{jt}^T b_3$ (3.5) *Household-level*

$v_{0j}^2 = x_{jt}^T c_3$ (3.6) *Commune-level*

$s_{ijt}^2 = x_{ijt}^T d_1 + x_{ij}^T d_2 + x_{jt}^T d_3$ (3.7) While *Total variance* = $s_{ijt} = e_{ijt} + u_{0ij} + v_{0j}$

3. From the regression results in Step 2, we obtain following expected variances: unobservable idiosyncratic variances (household-level), covariate variance (commune-level) and total variance.

4. Using the three predicted variances, we compute the estimated vulnerability to poverty of household (i) in commune (j) at time (t) under three different types of shocks by the following formula:

$$\widehat{V_{tij}} = \widehat{\mathrm{P}}(\ln y_{ijt} < \ln \bar{y} \mid x_{ijt}^T) = \Phi\left(\frac{\ln \bar{y} - \ln \widehat{y_{ijt}}}{\sqrt{\widehat{\delta_{ijt}^2}}}\right) \qquad (3.8)$$

5. Identify vulnerability threshold or minimum level of vulnerability above which all households are classified as vulnerable:

$$V^{*}_{t+2,ij} = 1 - \left[\!\left[P\left(\ln y_{tij} > \ln \bar{y}\right)\right]\!\right]^{2} \qquad (3.9)$$

A common vulnerability threshold in the empirical literature is 50% and a time horizon of (t+2) years. A household is considered as vulnerable if they have a 50% or higher probability to fall below the poverty line (at least once) in the next two years. This is equivalent to about 29% or higher probability to fall below the poverty line in any given year.

According to the Statistical year book of Vietnam 2018 and 2019, the national poverty thresholds of monthly average income per capita of household for rural area adjusted by CPI as follows: 570 thousand dongs in 2012; 605 thousand dongs in 2014; 700 thousand dongs in 2016; and 755 thousand dongs in 2018, respectively. Therefore, these thresholds are equivalent to US$1.20 (2012), US$ 1.25 (2014), US$ 1.3 (2016) and US$ 1.35 (2018) per capita per day in 2005 PPP, respectively, which range between the two international poverty lines based on US$1.25 and US$2.

Having discussed how to construct the vulnerability, the next section describe the main model of happiness in which vulnerability is used as a variable of interest.

3.3.2. Poverty risk and subjective well-being

To examine the relationship between poverty risk and subjective well-being, we employ the following model with individual fixed effects:

$$S_{i,t} = \alpha_1 V_{i,t} + \alpha_2 X_{i,t} + \eta_i + \varepsilon_{i,t} \qquad (3.1)$$

where $S_{i,t}$ is a subjective well-being outcome of individual *i* in the year *t*, including life

satisfaction, and the CES-D score (depression index) which are described in section 3.1.1.

$V_{i,t}$ is vulnerability to poverty (or, poverty risk) that indicates the probability of household income falling below the income poverty threshold once in the next two years. In the above section (3.3.1), we presented in detail the methodology to construct the vulnerability.

$X_{i,t}$ is a vector of individual characteristics (such as age, marital status, communist member and unemployment) that are expected to correlate with happiness outcomes[25].

η_i and $\varepsilon_{i,t}$ are respectively individual fixed effects and unobserved variables;

The coefficients of interest are α_1. Our main hypothesis is that α_1 is negative when happiness outcome is life satisfaction and α_1 is positive when the outcome is the CES-D score. In other words, increasing vulnerability to poverty (or the risk of poverty) is likely to reduce life satisfaction and enhance depression.

In order to estimate the causal impact of vulnerability to poverty on subjective well-being, we acknowledge two identification challenges. The first challenge is omitted variable bias, particularly the possibility of unobserved characteristics of individuals. Each individual has their own unique personal traits, that may or may not influence their happiness, and may be correlated with vulnerability to poverty and income. For instance, some people were born more optimistic, active and talented than other people, thus they tend to take actions and finds solutions when they are experiencing difficulties, and as a result they can help themselves and their family get out of poverty or prevent them from falling into poverty. We apply fixed effect model in an attempt to remove the effect of those time-invariant individual characteristics[26], so as to be able to assess the

[25] In this model, because the vulnerability index is a function of mean and variance of income, which are also a function of household and individual characteristics (as shown in Section 3.1.2), hence in the happiness regression, we keep only few controls that are the most related and exogenous to the happiness outcomes.

[26] We follow Baetschmann et al. (2020) in applying panel fixed-effects ordered logit model for life satisfaction

net effect of the poverty risk on the subjective well-being.

In addition, having a panel data gives us an advantage in better being able to identify and measure effects that are simply not detectable in pure cross-section or time-series data such as measuring level of life satisfaction. Researchers usually run into the problem of anchoring in a cross-section study. Each individual anchors their scale at different levels, make interpersonal comparisons of response meaningless. In a panel data, with time-invariant individual characteristics over a period, one can avoid the problem since fixed effects estimator will make inference based only on intra rather than interpersonal comparison of satisfaction (Baltagi, 2021).

The second challenge is the issue of simultaneity bias. Happy individuals may be more creative and find ways to earn more income and hence lessen their vulnerable situation (Walsh et al., 2018; Krekel, 2019). One way to deal with the reverse causality is to adopt the instrument variable (IV) approach with controls on individual fixed effects. However, we acknowledge that even if the instrument approach performs well, the causality from vulnerability to happiness will not be identified because of the nature of the vulnerability model. The vulnerability is estimated from the prediction based on household and community characteristics, while subjective wellbeing is a raw score. Therefore, an underlying assumption to justify the instrument approach is that the explanatory variables which are used for the vulnerability model do not affect the subjective wellbeing measures which is unlikely to hold and thus the model is not identified. Notwithstanding the limitation in using instruments to address the reverse causality, the study significantly reduce scope for bias by employing fixed effect model and offers insight to understand more about the relationship between vulnerability and subjective well-being. (In the appendix, nevertheless, we

as ordinal outcome variable.

attempt and present the findings of fixed effect-instrument model to see a broad picture of the results.)

In the next section, we present the results of vulnerability measures and the impact of vulnerability on happiness.

3.4. Results

In this section, we present three sets of results. First, we discuss our estimates of vulnerability to poverty. Second, we present a number of regressions of life satisfaction and the CES-D score (depression index) on vulnerability, which constitute the central results of our analysis. This section also offers separate regressions distinguishing between the effect of vulnerability under idiosyncratic and covariate shocks on happiness. Third, we present the results of instrumental variable estimation.

3.4.1. Estimates of vulnerability to poverty

The main variables of households and commune characteristics that we use in the estimation of vulnerability are summarized in **Table 3- 3**. Since per capita income is the welfare measure used in the generation of official poverty statistics in the country, (log of) per capita income is used as a dependent variable in the vulnerability model.

Figure 3- 3 shows the distribution of per capita income and log of per capita income in the study, both of which are close to the normal distribution.

For commune characteristics, three indexes are computed using Principal Component Analysis (PCA): road index, utilities index and infrastructure index. The road index is the PCA of four variables on different kinds of commune and village roads; the infrastructure index is the PCA of four variables on permanent market, primary and secondary school and healthcare centers; and

the utilities index is the PCA of street lighting and water drinking. Using PCA indexes helps to reduce the number of variables that are correlated. (Details of PCA indexes are in **Table 3A-1)**.

Table 3- 4 shows the regression results of vulnerability estimation using multilevel model based on Mina and Imai (2017). The dependent variable is log household income per capita. The explanatory variables chosen include characteristics of household, household head, commune, time, shocks at household level, shocks at commune level, and interaction terms. The main results are discussed below.

A number of variables are highly significant and has the expected sign. Particularly, households whose heads have higher education are more likely to have higher income than those with less educated heads, especially those who have studied at the higher education level, such as vocational school and university. Kinh (Vietnamese) ethnicity group are more likely to have higher income than other ethnicities. Larger households tend to have lower per capita household income with some non-linear effect. Other highly significant variables include age (positive) and age squared (negative); a dependency ratio and its interaction with household size (negative). Male-headed households have higher income than female-headed ones. Regarding commune characteristics, infrastructure plays an important role in bringing better income for households.

Natural disasters such as droughts, floods and typhoons, reported at both commune and household levels, are expected to reduce income since the majority of our sample are engaged in agriculture activities, and the agriculture sector is considered highly vulnerable to natural disasters (The World Bank Group and Asian Development Bank, 2020). Households residing in regions such as Viet Nam's North and Central Coast, which experience more natural hazards than other

regions tend to have lower income than other regions. In addition, household income is also negatively affected by animal epidemics and crop diseases.

Identifying vulnerable households and decomposition of vulnerability

Table 3- 5 provides the results of (1) decomposition of poverty and (2) vulnerability to poverty by degree and by source. In that decomposition, households whose per capita income is below (above) the poverty threshold, are divided into three groups. The *chronic poor* are referred to as households that have been persistently poor from 2012 to 2018. The *transitory poor* are households that became poor once or twice during the period 2012-2018. The *never poor* are referred to as the households which were consistently non-poor throughout the period.

Vulnerability status is identified in a similar manner. A household is considered vulnerable (not vulnerable) if its estimated vulnerability to poverty is below (above) the vulnerability threshold. The vulnerability threshold of 0.293 was calculated using a vulnerability threshold of 0.5 and a time horizon of two years. It should be noted, however, that the estimated vulnerability of a household in this study is interpreted as the household's probability of falling into poverty at least once in the next two years. The major vulnerable groups of households are defined based on the number of times a household is classified as vulnerable. The categorized groups include *highly vulnerable* (vulnerability level equal to or above 0.9 in all four waves), *relatively vulnerable* (vulnerability level fluctuating between 0.29 and 0.9 during the period), and *not vulnerable* (vulnerability level always less than or equal to 0.293).

The findings show that about 20 per cent of panel households are classified as vulnerable (the sum of highly vulnerable and relatively vulnerable households) at least once in any of the periods covered, that is, 2012, 2014, 2016 and 2018. Households have a higher probability of

falling into poverty when faced with idiosyncratic shocks than when faced with covariate shocks. 10.51 per cent of panel households are classified as vulnerable to unobservable covariate shocks while 18.43 per cent as vulnerable to unobservable idiosyncratic shocks. Probably households are more vulnerable to idiosyncratic shocks because the impacts of these shocks are more direct and more specific. The impacts of covariate shocks, on the other hand, are indirect and vary across households. Among households who are in vulnerable group, the majority reside in the East Northern Mountain and Central Coast of Vietnam. These are also the two regions that are heavily affected by natural disasters such as floods every year.

Examination of the different poverty groups reveals that majority of poor households in the panel are vulnerable to unobservable shocks. In fact, most of the chronic poor are classified as vulnerable to both unobservable idiosyncratic shocks (98.3 percent) and covariate shocks (96 percent) in at least one of the periods covered. Nearly half of the transitory poor (47.2 percent) are classified as vulnerable to unobservable idiosyncratic shocks at least once in two years. However, 26.02 per cent of the transitory poor are found to be vulnerable to unobservable covariate shocks. Notably, among chronic and transitory poor households, more are vulnerable to unobservable idiosyncratic shocks than to unobservable covariate shocks. On the other hand, a majority of the never poor are classified are not under the risk of poverty for any of the periods covered. Only 2.5 of the never poor are considered vulnerable. In general, households are more vulnerable to shocks at household level than shocks at commune level across different income groups. Our results are consistent with those of Mina and Imai (2017) and Gaiha and Imai (2008), and provide further support for the claim that idiosyncratic shocks might not be insured perfectly by village-level mutual help or mutual support between relatives , or in general by social network as informal mutual assistance.

In order to determine the factors associated with vulnerability, we run an OLS regression of predicted household vulnerability to poverty on the same set of household and commune characteristics and shocks to the households. **Table 3- 7** shows that the factors which are correlated to household vulnerability include: (i) non-Kinh (non-Vietnamese) ethnicity group (ii) having a younger and less educated head; (iii) a higher dependency ratio; (iv) being located in natural disasters-prone areas such as the East Northern Mountains and the Central Coast ; and (vi) lack of access to roads, living in communes with less-developed infrastructure system and utility development;(vii) exposed to and affected by shocks such as natural disasters, epidemics at both commune and household level; and (viii) serious illness of household members are also highly associated with vulnerability.

After obtaining the probability of each household falling under the poverty line, we use the results to estimate the impact of vulnerability on happiness, discussed in the next section.

3.4.2. Vulnerability and happiness results

Having constructed the vulnerability index, we can now use it in our central model, in equation (3.1). In this section, we present the results of exploring relationship between vulnerability to poverty and happiness using fixed effect model. **Table 3- 8** provide findings from fixed effect ordered logit model with life satisfaction as dependent variable. **Table 3- 9** provide findings from OLS-fixed effect model with the CES-D score as an outcome. The two tables present the main results of our analysis. Regression results are also obtained for never-poor and transition poor groups.[27]

[27] Results for chronic poor are not presented due to a small number of observations (62 observations across four years).

The first result is that vulnerability to poverty is negatively associated with life satisfaction and positively associated with depression, both before and after putting controls. In other words, when a person experiences higher poverty risk, he/she tends to be less satisfied with life and more depressed. However, the relationship is only significant for the CES-D score. The effect of income on happiness is strong and statistically significant in all regressions.[28] This is consistent with the literature (Clark et al., 2008; Markussen et al., 2018; and Cuong, 2021). The result is both statistically significant and economically meaningful. We find that 16 percentage point reduction in the risk of poverty, which amounts to entirely offsetting the risk of poverty for the mean individual in our sample, has the same effect on CES-D score as a 70% increase in income (**Table 3- 9**).

Other explanatory variables also have significant relationship with happiness. For instance, we observe a U-shaped relationship between age and subjective well-being. Younger age is associated with less life satisfaction and more depression in comparison with middle age (41–50) after controlling for time-invariant characteristics of individuals and the other variables in the model. As expected, some major life event shocks, such as being unemployed or getting divorced, are negatively associated with high CES-D score.

In addition, vulnerability to poverty under idiosyncratic shocks seems to be linked with greater impact on subjective well-being than under covariate shocks. As for various poor groups, we observe that vulnerability to poverty has a stronger and more significant effect on the CES-D

[28] Income is used the regressions as a control because it is an important determinant of individual happiness. We have checked the correlation between income and vulnerability with the magnitude of 0.6. The Appendix shows the scatter plot of vulnerability against household per capita income with a negative relationship between them. We have also tried the regressions with and without income and see the standard errors of vulnerability change only slightly.

score for the never-poor than for the transition and always-poor groups. In particular, a one percentage point increase in the risk of poverty is associated with a 7.8 unit increase in CES-D score for the never-poor, but only a 3.9 unit increase in CES-D score for the transition poor.

3.5. Robustness check

We implement a robustness check in this section, which indicate that estimation results are robust to different vulnerability index values from different poverty lines. We experimented with poverty lines that range from about 1.2 to about two times the official poverty line to estimate vulnerability index and find no major changes in the relationship with life satisfaction and the CES-D score.

We also use the approach of Caria and Falco (2018), estimating the vulnerability using fixed effect model, and then examine its relationship with the happiness outcomes. We compare the results of vulnerability (fixed effect) – life satisfaction with our results (vulnerability (multilevel model) – life satisfaction)). The results are provided in the Table 3-15. In contrast with our results, when income vulnerability is estimated by fixed effect model, vulnerability to poverty is strongly and significantly correlated with life satisfaction.

3.6. Concluding remarks

We implement the first study in Vietnam to examine the relationship between vulnerability to poverty and subjective well-being, which we measure using life satisfaction and CES-D score (depression index) using a panel data for rural areas in Vietnam, covering the period 2012–2018.

To estimate vulnerability to poverty of Vietnamese households, we employ an extended VEP approach that overcomes the shortcomings of VEP. Specifically, our methodologies are based on a three-level model from Mina and Imai (2017) and four-wave household-level panel data. The

estimated multilevel model contains a set of significant and empirically sound predictors of household income. Profile of household head (education, sex, and age), household characteristics (ethnicity, household size and dependency ratio), and commune characteristics (infrastructure) significantly explain the variation in household income. Observable shocks reported at both commune and household levels, such as natural disasters (droughts, floods and typhoons) also have significant and negative impacts on household income.

Our findings show that around 20 per cent of the panel households are classified as vulnerable at least once in any of the periods covered. More importantly, by using the extended VEP, we can acquire a deeper understanding of household vulnerability by determining the sources of household poverty risk. Only 10.51 per cent of the panel households are classified as vulnerable to unobservable covariate shocks, while around 18.43 per cent were found to be vulnerable to unobservable idiosyncratic shocks. A further analysis by categorization of poverty and vulnerability to poverty indicates that the chronic and the transitory poor, and even the never poor, are more vulnerable to unobservable idiosyncratic shocks than to unobservable covariate shocks. These results are consistent with Mina and Imai (2017) and Gaiha and Imai (2008), and once again lend support to the observation that idiosyncratic shocks might not be insured perfectly by village-level mutual help or mutual support between relatives , or by social network as informal mutual assistance.

We find that households who live in the mountainous area (East Northern Mountains) and Central Coast of Vietnam (where is also natural disaster-affected areas), have higher risk of falling into poverty than households living in other regions. These results reflect those of Imai et al. (2011) and Pham et al. (2021) who also found that households of ethnic minorities who live in high mountain areas are both poorer monetarily and more vulnerable than ethnic majority households

or those living in other regions. Factors associated with higher vulnerability include less educated household head, non-Vietnamese ethnicity, and lack of access to road, infrastructure and utility. These observations also accord with earlier studies by Imai et al. (2011) and Pham et al. (2021). Similarly, this study also supports evidence from previous observations (e.g. Imai et al., 2011; and Pham *et al*., 2011) that chronically poor households in monetary dimension are more likely to remain poor in the near future.

To examine the relationship between poverty risk and happiness, we employed a Fixed Effect model to deal with the endogeneity of vulnerability. Additionally, as well as using life satisfaction as a measure of subjective well-being, we also constructed a depression index that has been validated as a stronger measure of individual happiness in the recent studies. We find a significant and strong relationship between vulnerability to poverty and depression score (CES-D), but not between vulnerability to poverty and life satisfaction. Reducing the risk of poverty by 16 percentage points, which amounts to entirely offsetting the risk of poverty for the mean individual in our sample, has the same effect on CES-D score as increasing income by 70%. This association is stronger related to idiosyncratic shocks than covariate shocks. Looking at different poor groups, we observe that vulnerability to poverty has stronger and more significant effect on higher CES-D score to the never-poor than the transition and always-poor groups. In particular, one percentage point increase in the risk of poverty is linked with 7.8 unit increase in the CES-D score of the poor while only 3.4 unit increase in the CES-D score of the transition poor.

CHAPTER 4

CONCLUSION

Shocks to households, such as natural hazards, price fluctuation and family member illness, can cause physical and economic damage. One of the shocks that cause heavy damage to household is natural disasters. Recently, climate change makes natural disasters more frequent, more severe and more unpredictable. Vietnam has been listed by the World Bank as one of the five countries that will be worst affected by climate change. The United Nations Office for Disaster Risk Reduction (UNISDR) estimates the country's average annual losses due to disasters at around $2.4 billion, or almost 1.5% of GDP (The World Bank Group and Asian Development Bank, 2020). Climate change also places multiple stressors (including high temperature, saline intrusion, drought, and flood) on agriculture, particularly on production of rice, one of the most important food crops in Vietnam and a major source of income for numbers of farmers.

Moreover, the poor generally suffer the most from shocks. According to the Asian Development Bank, a large number of households in Vietnam have a high probability of falling into extreme poverty when exposed to relatively high frequency flooding and/or drought events (The World Bank Group and The Asian Development Bank, 2020). When such events happen once in every four years, households in the three highly exposed communities have approximately a 50% chance of falling into extreme poverty. As a result, a forward-looking approach that considers shock information and the characteristics of households and communes plays an important role predicting the probability of a household falling into income poverty, and in the framing of appropriate supporting policies to reduce the harmful effects of shocks or even prevent such shocks altogether.

Moreover, daily exposure to uncertainty and the above types of shocks can have a significant impact on households, on their attitude toward risks as well as their physical and emotional well-being. People subjected to shocks and risks may become more risk-averse—and impose serious constraints that keep them from achieving their optimal productivity. Living under risk of poverty may also give rise to depression in farmers and eventually impair their ability to work efficiently. Overcoming such barriers to risk would help households improve their livelihoods.

This dissertation examines three prominent features of household behavior in the context of rural areas: risk preferences, vulnerability to income poverty, and subjective well-being. Two studies are presented in the two main chapters of the dissertation: Chapter 2 investigates the validity of various elicitation methods; and Chapter 3 examines the impact of poverty risk on subjective well-being.

