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Vulnerability and household welfare in Vietnam

by

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Declaration of Authorship

I, TAT THANG VO, declare that this thesis titled, 'VULNERABILITY AND HOUSEHOLD WELFARE IN VIETNAM' and the work presented in it are my own. I confirm that:

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- Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated.
- Where I have consulted the published work of others, this is always clearly attributed.
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"Indeed, poverty is frequently seen as the defining characteristic of underdevelopment and its elimination as the main purpose of economic development."

Angus Deaton, Nobel Prize in Economics

"There needs to be a better assessment of what the vulnerabilities are and what constitutes vulnerability."

William Ramsay, Nobel Prize in Chemistry

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Abstract

This thesis contains three studies which provide a complete set of vulnerability assessments in Vietnam.

The first study in the thesis estimates the extent of vulnerability and analyses who the vulnerable are. In addition, this study investigates the link between dynamic poverty and vulnerability, something which has rarely been done. To do this, the most common definition of vulnerability as 'Vulnerability as Expected Poverty' (VEP) is used, along with a data set extracted from three consecutive surveys from 2002 to 2006. The results reveal that, (*i*) vulnerability estimated using the reference line is more appropriate than when estimated using the actual poverty line for poverty prediction in the case of Vietnam; (*ii*) *ex ante* vulnerability in previous periods might translate to *ex post* poverty in the following periods though both vulnerability and the incidence of poverty tend to fall over time; (*iii*) the vulnerability of the poor may trap them in poverty; and (*iv*) the vulnerability of the non-poor could propel them into poverty.

The second study investigates sources of household vulnerability and responses to risks in rural Vietnam using data from Vietnam Access to Resources Household Surveys (VARHS). Vulnerability as low utility measure (VEU) is employed to estimate and distinguish the sources of vulnerability. Next the household's behavior to cope with shocks is analyzed; and finally the effectiveness of the insurance mechanism is evaluated. The main findings are that: (*i*) the utility of the average household is 71 per cent less than the hypothetical situation without any risk or inequality in consumption, and idiosyncratic shocks contribute 50 per cent of the loss; (*ii*) households depend heavily on informal coping strategies such as food consumption reduction, savings withdrawal, taking children out of school, or capital depletion. The opportunity to borrow money from formal institutions is limited, while subsidies from the government or NGOs are available only in cases of natural disaster; and (*iii*) household consumption and income exhibit highly correlated variation, implying that existing informal insurance instruments are less effective than expected.

The third study provides new evidence on the impact of health insurance coverage on household vulnerability using Vietnam Access to Resources Household Surveys (VARHS) undertaken during 2010-2012. The outcomes of interest are the probability of falling into poverty (VEP) and the magnitude of utility loss (VEU). Since the

data set is not from an intervention program, the propensity score- matching method is employed to construct treatment and control groups. Risk aversion is calculated and used as an important explanatory variable for health insurance enrollment. The implications of the study suggest actions for the government to attain its goal of universal health insurance coverage. The estimates show that health insurance coverage helps rural households in Vietnam reduce the idiosyncratic component of utility loss by 81 per cent and has the added benefit of reducing the probability of being poor by about 19 per cent. The reverse effect of the risk aversion on health insurance enrollment implies that not only is there a potential 'rigidity' effect on health insurance demand, but also that there are deficiencies in health insurance market.

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To my wife and son

Chapter 1

General Introduction

1.1 A need for vulnerability analysis

Poverty is globally viewed as 'deprivation in well-being' (Haughton & Khandker 2009) or as one of the profound 'characteristics of underdevelopment' (Deaton 1997). For these reasons both the World Bank and the United Nations have adopted a goal of ending extreme poverty by 2030 (Ferreira et al. 2015). Several national governments, bilateral development agencies and non-governmental organizations are also attempting to alleviate, and eventually to eliminate, extreme poverty. World Bank estimates suggest that in 2012 more than 900 million people, or around 12.7 percent of the total population of the world, were living below the international poverty line (USD1.9 per day). Compared to almost two billion poor people in 1990 (or more than one-third of the world's population at that time), this number reflects a significant decrease in poverty.

However, there are still challenges on the road to 'the end of poverty' (Sachs 2006). There are still many people who escape from poverty but then quickly fall below the poverty line again; and there are many people in chronic poverty who remain below the poverty line over time, and even across generations. Therefore, trends in poverty and every aspect of the lives of the poor are topics of great interest to both researchers and policymakers worldwide[1].

[1]See Lipton & Ravallion (1993) and Kanbur (2008) for a review of poverty literature.

For policy purposes, it is crucial to identify what poverty is and what causes poverty. For the first question, the simplest concept of well-being and poverty is income or consumption. Typically, poverty is measured by comparing individuals' income or consumption with some defined threshold below which they are considered poor. Specific types of consumption goods such as health care, nutrition and education can also be used to measure poverty. Ultimately, the concept of well-being can include abstract aspects of life such as a sense of powerlessness, or the absence of rights such as freedom of speech (Sen 1987) and it is then that poverty becomes a multidimensional phenomenon[2]. Regarding the determinants of poverty, it is widely accepted that poverty is a consequence of some common factors such as low education attainment, limited access to economic resources, living in an isolated area and a high percentage of dependents (Fiess & Verner 2004). As in medicine where diagnosis is often followed by the treatment, these results lead governments and development agencies to adopt pro-poor policies that ensure the participation of the poor in economic growth, and to provide basic social services, especially education, preliminary health care and family planning. These policies must be supplemented by well-targeted transfer, in order to assist those who may not benefit from these policies, and by safety nets, in order to give protection to those exposed to negative shocks (World Bank 1990).

The static poverty estimation focuses on those who were (or are currently) poor and provides only *ex post* information on household welfare. Such an approach allows us to identify whose poverty needs to be alleviated, or to measure the impacts of past pubic interventions on the extent of poverty. However, the results do not predict the trend of poverty, and therefore do not reveal whether a poor household will escape from poverty or will remain poor in the near future. The measure of who are currently poor is not sufficient for effective forward-looking anti-poverty interventions due to the fact that households move out of or into poverty from one year to the next. From the policy perspective, governments and policy makers are more interested in the impact of their policies in the future. For this reason, it would be valuable to be able to identify those who are expected to be poor *ex ante* (that is, in the future). Such households are considered as vulnerable to poverty.