4.1. Main Findings and Policy Implications

4.1.1. Validity of measurements of risk preference

Chapter 2 examines the validity of various elicitation methods in terms of internal consistency and predictive and behavioral relevance. We obtain data on risk preferences by conducting a field survey and an experiment with 350 households in rural areas of Kien Giang and Long provinces in Vietnam. Elicitation methods used in the study include the Multiple Price List, loss-gain, investment game, lottery task, and self-rating of risk attitude. This is the first study set in Vietnam to comprehensively assess the validity of measurements of risk preference. The study presented in Chapter 2 is also the first study to examine the validity of a set of hypothetical questions in a Vietnamese household survey (the Vietnam Access to Resources Household Survey). Most of participants (94% of the sample) appear to have no difficulty in understanding the questions in both the hypothetical and experimental settings and their choices appear rational.

Most elicitation methods (except for the self-assessment method) provide evidence that respondents are, on average, risk averse and loss averse. The mean CRRA from the MPL in our study, 1.1, is higher than other studies, such as 0.68 in northern Vietnam (Tanaka et al., 2010) and 0.63 in marginal upland area in northwestern Vietnam (Nielson et al., 2013). Responses to the general self-assessment scale (mean = 5.86) are similar to those in Nielson et al. (2013). Based on the responses to the same self-assessment scale used in Dohment et al. (2011), we find that Vietnamese farmers reported greater tolerance for risk than typical Germany adults with more than half of the total sample chosen the upper scale. This finding is consistent with Vieider et al. (2019) that Vietnamese farmers are more risk tolerant than Western subjects, and with Charness and Viceisza (2011) that participants in rural Senegal, particularly women, are more risk-tolerant than typical experimental subjects in the western world, including the Dohmen et al. (2011) study.

As for internal consistency, on the Multiple Price List task, 75% of the subjects made choices that were consistent or nearly consistent between the hypothetical and experimental situations. However, the responses by more than half of the sample were inconsistent between the experimental and hypothetical questions related to loss aversion. This could be explained by the fact that losses loom larger than gains for people, and hence people become more cautious and loss-averse in experiments (Tversky and Kahneman, 1989; and Gal and Derek, 2018). In the correlation test, the strongest correlation was between questions of the same design, such as the MPL and loss-gain tasks. In the investment scenario we also found a strong association with other methods such as the MPL and loss-gain. Relations with other measures were weak or absent for self-assessment and hypothetical lottery.

For behavioral relevance test, we implement the OLS regression to examine the predictive and explanatory power of the hypothetical measures with the behaviors in

experiments after controlling for other factors; and of the elicitation methods with observed individual and household behaviors. We find that responses from hypothetical MPL and loss-gain questions significantly predict experimental behaviors while responses from the self-assessment and lottery have very least or no explanatory power. The results are similar in predicting individual and household behaviors. In terms of numbers of predicted behaviors, the explanatory power of the hypothetical measures is relatively stronger than the experimental-based measures in MPL task. In particular, response from hypothetical MPL can predict 4 out of 6 observed behavior in comparison with 2 out of 6 from response of experimental MPL.

The findings of chapter 2 offer some implications and suggestions for the use of elicitation methods.

First, the finding that most respondents are risk averse supports other studies in the context of rural area in Vietnam (e.g., Tanaka et al., 2010; Nielson et al., 2013; and Hold and Laury, 2012). High risk preference may be explained by the fact that households are frequently exposure to shocks. Some of the shocks can be natural disasters (flooding and sea level rise in Long An) and salt water intrusion and alum that affect rice productivity or high temperature in Kien Giang that might cause serious illness or death of household members. In fact, some of studies have found a greater impact of idiosyncratic shocks on risk preferences rather than covariate shocks (Nielson et al., 2013; and Gloede et al., 2015) and as found later in Chapter 3, vulnerability to poverty of households are also more associated with idiosyncratic shocks than covariate shocks. The finding suggests social protection policies and better health insurance coverage for farmers.

Second, respondents appear less risk averse in the self-assessment method than other methods such as the MPL and investment scenario. Therefore, comparing risk preferences elicited from survey and experimental methods should be done with caution.

Although survey methods are in general simple, easy to implement and can be a low-cost alternative in measuring risk preferences, it usually brings a broad context. In addition, using survey methods do not provide sufficient information in order to estimate parameters of a utility function as it lacks a clear theory background, hence restrict their helpfulness in structural modeling (Eckel, 2019). As it usually happens with self-report question, the self-assessment task may be biased due to framing effects because about 20% of total subjects selected the middle category. As proposed by Nielson et al. (2013), the self-assessment task can be rescaled, such as from 0 to 9, to avoid an easily identifiable middle category. Another issue with self-report question is that it does not provide information for the researcher to draw any conclusion about loss aversion that are one of fine characteristics of risk preferences that can be essential in understanding a broad number of economic decisions such as insurance choices (Vieider, 2015).

Third, we find that self-assessment, in both general and in specific context, had limited validity since it had the least relation with other measures and observed behaviors (or none at all). This finding is similar to those reported by Nielson et al. (2013), Lönnqvist et al. (2015) and Ding et al. (2014). Particularly, in Nielson et al. (2013), the correlation between self-assessment scale and multiple price list is weak (0,19). Ding et al. (2014) found low association among the hypothetical lottery question, self-assessment question and an experimental lottery. However, the result is different from other studies whose evidence provides some support for the use of self-assessment of risk attitude in surveys, such as Dohmen et al. (2011). A possible explanation for this opposite result might be that our study is different from Dohmen et al. (2011) in some respects[29]. First, subjects in Dohmen et al. (2011) are German adults and

[29] though our sample sizes are similar (sample size in Dohmen et al. (2011) and our study are 450 and 350 respondents, respectively)

subjects in our study are Vietnamese farmers. They may have different life experiences, living and working environments, and personal traits, so their perception of risks may differ. In addition, characteristics of each type of elicitation may have also contributed to the difference in perception about ‘risk’ even though we had told the respondents a clear definition of risk and risk-taking from the beginning. Notably, people would perceive the term ‘risk’ in the self-assessment (in general, in agriculture and other dimensions in real life) is much broader and more complex than what MPL/loss-gain tasks would capture. In comparison, the 'risk' in the MPL or loss-gain tasks is only defined by the two choices (50%-50%) and by monetary gains/losses. Second, in terms of elicitation methods, Dohmen et al. (2011) compared the responses between survey method with only one experimental method (the MPL) while our study does not only compare the responses of survey methods with the experimental MPL, but also with two other hypothetical methods (lottery, MPL, and loss-gain tasks) and three experimental tasks (loss-gain and investment tasks). In terms of behavioral relevance, the chosen behaviors in Dohment et al. (2011) are an investment in stocks, active sports, and self-employed that are not common activities for farmers in the context of rural areas in developing countries. In our study, the observed household behaviors are related to agricultural activities. In general, the difference in findings of our research with Dohment et al. (2011) could reflect the differences between developed and developing countries.

Lastly, the Multiple Price List and loss-gain tasks are dominant methods for predicting household behaviors and individual behaviors, in both hypothetical and experimental situations. Validity of the lottery question was limited and unstable throughout the tests. In that light, among the hypothetical questions from the VARHS survey, we prefer to use the MPL and loss-gain questions in measurement of risk attitude. However, the loss-gain questions should be used with caution otherwise it would be better to be replace or complement them with an

experiment to measure loss-aversion, since people show more loss-aversion in incentivized situations than in theoretical ones.

Lessons learned during the field survey and experiment from our study

Also, in chapter 2 we would like to share some of helpful lessons from our experiences during field survey and implementing experiment.

First, given major participants in our study are farmers and have limited education and numeracy, it is important to explain clearly and consistently from the beginning some major concepts in the study, including risk and risk-taking and some words such as “random”, “percent”, “probability”. The explanation can come with simple examples and it is easier to understand if it is related to their daily activities. More importantly, it is essential to be neutral in asking questions. The enumerators should not show their own feeling or opinions that can have impact on the decision of participants. Some subjective words should be avoided such as “only”, “don’t worry you can lose only 2,000 VND” or telling the enumerators’ own opinions that can bias the answers of participants and can even make them confuse. In addition, some words such as “risk”, “lottery” may have different connotations and sensitive meaning to the locals, hence, it should be used with caution. In order to prevent these issues, besides having a main training for all enumerators, we also have a pilot survey, a review and discussion session every day. Besides, the enumerators practice numbers of times among themselves and learn from each other and use tokens and visual aids together with clear explanation.

Second, understanding the survey area: In some cases, some villages might experience some cheating cases in the past. Because of that, they may refuse to answer the questions and participate in experiment. In such case, clear introduction about the research team and purpose of the research and the accompany of a local guide, or necessarily a village leader, is helpful to have a smooth interview.

Third, the importance of teamwork that include enumerators, supervisors, commune and village leader and local guide. When enumerators come from the survey area, they can assist arrange accommodation and transportation for the team. They can support each other in case any of them get tired. Skillful enumerators know how to manage distractions during interview. Some distractions can come from the interfere of neighbors, children, relatives, grandparents, and spouse or requirement of taking care of children and the like. Enumerators could also create rapport which encourages respondents to open up and share more than they might reveal otherwise. Friendly and kind support of the village and commune leaders play a crucial role in guiding the team around villages and giving a clear introduction to people, especially when the research has an experiment part involving some money payment and in case of incident. A local guide should be a well-known person in the village such as the head, leader of an association (youth, farmers, women's). A good local guide is also helpful not only in finding households, but also a place for enumerators to have lunch and take a rest for an afternoon interview so that we can save time and energy. During the field survey, we usually had a group meeting every day so that we can share our experiences as well as difficulties during the day to improve for next day.

4.1.2. The impact of vulnerability to poverty on subjective well-being

Chapter 3 explores the relationship between vulnerability to poverty and subjective well-being by employing a fixed effect model and using a four-wave panel data in rural Vietnam. In order to examine this relationship, it is necessary to construct the two key variables: measures of subjective well-beings as outcome and construction of vulnerability index as main control. This study contributes to existing studies by using a more comprehensive measure of well-beings that is the CES-D score (depression score) and by trying another measure of income vulnerability, specifically the extended VEP based on Mina and Imai (2017), to overcome some

econometric issues that the previous studies have not addressed. This is also a first study implemented in the context of rural area in developing country in general and in Vietnam in particular.

Our findings show that around 20 per cent of the panel households are classified as vulnerable at least once in any of the periods covered. Only 10.51 per cent of panel households are classified as vulnerable to unobservable covariate shocks while around 18.43 per cent are vulnerable to unobservable idiosyncratic shocks. Looking further by categorization of poverty and vulnerability to poverty, we observe that the chronic and the transitory poor, and even the never poor, are more vulnerable to unobservable idiosyncratic shocks than to unobservable covariate shocks. These results are consistent with Mina and Imai (2017) and Gaiha and Imai (2008), and hence, once again imply that idiosyncratic shocks might not be insured perfectly by village-level mutual help or mutual support between relatives , or social network as informal mutual assistance.

Households who live in the mountainous area (East Northern Mountains) and Central Coast of Vietnam (where is also natural disaster-affected areas), have higher risk of falling into poverty than households living in other regions. These results reflect those of Imai et al. (2011) and Pham et al. (2021) who also found that households of ethnic minorities who live in high mountain areas are both poorer monetarily and more vulnerable than ethnic majority households or those living in other regions. Factors associated with higher vulnerability include less educated household head, non-Vietnamese ethnicity, and lack of access to road, infrastructure and utility. These observations also accord with earlier studies by Imai et al. (2011) and Pham et al. (2021). Similarly, this study also supports evidence from previous observations (e.g. Imai *et al*, 2011; and Pham *et al*., 2011) that chronically poor households in monetary dimension are more likely to remain poor in the near future.

Having the vulnerability index together with the individual CED-S score and self-rating life satisfaction, we can examine the relationship between them. Findings from chapter 3 present a significant and strong relationship between vulnerability to poverty and depression score (CES-D), but not with life satisfaction. Reducing the risk of poverty by 16 percentage points, which amounts to entirely offsetting the risk of poverty for the mean individual in our sample, has the same effect on CES-D score as increasing income by 70%. This association is stronger related to idiosyncratic shocks than covariate shocks. Looking at different poor groups, we observe that vulnerability to poverty has stronger and more significant effect on higher CES-D score to the never-poor than the transition and always-poor groups. In particular, one percentage point increase in the risk of poverty is linked with 7.8 unit increase in the CES-D score of the poor while only 3.4 unit increase in the CES-D score of the transition poor.

The empirical results in Chapter 3 are the basis for some tentative policy implications.

Since education emerged as a significant predictor of both income and vulnerability, policy aimed at human capital investment may be important for government intervention. Some policy elements such as employment and skills training programs, and supporting of job search, can be implemented on a regular basis and can be intensified in times of crisis. In addition, continued efforts, including improvement and maintenance of the infrastructure (transportation and irrigation systems), are needed to make it more accessible to vulnerable households.

The findings that non-Vietnamese ethnicity and households who lives in the natural disaster-affected area are more vulnerable to poverty than other households, can be used to develop targeted interventions aimed at protecting these households. Particularly, ensuring appropriate and supportive systems of social protection and adequate safety nets as a cushion against the risk of falling into poverty could be tried as a priority for farmers in the East Northern Mountains and Central Coast of Vietnam. The two areas have experienced high frequency of natural hazards every year. One of crucial types of insurance that is getting more

attention for agricultural area in developing countries is weather insurance. In fact, Vietnam has implemented a three-year pilot of agricultural insurance since 2011, known as the National Agricultural Insurance Pilot Programme (NAIPP). The NAIPP has been carried out in 20 provinces with products including an index-based insurance for rice and indemnity-based insurance product for livestock and aquaculture (Tinh, 2018). However, as explored by King and Sign (2020), demand for agricultural insurance in Vietnam is low and the authors have investigated the reasons for the low take-up of weather insurance by using the same VARHS survey for the period 2010-2018. Their results indicate that private transfer (from family members, friends and neighbors) suppressed agricultural insurance demand. Membership of a farmer's union is positively related to willingness to pay for index insurance and so trust in institution is important factor in insurance intake. Willingness to take risks have a positive and significant relationship with willingness to pay. King and Sign (2020) suggest to improve the attractiveness of index insurance products and the credibility of the insurance offered and this might be a policy worth exploring.

The fact that households (across chronic, transitory and never poor) are more vulnerable to shocks happened at household level than shocks at commune level, imply that informal mutual assistance such as mutual support between relatives or social network might not be perfect insurance against idiosyncratic shocks. One of the most affected shocks to household is serious illness of a household member, especially the member who is mainly responsible for income earning in the household. A study by Vo (2019) suggests that health insurance significantly help reduce the probability of becoming poor for rural households in Vietnam and so expanded provision of health insurance coverage in Vietnam will be beneficial especially for the vulnerable poor. Another suggestion for reducing vulnerability by Vo (2019) is to improve access to health care services for the poor or to reduce costs for health services.

4.2. Prospect for Future Research

As a possible extension of the work in Chapter 2, I would like to propose three directions for further research which it was not feasible to develop more deeply in the course of this study, due to constraints on resources. First, it would be valuable to conduct other validity tests on the stability of risk preferences over time. For instance, if we can observe a similar degree of risk preference between one year and the other year; Is there a change (in short-term and long-term) in risk preferences if subjects are exposure to a major life events, such as a natural disaster or financial shocks. Second, validity tests could be applied to other parameters considered important in behavioral economic, such as time preferences. Third, it would be interesting to collect more detailed data on some risky agricultural activities such as irrigation investment and to examine that data to explore other determinants of the investment including credit constraint, hyperbolic discounting, and types of irrigation.

As a possible extension to Chapter 3, I identify here three main areas that could be improved. First, it would be intriguing to try another measure for estimation of vulnerability to poverty, and compare the results with those obtained here. For instance, more dimensional measure of vulnerability (such as, vulnerability to health, education, housing and basic services) as in Pham et al. (2021) would help us to establish a greater and more comprehensive degree of understanding on the relationship between vulnerability and subjective well-being. Second, another possibly valuable direction would be to examine the impact of vulnerability on individual risk preferences. Individual risk preferences could be obtained from the responses to hypothetical questions in VARHS, particularly the Multiple Price List questions that are validated in Chapter 2. Last, another interesting extension of the study would be to investigate whether individuals with higher risk aversion or loss aversion experience higher losses in well-being as a result of vulnerability—or whether income vulnerability gives rise to larger well-being costs for loss-averse individuals.

APPENDIX

Appendix 2- 1: Survey Questionnaire (English Language Version)

HOUSEHOLD QUESTIONNAIRE

Hello! We are coming from (_partner organization's name_) with permission from the local government. We are doing a research about risk assessment in the Mekong Delta.

You will be asked questions regarding your household and farm characteristics, experience of climate change, migration decision both practically and hypothetically. The results of the study will be disseminated through seminars, reports, conferences, and journal articles. The interview takes around 1 and half hours. We assure that the information you provide will only be used for research purposes. Your identities are confidentially kept and not linked to your response.

You have the right to withdraw the interview at any time without any penalty. Thank you very much for your participation.

The interview includes two main parts: survey and an experiment. ***You will certainly receive 90,000 VND after completing the interview, and you have chance to receive either higher or lower amount of payment after participating the experiment. You can only receive the payment after finishing both parts.***

Content		*Code*	*Content*		*Code*
Full name			**Province/City**		
Enumerator					
Interview time (Date/Month/Year			**Commune**		
Supervisor			**Village**		
Time of starting the interview					

PART A: SURVEY

D1	**D2**	**D3**	**D4**	**D5**	**D6**
What is the relationship to household head? □ 1 = Household head □ 2 = Spouse □ 3 = Other (Specify…)	Gender of the respondent? □ 1 = Male □ 2 = Female	What is the highest grade of education you completed? ***[See code 1: EDU]***	What is your current marital status? 1 = Single 2 =Married 3 = Widowed 4 = Divorced 5 = Separated 6 = Other (Specify)	What is your current occupation? ***[See code OCCUPATION]***	Birth year (by Western calendar)?

Now we would like to ask you some questions about your attitude toward risks in daily life

A-I: ASSESSMENT OF RISK AND TIME PREFERENCE

R1. In your day-to-day life, what do you consider to be a risky decision in the following activities?

R11. Activities in agriculture

R12. Education of children

R13. Healthcare of children and yourself

R2. General risk question

Definition of risk: risk are uncertain events that occur in daily life. For example, smoking or inhaling polluted air will cause some respiratory diseases in *short-term* or cancers in *long-term*. Or buying a land at low-price this year and can sell it at high-price next year in order to get profit.

Definition of taking risk*? Taking risk is making a decision or choice eventhough you do not know in advance whether the result is good or not. For instance, buying a dimond ring but you detect it is a fake one later; Trying a new food but getting food poison.*

Now please answer risk-related questions as follows:

Please use a scale from 0 to 10, where 0 means you are "completely unwilling to take risks" and a 10 means you are "very willing to take risks".

You can also use any numbers between 0 and 10 to indicate where you fall on the scale, like 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

	Questions	**Completely unwilling to take risks**										**Very willing to take risks**	**N/A**
R21	In general, how willing or unwilling you are to take risks?	0 □	1 □	2 □	3 □	4 □	5 □	6 □	7 □	8 □	9 □	10 □	98 □
In the following circumstances, how would you assess your readiness to take risks?													
R22	How willing or unwilling you are to take risks in ***agriculture*** activities such as planting new crops?	0 □	1 □	2 □	3 □	4 □	5 □	6 □	7 □	8 □	9 □	10 □	98 □

R23	How willing or unwilling you are to take risks in ***non-farm activities*** such as opening an enterprise?	0 □	1 □	2 □	3 □	4 □	5 □	6 □	7 □	8 □	9 □	10 □	98 □
R24	How willing or unwilling you are to take risks with ***your own health*** such as smoking, drinking alcohol, doing exercise,)?	0 □	1 □	2 □	3 □	4 □	5 □	6 □	7 □	8 □	9 □	10 □	98 □
R25	How willing or unwilling you are to take risks with investing in ***education of your children***?	0 □	1 □	2 □	3 □	4 □	5 □	6 □	7 □	8 □	9 □	10 □	98 □

CO. Cognitive measurement: ***Note***: Please do not use pen, paper or digital devices such as computers, calculators or smart phones,

CO1	12 x 30 =	□ 0 = Do not know (less than 2 minutes)
CO2	15 + 36 =	□ 0 = Do not know (less than 2 minutes)
CO3	10% x 400 =	□ 0 = Do not know (less than 2 minutes)

R3a	**Do you play lottery?**	□ 1 = Yes □ 2 = Yes, sometimes □ 3 = Never

R3. Consider an imaginary situation where you are given the chance of entering a state-run lottery where only 10 people can enter and 01 person will win the prize.

10,000 VND/lottery sheet

R31	How much would you be willing to pay for a 1 in 10 chance of winning a prize of 2,000,000 VND	----------VND
R32	How much would you be willing to pay for a 1 in 10 chance of winning a prize of 20,000,000 VND?	----------VND

R4. You are given the opportunity of playing a game where you have a 50:50 chance of winning or losing (for example, a coin is tossed so that you have an equal chance of it turning up either heads or tails).