The concept of vulnerability is interpreted in various ways in different contexts. In economics, the concept of vulnerability emerges from the concept of poverty. For

[2]See Kakwani & Silber (2008) for a progress in multidimensional poverty.

example, from the traditional view of poverty reflected in World Development Report 1990, the notion of poverty consists of material deprivation and low attainment in education and health (World Bank 1990). Later, the term 'vulnerability' is mentioned when examining the relationship between poverty and uncertainty of income (Morduch 1994). Since then, the term 'vulnerability' is often used to extend the traditional concept of poverty. While poverty measurement is based on fixed standards such as income or expenditure during a short period of time, vulnerability broadens the poverty notion by including the potential risk of adverse shocks such as income loss, bad health (idiosyncratic risks) and natural disasters (covariate risks). For example, in the work of Glewwe & Hall (1998) and Cunningham & Maloney (2000), vulnerability is defined as exposure to negative shocks that impact on welfare. It is also defined as "the probability or risk today of being in poverty or to fall into deeper poverty in the future" (World Bank 2001) or "the ex-ante risk that a household will, if currently non-poor, fall below the poverty line, or if currently poor, will remain in poverty" (Chaudhuri 2003).

There are four major reasons why an analysis of vulnerability to poverty is necessary and desirable (Chaudhuri 2003). First, vulnerability assessment supports forward-looking anti-poverty interventions. Along with the static approach to well-being, vulnerability assessment reveals some potential paths to improve well-being in the future. Second, a focus on vulnerability to poverty operates as an *ex ante* poverty prevention intervention, which differs from *ex post* poverty alleviation interventions. Third, vulnerability analysis helps to expose sources and forms of the risks that household suffer. This, in turn, supports appropriate designs of safety net programs to lower or alleviate risk, and hence poverty. Finally, yet importantly, risk and uncertainty about the future negatively affect current well-being. Therefore, vulnerability is an intrinsic aspect of well-being.

Since 1990, when the World Bank started to focus on poverty in developing countries, there have been a large number of attempts to conceptualize and empirically investigate vulnerability. Development economists find it hard to ignore the term 'vulnerability' when exploring the lives of the poor. Vulnerability is distinguished from poverty in the sense that there are households who are non-poor but vulnerable, and those that are poor but non-vulnerable. Moreover, as a measure of well-being, vulnerability is more appealing since it takes into account not only varying levels of consumption, but also the flexibility of households to react to covariate and idiosyncratic shocks. Nevertheless, economists have interpreted the concept of vulnerability

to poverty from different viewpoints. As a result, the empirical studies on the topic are diverse, and the results are as varied as the approaches adopted. Also, for developing countries, the precise assessment of vulnerability is more difficult because of the limited availability of panel data that are necessary to trace the well-being of households over time.

1.2 Research motivation

My thesis points to the need for designing poverty alleviation policies in Vietnam, a developing country which has made remarkable progress in reducing poverty and promoting prosperity over the last two decades (World Bank 2011, 2013). Originating from a thoroughly political and economic reform (Doi Moi) in 1986, the level of real GDP per capita in Vietnam has significantly increased from below USD 100 in 1986 to USD 1,130 by the end of 2010. The Vietnamese economy is four times larger than it was in the early 1990s. As a result, the poverty headcount has fallen from 58 per cent in the early 1990s to 14.2 per cent in 2010[3]. Similar trends are discernible using international standards of USD1.25 and USD2 per person per day and most indicators of welfare, such as education and health, have improved. To date, Vietnam has achieved, and in some cases surpassed, many of the criteria of the Millennium Development Goals. However, the task of poverty reduction is far from complete and the road ahead is challenging in some respects. The poverty line, set in the 1990s, is very low by international standards and the methods used to monitor poverty are outdated. Vietnam still has a high proportion of near-poor households who easily fall back into poverty because of both covariate shocks and idiosyncratic shocks. The remaining poor are more difficult to reach, especially the ethnic minority households which still face difficult situations such as isolation, limited assets, low levels of education, and poor health status.

The same factors that make households slip into poverty also contribute to household vulnerability. For instance, households in rural areas with their income dependent on farm activities are most vulnerable. In the Mekong Delta, landless households are

[3]Based on the new poverty line applied to the 2010 VHLSS (VND 653,000/person/month), the poverty rate in 2010 is 20.7 per cent. However, using official urban and rural poverty lines (VND 500,000/person/month and VND 400,000/person/month, respectively), the poverty rate is 14.2 per cent. The General Statistical Office and World Bank (GSO-WB) poverty rate is substantially higher in rural areas, in part due to differences between official poverty lines and the new GSO-WB poverty line, but also due to differences in the overall methodological approach (World Bank 2013).

considered to be particularly vulnerable because the demand for day labor is seasonal and rarely adequate. Physical isolation has a close relationship with vulnerability because difficult access to markets gives households less incentive to diversify their livelihood. In addition, households in some regions frequently suffer from droughts, floods and tropical storms. In urban areas, households who depend heavily on informal sector work often encounter problems related to unexpected expenditure; and unsurprisingly, having a regular income is one of the important determinants of well-being. For this reason a complete set of vulnerability assessments for Vietnam is necessary. It is time to shift the policy focus from static indicators of poverty to ones which measure vulnerability and resilience of different groups when preceded by unexpected shocks and policy changes.

Motivated by this, the first study in the thesis estimates the extent of vulnerability and analyses who the vulnerable are. In addition, this study investigates the link between dynamic poverty and vulnerability, something which has rarely been done. To do this, the most common definition of vulnerability as 'Vulnerability as Expected Poverty' (VEP) is used, along with a data set extracted from three consecutive surveys from 2002 to 2006. Specifically, the reference line proposed by Dutta et al. (2011) is adopted to improve Chaudhuri's measure of vulnerability. Then the association between household vulnerability and the probability of being poor is examined; and finally, the role of *ex ante* vulnerability on movement into and out of poverty during the sample periods is investigated. To the best of my knowledge, this study is the first to adopt a reference line in a vulnerability measure with cross-sectional data. This study also makes improvements to the model specifications that previous studies have used.

Continuing with vulnerability analysis, it is important to know the effectiveness of existing coping mechanisms. Unfortunately, the social safety nets in Vietnam are not adequate. Unemployment insurance commenced since 2009, but few people have benefited from the legislation because of bureaucratic hurdles. In addition, few households have access to the formal credit market due to asymmetric information in the financial markets. Commercial banks favor giving commercial loans over personal loans. Credit cards are usually for individuals with high, stable income. Consequently, poor and vulnerable households have to depend mainly on their own resources to cope with unexpected shocks. Household consumption levels have varied considerably and, not unexpectedly, low-income households are more likely to fall into, or stay in, poverty. These facts explain why it is necessary to have studies that

include both a vulnerability assessment and coping strategies in response to negative shocks.

Taking advantage of the panel data, this second study investigates sources of household vulnerability and responses to risks in rural Vietnam using data from Vietnam Access to Resources Household Surveys (VARHS). Vulnerability as low utility measure (VEU) is employed to estimate and distinguish the sources of vulnerability. Next the household's behavior to cope with shocks is analyzed; and finally the effectiveness of the insurance mechanism is evaluated. As far as I know, this paper is the first analysis using the data set of Vietnam Access to Resources Household Survey (VARHS) to estimate vulnerability as low expected utility (VEU) in Vietnam. In addition, this is the first work that combines vulnerability estimation, sources of vulnerability and response to risks in a single paper.

While decomposing the sources of household vulnerability, one may find that one of the worst shocks to households is the serious illness of one of its members. This has a negative and significant effect on consumption and income. Illness raises two important economic costs: the cost of medical care and income loss due to reduced labor supply. The unpredictable nature of these two costs makes households unable to smooth their consumption over periods of major illness. This is particularly true in developing countries where few individuals have health insurance. In addition, households in developing countries find it difficult to access the formal credit market. Therefore, they have to rely on informal coping mechanisms such as drawing on savings, selling assets, transfers from other families or social support networks. Low-income households who cannot use these channels to smooth their consumption are more likely to fall into a poverty trap. In other words, the burden of health care pushes individuals experiencing illness into poverty or forces them into deeper poverty. Unfortunately, there is no study in the literature that measures the impact of health insurance coverage on household vulnerability.

The third study in this thesis attempts to fill this gap in the empirical literature and is the first to investigate the role of health insurance in mitigating vulnerability. A panel data set extracted from Vietnam Access to Resources Household Surveys (VARHS) for 2010-2012 is used in the analysis. The outcomes of interest are the probability of falling into poverty (VEP) and the magnitude of utility loss (VEU). Since the data set is not from an intervention program, the propensity score- matching method is employed to construct treatment and control groups. Risk aversion

is calculated and used as an important explanatory variable for health insurance enrollment. The implications of the study suggest actions for the government to attain its goal of universal health insurance coverage.

In short, the thesis provides a complete set of vulnerability assessments as suggested by Hoddinott & Quisumbing (2003*b*) and Haughton & Khandker (2009). Vietnam is chosen as a case study because of its impressive achievement in poverty reduction (Cord 2007, Klump 2007) and the availability of detailed data on both consumption and risks. The case study approach in this thesis is appropriate because cross-country data may hide the heterogeneity of the impact (Ravallion 2001). Also, it is impossible for a cross-country study to capture the heterogeneity of socio-demographic factors across countries (Bourguignon 2002).

1.3 Objectives, research questions and methodologies

In general, this thesis aims to contribute to the vulnerability literature and provide a complete set of vulnerability assessments for the purpose of targeted intervention[4]. As far as I know, the thesis is the first study to provide the vulnerability assessment with relatively individual thresholds rather than the poverty line, which has been commonly used in previous studies. In addition, the thesis is the first to decompose sources of vulnerability in the case of Vietnam. Finally, yet importantly, the thesis is the first research in the literature to estimate the impact of health insurance coverage on vulnerability. The specific aims in each study are as follows:

Household vulnerability as expected poverty in Vietnam

Here, the thesis aims to adopt the reference line proposed by Dutta et al. (2011) to improve Chaudhuri's measure of vulnerability. Then the study examines the association between household vulnerability and the probability of being poor; and finally this study evaluates the role of *ex ante* vulnerability on movement into and

[4]According to Hoddinott & Quisumbing (2003*b*), a complete vulnerability assessment should answer five crucial questions: 1) what is the extent of vulnerability; 2) who is vulnerable; 3) what are the sources of vulnerability; 4) how do households respond to shocks; and 5) what gaps between risks and risk management mechanism?.

out of poverty during the sample periods. Research questions answered in this study are as follows:

- What is the extent of vulnerability?
- Who are the vulnerable?
- What is the link between vulnerability and dynamic poverty?

The econometrics method has been applied to address these questions. First, I adopt the 3-steps Feasible Generalized Least Squares (FGLS) with an ordinary least squares (OLS) procedure to measure vulnerability, and therefore to answer the first questions. Then I apply the Receiver Operating Characteristics (ROC) curve to compare the poverty predictive power between Dutta et al.'s measure and Chaudhuri's measure. For the second question, a probit model is used to estimate whether a household's per capita consumption expenditure is below the poverty line, conditioned on a vector of household and commune characteristics. Finally, I employ a multinomial logit model to answer whether the vulnerability traps households into poverty (for the already poor) or increases the likelihood of falling into poverty (for the non-poor).

Household vulnerability as low expected utility and responses to risks in rural Vietnam

The aim of this section is to estimate the vulnerability as low utility and to distinguish the sources of vulnerability. Then the study examines the household?s behavior when coping with shocks, and finally evaluates the effectiveness of the insurance mechanism. In particular, the following research questions are discussed:

- What are the sources of vulnerability?
- How do households respond to shocks?
- What are the gaps between risks and risk management mechanisms?

For the first question, a two-way error component model is employed with a panel data. To reduce the simultaneous bias in the regression, the instrumental variable (IV) technique is applied at this step. To address the second question, the multivariate probit model is utilized due to the fact that households can choose various

coping instruments simultaneously when they confront shocks, and the model allows for a correlation among choices. The IV technique with panel data is used again to measure the effectiveness of existing insurance schemes on consumption and answer the third question.

Risk aversion and the impact of health insurance on household vulnerability: New evidence from rural Vietnam

This section of the thesis aims to shed light on the impact of health insurance coverage on household vulnerability. The outcomes of interest are the probability of falling into poverty (VEP) and the magnitude of utility loss (VEU). There is only one research question, i.e.,

- Does health insurance coverage reduce household vulnerability?

To address this question, the propensity score-matching method is employed to construct treatment and control groups. Risk aversion is calculated and used as an important explanatory variable for health insurance enrollment. The random effect estimator is used to check the robustness of the matching method because some explanatory variables are time-invariant or have minimal within-unit variation.

1.4 Thesis structure

The thesis has five chapters, as follows:

Chapter 1: General introduction

This chapter reviews facts and development literature, and then introduces the need for vulnerability assessments. This section continues to provide research motivations for each of the studies in the thesis. Objectives, research questions, methodologies and a thesis outline are also provided in this chapter.

Chapter 2: Household vulnerability as expected poverty in Vietnam

This chapter begins by reviewing the literature on vulnerability to poverty, including the definition, the measures and empirical results. It then provides an overview of

the poverty situation in Vietnam, particularly poverty trends and coping strategies. Empirical strategies, including data description and econometric specifications, are discussed in the subsequent section, followed by the results and findings. The final section presents policy implications and concluding remarks.