	Questions	**Accept (A)**	**Reject (R)**
R41	Either losing 2,000 VND or winning 6,000 VND	□	□
R42	Either losing 3,000 VND or winning 6,000 VND	□	□
R43	Either losing 4,000 VND or winning 6,000 VND	□	□
R44	Either losing 5,000 VND or winning 6,000 VND	□	□
R45	Either losing 6,000 VND or winning 6,000 VND	□	□
R46	Either losing 7,000 VND or winning 6,000 VND	□	□

R5	If you win a lottery, you can choose between			Code/question
R51	1. Receive 10 million VND today	or	2. Receive 10 million VND after 1 year for sure *Which option will you choose?*	1. Receive 10 million VND today >>> Q R52 2. Receive 10 million VND after 1 year for sure >>> Q R55
R52	1. Receive 10 million VND today	or	2. 2. Receive 30 million VND after 1 year for sure *Which option will you choose?*	1. Receive 10 million VND today >>> Q R53 2. Receive 30 million VND after 1 year for sure >>> Q R54
R53	1. Receive 10 million VND today	or	2. Receive 60 million VND after 1 year for sure *Which option will you choose?*	1. Receive 10 million VND today >>> End 2. Receive 60 million VND after 1 year for sure >>> End
R54	1. Receive 10 million VND today	or	2. Receive 20 million VND after 1 year for sure *Which option will you choose?*	1. Receive 10 million VND today >>> End 2. Receive 20 million VND after 1 year for sure >>> End
R55	Are you sure that you would like to receive this payment in the future though you can receive the same amount of money at the present (if you do not want to wait)?			1. Yes >>> End 2. No, I would like to receive 10 million VND today > Q R52

R6	Now imagine you have two options to earn money			Code/question
R61	1. Receive 2 million VND for sure	or	2. Tossing a coin and receiving 2 million VND if it's head or receiving 4 million VND if it's tail. *Which option will you choose*?	1. Receive 2 million VND for sure >>> Q R65 2. Receive 2 million VND or 4 million VND >>> Q R62
R62	1. Receive 2 million VND for sure	or	2. Tossing a coin and receiving 4 million VND if it's head or receiving 1 million VND if it's tail. *Which option will you choose*?	1. Receive 2 million VND for sure >>> Q R63 2. Receive 4 million VND or 1 million >>> Q R64
R63	1. Receive 2 million VND for sure	or	2. Tossing a coin and receiving 4 million VND if it's head or receiving 1.5 million VND if it's tail. *Which option will you choose*?	1. Receive 2 million VND for sure >>> End 2. Receive 4 million VND or 1.5 million VND >>> End

R64	1. Receive 2 million VND for sure	or	2. Tossing a coin and receiving 4 million VND if it's head or receiving 500,000 VND if it's tail. *Which option will you choose*?	1. Receive 2 million VND for sure >>> End 2. Receive 4 million VND or 500,000 VND >>> End
R65	Are you sure? According to Option 2, you will receive at least 2 million VND and there is possibility to receive 4 million VND. According to Option 1, you always receive only 2 million VND.			1. Still choose option 1 >>> End 2. Change to option 2 >>> Q R62

RP. Which activity do you think is risky?

Each of the items below contains two choices A and B. Please indicate which of the decisions that you think is risky for you and your family. Do not leave any items blank. It is important you respond to all items with only one choice, A or B. We are interested only in your opinions, not in others risk opinions about these things or how one is supposed to think. There are no right or wrong answers as in other kinds of tests. Be frank and give your honest appraisal.

RP	**Option A**	**Option B**	**A is riskier than B**	**A and B is equally risky**	**B is riskier than A**	**A and B is both not risky**
	A	**B**	**AB**	**ABBA**	**BA**	**NANB**
RP1	Planting multiple crops such as maize and beans on the field	Planting only one crop on the field				
RP2	Trying to plant new crops	Usually planting old crops				
RP3	Investing in the education of children	Not letting the kids go to school				
RP4	Investing in the education of ***sons*** ***daughters***	Investing in the education of ***sons***				

RP5	After your children finish ***secondary school***, let them continue ***high school***	After your children finish ***secondary school***, not letting them continue high school, instead they stay at home to help farming works and/or family business.				
RP6	After your children finish ***high school***, let them continue ***university or higher education***	After your children finish ***high school***, not letting them continue higher education, instead they stay at home to help farming works and/or family business.				
RP7	If your children get normal sick such as flu, fever, coughing, getting cold, let them recover by themselves, buying medicine or taking care of them at home	If your children get normal sick such as flu, fever, coughing, getting cold, bring them to commune health centers, provincial hospitals or private clinics,				
RP8	Owning healthcare insurance	Do not have healthcare insurance				
RP9	Migration to the city	Stay at home				

Appendix 2- 2: Experiment Instruction (English Language Version)

B-II: EXPERIMENT ON ASSESSING ATTITUDE TOWARD RISKS

General instructions:

Thank you for spending your time with us today. Now we will move to the game part.

In this part, I am going to ask you 11 questions in 3 different situations. **After** you answer **all** the questions, we will pick a chip from this bag to identify **a question** to calculate your final payment.

Here is the numbered chips and bags we will use later.

Depending your answer, you may lose or gain some amount of money beside the participation fee of ***90.000 VND***. And you always have the right to "Reject" when facing the situation in which you may lose money. Also, you will never be forced to choose an option in which you may lose money.

Hence, we would like you to think about each question carefully and take the decision seriously, as you make any other choices in daily life.

We will give you instructions for each situation.

After you answer all the questions, we will calculate your final payment together. Then a field supervisor will come and pay you all the money for today, and you need to sign a receipt of payment.

Do you have any questions before we start?

Note: The enumerators read the questions and instructions to respondents clearly. Respondents are also able to read the question themselves, if ready.

ER1. SITUATION 1-WINNING LOTTERY AND INVESTMENT

*In this situation you will need to choose **only one investment option**.*

Now, imagine you had just won 100,000 VND in a lottery.

Almost immediately after you collect, you receive the following financial offer from a ROSCA (Rotating Savings and Credit Association) leader as follows: You can send a part or all of winning money to ROSCA. There is the chance to **double** the money within two weeks. However, it is also **equally likely** that you could lose **half** of the amount invested.

For example, if you decide to invest 30,000 VND out of 100,000 VND in this ROSCA.

We will replace investment decision by drawing a chip randomly from a bag.

If the chip you pick is BLACK, you will ***lose half*** of invested money that is 15,000 VND.

If the chip you pick is RED, you will receive ***double*** of invested money that is 60,000 VND.

In this situation, we will give you 100,000 VND as if you just won the lottery. Hence, there is no chance that you will lose any money by participating in this game.

Now I will give you six investment options out of 100,000 VND. Which option will you be willing to choose?
Table 1: Answer for Situation 1

1 (ER1)	Please tick the option you are willing to invest?	Picking up token		Final results
		RED (R)	BLACK (B)	
	□ Do not invest	+ 100.000	0	Final earnings of either 100,000 VND or 100,000 VND
	□ Invest 20,000 VND	+ 40.000	- 10.000	Final earnings of either 120,000 VND or 90,000 VND
	□ Invest 40,000 VND	+ 80.000	- 20.000	Final earnings of either 140,000 VND or 80,000 VND
	□ Invest 60,000 VND	+ 120.000	- 30.000	Final earnings of either 160,000 VND or 70,000 VND
	□ Invest 80,000 VND	+ 160.000	- 40.000	Final earnings of either 180,000 VND or 60,000 VND
	□ Invest all 100,000 VND	+ 200.000	- 50.000	Final earnings of either 200,000 VND or 50,000 VND

For enumerators: *Go through each option and show the options to the respondent. Then remind them that they have to choose one of the options only. Check understanding and ask them to choose. Once they have picked one option remind them of the consequences of this option and confirm their choice.*

Thank you for answering questions in this situation. We will now move to the situation 2.

ER2. SITUATION 2-CHOOSING BETWEEN TWO OPTIONS

Now we will start Situation 2. In this situation, you will be making choices between two options:

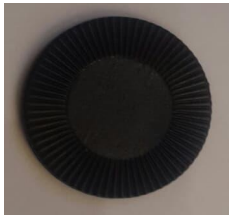
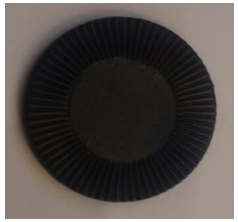
Option A, you always receive a fixed amount of money for sure.

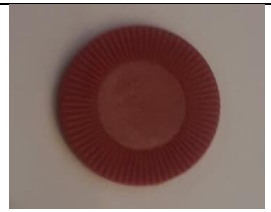
Option B, we will pick a chip from a bag randomly, and depending on whether its color is RED or BLACK, you will have chance to receive a different amount of money that may be higher than the amount of money in Option A.

Enumerators show the respondents RED and BLACK chips.

There is no chance that you will lose any money by participating in this game.

EXAMPLE: *Here is an example of a choice between two options: It is just a practice question to help you understand.*

OPTION A **You always receive 300,000 VND for sure**	**OPTION B – RED OR BLACK**
 BLACK +300000 VND	 BLACK +300000 VND

 RED +300000 VND	 RED +600.000 VND

Do you understand the choice between Option A and Option B?

Which option do you prefer? Option A or Option B?

For enumerators: check for his/her understanding especially if the subject chooses option A in the example

* Now you will answer **five** questions similar to the example above. And if this Situation 02 is chosen for real payment, only one of these 5 questions will be picked randomly for real money **after** you have answered **all** 05 questions.

No pair of choices is any more likely to be used than any other, and you will not know in advance which one will be selected, so please think about each question carefully.

You will see from the table as we go down the page, in Option B, the winning amount with RED stays the same with 200,000 VND, but the amount with BLACK gets smaller and smaller. In other words, the amount with BLACK gets worse. You will make your own decision. However, I think if you already choose Option A in one question. You also want to choose Option A in the

following questions because if you choose Option B, you will receive an amount of money that is getting lower than that in Option A.

Table 2: Answers for Situation 02 (Unit: VND)

Order	Code	Option A	Option B – Red or Black		Which option do you prefer?	
			RED	BLACK	Option A	Option B
2	**ER2**	100,000	200,000	100,000		
3	**ER3**	100,000	200,000	75,000		
4	**ER4**	100,000	200,000	50,000		
5	**ER5**	100,000	200,000	25,000		
6	**ER6**	100,000	200,000	0		
For enumerators		- Reminding subjects if they misunderstand or giving inconsistent answers - Original answers changed?				

Thank you for answering questions in this situation. We will now move to the situation 3.

SITUATION 3 – BLACK AND RED GAME

This situation includes five questions. For each question you have to decide whether to "Accept" or "Reject" to play BLACK and RED game. ***Now, an important point is if the chip comes with RED, you will gain money but if the chip comes with BLACK, you will lose some money.***

Enumerators show the respondent Red and Black chips in a bag.

EXAMPLE

Here is an example of an option that you can either Accept or Reject it: Remember, it is just a practice question.

If the picked coin is BLACK, you will lose 5000 VND. However, If the picked coin is RED, you will win 70,000 VND. Would you Accept or Reject playing this game?

BLACK
Lose 5,000 VND

-5,000 VND

RED
Win 70,000 VND

+70,000 VND

* Is it clear? Do you understand how you make decision and payouts are decided by picking a chip from the bag?

Therefore, you have the right to either "Accept" or "Reject" participating in the game for each question.

Any amount of money you win in this game, will be added to the participation fee.

Any amount of money you lose in this game, will be deducted from the participation fee.

If you choose "Reject" in any question, you will not lose money and you also do not have chance to receive additional amount of money, either. You can *only* receive the participation fee. Is it clear? Do you have any question?

* Now please look at the questions below. You'll see that as we go down the page, the winning amount stays **the same at 30,000 VND** in every question, but the losing amount gets bigger and bigger. How you choose in each question is your own decision, but

we think that if you decide to reject one you will also want to reject the questions lower down the page. This is because the consequences of losing get worse while the consequences of winning stay the same. In other words, overall accepting the coin toss gets worse.

Table 03: Answers for Situation 03 **Unit: VND**

Order	**Codes**	**Drawing a chip from bag**		**Accept (A)**	**Reject (R)**
		BLACK (Lose)	**RED (Win)**		
7	**ER7**	- 5.000	+ 30.000		
8	**ER8**	- 10.000	+ 30.000		
9	**ER9**	- 15.000	+ 30.000		
10	**ER10**	- 20.000	+ 30.000		
11	**ER11**	- 25.000	+ 30.000		
For enumerators		- Reminding subjects if they misunderstand or giving inconsistent answers - Original answers changed?			

PART C: DEMOGRAPHIC AND HOUSEHOLD CHARACTERISTICS

C-I: DEMOGRAPHIC

D7	D8	D9	D10	D11	D12	D13	D14	D15	D16
Religion? □ 1 = Buddhism □ 2 = Christian □ 3 = Christian 2 □ 4 = Cao Dai □ 5 = Buddhism 2 □ 6 = None □ 7 = Other specify	Ethnicity? □ 1 = Kinh □ 2 = Hoa □ 3 = Khmer □ 4 = Other (Specify)	How long have you been staying in this village? □ 1 = > 30 years □ 2 = >10-30 years □ 3 = > 5 – 10 years □ 4 = < 5 years	How many members are there in your household (based on household book)?	How many members in your household are under the age of 15 years old?	How many members in your household are over the age of 64 years old?	How many children do you have?	How many sons do you have?	How many daughters do you have?	How many children are now in primary school and secondary school?

D17	D18	D19	D20	D21	D22	D23	D24	D25	D26
How many children are now in high school?	How many children are now in higher education such as university, Master's course?	How many children are now having jobs?	How height you are? (cm)	How weight you are? (kg)	Do you smoke? □ 1 = Yes □ 2 = No □ 3 = Sometimes	Do you drink alcohol? □ 1 = Yes □ 2 = No □ 3 = Sometimes	Have you ever served time in the Vietnamese army? (Only ask people who were born before 1998) □ 1 = Yes □ 2 = No	Are you member of any group? □ 1 = Yes □ 2 = No	If yes, what is the name of the group? (you can choose many options) □ 1 = Women Association □ 2 = Farmers □ 3 = Elderly □ 4 = Business Association □ 5 = Army group □ 6 = Credit group □ 7 = Youth □ 8 = Others (please

C-2: HOUSEHOLD CHARACTERISTICS

C1	How long have you been working in agriculture/rice cultivation?	□ 1 = less than 05 years □ 2 = 5-10 years □ 3 = more than 10 years
C2	How many agricultural land/pond your household own?	…..….. ha
C21	In which: Agricultural land	…..….. ha
C22	Pond	…..….. ha
C3	Is your family's agricultural land under regulation of growing rice?	□ 1 = Yes, all seasons in a year □ 2= Yes, in some seasons □ 3 = No
C4	How much of your family income in the past 12 months (after deducting tax and production cost)?	.....VND
C5	In the past 12 months, on average, how much does your family consumption per month?	**.....** VND
C51	In which: Daily expenditure (foods, utilities, drinks,…)	.....VND
C52	Expenditure for children (tuition fee, books,…)	.....VND
C53	Other expenditure (not include production cost)	.....VND
C6	Do you own house?	□ 1 = yes □ 2 = no
C7	Do you have any of the following assets?	
C71	Fridge	□ 1 = yes □ 2 = no
C72	Washing machine	□ 1 = yes □ 2 = no
C73	Air conditioner	□ 1 = yes □ 2 = no
C74	Motorbike	□ 1 = yes □ 2 = no

C75	Car	□ 1 = yes □ 2 = no
C76	Boat/ship	□ 1 = yes □ 2 = no
C77	Plough machine	□ 1 = yes □ 2 = no

C7. Think now about some household responsibilities, who in your household has the final say on:

Answer codes

1 = Respondent only

2 = Jointly with spouse

3 = The whole family

4 = Jointly with someone else (Please specify…)
5 = Spouse only

6 = Someone else only (Please specify…)

C71	Education of children	
C72	Type of crop (such as type of rice)	
C73	Healthcare of children	
C74	Finance and investment (land rent, borrowing money)	
C75	Daily life expenditure of the family	

7 = Others (Please specify…)

C-III: OPINIONS OF EDUCATION

In this part, we would like to listen to your opinions about the education of your children

E1. What are your expectations when you let your children go to school? (You can choose many options)

E11	They will have a brighter future than me	□ 1 = Yes □ 2 = No
E12	Be proud because the children can go to school	□ 1 = Yes □ 2 = No
E13	Finding a stable job and get respected such as commune officials, civil servants, teachers	□ 1 = Yes □ 2 = No
E14	Finding a high-salary job	□ 1 = Yes □ 2 = No
E15	Others (please specify):	□ 1 = Yes □ 2 = No

E2. What are the main reasons you do not let your children go to school? (You can choose many options)

Only ask the households having children who do not go to school or stop going to school

E21	Cannot afford the school payment continuously	□ 1 = Yes □ 2 = No
E22	Way to school is far and dangerous	□ 1 = Yes □ 2 = No
E23	No future jobs guaranteed/secured	□ 1 = Yes □ 2 = No
E24	Supporting family in earning money	□ 1 = Yes □ 2 = No
E25	Your children are not able to continue studying such as unhealthy, staying at the same level for more than 1 year, getting very low grades in class	□ 1 = Yes □ 2 = No
E26	Your children do not want to go to school	□ 1 = Yes □ 2 = No
E27	Other reasons (please specify):	

E3. Do you agree/disagree with the following statements?

1= Agree; 2 = Disagree 3 = Do not know

E31	It is useless to send girls to secondary school or higher education level since they will get married	
E32	Children going to school usually have good manners such as respecting their elders,…	
E33	I want ***my son*** to have more and better education than myself	
E34	I want ***my son*** to go to school to have a better job than myself	
E35	I want ***my son*** to go to school to have better social status than myself	
E36	I want ***my daughter*** to have more education than myself	
E37	I want ***my daughter*** to go to school to have a better job than myself	
E38	I want ***my daughter*** to go to school to have better social status than myself	

E4. When your children wish to continue studying at higher level like high school but there is no such school nearby. What you will do?

1 = Go to work instead of go to school

2 = Go to a town/village nearby or further with a secondary school

FINAL PAYMENT:

After you have answered all the questions, please follow the enumerators to calculate your final payment. Chips numbered from 1 to 11, represents for 11 questions, are put in a bag. We will pick a chip from the bag randomly in order to identify which question among 11 questions is selected for real payment.

<table>
<tr><th>Selected question from picking a chip from the bag randomly (QP)</th><th>Option 1</th><th>Option 2</th><th>Final payment</th></tr>
<tr><td>□ ER 1</td><td>(The invested amount is ……VND)</td><td>□ Red (R)
□ Black (B)</td><td></td></tr>
<tr><td>□ ER 2
□ ER 3
□ ER 4
□ ER 5
□ ER 6</td><td>□ Option A (A)
□ Option B (B)</td><td>100,000 VND
□ Red (R)
□ Black (B)</td><td></td></tr>
<tr><td>□ ER 7
□ ER 8
□ ER 9
□ ER 10
□ ER 11</td><td>□ Accept (A)
□ Reject (R)</td><td>□ Red (R)
□ Black (B)
0 VND</td><td></td></tr>
<tr><td>Participation fee</td><td></td><td></td><td>90,000 VND</td></tr>
<tr><td>Total</td><td></td><td></td><td></td></tr>
</table>

*** Final payment**

	Codes	Content	Amount (VND)
1	Fee	Participation fee	90,000 VND
2	Game	Amount of money added/deducted from the game	
3	Total	Total = 1 + 2	

CASH RECEIPT			
Date: _____			
Final amount received: _____VND			
Name and signature of recipient: _____			
Enumerator			
Full name		**Sign**	
Supervisor approval			
Full name		**Sign**	

Thank you very much for spending your time with us today!
Wish you health and luck!
Interview ended at (TF):
Total time of interview (TT):……..minutes

Appendix 2- 3: Some pictures during field survey and experimental time

Three-day training for enumerators

Rehearsal among enumerators

Pilot survey

A participant was picking up token from a bag to identify his pay-off after completion the survey and experiment

Tokens and bags using in the experiment

A survey and experiment day in Kien Giang

Appendix 2- 4: Computation of risk preference in lottery2 and lottery20

Following Hartog et al. (2002) to compute risk preference parameter without specifying a utility function, we obtain the Arrow-Pratt measure of absolute risk aversion (ARA) that is ARA = - U" (W)/U' (W). The expected theory implies that an individual is willing to pay at prize Z, has the utility of wealth w without participation in the lottery is indifferent with the expected utility when joining at reservation price Z:

U (W) = 0.9U (W-Z) + 0.1U (W+M-Z)

With M is the winning prize, M = 2 million or 20 million VND depending on the situation. By developing a Taylor expansion of U (W-Z) and U (W+M-Z) around U (W) we can obtain:

ARA= (0.1M-Z)/ (Z^2/2+0.1M^2/2-0.1ZM)

The Arrow-Pratt measure of relative risk aversion (RRA) is obtained by multiply ARA by W.

Appendix 2- 5: Creating an index from self-assessment measures:

Factor analysis of self-assessment WTTR

Since there is certain correlation among WTTR questions, we apply factor analysis in order to find a dominant factor and then to have a single variable from five self-assessment measures of WTTR. The factor analysis produces a common index, namely Factor 1. In particular, WTTR in general and in agriculture defines factor1 while WTTR in non-agricultural activities has the lowest correlation with factor1 (58%). Furthermore, WTTR in general and in agriculture play an important role in defining Factor1 with uniqueness of 32.6% and 36.1%, following by WTTR in healthcare, education of children and WTTR in non-agricultural activities. The last sub table brings a clearer picture of the relevance of each variable in the factor, indicating that WTTR in general and WTTR in agriculture have the most important contributions in Factor 1 while WTTR in non-agriculture has the least role. We then use Factor 1 as an index for all five self-assessment measures.

(obs=283)

Factor analysis/correlation	Number of obs =	283
Method: principal-component factors	Retained factors =	1
Rotation: (unrotated)	Number of parameters =	5

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	2.442	1.643	0.488	0.488
Factor2	0.799	0.072	0.160	0.648
Factor3	0.727	0.061	0.145	0.794
Factor4	0.666	0.301	0.133	0.927
Factor5	0.365	.	0.073	1.000

LR test: independent vs. saturated: chi2(10) = 298.30 Prob>chi2 = 0.0000

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Uniqueness
R21	0.821	0.326
R22	0.799	0.361
R23	0.583	0.660
R24	0.650	0.578
R25	0.606	0.632

(Option regression assumed; regression scoring)

Scoring coefficients (method = regression; based on varimax rotated factors)

Variable	Factor1
R21	0.336
R22	0.327
R23	0.239
R24	0.266
R25	0.248

The first sub-table shows the sum of all eigenvalues equal to total number of variables (= five self-assessment measures). Kaiser criterion suggest retaining those factors with eigenvalues equal or higher than one. Therefore, we keep Factor1. The “Difference” column shows the

difference between one eigenvalue and the next. The "Proportion" column indicates the relative weight of each factor in the total variance. For instance, the first factor explains about 49% of the total variance. This is highest among compared with other factors. The Cumulative represents the amount of variance explained by n+ (n-1) factors. For example, factor1 and factor2 make up about 65% of the total variance.

The Factor loadings table are the weights and correlations between each variable and the factor. The higher the load the more relevant in defining the factor's dimensionality. A negative value shows an inverse impact on the factor. Factor1 retains as it has eigenvalues over 1. We can see that R21 and R22, namely WTTR in general and WTTR in agriculture, defines factor1 while R23 or WTTR in non-agricultural activities has the lowest correlation with factor1 (58%).

The Uniqueness is the variance that is 'unique' to the variable and not shared with other variables. In other words, the greater 'uniqueness' the lower the relevance of the variable in the factor model. About 32.6% of the variance in WTTR in general is not share with other variables in the overall factor model. WTTR in general and in agriculture play an important role in defining factor1 with uniqueness of 32.6% and 36.1%, following by WTTR in healthcare, education of children and the last one is WTTR in non-agricultural activities. The last sub table brings a clearer picture of the relevance of each variable in the factor, indicating that WTTR in general and WTTR in agriculture have the most important contributions in Factor 1 while WTTR in non-agriculture has the least role. We then use Factor 1 as an index for all five self-assessment measures.

Appendix 2- 6: Issue of multiple hypothesis testing

In the behavioral relevance test, we perform several regressions in order to compare various measures of risk preferences with regard to multiple outcomes. As a result, this is likely to involve the issue of multiple hypothesis testing or the probability that at least one of the true null hypotheses will be falsely rejected using randomization inference. There are several approaches to deal with this issue: the traditional and conservatives Bonferroni correction, the Benjamini-Hochberg procedure and the Romano-Wolf Multiple Hypothesis correction that is newly updated in 2019.

The Bonferroni correction and Benjamini-Hochberg procedure assume that the individual tests are independent of each other. However, this is not the case in our data since there are

correlation among measures. In some cases, the correlation is even strong (more than 50%). Therefore, we apply the Romano-Wolf Multiple Hypothesis correction is developed by Clarke et al. (2019). This method is considered as more powerful than earlier ones such as Bonferroni and Holm corrections. It considers the dependence structure of the test statistics by resampling from the original data. The below table provides detail of the Romano-Wolf step-down adjusted p-values with the number of resamples are 10000. The first column is original model P-value and the third column show adjusted Romano-Wolf P value. There are no changes in adjusted P-value compared to the model P-value, indicating validity of our results.

Table A3- 1: PCA results of commune characteristics

	Scoring coefficients	
Indexes and components	**Factor 1**	**Factor 2**
Commune road index		
Concrete central commune roads (%)	0.49	
Concrete village roads (%)	0.55	
Clean and not muddy hamlet roads in rainy season	0.51	
Concrete yield roads and available for vehicle travel (%)	0.45	
Per cent of variance (%)	0.70	
Cumulative (%)	0.70	
Infrastructure index		
Permanent market	0.25	0.36
Primary school	0.34	0.78
Secondary school	0.68	-0.09
Healthcare center	0.60	0.50
Per cent of variance (%)	0.34	0.25
Cumulative (%)	0.34	0.59
Utilities index		
Coverage of streetlighting in the commune (%)	0.71	
Coverage of network for drinking water distribution in the commune (%)	0.71	
Per cent of variance (%)	0.65	
Cumulative (%)	0.65	

Note: Infrastructure index is linearly calculated using the first two factors, with their shares of explained variation as weights. The indexes are subsequently transformed to a 0–100 scale to for the ease of interpretation.

Vulnerability to poverty (by fixed effect model) and its relationship with life satisfaction and CES-D score

Table A3- 2: Vulnerability to poverty and life satisfaction

	Dependent variable = Life satisfaction							
Explanatory variables	**Whole sample**				**Never poor**		**Transition poor**	
Vulnerability to poverty (fixed effect)	-11.15***	-7.140***	-4.932***	-8.603***	-7.513***	-11.42***	-1.232	-4.990**
	(1.174)	(1.317)	(1.425)	(1.292)	(1.035)	(1.064)	(2.949)	(2.415)
Log of per capita income in the last 12 months		0.430***	0.410***		0.476***		0.355***	
		(0.0651)	(0.0638)		(0.0631)		(0.0960)	
Age 19-30			-0.742***	-0.737***	0.0592	0.00443	-1.702***	-1.617***
			(0.242)	(0.238)	(0.294)	(0.297)	(0.456)	(0.456)
Age 31-40			-0.569***	-0.611***	-0.168	-0.247	-1.034***	-1.037***
			(0.131)	(0.129)	(0.188)	(0.189)	(0.178)	(0.178)
Age 51-60			0.474***	0.511***	0.261**	0.327***	0.694**	0.698**
			(0.116)	(0.112)	(0.128)	(0.120)	(0.285)	(0.274)
Age 61-80			0.910***	0.988***	0.624***	0.718***	1.170**	1.252***
			(0.181)	(0.176)	(0.178)	(0.175)	(0.462)	(0.443)
Age 80+			1.610***	1.818***	1.494**	1.716***	1.510***	1.740***
			(0.432)	(0.414)	(0.591)	(0.588)	(0.529)	(0.482)
Married (=1)			-0.543	-0.483	-0.330	-0.282	-1.290	-1.144
			(0.463)	(0.471)	(0.505)	(0.523)	(0.951)	(0.976)
Widow/Divorce/Separate (=1)			-0.582	-0.551	-0.419	-0.452	-1.310	-1.085
			(0.492)	(0.510)	(0.569)	(0.599)	(1.298)	(1.319)
Member of Communist party (=1)			0.281	0.279	0.203	0.208	0.570	0.532
			(0.207)	(0.202)	(0.252)	(0.250)	(0.396)	(0.346)
Not employed			0.0104	-0.0248	0.00726	-0.0250	0.00137	-0.0469
			(0.165)	(0.170)	(0.180)	(0.178)	(0.255)	(0.267)
Observations	8,065	8,065	8,065	8,065	5,201	5,201	2,636	2,636

Robust standard errors clustered at commune level in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table A3- 3: Vulnerability to poverty and CES-D score

	Dependent variable							
Explanatory variables	Whole sample				Never poor		Transition poor	
Vulnerability to poverty (fixed effect)	30.86***	28.26***	26.69***	29.11***	32.39***	35.17***	22.09***	23.45***
	(5.176)	(5.040)	(5.210)	(5.325)	(4.897)	(5.759)	(6.867)	(6.234)
Log of per capita income in the last 12 months		-0.327*	-0.308*		-0.376*		-0.147	
		(0.183)	(0.176)		(0.204)		(0.240)	
Age 19-30			1.922*	1.920*	2.108	2.146	1.576	1.534
			(1.134)	(1.129)	(1.503)	(1.491)	(1.835)	(1.812)
Age 31-40			0.894*	0.911*	1.426*	1.457*	0.129	0.128
			(0.509)	(0.507)	(0.758)	(0.757)	(0.736)	(0.735)
Age 51-60			-0.691*	-0.704*	-0.297	-0.309	-1.780	-1.795
			(0.381)	(0.385)	(0.421)	(0.431)	(1.154)	(1.185)
Age 61-80			-1.622***	-1.636***	-1.064*	-1.095*	-2.999**	-2.997**
			(0.496)	(0.491)	(0.603)	(0.604)	(1.335)	(1.347)
Age 80+			1.495	1.454	0.403	0.315	3.058	3.061
			(1.210)	(1.208)	(2.220)	(2.271)	(3.629)	(3.653)
Married (=1)			1.960	1.964	2.323	2.315	-2.153**	-2.130**
			(1.649)	(1.644)	(1.923)	(1.902)	(0.981)	(0.985)
Widow/Divorce/Separate (=1)			2.404	2.412	2.062	2.082		
			(1.614)	(1.613)	(1.607)	(1.589)		
Member of Communist party (=1)			-0.858*	-0.854*	-1.678***	-1.686***	1.503	1.530
			(0.487)	(0.491)	(0.525)	(0.530)	(1.074)	(1.095)
Not employed			1.619***	1.642***	1.100**	1.114**	3.260***	3.288***
			(0.381)	(0.390)	(0.476)	(0.481)	(1.020)	(1.033)
Constant	-3.704**	0.510	-0.879	-4.840**	-1.775	-6.607***	2.633	0.684

	(1.802)	(2.672)	(2.862)	(2.004)	(2.839)	(2.341)	(4.625)	(2.797)
Observations	**4,684**	**4,684**	**4,684**	**4,684**	**3,090**	**3,090**	**1,470**	**1,470**
R-squared	0.048	0.050	0.067	0.065	0.083	0.080	0.081	0.081
Number of hhid2012	2,342	2,342	2,342	2,342	1,545	1,545	735	735

Robust standard errors clustered at commune level in parentheses; *** p<0.01, ** p<0.05, * p<0.10

Instrument variable estimations

In this appendix, we attempt to adopt the instrument variable (IV) approach with controls on individual fixed effects to deal with this reverse causality issue. We look for the instrument variables that need to satisfy the relevance and exogeneity assumptions. The latter implies that the instruments do not affect happiness outcomes, apart from their influence through poverty risk, or more explicitly through income. Some studies have proposed and attempted the instruments for income in happiness regression, including lagged income (Powdthavee, 2010), the proportion of household members with pay slip information (Powdthavee, 2010), age threshold for social pension (Cuong, 2021), survey respondent's parents' years of education and the value of productive assets (Knight et al., 2008), and predicted household earnings (Luttmer, 2005)[30]. However, the validity of these instruments is still controversial such as lagged income and productive assets. Moreover, most of them are not available given our secondary survey dataset.

Alternatively, we have considered other exogenous over-time variations at the commune level that potentially satisfy the IV requirements.

[30] Prediction is based on (industry x occupation) of the survey respondents and their spouse and national earnings information by (industry x occupation) and time period.

Our proposed instruments are numbers of firms in the neighboring commune that people can come work and return within the day (hereafter, neighbor firms); and a dummy variable for active participation of commune in the National Target Program on New Rural Development (NRD). These variables are obtained from the commune module answered by commune leaders in the VARHS survey. Numbers of firms in neighboring commune provides additional opportunity for individuals to earn more income and so can support their family especially in difficult time. However, the major income source of household in our sample come from agriculture activities in their village, people only come to work in neighboring firms occasionally in specific season with some seasonal works such as construction and production of traditional products or foods in New year. Therefore, numbers of firms in neighboring commune only affect individual happiness through increasing their income.

The National Target Program on New Rural Development (NRD) for 2010-2020 is a national policy focusing on agriculture and rural development of Vietnam. The program has been implemented since 2010[31] in the whole country[32]. This is a top-down policy with its implementation from the central government to province to district and to commune. Commune is the lowest planning and budgeting unit as well as a basic unit of NRD. The target of the NRD is to reduce poverty gap between urban and rural areas, between leading and lagging regions, and among ethnic groups. More importantly, NRD aims to mobilize internal resources, particularly the involvement of community, as mentioned by the slogan of the program "*people know, people discuss, people do and people monitor for the benefit of rural people themselves*". NRD includes

[31] Decision No. 800/QD-TTg dated 04/06/2010 to approve the NRD between 2010 and 2020; and the Decision No. 1600/QD-TTg dated 16/08/2016 to renew the NRD for the period of 2015-2020.
[32] 8,973 communes of 63 provinces (GSO, 2017)

11 groups of activities and are categorized into 19 criteria[33].

By the end of 2019, there are 55.3 percent of communes that met 19 NRD criteria, in which 52.4 percent of communes that are officially recognized as NRD commune and 2.9 percent of other communes are making procedure to be acknowledged as NRD commune (CSC-NTPs, 2019). The numbers of communes meeting new rural criteria varies greatly due to their initial economic conditions, as well as the effort of commune leaders and effectiveness of community participation. A commune is considered as active engagement in meeting the NRD criterion when it has fulfilled 19 criterion and achieve "*New Commune Standard*" by 2020. Studies have shown that the NRD effectively and positively impact on rural household income by creating more job opportunities and improvement of infrastructure (Do et al., 2016; Do and Park, 2019; and Hoang, 2020).

Instruments variables estimation relies on the exogeneity assumption, and thus it is important to consider and counteract potential threats to its validity. A possible threat to validity is that active engagement of community in the implementation of the NRD usher in the development of infrastructure, such as roads, irrigation system, and led to changes in the income distribution that themselves influenced individual happiness. When constructing the vulnerability index, we include the following commune-level controls for this possibility: road index, utility index and irrigation system and. The vulnerability estimation also includes proportion of household members as wage-worker, agriculture activities, non-

[33] 11 activities include: (1) planning to build a new countryside; (2) developing socioeconomic infrastructure; (3) restructuring and developing the economy and increasing income; (4) poverty reduction and social security; (5) renewing and developing forms of effective production organization in rural areas; (6) developing education and training in rural areas; (7) developing medical services and providing health care for rural inhabitants; (8) building a cultured life and developing information and communications in rural areas; (9) clean water supply and environmental sanitation in rural areas; (10) raising the quality of party organizations, administrations and sociopolitical organizations in localities and (11) maintaining social security and order in rural areas.

farm jobs. Another possible threat to the validity of the instrument is the possibility that the active participation of NRD has a direct effect on happiness through changing people motivation and attitude to working together. We argue that the motivation effects should be much stronger if household has members who are commune leader or member of communist party than if households who do not have, and so the direct effect of the NRD is likely to be second order in happiness. There is also some evidence of bureaucratic issue of NRD in which only commune leaders know about the program while people don't know about it or they only know when they see some positive effect such as construction of infrastructure (e.g., Do et al., 2016)).

With the above instruments, we estimate the following equation as a first-stage estimation:

$$V_{i,t} = \beta_1 Z_{i,t} + \eta_i + \varepsilon_{i,t} \qquad (3.2)$$

Where $V_{i,t}$ is vulnerability to poverty of individual *i* in year *t*; $Z_{i,t}$ is instruments, including neighbor firms and active participation in the NRD program. Since these instruments vary at the commune level, we cluster our standard errors at the commune level to allow for arbitrary correlation in the error structure of individuals within a commune.

The results of Instrument variable estimations

In this section, we present instrument estimation of the impact of income vulnerability on happiness. **Table A3-4** presents the results of instrument variable estimation by means of a two-stage least squares regression where vulnerability to poverty and income per capita (log) are instrumented by numbers of firms in neighboring village and active participation of commune in the National target Program on New Rural Development (NRD). The first stage shows that active participation of commune in the NRD significantly predicts a reduction in vulnerability to poverty, and an increase in number of firms in neighboring communes significantly predicts a decrease in vulnerability to poverty.

The bottom rows of **Table A3-4** show tests for endogeneity of vulnerability to poverty and for instrument validity. A Chi squared test of endogeneity does not reject the null-hypothesis that vulnerability to poverty is exogenous. This should increase confidence in the results of fixed effect model. The Kleibergen-Paap F-statistic is useful for judging whether instruments are weak (Kleibergen and Richard, 2006). The value of the F-statistic is 4.2 for life satisfaction as outcome and only 1.3 for depression as outcome. Comparison with the critical values in Stock and Yogo (2005) suggests that the instruments are quite weak, thus the results in IV estimation should be treated with caution. Although this makes the IV-results less interesting we present them here, noting that the power of the endogeneity test is limited.

Table A3- 4: Instrumental Variable Estimation

	2SLS (Life satisfaction)		2SLS (CES-D score)	
	First stage	Second-stage	First stage	Second-stage
Explanatory variables	**Vulnerability to poverty**	**Life satisfaction**	**Vulnerability to poverty**	**CES-D score**
Commune actively engage in meeting criteria of the New Village Program	-0.0122		-0.0317***	
	(0.00928)		(0.0112)	
Numbers of firms in neighboring communes (> 10 employees) where people can work and come back within a day	-0.0131***		-0.0206***	
	(0.00481)		(0.00695)	
Vulnerable to poverty		2.118		13.01
		(2.171)		(13.58)
Log of per capita income in the last 12 months		0.920*		0.843
		(0.535)		(7.942)
Age 19-30	0.167***	-0.0216	0.155***	2.080
	(0.0249)	(0.360)	(0.0196)	(3.103)
Age 31-40	0.0920***	0.00716	0.0677***	1.455
	(0.0123)	(0.224)	(0.0122)	(2.260)
Age 51-60	-0.0610***	-0.0678	-0.0386***	-1.366
	(0.00818)	(0.193)	(0.00575)	(1.879)
Age 61-80	-0.147***	-0.0680	-0.100***	-3.642
	(0.0172)	(0.473)	(0.0196)	(3.286)

Age 80+	-0.182***	-0.0632	-0.103***	-0.808
	(0.0241)	(0.663)	(0.0276)	(4.626)
Married	-0.0172	-0.312*	0.0654***	2.803
	(0.0189)	(0.163)	(0.0223)	(4.429)
Widow/Divorce/Separate	-0.0673***	-0.323	0.00953	2.278
	(0.0250)	(0.207)	(0.00857)	(2.808)
Member of Communist party	0.00258	0.0533	0.0113	-0.804
	(0.00696)	(0.0664)	(0.00792)	(0.551)
Not employed	-0.00147	0.0263	0.00302	1.625***
	(0.00461)	(0.0426)	(0.00473)	(0.567)
Endogeneity test of endogenous regressors		0.024		0.267
Chi-sq(1) P-val		0.8765		0.6054
Underidentification test				
Kleibergen-Paap rk LM statistic		6.921		1.908
Chi-sq(1) P-val		0.0085		0.1672
Weak Identification test				
Cragg-Donald Wald F statistic		8.842		0.744
Kleibergen-Paap rk Wald F statistic		4.198		1.273
Hansen J statistic (over identification test) (equation exactly identified)		0.000		0.000
Observations	9,227	9,227	4,556	4,556
Number of ID2012	2,337	2,337	2,278	2,278

Note: *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors clustered at commune level are in parentheses. The number of observations for CES-D score is lower than that in the vulnerability estimates and life satisfaction tables because questions to construct depression index are only added since 2016.