Chapter 3: Household vulnerability as low expected utility and responses to risks in rural Vietnam

The chapter starts with a literature review focusing on concepts of vulnerability as low expected utility and the results of previous studies. The chapter then goes on to briefly summarize an overview of risk and coping strategies in Vietnam. Description of the data and an overview of analytical framework used in the empirical analysis are presented subsequently. The next section discusses the results, and the conclusion with policy implications is the last section.

Chapter 4: Risk aversion and the impact of health insurance on household vulnerability: New evidence from rural Vietnam

The chapter commences by reviewing studies on the topic of vulnerability and health insurance impact. Then it provides an overview of health insurance schemes in Vietnam. The next two sections are dedicated to data description and analytical framework. The results are presented together with discussion, and the last section concludes the chapter.

Chapter 5: General conclusion

This chapter summarizes the main findings of the thesis, provides policy implications, identifies the contributions to the literature, and finally suggests directions for future research.

Chapter 2

Household vulnerability as expected poverty in Vietnam

2.1 Introduction

When development economists decide to explore the lives of the poor, they find it hard to ignore the term 'vulnerability'. That explains why there have been a large number of attempts to conceptualize and empirically investigate vulnerability since 1990, when the World Bank started to focus on poverty in developing countries. Vulnerability in development microeconomics is distinguished from poverty in the sense that there are households who are non-poor but vulnerable, and one that are poor but non-vulnerable. However, as a measure of well-being, vulnerability is more enticing since it takes into account not only varying levels of consumption, but also the flexibility of households to react to covariate and idiosyncratic shocks. In fact, economists have interpreted the concept of vulnerability to poverty from different viewpoints. As a result, the empirical studies on the topic are diverse, and a distinction in those studies can be made based on the approach they adopt. Also, for developing countries, the precise assessment of vulnerability is more difficult because of the limited availability of panel data that are necessary to trace the well-being of households over time.

This study points to the need for designing poverty alleviation policies in Vietnam. There is concern that the speed of poverty reduction has slowed down, and also that it is no longer linked to economic growth. It is suggested to shift the policy focus

from static indicators of poverty to vulnerability and resilience of different groups preceded by unexpected shocks and policy changes. To do this, it is necessary to identify the vulnerable and to know the extent of the vulnerability. Moreover, it is essential to study the link between dynamic poverty and vulnerability, which has rarely been done in previous studies.

In this paper, the concept we use is the most common definition of vulnerability, which is 'Vulnerability as Expected Poverty' (VEP). We analyze Vulnerability as Expected Poverty in Vietnam using a data set extracted from three consecutive surveys from 2002 to 2006. Specifically, we attempt to (i) estimate household vulnerability in Vietnam, (ii) compare the predictive ability of different indicators of vulnerability (iii) examine the association between household vulnerability and the probability of being poor, and finally (iv) investigate the role of *ex ante* vulnerability on poverty shift during the sample periods. To the best of my knowledge, this study is the first to adopt the reference line in a vulnerability measure, along with cross-sectional data. This study also makes improvements to the specification in the models used in previous studies.

The paper is organized as follows. In Section 2, we briefly review the literature on vulnerability to poverty, including the definition, the measures and some empirical results. Section 3 provides an overview of the poverty situation in Vietnam, particularly poverty trends and coping strategies. Empirical strategies, including data description and econometric specifications, are discussed in Section 4, while Section 5 presents the results and findings. The final section offers policy implications and concluding remarks.

2.2 Literature review

Concepts of vulnerability

The concept of vulnerability is interpreted in various ways in different contexts. In economics, the vulnerability concept emerges from the poverty concept. From the traditional view of poverty, as reflected in World Development Report 1990, the notion of poverty consists of material deprivation and low attainment in education and health (World Bank 1990). Later, the term 'vulnerability' was introduced when examining the relationship between poverty and uncertainty of income (Morduch

1994). Since then, the term 'vulnerability' is often used to extend the traditional concept of poverty. While poverty measurement is based on fixed standards such as income or expenditure during a short period of time, vulnerability broadens the poverty notion by including the potential risk of adverse shocks such as income loss, bad health (idiosyncratic risks) and natural disasters (covariate risks). For example, in the work of Glewwe & Hall (1998) and Cunningham & Maloney (2000), vulnerability is defined as exposure to negative shocks to welfare. Other definitions are "the probability or risk today of being in poverty or to fall into deeper poverty in the future" (World Bank 1990) and "the ex ante risk that a household will, if currently non-poor, fall below the poverty line, or if currently poor, will remain in poverty" (Chaudhuri 2003).

However, vulnerability and poverty are highly correlated as "two sides of the same coin". While the observed poverty status is an *ex post* concept, the predicted vulnerability is an ex ante concept. If we can predict the probability of poverty for households, given various sets of characteristics, we then have the estimates of vulnerability of these households (Chaudhuri 2003). Recently, since policy concern has shifted from static indicators of poverty to dynamic poverty, and toward the vulnerability of various policy target groups due to uncertainty (such as policy change, income and weather shocks, health shocks), vulnerability is considered a more appropriate measure of welfare compared to poverty indicators (Jha et al. 2010). In terms of development microeconomics, vulnerability is widely evaluated at the individual or household level. Occasionally, this concept is also measured by aggregating over these units of observation (Hoddinott & Quisumbing 2003*b*).

According to Chaudhuri (2003), there are four major reasons why an analysis of vulnerability to poverty is necessary and desirable. First, vulnerability assessment supports forward-looking anti-poverty interventions. Along with the static approach to well-being, vulnerability assessment reveals some potential paths to improve well-being in the future. Second, a focus on vulnerability to poverty operates as an *ex ante* poverty prevention intervention which differs from *ex post* poverty alleviation interventions. Third, vulnerability analysis helps to expose the sources and forms of risks households suffer. This in turn supports appropriate designs of safety net programs designed to lower or alleviate risk, and hence poverty. And last but not least, risk and uncertainty about the future negatively affect current well-being. Therefore, vulnerability is an intrinsic aspect of well-being.

Measuring vulnerability as expected poverty

In an excellent summary of risk and vulnerability, Hoddinott & Quisumbing (2003*b*) classify approaches to assessing vulnerability into three methods according to their distinct definitions: vulnerability as expected poverty (VEP), vulnerability as low expected utility (VEU), and vulnerability as uninsured exposure to risk (VER). These approaches all predict changes in welfare, but with different measurements of welfare. The VEP and VEU differ in the definition of welfare used: VEP regards consumption as welfare, while VEU uses utility which is derived from consumption. While VEP and VEU commonly use a benchmark welfare indicator (z) and estimate the probability of falling below this benchmark (p), VER evaluates whether downside risks or observed shocks result in welfare loss. In other words, VER assesses the household's ability to smooth, or insure, consumption when facing income shocks while maintaining a minimum level of assets. In this case, household vulnerability is equivalent to household consumption volatility. "Household vulnerability is measured by the conditional covariance between changes in household consumption and changes in income, subject to an asset constraint"(Jha et al. 2010).