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TABLES

Table 2- 1: Elicitation methods in the study

Elicitation methods	Characteristics
Self-assessment questions	Hypothetical
Self-assessment in general	
Self-assessment in agriculture	
Self-assessment in non-agriculture	
Self-assessment in healthcare	
Self-assessment in education of children	
Lottery task (low and high stake)	Hypothetical (from VARHS survey)
Loss-gain	Hypothetical (from VARHS survey) and Experimental
MPL	Hypothetical (from VARHS survey) and Experimental
Real investment	Experiment

Table 2- 2: Description and summary statistics of individual characteristics (N=350)

	Mean	St.Dev	Min	Max
Age	48.38	10.63	26	78
Education	6.07	3.08	0	14
Female	.29	.46	0	1
Household wealth (land, in ha)	0.27	0.25	0.013	25
Household size	4.7	1.62	2	15
Numbers of biological children	2.86	1.47	0	8

Table 2- 3: Choices in the hypothetical MPL in VARHS

Choice where a subject switched to safe option A	Safe option (A)	Risky option (B)					
		Pr (p)	Payoff	Pr(1-p)	Payoff	E(B)	E(A)-E(B)
1	2,000,000	0.5	2,000,000	0.5	4,000,000	3,000,000	-1,000,000
2	2,000,000	0.5	1,500,000	0.5	4,000,000	2,750,000	-750,000
3	2,000,000	0.5	1,000,000	0.5	4,000,000	2,500,000	-500,000
4	2,000,000	0.5	500,000	0.5	4,000,000	2,250,000	-250,000

* Note: 20,000 VND = 1 USD

Table 2- 4: Choices in the experimental MPL

Choice where a subject switched to safe option A	Safe option (A)	Risky option (B)					
		Pr (p)	Payoff (VND)	Pr(1-p)	Payoff (VND)	E(B)	E(A)-E(B)
1	100,000	0.5	100,000	0.5	200,000	150,000	-50,000
2	100,000	0.5	75,000	0.5	200,000	137,500	-37,500
3	100,000	0.5	50,000	0.5	200,000	125,000	-25,000
4	100,000	0.5	25,000	0.5	200,000	112,500	-12,500
5	100,000	0.5	0	0.5	200,000	100,000	0

Table 2- 5: Risk preferences from the Hypothetical MPL task

Numbers of safe options chosen	Percent of subjects	CRRA Interval if switch to safe option A	Midpoint CRRA
Always choose safe options A	24.86	NA	NA
3	16.86	$r \geq 2.91$	2.91
2	7.71	$1 < r < 2.91$	1.96
1	14.29	$0.31 \leq r < 1$	0.66
Always choose risky options B	36.29	$r < 0.31$	0.31
Inconsistent answers	0		

Table 2- 6: Risk preferences in experimental MPL

Numbers of safe options chosen	Percent of subjects	CRRA Interval if switch to safe option A	Midpoint CRRA
Always choose safe options			
A	21.71	NA	NA
4	14.86	$r \geq 2.91$	2.91
3	12.86	$1 < r < 2.91$	1.96
2	16.57	$0.31 \leq r < 1$	0.66
1	11.14	$0 \leq r < 0.31$	0.16
Always choose risky options			
B	18.57	$r < 0$	0
Inconsistent responses	4.29		

Inconsistent response = multiple or irrational switching.

Table 2- 7: Choices in hypothetical loss-gain questions

Option where a subject refused	Refuse (R)	Accept (A)				Expected value	Numbers of accepted options	Proportion of subjects accepted
		Pr (p)	Payoff (VND)	Pr (1-p)	Payoff (VND)			
1	0	0.5	-2,000	0.5	6,000	2,000	Refuse all	33.71
2	0	0.5	-3,000	0.5	6,000	1,500	1	11.43
3	0	0.5	-4,000	0.5	6,000	1,000	2	17.43
4	0	0.5	-5,000	0.5	6,000	500	3	8.57
5	0	0.5	-6,000	0.5	6,000	0	4	8.29
6	0	0.5	-7,000	0.5	6,000	-500	5	7.71
							Accept all	11.71
N = 350							Inconsistent answers	1.14

Note: 1,000 VND = 5 cents; Inconsistent responses = multiple or reverse switching

Table 2- 8: Choices in experimental loss-gain questions

Option where a subject refused	Refuse (R)	Accept (A)				Expected value	Numbers of accepted options	Proportion of subjects accepted
		Pr (p)	Payoff	Pr (1-p)	Payoff			
1	0	0.5	-5,000	0.5	30,000	12,500	Refuse all	35.14
2	0	0.5	-10,000	0.5	30,000	10,000	1	13.43
3	0	0.5	-15,000	0.5	30,000	7,500	2	8.86
4	0	0.5	-20,000	0.5	30,000	5,000	3	12.57
5	0	0.5	-25,000	0.5	30,000	2,500	4	2.57
							Accept all	26.00
							In consistent	
N=350							answers	1.43

Inconsistent response = multiple or irrational switching.

Table 2- 9: Hypothetical loss-aversion interval across different risk coefficients in hypothetical loss-gain task

	Risk coefficients from hypothetical MPL				
Numbers of accepted options	**r = 2.91**	**r = 1.96**	**r = 0.66**	**r = 0.31**	**Na**
0 (Reject all)	$\lambda \leq 0.12$	$\lambda \leq 0.35$	$\lambda \geq 1.45$	$\lambda \geq 2.13$	
1	$0.12 < \lambda \leq 0.27$	$0.35 < \lambda \leq 0.51$	$1.27 \leq \lambda < 1.45$	$1.61 \leq \lambda < 2.13$	
2	$0.27 < \lambda \leq 0.46$	$0.51 < \lambda \leq 0.68$	$1.15 \leq \lambda < 1.27$	$1.32 \leq \lambda < 1.61$	
3	$0.46 < \lambda \leq 0.71$	$0.68 < \lambda \leq 0.84$	$1.06 \leq \lambda < 1.15$	$1.13 \leq \lambda < 1.32$	
4	$0.71 < \lambda \leq 1$	$0.84 < \lambda \leq 1$	$1 \leq \lambda < 1.06$	$1 \leq \lambda < 1.13$	
5	$1 < \lambda \leq 1.34$	$1 < \lambda \leq 1.16$	$0.95 \leq \lambda < 1$	$0.90 \leq \lambda < 1$	
6 (Accept all)	$\lambda > 1.34$	$\lambda > 1.16$	$\lambda < 0.95$	$\lambda < 0.90$	

**Na= always choose safe option A; Not include subjects who always choose safe option A in the MPL and subjects who have irrational answers.*

Table 2- 10: Loss-aversion interval across different risk coefficients in experimental loss-gain task

	Risk coefficients from experimental MPL				
	r = 2.91	**r = 1.96**	**r = 0.66**	**r = 0.16**	**r= 0**
Reject all	$\lambda \leq 0.03$	$\lambda \leq 0.18$	$\lambda \geq 1.84$	$\lambda \geq 4.5$	$\lambda > 6$
1	$0.03 < \lambda \leq 0.12$	$0.18 < \lambda \leq 0.35$	$1.45 \leq \lambda < 1.84$	$2.52 \leq \lambda < 4.5$	$3 \leq \lambda < 6$
2	$0.12 < \lambda \leq 0.27$	$0.35 < \lambda \leq 0.51$	$1.27 \leq \lambda < 1.45$	$1.79 \leq \lambda < 2.52$	$2 \leq \lambda < 3$
3	$0.27 < \lambda \leq 0.46$	$0.51 < \lambda \leq 0.68$	$1.15 \leq \lambda < 1.27$	$1.41 \leq \lambda < 1.79$	$1.5 \leq \lambda < 2$
4	$0.46 < \lambda \leq 0.71$	$0.68 < \lambda \leq 0.84$	$1.06 \leq \lambda < 1.15$	$1.17 \leq \lambda < 1.41$	$1.2 \leq \lambda < 1.5$
Accept all	$\lambda > 0.71$	$\lambda > 0.84$	$\lambda < 1.06$	$\lambda < 1.17$	$\lambda < 1.20$

**Na= always choose safe option A; Not include subjects who always choose safe option A in the MPL and subjects who have irrational answers.*

Table 2- 11: Risk preferences in the Investment task

Real Investment	**Lose**		**Win**		**Expected value and remained wealth**	**CRRA interval**	**Midpoint interval**	**Percent of subjects**
	Pr (p)	**Payoff**	**Pr (1-p)**	**Payoff**				
0	0.5	**100000**	0.5	**100000**	100000	$r \geq 4.91$	4.91	27.71
20000	0.5	**90000**	0.5	**120000**	105000	$1.64 \leq r < 4.9$	3.28	20.57
40000	0.5	**80000**	0.5	**140000**	110000	$1 \leq r < 1.64$	1.32	19.43
60000	0.5	**70000**	0.5	**160000**	115000	$0.72 \leq r < 1$	0.86	10.57
80000	0.5	**60000**	0.5	**180000**	120000	$0.56 \leq r < 0.72$	0.64	4.29
100000	0.5	**50000**	0.5	**200000**	125000	$r < 0.56$	0.56	17.43

Table 2- 12: Subjects with consistent and inconsistent answers

Variables	**Consistent**	**Inconsistent**	**P-value**
	mean	**mean**	
Female	0.28	0.43	0.21
Highest education	6.75	6.19	0.83
Cognitive ability	2.00	2.10	0.71
Observations	329	21	350

Table 2- 13: Responses between hypothetical and experimental MPL tasks (N = 335)

Numbers of safe options chosen\ CRRA midpoint in hypothetical MPL		CRRA midpoint in experimental MPL					
		0	**1**	**2**	**3**	**4**	**5**
		0	**0.16**	**0.66**	**1.96**	**2.91**	**Na***
0	**0.31**	**12.54**	**8.36**	6.87	2.39	3.28	3.28
		C	C	NC	IC	IC	IC
1	**0.66**	2.69	1.49	**3.88**	2.69	2.39	1.79
		IC	NC	**C**	NC	IC	IC
2	**1.96**	1.49	0.60	0.90	**1.19**	2.09	0.60
		IC	NC	NC	C	NC	NC
3	**2.91**	0.60	0.90	2.99	4.48	**5.97**	2.69
		IC	IC	NC	NC	**C**	NC
4	**Na***	2.09	0.30	2.69	2.69	1.79	**14.33**
		IC	IC	IC	NC	NC	**C**

**Na=always choose safe option A in MPL; C = Consistent; NC = nearly consistent; IC=Inconsistent*

Table 2- 14: Correlation among self-assessment methods (N=283)

Variables	(1)	(2)	(3)	(4)	(5)
(1) General	1.000				
(2) Agriculture	0.63*	1.000			
(3) Non-agriculture	0.27*	0.31*	1.000		
(4) Healthcare	0.40*	0.34*	0.29*	1.000	
(5) Education of children	0.35*	0.37*	0.23*	0.21*	1.000

*Spearman rank correlations; *shows significance at the .01 level; N=283, Exclude the people who choose "n/a"*

Table 2- 15: Correlations among elicitation methods (N=275)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) WTTR non-agriculture	1.000							
(2) Lottery2	-0.02	1.000						
(3) Lottery20	-0.02	**0.85***	1.000					
(4) Investment	0.08	0.10	0.09	1.000				
(5) Hypothetical loss-gain	0.11	**0.26***	**0.23***	**0.35***	1.000			
(6) Experimental loss-gain	**0.16***	0.11	0.13	**0.52***	**0.38***	1.000		
(7) Hypothetical MPL	-0.09	-0.09	-0.10	**-0.42***	**-0.42***	**-0.45***	1.000	
(8) Experimental MPL	-0.10	-0.08	-0.09	**-0.58***	**-0.42***	**-0.66***	**0.52***	1.000

Spearman rank correlations; Self-assessment methods include only WTTR in non-agricultural activities;

Table 2- 16: OLS regression for behavioral relevance validity

	Experimental measures		
	(1)	**(2)**	**(3)**
(1) Hypothetical measures	**MPL**	**Loss-gain**	**Investment**
WTTR index	-0.00959	-0.0297	0.0645
	(0.0646)	(0.0929)	(0.0723)
Constant	1.462	-4.152***	-4.340**
	(1.721)	(1.231)	(1.676)
Observations	335	345	350
N	335	345	350
r2	0.218	0.206	0.270
	MPL	**Loss-gain**	**Investment**
(2) WTTR in general	-0.00633	0.0469	0.0537
	(0.0703)	(0.0808)	(0.0628)
Constant	1.457	-4.166***	-4.272**
	(1.714)	(1.127)	(1.689)
Observations	335	333	350
N	335	333	350
r2	0.218	0.219	0.270
	MPL	**Loss-gain**	**Investment**
(3) Lottery2	-0.0384	0.0499	0.0180
	(0.0421)	(0.0407)	(0.0472)
Constant	1.401	-4.117***	-4.205**
	(1.754)	(1.204)	(1.732)
Observations	335	345	350
N	335	345	350
r2	0.219	0.207	0.268
	MPL	**Loss-gain**	**Investment**
(4) Lottery20	-0.0501	-0.00244	-0.0111
	(0.0481)	(0.0589)	(0.0632)

Constant	1.364	-4.204***	-4.254**
	(1.726)	(1.133)	(1.648)
Observations	335	345	350
N	335	345	350
r2	0.220	0.205	0.268
	MPL	**Loss-gain**	**Investment**
(5) Hypothetical MPL (Numbers of safe options chosen)	0.444***	-0.350***	-0.242***
	(0.0782)	(0.0556)	(0.0690)
Constant	0.431	-3.544***	-3.794**
	(1.588)	(1.104)	(1.643)
Observations	335	345	350
N	335	345	350
r2	0.371	0.300	0.313
	MPL	**Loss-gain**	**Investment**
(6) Hypothetical loss-gain (Numbers of accepted options)	-0.402***	0.327***	0.224***
	(0.0467)	(0.0582)	(0.0529)
Constant	0.173	-3.403**	-3.589**
	(1.513)	(1.292)	(1.594)
Observations	331	341	346
N	331	341	346
r2	0.349	0.295	0.311
(7) All hypothetical measures	**MPL**	**Loss-gain**	**Investment**
WTTR index	-0.0582	-0.00510	0.0953
	(0.0536)	(0.0846)	(0.0896)
Lottery2	0.0694	0.0423	0.0182
	(0.0540)	(0.0697)	(0.0833)
Lottery20	-0.0552	-0.0560	-0.0379
	(0.0539)	(0.0843)	(0.0927)
Hypothetical MPL (Numbers of safe options chosen)	0.341***	-0.261***	-0.176**
	(0.0728)	(0.0580)	(0.0647)
Hypothetical loss-gain (Numbers of accepted options)	-0.301***	0.230***	0.175***
	(0.0383)	(0.0641)	(0.0415)
Constant	-0.149	-3.272**	-3.657*
	(1.516)	(1.258)	(1.708)
Observations	329	341	341
N	329	341	341
r2	0.438	0.342	0.338

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Other controls: male, religion, ethnicity, education, household wealth (land area), household income (log), numbers of children, dummies for province and enumerator; cluster at village level; loss-averse = less accepted options in the loss-gain tasks; risk-averse = more safe options chosen in the MPL tasks.

Table 2- 17: Summary of behavioral relevance validity

Hypothetical elicitation methods	Real amount invested	Experimental MPL	Experimental loss-gain
Self-assessment			
WTTR Index			
In general case			
Lottery			
Lottery2			
Lottery20			
MPL	✓	✓	✓
Hypothetical loss-gain	✓	✓	✓

Table 2- 18: Probit regressions of predictive power validity

	Household behaviors in agriculture				Individual behaviors	
	(1)	(2)	(3)	(4)	(5)	(6)
Elicitation measures	**Seeding time adjustment**	**Diversification of crops or animals**	**Irrigation investment**	**All three activities**	**Smoking**	**Drinking**
WTTR index	0.0159	-0.00131	0.0134	-0.00345	-0.00465	-0.0258
	(0.0147)	(0.0262)	(0.0249)	(0.0245)	(0.0255)	(0.0261)
Observations	348	348	330	330	350	323
WTTR in general	0.0127	-0.0329**	0.00349	-0.00515	-0.00227	-0.00534
	(0.0210)	(0.0141)	(0.0220)	(0.0160)	(0.0280)	(0.0179)
Observations	348	348	330	330	350	323
Lottery2	-0.00113	0.0315***	0.00729	0.0137	-0.0109	-0.000708
	(0.0255)	(0.0110)	(0.0217)	(0.0149)	(0.0168)	(0.0247)
Observations	348	348	330	330	350	323
Lottery20	-0.00562	0.0711***	-0.00345	0.00220	-0.0128	0.00344
	(0.0302)	(0.0157)	(0.0194)	(0.0168)	(0.0205)	(0.0194)
Observations	348	348	330	330	350	323
MPL						
Numbers of safe options chosen in *hypothetical* MPL	-0.0586***	0.0178	-0.0494**	-0.0510**	-0.0331	0.0402*
	(0.0201)	(0.0180)	(0.0232)	(0.0202)	(0.0220)	(0.0240)
Observations	348	348	330	330	350	323
Numbers of safe options chosen in *experimental* MPL	0.00966	0.0205	-0.0563***	-0.00926	-0.0674***	-0.0101
	(0.0273)	(0.0128)	(0.0205)	(0.0251)	(0.0212)	(0.0230)
Observations	327	327	310	310	329	303
Loss-gain task						
***Hypothetical* numbers of accepted options**	0.0377	-0.0604***	-0.00198	-0.00804	0.0895***	0.0137
	(0.0233)	(0.0147)	(0.0257)	(0.0280)	(0.0166)	(0.0225)
Observations	327	327	310	310	329	303

***Real* numbers of accepted options**	0.00900	-0.0203	0.0346**	0.00438	0.0878***	0.0164
	(0.0143)	(0.0149)	(0.0175)	(0.0189)	(0.0168)	(0.0222)
Observations	327	327	310	310	329	303
Investment game: Amount invested	-0.0384	0.00359	0.00648	-0.0277**	-0.000597	-0.0128
	(0.0237)	(0.0173)	(0.0248)	(0.0131)	(0.0204)	(0.0152)
Observations	327	327	310	310	329	303
All measures	**Seeding time adjustments**	**Diversification of crops or animals**	**Irrigation investment**	**All three activities**	**Smoking**	**Drinking**
WTTR index	-0.00139	-0.0134	0.0147	-0.0206	0.00271	-0.00717
	(0.0169)	(0.0258)	(0.0274)	(0.0231)	(0.0237)	(0.0188)
Lottery2	0.00615	0.0131	0.00239	0.0227	-0.0266	-0.00516
	(0.0416)	(0.0192)	(0.0261)	(0.0216)	(0.0238)	(0.0324)
Lottery20	-0.0101	0.0620**	-0.00769	-0.00740	0.00253	0.0172
	(0.0453)	(0.0277)	(0.0252)	(0.0212)	(0.0228)	(0.0229)
Numbers of safe options chosen in experimental MPL	0.0451	0.00687	-0.0619**	-0.0136	-0.0315	-0.0247
	(0.0426)	(0.0251)	(0.0274)	(0.0310)	(0.0457)	(0.0245)
Numbers of safe options chosen in hypothetical MPL	-0.0736***	-0.0272	-0.0353	-0.0649***	0.00101	0.0750**
	(0.0249)	(0.0201)	(0.0297)	(0.0222)	(0.0253)	(0.0304)
Hypothetical numbers of accepted options	0.0325	-0.0707***	-0.0321	-0.0315	0.0163	0.0354
	(0.0240)	(0.0169)	(0.0259)	(0.0294)	(0.0341)	(0.0230)
Real numbers of accepted options	0.0180	-0.0130	0.000690	0.000363	0.0844***	0.0235
	(0.0216)	(0.0145)	(0.0230)	(0.0214)	(0.0308)	(0.0183)
Amount invested	-0.0533*	0.0202	-0.0223	-0.0440*	-0.0495*	-0.0188
	(0.0279)	(0.0223)	(0.0195)	(0.0240)	(0.0265)	(0.0204)
Observations	327	327	310	310	329	303
Unconditional probability (Dependent variable = 1)	**50.9**	**78.3**	**38**	**22.3**	**37.4**	**28.0**

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Other controls: gender, education, household wealth, household net income (log), religion, ethnicity, numbers of children, membership, dummies for communes and enumerator; cluster at village level

Table 2- 19: Predictive power of elicitation methods

	Household behaviors				Individual behaviors	
	Seeding time adjustments	**Crop diversification**	**Irrigation investment**	**All 3 adjustments at the same time**	**Smoking**	**Drinking**
Self-assessment						
WTTR Index						
General		✓				
Hypothetical lottery						
Lottery2		✓				
Lottery20		✓				
Real investment				✓		
MPL						
Hypothetical	✓		✓	✓		✓
Experimental			✓		✓	
Loss-gain						
Hypothetical		✓			✓	
Experimental			✓		✓	

Robustness check: issue of multiple hypothesis testing

Table 2- 20: Romano-Wolf step-down adjusted p-values (Number of resamples: 10000)