In this paper, we modify the methodology that is used in the VEP estimation[1]. This is well known through the work of Chaudhuri (2003) and summarized in the review paper by Hoddinott & Quisumbing (2003*b*). Recently, most empirical works have been derived from these papers; so they present similar reviews on methodology, such as those of Imai et al. (2011) and Jha et al. (2010). The review of methodology in this paper draws on these.

Vulnerability as Expected Poverty (VEP) is a vulnerability measure first proposed and applied to Indonesian household data by Chaudhuri (2003). In that study, the authors define vulnerability as the likelihood that a household will fall into poverty in the next period. Household consumption is used as a measure of household welfare. Thus, vulnerability takes the form:

$$V_{it} = Pr(c_{i,t+1} \leq z), \tag{2.1}$$

where vulnerability of household i at time t (V_{it}) is the likelihood that the household consumption at time $t+1$ ($c_{i,t+1}$) will be lower than the poverty line (z).

[1]The methodology of VEU estimation from Ligon & Schechter (2003) is used in Chapter 3.

Since the concept of vulnerability is strongly connected to concepts of poverty, a number of studies have conceptualized and empirically investigated vulnerability to poverty. Among early studies are the work of Pritchett et al. (2000), Christiaensen & Boisvert (2000), and Chaudhuri (2003). In these papers, vulnerability is defined as the probability of falling below the poverty line in the future, and household consumption is used to reflect household welfare. The time period varies from one to three consecutive years in the future. Later papers of Kamanou & Morduch (2002), Ligon & Schechter (2003) and Christiaensen & Subbarao (2005) modify this framework to take into account the depth of the loss, but their time period is restricted to only one year ahead. For instance, Ligon & Schechter (2003) suggest a specific utility function and define vulnerability as the difference between utility derived from expected consumption and utility obtained from a certain level of consumption. In fact, the authors account for individual risk preferences through their choice of the utility function. Based on these works, Calvo & Dercon (2005) propose a new measure of vulnerability that is sensitive to the size of the loss. These expected poverty measures always include the poor in the vulnerable and, as a result, the factors that determine poverty and vulnerability are rather similar.

Other efforts suggest that vulnerability should be measured using the variations around a certain level of income that is completely different from the poverty line. For example, deviations from the permanent income line, according to Morduch (2004), are a measure of vulnerability. In this case, a households inability to smooth consumption is considered as a component of poverty. Similar studies by Dercon & Krishnan (2000) and Morduch (2004) have supported this trend. They consider consumption smoothing as a method for risk sharing and the alleviation of vulnerability. With this method, people who were previously very poor may not be considered vulnerable if they have not experienced a large change in their consumption in response to a shock. This method distinguishes the poor from the vulnerable, however standard deviations from a given consumption line might not be the correct indicator of vulnerability (Dutta et al. 2011)[2].

Regardless of how vulnerability is interpreted and what measures are used, most empirical studies attempt to address vulnerability in developing countries, especially in rural areas where household income suddenly fluctuates due to various downside

[2]For further discussion see Christiaensen & Subbarao (2005) and Dutta et al. (2011).

risks such as changes in weather, floods, food prices, illness and so on. For example, Dercon et al. (2005) examine vulnerability to various types of shocks in rural Ethiopia. They define shocks as adverse events that lead to a loss of household income, a reduction in consumption and/or a loss of productive assets. Their study finds that drought and illness have seriously affected households there as they are associated with lower levels of per capita consumption. They also highlight that the impact of certain shocks depends on a household's characteristics such as gender of head, schooling of head, and landholding.

Christiaensen & Subbarao (2005) estimate vulnerability as expected poverty in rural Kenya and find that "households in arid areas, who experience large rainfall volatility, appear more vulnerable than those in non-arid areas, where malaria emerges as a key risk factor. Idiosyncratic shocks also cause non-negligible consumption volatility. Possession of cattle and sheep/goats appears ineffective in protecting consumption against covariate shocks, though sheep/goats help reduce the effect of idiosyncratic shocks, especially in arid zones."

Taking advantage of two data sets, one of which is based on the ICRISAT panel surveys and the other comes from Gautam (1991), Gaiha & Imai (2008) apply all VEP, VEU and VER to measure vulnerability in rural India. Gaiha and Imai decompose household vulnerability into poverty, covariate risks, and idiosyncratic risks. According to the authors, idiosyncratic risks represent the largest share, preceding poverty and covariate risks. The landless and the small farmers are seriously vulnerable despite some degree of risk-sharing.

Another empirical work on poverty and vulnerability has been done in Bangladesh. Azam & Imai (2009) apply Chaudhuri's method (VEP) for a cross-sectional dataset and find that poverty is not the same as vulnerability, as a substantial share of those currently above the poverty line are highly vulnerable to poverty in the future. The study shows that agricultural households and those without education are likely to be the most vulnerable. The impact of geographical diversity on vulnerability is significant.

Using cross section data in Ghana, Novignon (2010) uses a three-step Feasible Generalized Least Squares (FGLS) estimation technique to evaluate vulnerability to poverty and to measure the impact of household socioeconomic status on expected future consumption and variations in future consumption. His results indicate that around 56 per cent of households in Ghana are vulnerable to poverty, compared

to 28 per cent of observed poverty. Household characteristics such as health status, household size, gender of head and education attainments considerably affect vulnerability. Unexpectedly, urban households are more vulnerable than rural households, with 61 per cent and 25 per cent of population respectively.

Jha et al. (2012) use panel data to investigate poverty and vulnerability to poverty in rural India. They conclude that economic growth is good for poverty reduction. They show that the chronic poverty is relatively small but the incidence of transient poverty is high, reflecting the importance of aggregate and idiosyncratic shocks. Similar to Dercon et al. (2005), in this study, expected factors such as age, gender of head, education and landholding influence vulnerability. Furthermore, governance factors such as attendance at public meetings and identity-based voting significantly contribute to vulnerability.

There are a number of studies exploring both poverty dynamic and vulnerability in Vietnam. One of the interesting papers is that of Giang & Pfau (2009). They compare household average per capita expenditure to the poverty line and then use the probit model to determine factors that affect the probability of being poor for Vietnamese elderly. Their results show that some factors such as age, marital status, region and remittance receipts, significantly impact poverty in both urban and rural sectors. Others such as gender, ethnicity, and household composition and size, have different impacts in urban and rural areas. However, in this paper, the influence of living arrangements and household head characteristics is insignificant. While the measure in this paper is fit for the cross-section data from Vietnam Household Living Standard Survey (VHLSS) 2004, it is an *ex post* measure rather than an *ex ante* measure which is more appropriate for the vulnerability concepts.

An outstanding effort to explore vulnerability in Vietnam comes from the project "Impact of Shocks on the Vulnerability to Poverty: Consequences for Development of Emerging Southeast Asian Economies" by the German Research Foundation with its many contributing authors (Klasen & Waibel 2010). This project carried out a panel survey of about 4400 households in three provinces in Thailand and Vietnam in 2007 and 2008 (Hardeweg & Waibel 2009). A number of papers have been written using this data set. They separately explore the impact of certain events such as food price shocks, agricultural diversification and financial shock to vulnerability and household responses. Other papers have used this data set to test a new method for comparing vulnerability over time and space (Hardeweg et al. 2013). One disadvantage of

these studies lies in the coverage of the data set. In Vietnam, data is collected in three provinces located in central Vietnam where households' living conditions are completely different to the North and the South. Therefore, the results of these studies cannot be generalized to over sixty provinces in Vietnam.

Povel (2010) suggests a new measure of vulnerability called vulnerability to downside risk. He chooses the current level of wellbeing of a household as the relevant benchmark rather than the poverty line. Then the author applies the method of Calvo & Dercon (2007) to examine vulnerability in Vietnam using data from DFG project. The results show that consumption smoothing abilities and the probability of undergoing a difficult event differ considerably between different wealth groups. As a result, the relation between initial wealth and vulnerability to downside risk is highly non-linear. The author also demonstrates that while moderately, but not extremely, poor households are relatively vulnerable to extreme poverty, they are less vulnerable to downside risk than any other group of households.

Imai et al. (2011) apply the measure VEP proposed by Chaudhuri et al. (2002) and Chaudhuri (2003) for panel data constructed from the Vietnam Household Living Standard Survey (VHLSS) in 2002 and 2004. Their analyses indicate that, in most situations, vulnerability in 2002 becomes poverty in 2004. Vulnerability of the poor tends to prolong their poverty and it leads a proportion of the non-poor into poverty. They also find that landholding, education attainment and access to infrastructure are highly correlated with both poverty and vulnerability, but these relationships vary greatly among ethnic groups and locations. Imai et al's study is the first to examine empirically the links between vulnerability and poverty traps in Vietnam. From the approach the authors apply, the poor are a subset of the vulnerable and that explains why there is still some overlap between the determinants of poverty and vulnerability. However, by using only VEP measure, the authors cannot distinguish sources of risk. They also ignore the impact of agricultural jobs and regional differences on households' consumption[3]. Moreover, they do not mention the predictive power of the vulnerability measure to the actual poverty[4].

[3]The impact of these two characteristics were reported in World Bank (2003*a*).

[4]In a non-published version of the research, the authors noticed the predictive power but there was no analytical framework for that and then the results were ambiguous.

2.3 Overview of the poverty situation in Vietnam

Vietnam is a developing country and has attained remarkable progress in reducing poverty and promoting prosperity over the last two decades (World Bank 2011, 2013). Originating from thorough political and economic reform (Doi Moi) in 1986, the level of GDP per capita has significantly increased from below $100 in 1986 to $1,130 by the end of 2010. The Vietnamese economy is four times larger than it was in the early 1990s. As a result, the poverty headcount has fallen from 58 per cent in the early 1990s to 14.2 per cent in 2010[5]. Similar trends are discernible using international standards of $1.25 and $2 person/day and most indicators of welfare such as education and health have improved. To date, Vietnam has achieved, and in some cases surpassed, many criteria of the Millennium Development Goals (See more in Table 2.1)

However, the task of poverty reduction is far from complete and the road ahead is challenging in some respects. The poverty line, as used in the early 1990s, is very low by the international standards and the methods used to monitor poverty are outdated. Vietnam still has a high proportion of near-poor households who easily fall back into poverty as a consequence of both covariate shocks and idiosyncratic shocks. The remaining poor are more difficult to reach, especially the ethnic minority households. They still face difficult situations such as isolation, limited assets, low levels of educational attainment, and poor health status.

Economic growth now has less impact on poverty reduction than it did in the past. Inequality in income and opportunities are increasing, amplified by disparities between urban and rural areas as well as disparities across different socioeconomic groups. While poorer areas are not well connected to markets, urbanization continues to force a number of workers from these areas to migrate to the cities to work in informal sectors which are unstable and lack benefits.

[5]Based on the new poverty line applied to the 2010 VHLSS (VND 653,000/person/month), the poverty rate in 2010 is 20.7%. However, using official urban and rural poverty lines (VND 500,000/person/month and VND 400,000/person/month, respectively), the poverty rate is 14.2%. The General Statistical Office and World Bank (GSO-WB) poverty rate is considerably higher in rural areas, partly because of disparities between official poverty lines and the new GSO-WB poverty line, but also because of disparities between the methodological approaches (World Bank 2013). According to GSO, the poverty rate fell from 58% in 1993 to 37.4% in 1998, 28.9% in 2002, 16% in 2004 and 14.5% in 2008.

TABLE 2.1: Progress in reducing incidence, depth and severity of poverty in Vietnam 1993-2010

	The GSO-WB poverty line			$1.25/day 2005 PPP line			$2.00/day 2005 PPP line		
	Incidence (Headcount rate,%)	Depth (Poverty gap,%)	Severity (Squared) gap,%)	Incidence (Headcount rate,%)	Depth (Poverty gap,%)	Severity (Squared) gap,%)	Incidence (Headcount rate,%)	Depth (Poverty gap,%)	Severity (Squared) gap,%)
1993	58.1	18.5	7.9	63.7	23.6	11.0	85.7	43.5	25.7
1998	37.4	9.5	3.6	49.7	15.1	6.0	78.2	34.2	18.0
2002	28.9	7.0	2.4	40.1	11.2	4.1	68.7	28.0	14.1
2004	19.5	4.7	1.7	21.5	5.4	2.0	50.3	17.1	7.8
2006	15.9	3.8	1.4	16.8	4.2	1.5	42.4	13.9	6.2
2008	14.5	3.5	1.2	11.8	2.8	1.0	34.5	10.3	4.3
2010	20.7	5.9	2.4	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

Source: VASS, 2010 for 1993-2008 GSO-WB headcount estimates, POVCALNET for 1993-2008 US$1.25 and US$2.00 headcount estimates. Statistics for 2010 calculated by the World Bank using the comprehensive consumption aggregate.
Notes: World Bank poverty estimates using international poverty lines for Vietnam in 2010 have not yet been published.