Household behaviors	Model p-value	Resample p-value	Romano-Wolf p-value
Independent variable: WTTR index			
Seeding time adjustment	0.811	0.756	0.814
Diversification of crops and animals	0.498	0.424	0.763
Investment in irrigation system	0.046	0.026	0.098
All three activities	0.673	0.588	0.814
Independent variable: Lottery2			
Seeding time adjustment	0.367	0.285	0.594
Diversification of crops and animals	0.006	0.013	0.027
Investment in irrigation system	0.82	0.784	0.784
All three activities	0.6	0.516	0.756
Independent variable: Lottery20			
Seeding time adjustment	0.03	0.028	0.059
Diversification of crops and animals	0	0.001	0.002
Investment in irrigation system	0.372	0.294	0.464
All three activities	0.994	0.992	0.992
Independent variable: Midpoint CRRA in hypothetical MPL			
Seeding time adjustment	0.005	0.003	0.023
Diversification of crops and animals	0.044	0.053	0.083
Investment in irrigation system	0.048	0.034	0.083
All three activities	0.001	0.005	0.011
Independent variable: Midpoint CRRA in real MPL			
Seeding time adjustment	0.009	0.005	0.031
Diversification of crops and animals	0.141	0.165	0.165
Investment in irrigation system	0.003	0.007	0.031
All three activities	0.004	0.011	0.031
Independent variable: Hypothetical numbers of accepted options			
Seeding time adjustment	0.242	0.139	0.363
Diversification of crops and animals	0.004	0.004	0.012

Investment in irrigation system	0.794	0.757	0.925
All three activities	0.931	0.914	0.925
Independent variable: Real numbers of accepted options			
Seeding time adjustment	0.367	0.258	0.371
Diversification of crops and animals	0.192	0.142	0.278
Investment in irrigation system	0.023	0.008	0.034
All three activities	0.367	0.19	0.371
Independent variable: Amount invested			
Seeding time adjustment	0.529	0.452	0.615
Diversification of crops and animals	0.329	0.317	0.615
Investment in irrigation system	0.03	0.014	0.092
All three activities	0.331	0.288	0.615

Individual behaviors	**Model p-value**	**Resample p-value**	**Romano-Wolf p-value**
Independent variable: WTTR index			
drinking	0.498	0.392	0.84
smoking	0.536	0.497	0.84
Independent variable: WTTR in healthcare			
drinking	0.001	0.001	0.003
smoking	0.001	0.002	0.004
Independent variable: Lottery2			
drinking	0.469	0.378	0.378
smoking	0.174	0.144	0.24
Independent variable: Lottery20			
drinking	0.113	0.081	0.358
smoking	0.316	0.229	0.443
Independent variable: Midpoint CRRA in hypothetical MPL			
drinking	0.511	0.341	0.341
smoking	0.294	0.161	0.271
Independent variable: Midpoint CRRA in real MPL			

drinking	0.389	0.178	0.34
smoking	0.148	0.106	0.34
Independent variable: Hypothetical numbers of accepted options			
drinking	0.014	0.004	0.011
smoking	0.109	0.033	0.033
Independent variable: Real numbers of accepted options			
drinking	0.29	0.179	0.369
smoking	0	0	0.004
Independent variable: Amount invested			
drinking	0.29	0.243	0.575
smoking	0.926	0.914	0.914

Behavioral relevance	**Model p-value**	**Resample p-value**	**Romano-Wolf p-value**
Independent variable: WTTR Index			
Amount invested	0.074	0.03	0.118
Midpoint CRRA in real MPL	0.508	0.373	0.682
Real numbers of accepted options	0.513	0.505	0.682
Independent variable: Lottery2			
Amount invested	0.411	0.268	0.47
Midpoint CRRA in real MPL	0.309	0.201	0.434
Real numbers of accepted options	0.533	0.419	0.47
Independent variable: Lottery20			
Amount invested	0.198	0.066	0.245
Midpoint CRRA in real MPL	0.88	0.852	0.852
Real numbers of accepted options	0.682	0.611	0.852
Independent variable: Midpoint CRRA in hypothetical MPL			
Amount invested	0.001	0	0.004
Midpoint CRRA in real MPL	0	0	0.001
Real numbers of accepted options	0.901	0.903	0.903

Independent variable: Hypothetical numbers of accepted options			
Amount invested	0.029	0.063	0.089
Midpoint CRRA in real MPL	0.001	0.011	0.02
Real numbers of accepted options	0.891	0.865	0.865

Table 3- 1: Summary statistics, 2012

Variable	Mean	Std. Dev.	Min	Max
Ethnicity, (Kinh = Vietnamese = 1)	.64	.48	0	1
Male	.83	.37	0	1
Education				
No school, base category	.06	.25	0	1
Primary school	.19	.39	0	1
Secondary school	.33	.47	0	1
High school	.1	.31	0	1
Short-term vocational school	.21	.4	0	1
Professional school	.08	.27	0	1
University	.03	.18	0	1
Age of household head (years)	48.34	13.34	19	93
Married (=1)	.84	.36	0	1
Numbers of children	1	1.14	0	7
Natural disaster (=1)	.74	.44	0	1
Pest infection, crop disease (=1)	.74	.44	0	1

Table 3- 2: Questions for constructions of Depression index and scores for each answer

During the past week, how often do you feel this?	During the past week			
	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
1. How often do you sleep well?	3	2	1	0
2. How often do you satisfy with life?	3	2	1	0
3. How often do you have trouble keeping your mind on what you are doing?	0	1	2	3
4. How often do you believe in the future?				
5. How often do you try your best and get some results?				
6. How often do you feel lonely?				
7. How often do you feel sad?				
8.How often do you feel unmotivated to do anything?				
9. How often do you feel unfocused and irritated by things that usually do not bother you?				
10. How often do you feel fearful?				

Scoring: The first three rows are score demonstration for both negative (question 3) and positive items (question 1 and 2). Zero for answers in the first column, 1 for answers in the second column, 2 for answers in the third column, 3 for answers in the fourth column. The scoring of positive items, including question 1, 2, 4, and 5, is reversed.

Possible total score range of depression index (questions 1-10): 0 – 30, increasing scores imply depression symptom

Table 3- 3: Household summary statistics for vulnerability measure, 2012

	Mean	Std. Dev.	min	max
Household head characteristics				
Male	0.84	0.37	0	1
Ethnicity, Kinh	0.66	0.47	0	1
Education				
Never go to school (=1), base category	0.06	0.24	0	1
Primary school	0.18	0.39	0	1
Secondary school	0.33	0.47	0	1
High school	0.11	0.31	0	1
Short-term vocational school	0.21	0.4	0	1
Professional school	0.07	0.26	0	1
University	0.03	0.18	0	1
Age of household head (years)	48.35	13.22	19	93
Household characteristics				
Log of per capita income in the past 12 months	9.58	0.85	6.9	12.7
Household size	4.14	1.69	1	14
Dependency ratio	0.2	0.21	0	.8
Household members completed secondary school (%)	0.36	0.29	0	1
Household members completed vocational school (%)	0.22	0.27	0	1
Household members working as wage workers (%)	0.24	0.26	0	1
Household members working in agriculture (%)	0.6	0.31	0	1
Commune characteristics				
Commune with road index	41.03	37.49	0	100
Utilities index	3.82	4.26	0	10
Infrastructure index	88.04	17.93	0	100
Commune with irrigation system (=1)	0.94	0.23	0	1
Crop land area (Ha)	1273.97	1580.67	0	10150

Table 3- 4: Results of Random coefficient model 'within-between' formulation based on Mina and Imai (2017)

	Log of per capita income in the last 12 months	Standard errors
Fixed part		
Time		
Numbers of years from the baseline=2	-1.857*	(1.047)
Numbers of years from the baseline=4	-3.642*	(2.071)
Numbers of years from the baseline=6	-5.479*	(3.124)
Household head profile		
Male	0.224**	(0.102)
Ethnicity, (Kinh = Vietnamese = 1)	0.178***	(0.036)
Education (base category = no school)		
Primary school	0.271	(0.321)
Secondary school	0.594*	(0.315)
High school	0.447	(0.374)
Short-term vocational school	0.573	(0.349)
Professional school	1.359***	(0.434)
University	1.691***	(0.594)
Age (demean)	0.936*	(0.507)
Age squared, demean	-0.034	(0.028)
Age (between)	-0.035	(0.056)
Age squared, between	0.000	(0.001)
Household characteristics		
Household size, demean	-0.154**	(0.068)
Household size squared, demean	0.003	(0.007)
Household size, between	-0.136	(0.090)
Household size squared, between	0.012	(0.009)
Dependency ratio, demean	0.190	(0.288)
Dependency ratio, between	-0.262	(0.336)
Proportion of household members finished secondary school, demean	0.090	(0.058)
Proportion of household members finished vocational school, demean	0.163**	(0.075)
Proportion of household members as wage workers, demean	0.323***	(0.066)
Proportion of household members work in agriculture, demean	0.099	(0.083)
Proportion of household members finished secondary school, between	0.657***	(0.134)
Proportion of household members finished vocational school, between	1.405***	(0.169)
Proportion of household members as wage workers, between	0.164	(0.138)
Proportion of household members work in agriculture, demean	-0.136	(0.152)
Commune characteristics		
Roads index, demean	0.001	(0.001)
Utilities index, demean	0.001	(0.001)
Infrastructure index, demean	0.006***	(0.002)
Having irrigation system, demean	0.036	(0.108)
Crop land (ha), demean	0.000	(0.000)
Roads index, between	0.003	(0.002)
Utilities index, between	0.001	(0.004)
Infrastructure index, between	0.010**	(0.005)
Having irritation system, between	0.408	(0.314)
Crop land (ha), between	-0.000	(0.000)

Covariate shocks		
Natural disaster at commune level	-0.118*	(0.071)
Pest infection, crop disease or avian flu at commune level	-0.070	(0.059)
Idiosyncratic shocks		
Natural disaster at household level	-0.048***	(0.016)
Pest infection, crop disease or avian flu at household level	-0.002	(0.017)
Serious illness of household member	-0.044	(0.029)
Province dummies	***Yes***	
Interaction terms		
Province dummies x Shocks	Yes	
Time x Shocks	Yes	
Time x Province dummies	yes	
Time x Commune characteristics	yes	
Time x Household characteristics	yes	
Province dummies x Commune characteristics	yes	
Province dummies x Household characteristics	yes	
Commune characteristic x Household characteristics	yes	
Selected interaction terms		
Household size x Dependency ratio, between	-0.157***	(0.050)
Household size x Dependency ratio, demean	0.029	(0.052)
Household size x Proportion of household members working in agriculture, between	-0.127***	(0.025)
Household size x Proportion of household members working in agriculture, demean	-0.053***	(0.016)
Lao Cai # Natural disaster=1	-0.073	(0.095)
Dien Bien # Natural disaster=1	-0.083	(0.085)
Quang Nam # Natural disaster=1	-0.060	(0.104)
Dak Lak # Natural disaster=1	-0.040	(0.079)
Lai Chau # Pest infection, crop disease or avian flu=1	0.130*	(0.076)
Nghe An # Pest infection, crop disease or avian flu=1	-0.020	(0.073)
Dak Lak # Pest infection, crop disease or avian flu=1	-0.045	(0.062)
Lam Dong # Pest infection, crop disease or avian flu=1	-0.085	(0.106)
Random part		
Commune level		
Var (Random slope)	0.001	
Var (Random intercept)		
Cov (Random slope, Random intercept)		
Household level		
Var (Random slope)		
Var (Random intercept)		
Cov (Random slope, Random intercept)		
Var (Residual)		
Observations	**10,992**	

Note: *** p<0.01, ** p<0.05, * p<0.1. Standard errors are in parentheses. Estimation results are based on real household income per capita.

Table 3- 5: Vulnerability and poverty status of panel households, by degree and by source (%)

Vulnerability status	Chronic poor	Transitory poor	Never poor	All
Total vulnerability				
Highly vulnerable	20.69	1.24	0	1.0
Relatively vulnerable	77.6	49.1	2.46	19.0
Not vulnerable	1.72	49.7	97.54	80.2
Covariate vulnerability				
Highly vulnerable	81.7	18.3	0.1	7.8
Relatively vulnerable	8.8	7.72	0.2	2.7
Not vulnerable	9.52	74.02	99.7	89.49
Idiosyncratic vulnerability				
Highly vulnerable	26.53	1.9	0	1.3
Relatively vulnerable	71.8	45.3	1.8	17.2
Not vulnerable	1.70	52.8	98.2	81.6

Source: Authors estimates using the 2012-2014-2016-2018 VARHS panel data. Only sample households in the estimation sample were included.

Table 3- 6: Vulnerability status by regions (%)

Vulnerability status	All	East Northern Mountain	Red River Delta	Central Coast	Central Highlands	Mekong River Delta
Total vulnerability	20.45	67.6	6.41	13.32	12.08	0.60
Covariate vulnerability	18.63	71.01	5.4	11.6	11.6	0.4
Idiosyncratic vulnerability	9.6	80.28	3.58	8.13	7.80	0.22

Table 3- 7: Determinants of vulnerability, 2012-2018

	Vulnerability to poverty
Male	-0.00766
	(0.00828)
Ethnicity, Kinh	-0.0834***
	(0.0113)
Education (base category = no school)	
Primary school	-0.148***
	(0.0172)
Secondary school	-0.202***
	(0.0176)
High school	-0.187***
	(0.0195)
Short-term vocational school	-0.225***
	(0.0184)
Professional school	-0.241***
	(0.0203)
University	-0.222***
	(0.0200)
Age of household head (years)	-0.0131***
	(0.00181)
Square of age	0.000114***
	(1.59e-05)
Household size	0.000975
	(0.00710)
Square of household size	0.00565***
	(0.000811)
Dependency ratio	0.173***
	(0.0252)
Proportion of household members finished secondary school	-0.0898***
	(0.0146)
Proportion of household members finished vocational school	-0.185***
	(0.0161)
Proportion of household members as wage workers	-0.130***
	(0.00943)
Proportion of household members work in agriculture	0.0562***
	(0.00875)
Commune with road index	-0.000497***
	(0.000106)
Utilities index	-0.000239***
	(7.58e-05)
Infrastructure index	-0.000728***
	(0.000217)
Irrigation (=1)	0.0225
	(0.0159)

Crop land area (Ha)	-3.35e-06**
	(1.69e-06)
Natural disasters at commune level	0.0168**
	(0.00683)
Pest infection, crop disease or avian flu at commune level	0.00163
	(0.00613)
Natural disasters at household level	0.0460***
	(0.00923)
Pest infection, crop disease or avian flu at household level	0.0554***
	(0.00993)
Serious illness of household members (=1)	0.0231***
	(0.00853)
Region (base category = Red River Delta)	
East Northern Mountain	0.156***
	(0.0134)
Central Coast	0.0453***
	(0.00848)
Central Highlands	-0.0680***
	(0.00919)
Mekong River Delta	-0.0499***
	(0.00852)
Constant	0.784***
	(0.0598)
Observations	11,152
R-squared	0.426

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 3- 8: Fixed effect ordered logit model of life satisfaction by whole sample and sub-samples

Explanatory variables	Dependent variable = Life satisfaction							
	Whole sample				Never poor		Transition poor	
Vulnerable to poverty	-2.245***	-0.673*	-0.207	-1.461***	-1.778***	-3.540***	-0.206	-1.113***
	(0.406)	(0.364)	(0.363)	(0.385)	(0.564)	(0.589)	(0.479)	(0.429)
Log of per capita income in the last 12 months		0.557***	0.491***		0.585***		0.346***	
		(0.0599)	(0.0589)		(0.0641)		(0.0859)	
Age 19-30			-1.094***	-1.268***	-0.393	-0.750**	-1.755***	-1.747***
			(0.241)	(0.240)	(0.305)	(0.304)	(0.499)	(0.499)
Age 31-40			-0.753***	-0.893***	-0.398**	-0.646***	-1.074***	-1.111***
			(0.127)	(0.127)	(0.190)	(0.188)	(0.188)	(0.186)
Age 51-60			0.618***	0.760***	0.447***	0.656***	0.704***	0.745***
			(0.105)	(0.0981)	(0.126)	(0.112)	(0.247)	(0.239)
Age 61-80			1.130***	1.377***	0.920***	1.232***	1.151***	1.281***
			(0.157)	(0.149)	(0.172)	(0.164)	(0.406)	(0.383)
Age 80+			1.839***	2.222***	1.833***	2.270***	1.492***	1.748***
			(0.430)	(0.415)	(0.594)	(0.586)	(0.504)	(0.460)
Married (=1)			-0.485	-0.368	-0.234	-0.120	-1.297	-1.163
			(0.442)	(0.440)	(0.470)	(0.465)	(0.936)	(0.966)
Widow/Divorce/Separate (=1)			-0.422	-0.315	-0.231	-0.161	-1.262	-1.060
			(0.459)	(0.458)	(0.524)	(0.522)	(1.243)	(1.268)
Member of Communist party (=1)			0.281	0.270	0.211	0.209	0.562	0.506
			(0.212)	(0.206)	(0.261)	(0.260)	(0.397)	(0.363)
Not employed			0.0786	0.0668	0.0899	0.0849	0.0213	-0.00668
			(0.164)	(0.173)	(0.182)	(0.182)	(0.253)	(0.270)
Observations	7,949	7,949	7,949	7,949	5,133	5,133	2,593	2,593

Note: *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors clustered at commune level are in parentheses.

Table 3- 9: Fixed effect model of the CES-D score by whole sample and sub-samples

Explanatory variables	Dependent variable = CES-D scores							
	Whole sample				Never poor		Transition poor	
Vulnerable to poverty	5.477***	3.938***	**3.190****	4.531***	7.823***	9.574***	3.977**	4.365***
	(1.422)	(1.417)	(1.326)	(1.320)	(2.306)	(2.371)	(1.484)	(1.383)
Log of per capita income in the last 12 months		-0.668***	-0.610***		-0.842***		-0.161	
		(0.192)	(0.183)		(0.232)		(0.243)	
Age 19-30			2.846**	2.968**	2.866*	3.256**	2.166	2.127
			(1.095)	(1.120)	(1.508)	(1.531)	(1.844)	(1.829)
Age 31-40			1.626***	1.752***	2.260***	2.513***	0.550	0.562
			(0.544)	(0.548)	(0.717)	(0.715)	(0.803)	(0.802)
Age 51-60			-1.401***	-1.508***	-1.095***	-1.245***	-2.111*	-2.138*
			(0.327)	(0.329)	(0.382)	(0.389)	(1.043)	(1.070)
Age 61-80			-2.856***	-3.019***	-2.369***	-2.674***	-3.833***	-3.833***
			(0.533)	(0.533)	(0.616)	(0.613)	(1.246)	(1.258)
Age 80+			0.161	-0.0786	-0.952	-1.407	2.104	2.096
			(1.139)	(1.141)	(2.168)	(2.282)	(3.464)	(3.486)
Married (=1)			2.447**	2.735**	3.248**	3.641**		
			(0.958)	(1.150)	(1.286)	(1.449)		
Widow/Divorce/Separate (=1)			1.809***	2.004***	1.739***	2.007***	1.371	1.331
			(0.277)	(0.714)	(0.128)	(0.711)	(1.162)	(1.158)
Member of Communist party (=1)			-0.812	-0.787	-1.672***	-1.663***	1.610	1.644
			(0.504)	(0.514)	(0.561)	(0.575)	(1.009)	(1.024)
Not employed			1.508***	1.537***	0.953*	0.965*	3.247***	3.274***
			(0.385)	(0.400)	(0.485)	(0.500)	(0.997)	(1.011)
Constant	6.355***	13.31***	11.16***	4.589***	13.03***	3.858***	8.541***	6.920***
	(0.184)	(1.984)	(2.346)	(1.124)	(3.200)	(1.359)	(2.564)	(0.586)
Observations	4,624	4,624	4,624	4,624	3,050	3,050	1,452	1,452
R-squared	0.013	0.021	0.043	0.036	0.050	0.038	0.075	0.074
Number of households	2,339	2,339	2,339	2,339	1,543	1,543	734	734

Note: *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors clustered at commune level are in parentheses. The number of observations is lower than that in the vulnerability estimates and life satisfaction tables because questions to construct depression index are only added since 2016. We keep data from 2012 in the vulnerability estimates to ensure we model the income process as precisely as possible.