Back in the mid-1980s, it was estimated that seven out of every ten Vietnamese were poor. Starting from 1986, the incidence of poverty in Vietnam has been rapidly reduced as a result of the economic reform. The headcount poverty dropped considerably from 58 per cent in 1993 to 16 per cent in 2006. This achievement included improvement in other indicators of human development such as school enrollment, malnutrition, access to infrastructure (public health centers, clean water and electricity) and ownership of durable goods (radios, television, bicycles).

Nevertheless, a large proportion of the Vietnamese population was still living close to the poverty line. Therefore, the gains in poverty reduction remained fragile because poverty estimates are very sensitive to the choice of poverty line. For example, for 1998, if the poverty line is raised by 10 per cent, the headcount poverty rises to 45 per cent. If the poverty line is reduced by 10 per cent, the poverty rate falls to 29 per cent. Until 1998, nearly one-half of the rural population was still poor and therefore 90 per cent of the poor resided in rural areas in 1998 (World Bank 2001). Poverty has decreased in all 7 regions of Vietnam, but at different rates. Hence, in 2002, there were still three regions showing a high incidence of poverty, with poverty rates of 44% (Northern Uplands), 52% (Central Highlands) and 44% (North Central Coast) (World Bank 2003*a*). This is a result of many regional constraints (such as the difficult physical environment) which restrict agricultural development and confine access to infrastructure.

In general, poor households in Vietnam share common characteristics. First, they are mostly farmers with low levels of educational attainment. In 1998, approximately 80 per cent of the poor worked in agriculture. Second, poor households have small landholdings, and other households that can make a living from the land find it hard to have stable jobs off the farm. Third, households with more children and fewer workers are disproportionately poor, and are particularly vulnerable to health and education costs. Fourth, poor households are more vulnerable to seasonal adversity as well as household-specific (idiosyncratic) and community-wide (covariate) shocks. The fact that they suffer from bad fluctuations in income or abrupt demands for expenditure can easily lead them into poverty. Also, they may be socially or physically isolated. In particular, these factors are frequently found in ethnic minority groups and as a consequence the level of poverty in these groups is more serious compared to the majority of the population. In terms of vulnerability, the Poverty Participation Assessments (PPAs) in Vietnam have highlighted two other groups: unregistered migrants in urban areas and children.

Factors that make households slip into poverty also contribute to households' vulnerability. For instance, households in rural areas with income dependent on farm activities are most vulnerable. In the Mekong Delta, landless households are considered as particularly vulnerable because the demand for day labor is seasonal and rarely adequate. Also, physical isolation has a close relationship with vulnerability because difficult access to markets gives households less incentive to diversify their livelihood. In urban areas, households who depend heavily on informal sector work often encounter problems relating to unexpected expenditure; unsurprisingly, having a regular income is one of the important determinants of wellbeing.

2.4 Data

Vietnam Household Living Standard Surveys (VHLSS)

Data for this study are drawn from the Vietnam Household Living Standard Surveys (VHLSS). These nationally representative surveys have been conducted every two years since 2000 by the General Statistics Office (GSO) of Vietnam, with technical assistance from the World Bank. These surveys consist of two parts: a household survey and a commune survey. The household survey collects very detailed information on households, such as demography, education, employment and labor force participation, income, expenditure, health, housing, durable goods, fixed assets and participation in poverty programs. The commune survey collects basic information on demography, socioeconomic characteristics, and the infrastructure of communes. They are cross-sectional data but it is possible to build a panel dataset due to the overlap of samples.

Procedure for collecting data

In these surveys, a method of stratified random cluster sampling is applied to ensure the household samples are representative for national, rural and urban, and regional levels. The sample of households in the series of VHLSS from 2002 to 2006 is selected from a master sample which was randomly chosen from the enumeration areas (EA) of the 1999 Population Census. The sampling procedure can be briefly described in three stages. First, 2300 rural communes and 700 urban wards were selected as the

primary sampling units (PSU). Second, three EAs of the 1999 Population Census were selected from each PSUs. Finally, in each EA, 20 households in rural EAs and 10 households in urban EAs were selected.

In the VHLSS series, the sample is revolved from year to year. For two consecutive surveys, 50 per cent of the households selected from the EAs in a half of the PSUs from the previous survey are re-surveyed in the next survey. The other 50 per cent of households are chosen from new EAs in the remaining half of the PSUs. The 50 per cent overlap between the two surveys allows for a household panel.

In this study, we first use three surveys from 2002 to 2006 as cross-sectional data. Then we build two separate panels 2002-2004 and 2004-2006. We also construct a panel data set including information from all three surveys from 2002 to 2006. The household sample in the 2000 and 2010 surveys came from other master samples; therefore, we cannot use them to construct a panel data set.

Panel data with VHLSS

The survey of VHLSS 2002 was conducted between May and November of 2002. In the final release of this survey, 29,530 households were surveyed for both income and expenditure. Similar to VHLSS 2002, the survey of VHLSS 2004 was implemented between May and November of 2004. Both income and expenditure of 9,189 households were collected. There were two additional new modules in the 2004 questionnaires but this does not affect the core modules.

In VHLSS 2006, two expanded modules in the 2004 questionnaires were dropped and two other commune sections were added in order to collect information on schools and healthcare services. The number of households in the final release remains at 9,189.

Due to the inconsistency in household identification across surveys, a panel of only 3931 households is constructed between VHLSS 2002 and VHLSS 2004. Similarly, a panel of 4,193 households is built across the VHLSS 2004 and VHLSS 2006. Ultimately, three waves of VHLSS from 2002 to 2006 allow for a panel of 1844 households. The data structure of VHLSS 2002, 2004 and 2006 is presented in Table A.1 and the statistical summary of variables is presented in Table A.2, A.3 and A.4 of Appendix A.

As can be seen in Table A.2, A.3 and A.4, during 2002-2006, household consumption increased since the log of expenditure slightly increases. The age of head continuously increases while the female share fluctuates and the dependent share decreases. The mean of the samples shows that levels of education attainment fluctuates over three surveys, except that the mean of the technical school category has consecutively risen. It is important to notice that landholding rises during 2002-2004 but falls during 2004-2006. This reflects changes in economic policies and a shift in the role of land in household living. Households in the samples tend to leave rural areas, as evidenced by the gradual increase in the value of the urban variable across surveys. Last, but not least, household access to electricity and market improves considerably.