Table 3- 10: Fixed effect model of life satisfaction and vulnerability to poverty under idiosyncratic shocks

Explanatory variables	Dependent variable = Life satisfaction							
	Whole sample				Never poor		Transition poor	
Vulnerable to poverty under idiosyncratic shocks	-2.017***	-0.449	-0.0532	-1.285***	-1.267**	-3.106***	-0.154	-1.071***
	(0.354)	(0.315)	(0.325)	(0.343)	(0.634)	(0.656)	(0.406)	(0.383)
Log of per capita income in the last 12 months		0.588***	0.513***		0.615***		0.368***	
		(0.0571)	(0.0569)		(0.0622)		(0.0793)	
Age 19-30			-1.105***	-1.313***	-0.448	-0.873***	-1.757***	-1.752***
			(0.254)	(0.254)	(0.309)	(0.306)	(0.524)	(0.528)
Age 31-40			-0.747***	-0.908***	-0.416**	-0.703***	-1.061***	-1.106***
			(0.131)	(0.131)	(0.192)	(0.189)	(0.207)	(0.206)
Age 51-60			0.640***	0.807***	0.487***	0.735***	0.726***	0.778***
			(0.103)	(0.0933)	(0.124)	(0.107)	(0.245)	(0.235)
Age 61-80			1.172***	1.463***	0.989***	1.365***	1.221***	1.376***
			(0.154)	(0.143)	(0.168)	(0.158)	(0.396)	(0.369)
Age 80+			1.846***	2.297***	1.854***	2.393***	1.553***	1.847***
			(0.437)	(0.417)	(0.605)	(0.592)	(0.499)	(0.451)
Married (=1)			-0.483	-0.348	-0.233	-0.105	-1.290	-1.123
			(0.440)	(0.434)	(0.470)	(0.464)	(0.937)	(0.976)
Widow/Divorce/Separate (=1)			-0.421	-0.284	-0.221	-0.135	-1.227	-0.969
			(0.457)	(0.454)	(0.519)	(0.514)	(1.266)	(1.298)
Member of Communist party (=1)			0.269	0.266	0.196	0.205	0.565	0.508
			(0.208)	(0.203)	(0.254)	(0.255)	(0.401)	(0.362)
Not employed			0.0699	0.0566	0.0733	0.0681	0.0377	0.00442
			(0.163)	(0.170)	(0.177)	(0.174)	(0.253)	(0.269)
Observations	8,034	8,034	8,034	8,034	5,187	5,187	2,621	2,621

Note: *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors clustered at commune level are in parentheses.

Table 3- 11: Fixed effect model of CES-D score and vulnerability to poverty under idiosyncratic shocks

Explanatory variables	Whole sample				Never poor		Transition poor	
Vulnerable to poverty, idiosyncratic shocks	4.604***	3.022*	2.324	3.693**	8.015***	9.966***	3.210**	3.758**
	(1.535)	(1.521)	(1.427)	(1.438)	(2.441)	(2.480)	(1.559)	(1.498)
Log of per capita income in the last 12 months		-0.714***	-0.649***		-0.858***		-0.237	
		(0.186)	(0.177)		(0.237)		(0.219)	
Age 19-30			3.243***	3.393***	3.590**	4.005**	2.297	2.244
			(1.099)	(1.125)	(1.550)	(1.565)	(1.819)	(1.813)
Age 31-40			1.654***	1.798***	2.339***	2.616***	0.565	0.582
			(0.554)	(0.566)	(0.720)	(0.721)	(0.823)	(0.826)
Age 51-60			-1.391***	-1.523***	-1.064***	-1.236***	-2.190**	-2.236**
			(0.335)	(0.337)	(0.383)	(0.390)	(1.035)	(1.072)
Age 61-80			-2.758***	-2.959***	-2.356***	-2.691***	-3.568***	-3.583***
			(0.520)	(0.522)	(0.591)	(0.595)	(1.247)	(1.263)
Age 80+			0.257	-0.0294	-0.973	-1.470	2.405	2.377
			(1.182)	(1.183)	(2.154)	(2.272)	(3.503)	(3.538)
Married (=1)			4.116**	4.511**	4.863**	5.401**	-1.699	-1.664
			(1.650)	(1.796)	(2.000)	(2.138)	(1.067)	(1.078)
Widow/Divorce/Separate (=1)			3.706**	4.003**	3.616**	4.008**		
			(1.565)	(1.719)	(1.534)	(1.718)		
Member of Communist party (=1)			-0.752	-0.721	-1.570***	-1.557***	1.582	1.631
			(0.500)	(0.510)	(0.553)	(0.566)	(1.014)	(1.032)
Not employed			1.485***	1.514***	0.959**	0.971**	3.173***	3.210***
			(0.365)	(0.381)	(0.452)	(0.466)	(0.984)	(1.000)
Constant	6.485***	13.91***	9.947***	2.896*	11.59***	2.121	11.05***	8.643***
	(0.185)	(1.929)	(2.269)	(1.662)	(3.343)	(2.067)	(2.778)	(1.124)
Observations	4,668	4,668	4,668	4,668	3,078	3,078	1,466	1,466
R-squared	0.009	0.019	0.041	0.033	0.049	0.035	0.070	0.068
Number of hhid2012	2,339	2,339	2,339	2,339	1,543	1,543	734	734

Note: *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors clustered at commune level are in parentheses. The number of observations is lower than that in the vulnerability estimates and life satisfaction tables because questions to construct depression index are only added since 2016.

Table 3- 12: Fixed effect model of life satisfaction and vulnerability to poverty under covariate shocks

Explanatory variables	Dependent variable = Life satisfaction							
	Whole sample				Never poor		Transition poor	
Vulnerable to poverty under covariate shocks	-0.469***	0.102	0.222	-0.203	-0.193	-0.397	0.139	-0.210
	(0.144)	(0.142)	(0.139)	(0.139)	(0.673)	(0.662)	(0.146)	(0.147)
Log of per capita income in the last 12 months		0.625***	0.530***		0.639***		0.401***	
		(0.0597)	(0.0591)		(0.0617)		(0.0826)	
Age 19-30			-1.134***	-1.484***	-0.463	-1.056***	-1.928***	-2.050***
			(0.238)	(0.230)	(0.304)	(0.298)	(0.479)	(0.463)
Age 31-40			-0.744***	-0.982***	-0.405**	-0.766***	-1.128***	-1.253***
			(0.130)	(0.126)	(0.178)	(0.174)	(0.216)	(0.208)
Age 51-60			0.632***	0.858***	0.514***	0.819***	0.691***	0.825***
			(0.101)	(0.0909)	(0.129)	(0.110)	(0.216)	(0.209)
Age 61-80			1.225***	1.604***	1.048***	1.522***	1.378***	1.652***
			(0.181)	(0.174)	(0.180)	(0.173)	(0.424)	(0.396)
Age 80+			1.939***	2.510***	1.924***	2.616***	1.736***	2.177***
			(0.448)	(0.422)	(0.603)	(0.595)	(0.513)	(0.453)
Married (=1)			-0.494	-0.349	-0.235	-0.113	-1.309	-1.097
			(0.470)	(0.462)	(0.494)	(0.489)	(0.918)	(0.926)
Widow/Divorce/Separate (=1)			-0.429	-0.241	-0.255	-0.157	-1.121	-0.715
			(0.493)	(0.486)	(0.546)	(0.543)	(1.239)	(1.200)
Member of Communist party (=1)			0.287	0.282	0.212	0.228	0.624	0.551
			(0.214)	(0.205)	(0.264)	(0.258)	(0.425)	(0.382)
Not employed			0.0494	0.0389	0.0961	0.0929	-0.0556	-0.0901
			(0.171)	(0.179)	(0.182)	(0.179)	(0.252)	(0.273)
Observations	7,605	7,605	7,605	7,605	4,949	4,949	2,456	2,456

Note: *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors clustered at commune level are in parentheses.

Table 3- 13: Fixed effect model of CES-D score and vulnerability to poverty under covariate shocks

Explanatory variables	Dependent variable = CES-D scores							
	Whole sample				Never poor		Transition poor	
Vulnerable to poverty under covariate shocks	1.474*	0.844	0.585	1.111	15.98**	16.98**	0.766	1.183
	(0.838)	(0.859)	(0.889)	(0.864)	(6.674)	(6.592)	(1.061)	(1.058)
Log of per capita income in the last 12 months		-0.887***	-0.789***		-0.910***		-0.569**	
		(0.206)	(0.197)		(0.255)		(0.220)	
Age 19-30			3.264**	3.554***	4.070**	4.625***	1.277	1.270
			(1.257)	(1.307)	(1.652)	(1.690)	(2.718)	(2.749)
Age 31-40			1.919***	2.179***	2.611***	2.959***	0.909	1.061
			(0.595)	(0.623)	(0.792)	(0.810)	(0.867)	(0.864)
Age 51-60			-1.377***	-1.572***	-1.078**	-1.277***	-2.414**	-2.610**
			(0.376)	(0.380)	(0.428)	(0.435)	(1.093)	(1.196)
Age 61-80			-2.858***	-3.177***	-2.573***	-2.962***	-3.947***	-4.149***
			(0.530)	(0.543)	(0.654)	(0.659)	(1.333)	(1.389)
Age 80+			0.0781	-0.348	-1.523	-2.101	2.142	1.920
			(1.242)	(1.235)	(2.321)	(2.438)	(3.686)	(3.782)
Married (=1)			8.194***	8.984***	8.849***	9.668***	-1.471	-1.121
			(0.793)	(0.721)	(1.120)	(0.999)	(1.012)	(0.963)
Widow/Divorce/Separate (=1)			7.424***	8	7.336***	8***		
			(0.144)		(0.187)	(4.77e-07)		
Member of Communist party (=1)			-0.802	-0.746	-1.761***	-1.723**	2.297**	2.393**
			(0.542)	(0.551)	(0.615)	(0.639)	(1.039)	(1.108)
Not employed			1.463***	1.512***	1.012**	1.048**	2.925***	3.016***
			(0.380)	(0.401)	(0.481)	(0.493)	(1.034)	(1.059)
Constant	6.980***	16.02***	7.674***	-1.023	8.491**	-1.737*	14.94***	9.231***
	(0.0571)	(2.093)	(2.392)	(0.751)	(3.322)	(0.996)	(2.540)	(0.939)
Observations	4,210	4,210	4,210	4,210	2,798	2,798	1,306	1,306
R-squared	0.002	0.019	0.042	0.029	0.049	0.034	0.067	0.059
Number of hhid2012	2,105	2,105	2,105	2,105	1,399	1,399	653	653

Note: *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors clustered at commune level are in parentheses. The number of observations is lower than that in the vulnerability estimates and life satisfaction tables because questions to construct depression index are only added since 2016.

Table 3- 14: Marginal effects at the average of vulnerability to poverty on life satisfaction

Life satisfaction	Vulnerability		Vulnerability, idiosyncratic shocks		Vulnerability, covariate shocks	
	Margin	**Std.Err.**	**Margin**	**Std.Err.**	**Margin**	**Std.Err.**
Disappointed	0.009	0.02	0.002	0.015	- 0.01	0.006
Not satisfied	0.041	0.072	0.011	0.064	- 0.044	0.027
Satisfied	-0.040	0.070	-0.010	0.063	0.043	0.027
Very satisfied	-0.010	0.018	-0.003	0.016	0.011	0.007

Robustness check of chapter 3: Vulnerability to poverty and happiness

Table 3- 15: Happiness and vulnerability using different poverty lines, fixed effect model

	CES-D score			Life satisfaction		
	All	**Never-poor**	**Transition poor**	**All**	**Never poor**	**Transition poor**
	Poverty line = official poverty line					
Vulnerable to poverty	3.190**	7.823***	3.977**	-0.236	-1.667***	-0.272
	(1.326)	(2.306)	(1.484)	(0.364)	(0.615)	(0.487)
Log of per capita income in the last 12 months	-0.610***	-0.842***	-0.161	0.494***	0.590***	0.347***
	(0.183)	(0.232)	(0.243)	(0.0608)	(0.0648)	(0.0931)
	Poverty line = official poverty line * 1.2					
Vulnerability to poverty	3.211*	9.340***	4.674**	-0.386	-2.100**	-0.575
	(1.709)	(3.222)	(1.855)	(0.430)	(0.819)	(0.552)
Log of per capita income in the last 12 months	-0.636***	-0.864***	-0.167	0.599***	0.323***	0.489***
	(0.184)	(0.233)	(0.237)	(0.0650)	(0.0905)	(0.0607)
	Poverty line = official poverty line * 1.5					
Vulnerability to poverty	3.554***	5.934***	3.285**	-0.225	-1.195***	0.186
Log of per capita income in the last 12 months	(0.968)	(1.400)	(1.224)	(0.330)	(0.353)	(0.554)
	-0.546***	-0.768***	-0.180	0.489***	0.563***	0.399***
	(0.177)	(0.226)	(0.256)	(0.0600)	(0.0651)	(0.0981)
	Poverty line = official poverty line * 2					
Vulnerability to poverty	3.488***	5.411***	1.700	-0.382	-1.104***	0.459
	(1.042)	(1.258)	(1.426)	(0.335)	(0.280)	(0.640)
Log of per capita income in the last 12 months	-0.538***	-0.689***	-0.347	0.473***	0.537***	0.424***
	(0.179)	(0.227)	(0.263)	(0.0602)	(0.0666)	(0.0907)
Observations	4,624	3,050	1,452	9,955	6,422	3,268

Robust standard errors clustered at commune level in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Other controls: age, marital status, unemployment, communist member.

FIGURES

Figure 2- 1: Field Survey timeline

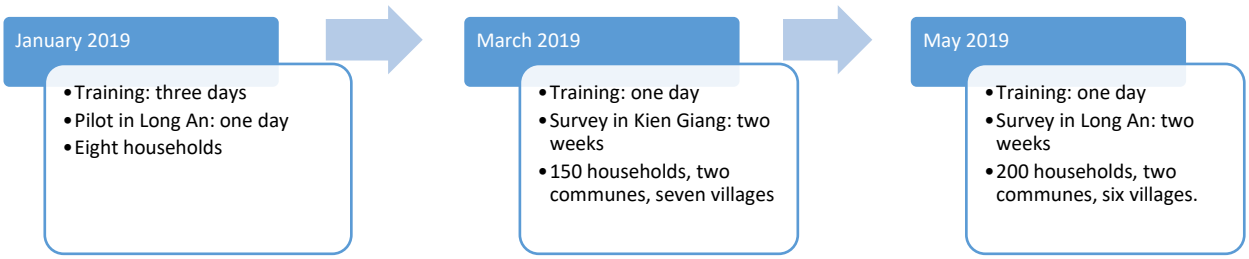


Figure 2- 2: Numbers of subjects give irrational response

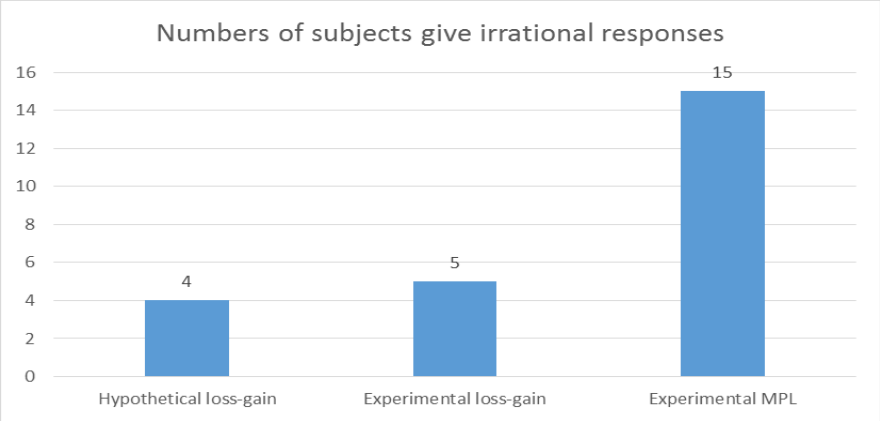


Figure 2- 3: Willing to take risk (WTTR) in general and across different domains

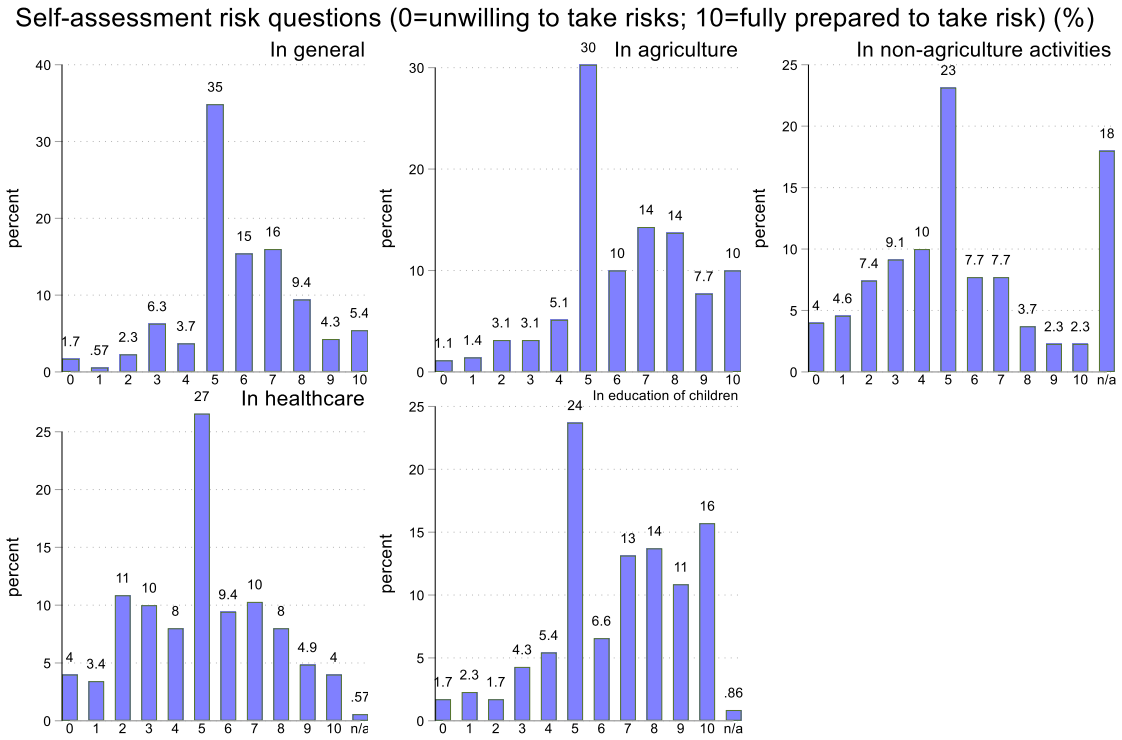
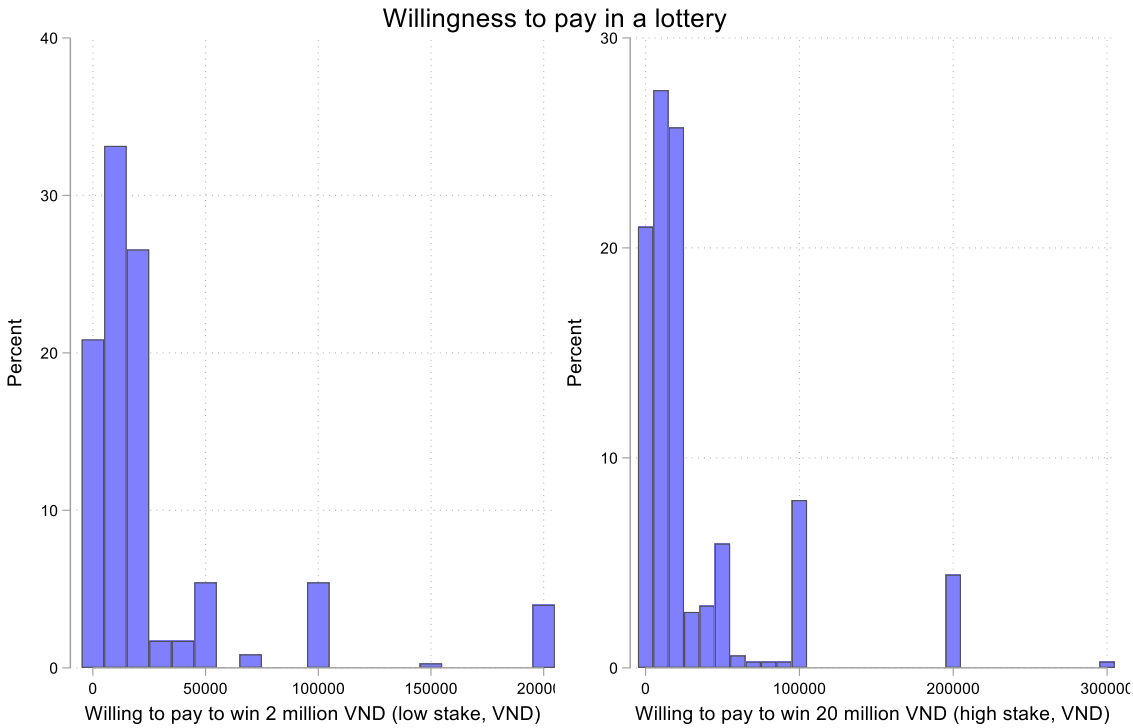


Figure 2- 4: Responses to lottery2 and lottery20 tasks



Note: the graph for WTP to win 20 million VND is truncated for clearer picture.

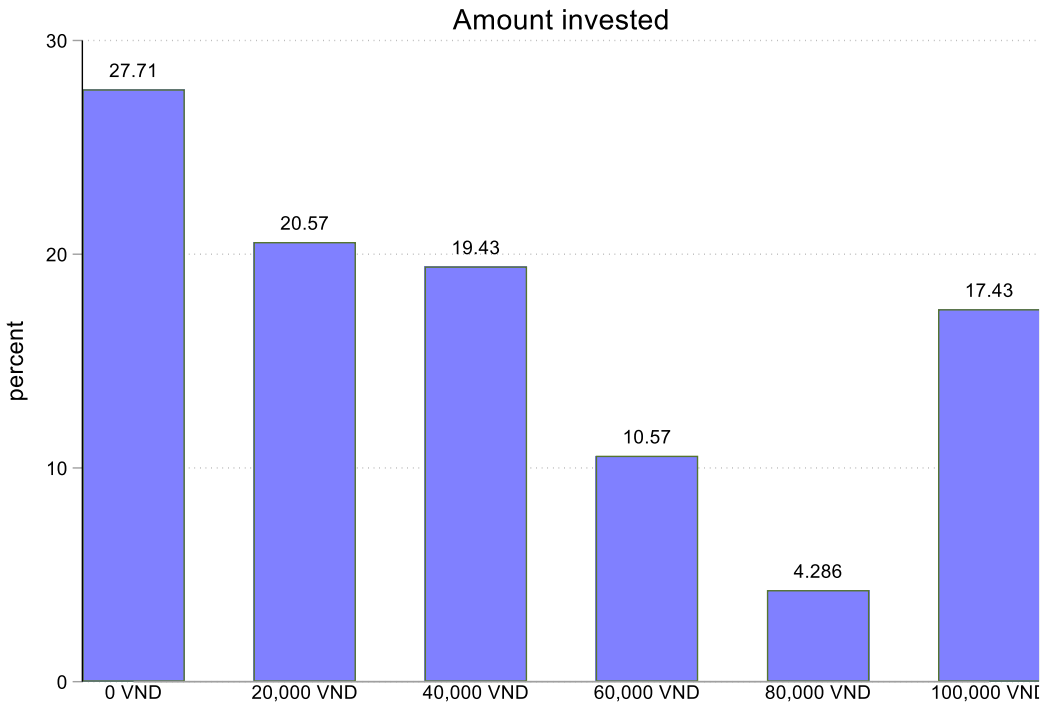


Figure 2- 5: Consistency within subjects between hypothetical and experimental MPL tasks (percent, N=335)

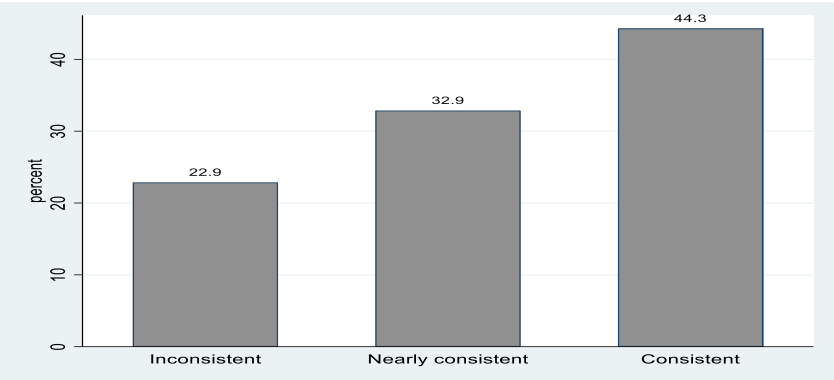
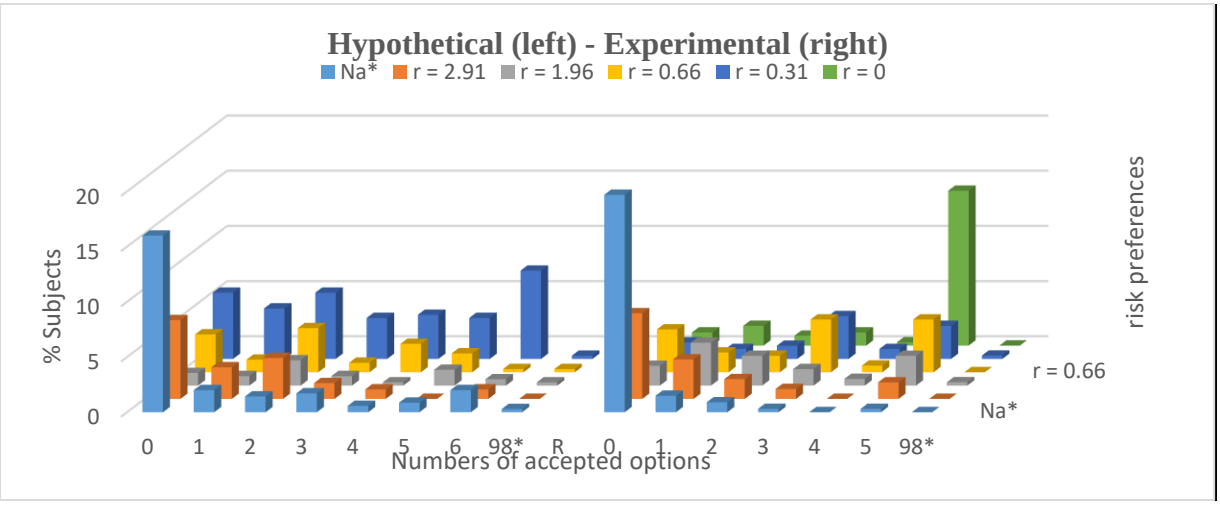


Figure 2- 6: Percentage responses from MPL and loss-gain task



Na=Always choose safe option A in MPL; 98*=irrational answers*

Figure 2- 7: Degree of consistency between risk-aversion and loss-aversion, percentage (N=222)

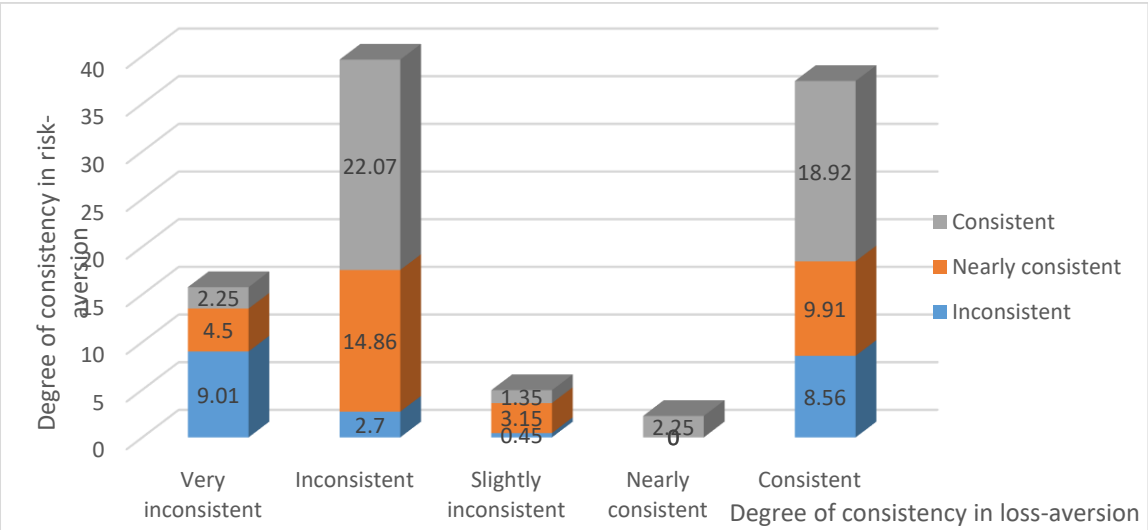


Figure 3- 1: Degree of satisfaction

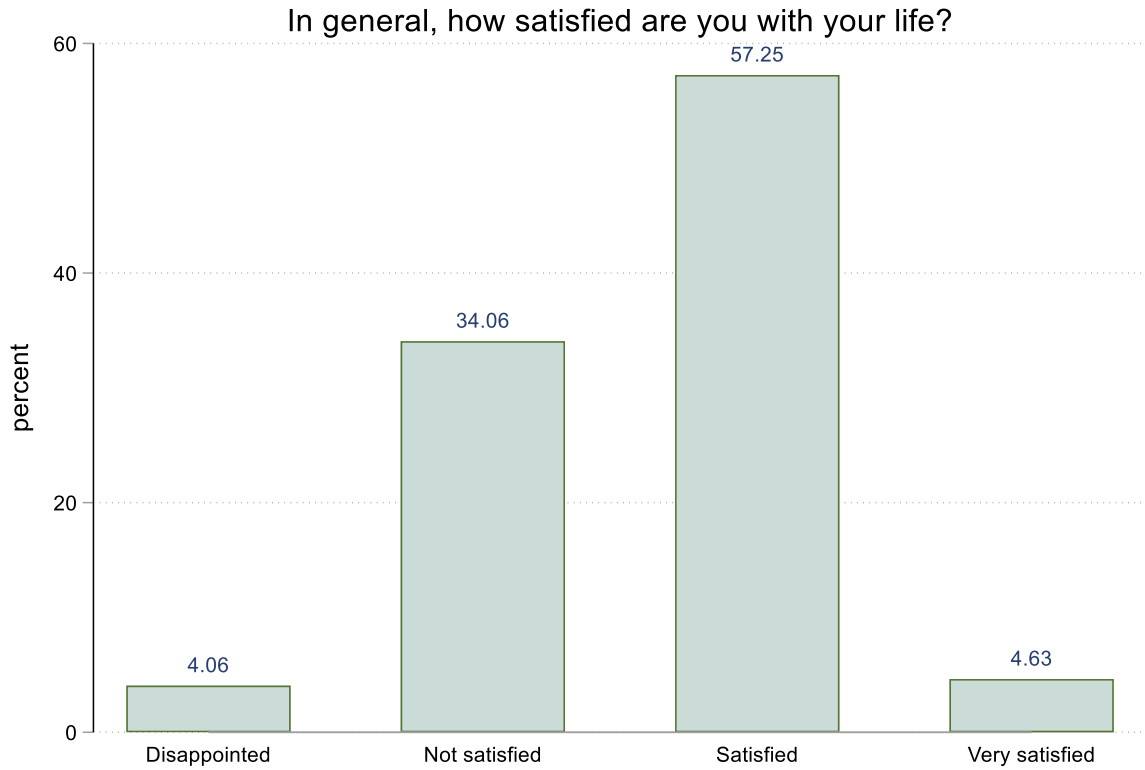


Figure 3- 2: Distribution of the CES-D scores

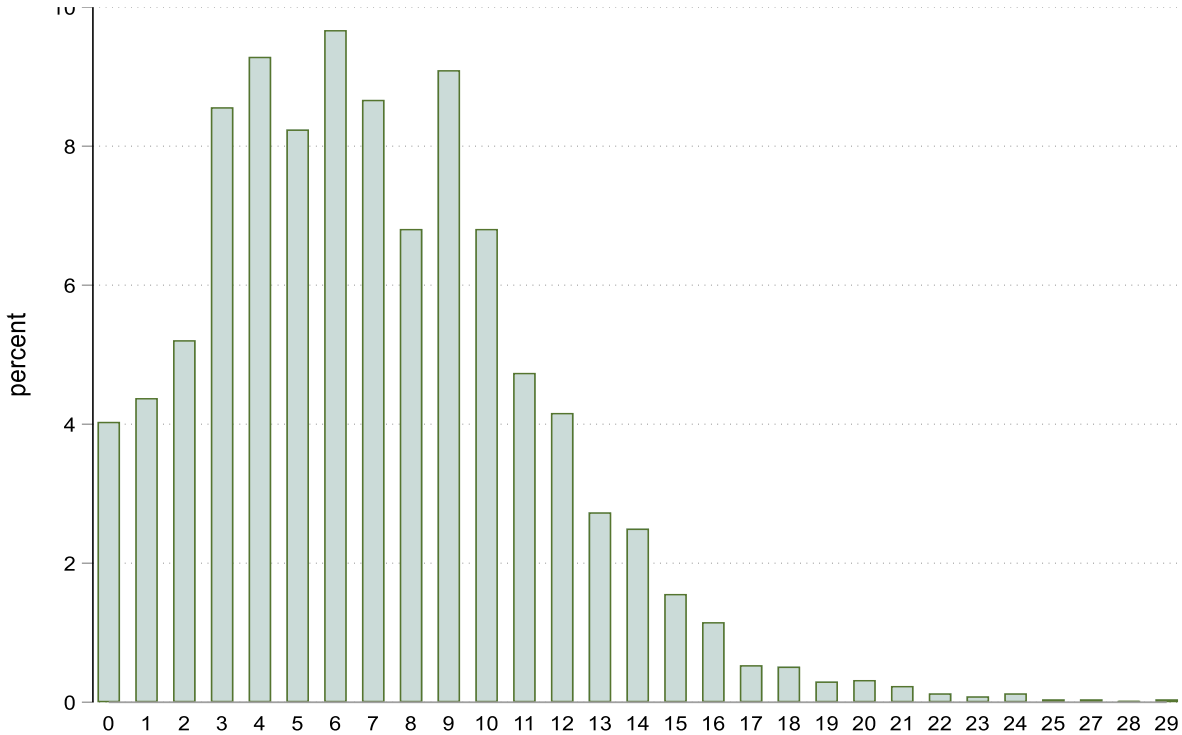
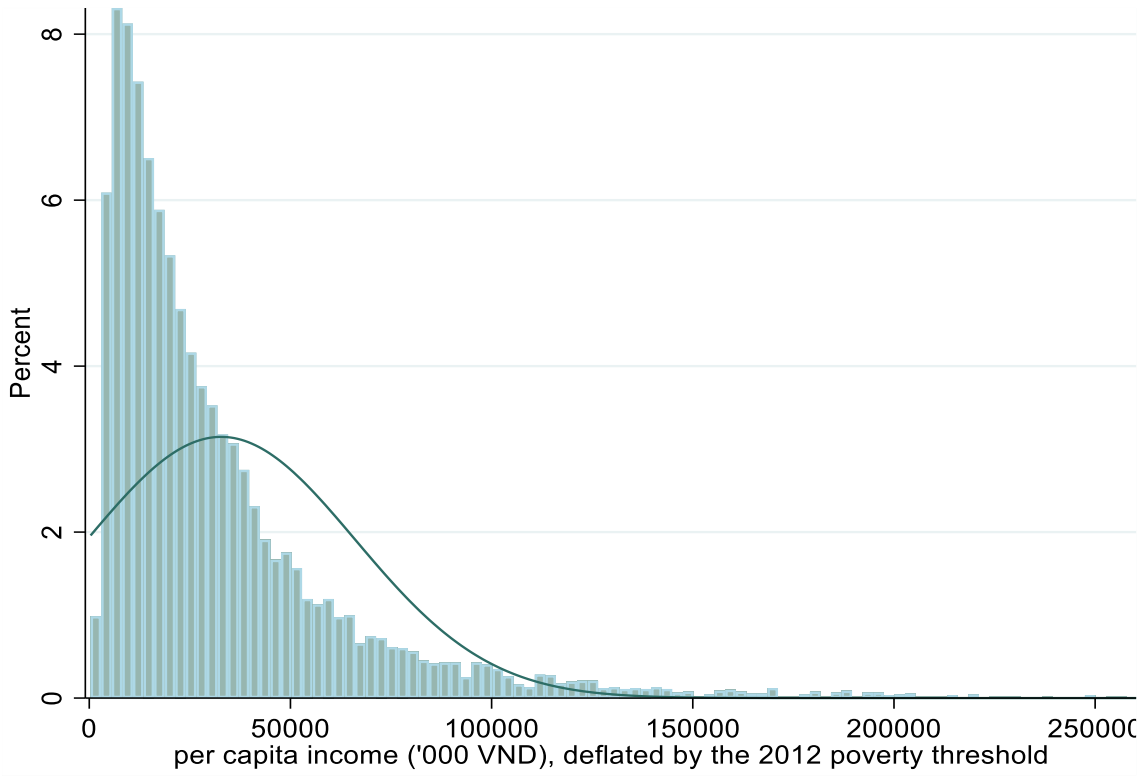


Figure 3- 3: Distribution of per capita income and log of per capita income



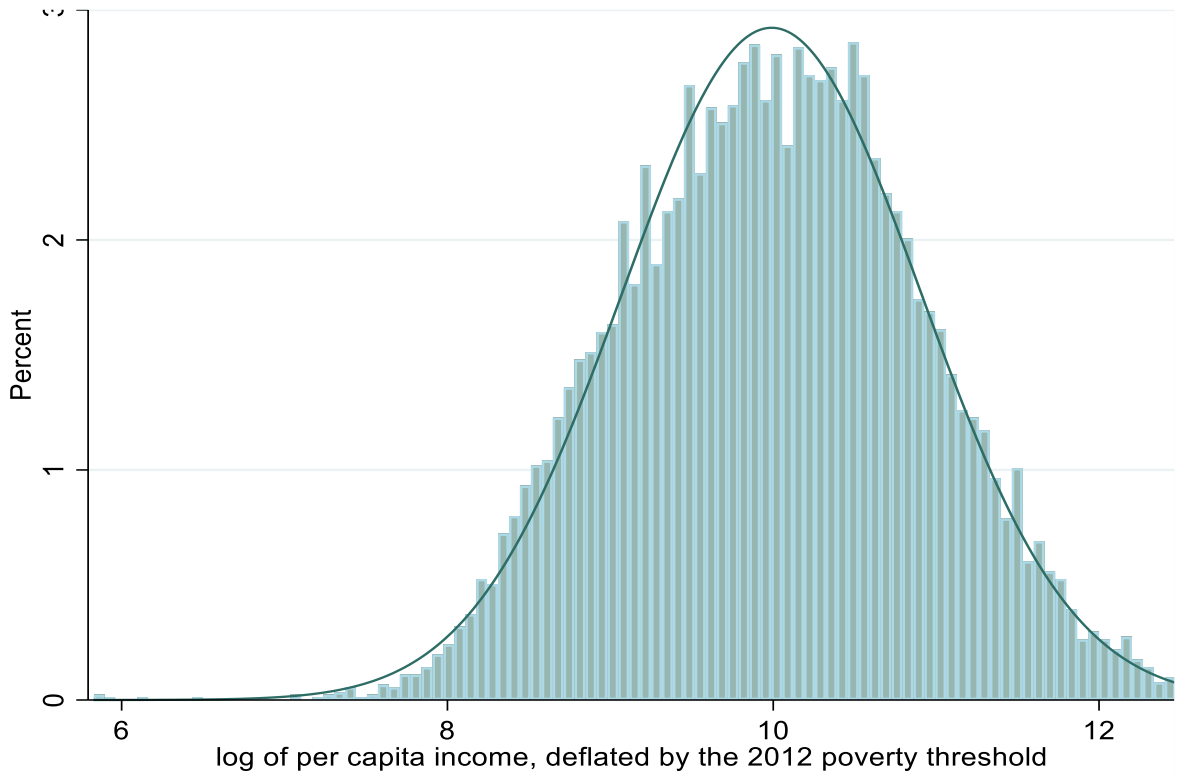


Figure 3- 4: Scatter plot showing correlation between vulnerability to poverty and household income per capita (log) (Correlation coefficient = 0.60)

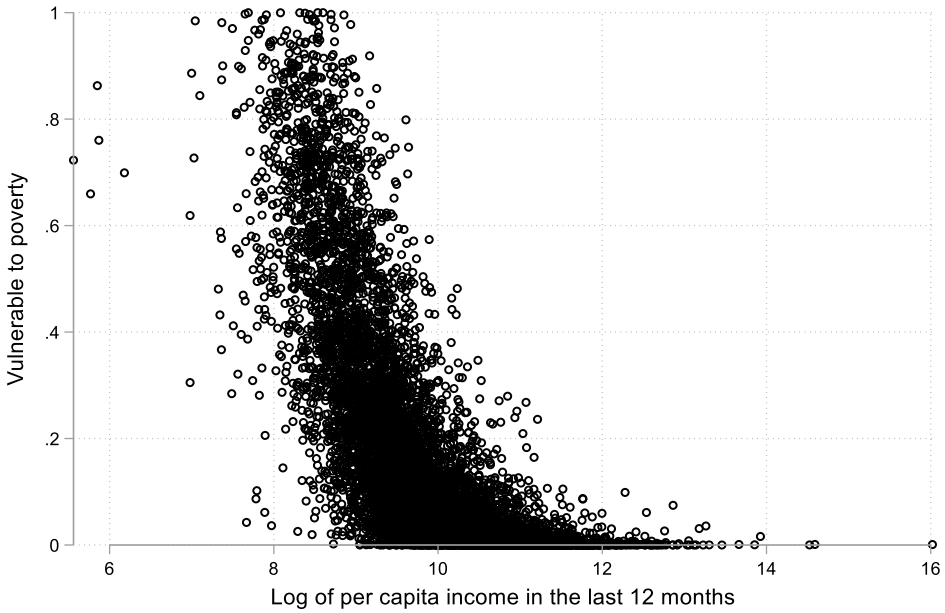


Figure 3- 5: Vulnerability to poverty using different poverty lines