Data issues

The use of the household panel data might raises concerns about the sample attrition. When households with certain characteristics leave the panel, the panel data are incomplete and biases emerge. If the attrition rate of vulnerable households and non-vulnerable households is considerately different, attrition becomes particularly problematic. Either households who leave the survey may be among the most vulnerable, or they may be less vulnerable as migration can be an effective way to cope with risks. Without follow-up surveys, it is impractical to identify the exact nature of biases. However, in the case of Vietnam, several previous studies using VLSS and VHLSS have proven that the attrition rate is rather low and random (e.g. Baulch & Masset (2003) and Günther & Harttgen (2009) for VLSS; Roelen (2010) for VHLSS).

Another potential problem with VHLSS is the changing household composition and size (Kamanou & Morduch 2002). The changes are generally less sharp for the non-poor. The changes are partly attributed to family splits and to migration, some of which was motivated by the economic forces. Births and the arrival of relatives and others both contribute to change in household composition. When household size changes, then per capita income or consumption may vary. However, this is not considered a shock, as it is the result of a deliberate household choice. This problem is also addressed in Pincus & Sender (2008). Thus there is a caveat on interpreting our result and there might be some resultant underestimation of vulnerability in our analysis.

2.5 Analytical framework and methodology

Measuring vulnerability as expected poverty

We start our estimation of vulnerability to poverty with an assumption about a consumption generating process. According to economic literature, the major part of household consumption is determined by wealth, uncertainty about future income and assets, and the households coping strategy in response to risks. In turn, these factors are determined by a variety of observable household characteristics and the surrounding economic environment (Deaton 1992, Browning & Lusardi 1996, Chaudhuri 2003, Dercon 2005). Therefore, assuming that consumption is log normally distributed and that the log-consumption is normally distributed, we start with a reduced-form of the consumption function, written as follows (based on Chaudhuri et al. (2002), Christiaensen & Subbarao (2005), Minot & Baulch (2005); Justino et al. (2008); Jha et al. (2009); Cuong et al. (2010); Nguyen & Winters (2011), and Imai et al. (2011)):

$$lnc_i = \alpha + \beta X_i + e_i, \tag{2.2}$$

where: c_i is per capita consumption expenditure on food and non-food items for household i (real value from data sets); and X_i represents a vector of observable household characteristics and commune characteristics. In this study, these characteristics are:

- Age of head of the household (years),
- Share of female members in total household members (%),
- Share of household members under 15 years or above 65 years in total household members (%),
- Whether the household head is married or not (dummy variable: 1 for married and 0 otherwise),
- Whether the highest level of education of household members (using five dummies to represent the five levels of education: primary school, lower secondary school, upper secondary school, technical school, and college or university),

- Whether the household is purely agricultural (dummy variable: 1 for household having income from only agriculture and 0 for a household having at least one source of income from the non-agricultural sector),

- Total land area owned by household members (10,000m^2),

- Whether the household is located in rural areas or urban areas (dummy variable: 1 for rural and 0 for urban),

- Whether the household is located in inland delta, coastal area, hills, low mountains, high mountains (using four separate dummy variables),

- Whether the household is located in Red River Delta (Region 1), North West (Region 2), South West (Region 3), North Central Coast (Region 4), South Central Coast (Region 5), Central Highland (Region 6), South East (Region 7), Mekong Delta (Region 8) (7 dummy variables are used),

- Whether the household belongs to a commune with a power supply (dummy variable: 1 for yes and 0 otherwise),

- Average distance to road, water transportation, passenger pick-up point, commune headquarters, commune centre, post office, telephone service provider, daily market and weekly market (km)

β is a vector of parameters to be estimated, and e_i is the mean-zero disturbance term that captures idiosyncratic shocks that lead to different levels of per capita consumption.

Chaudhuri et al. (2002) and Chaudhuri (2003) acknowledge that the error term (e_i) is not the same for all households (heteroskedasticity). Therefore, we adopt the three-step Feasible Generalized Least Squares (FGLS) technique proposed by Amemiya (1977).

Firstly, we estimate Equation 2.2 by employing the ordinary least squares (OLS) technique. Next we predict the residuals from the regression and regress the predicted residuals on the same covariates included in the specification of the consumption process. Then we have the error variance estimating process as follows:

$$\widehat{e}^2_{i,OLS} = \rho + \widehat{\delta} X_i + \eta_i. \tag{2.3}$$

The prediction of Equation 2.3 is used to weight the previous equation, thus leading to the transformed version:

$$\frac{\widehat{e}_i^2}{\widehat{e}_{i,OLS}^2} = \frac{\rho}{\widehat{e}_{i,OLS}^2} + \frac{\widehat{\delta} X_i}{\widehat{e}_{i,OLS}^2} + \frac{\eta_i}{\widehat{e}_{i,OLS}^2}. \tag{2.4}$$

According to Chaudhuri (2003), the OLS estimation of Equation 2.4 generates an asymptotically FGLS estimate, δ^{FGLS}, and thus e_i^2 is a consistent estimate of the variance of the idiosyncratic component of household consumption. Having obtained an efficient estimate of the variance as the predicted value of Equation 2.4, $(\widehat{\delta}_{i,FGLS}^2)$, we now take the square root and transform Equation 2.2 as follows:

$$\frac{lnc_i}{\widehat{\delta}_{i,FGLS}} = \frac{\alpha}{\widehat{\delta}_{i,FGLS}} + \frac{\beta X_i}{\widehat{\delta}_{i,FGLS}} + \frac{e_i}{\widehat{\delta}_{i,FGLS}}. \tag{2.5}$$

An OLS estimation of Equation 2.5 generates a consistent and asymptotically efficient estimate of α^{FGLS}, β^{FGLS}. Once we obtain these estimates, it is possible to predict both the expected log consumption and its variance:

$$\widehat{E}[lnC_i|X_i] = \alpha^{FGLS} + \beta^{FGLS} X_i, \tag{2.6}$$

$$\widehat{V}[lnC_i|X_i] = \rho^{FGLS} + \delta^{FGLS} X_i. \tag{2.7}$$

Chaudhuri (2003) assumes that lnc_i is normally distributed. Then the estimated probability that a household will be poor in the future (for example, at time $t+1$) is given by:

$$\widehat{v}_{i,Chaudhuri} = \widehat{Pr}(lnc_i < lnz|X_i) = \Phi\left(\frac{lnz - \widehat{E}[lnC_i|X_i]}{\sqrt{\widehat{V}[lnC_i|X_i]}}\right), \tag{2.8}$$

where $\Phi(.)$ is the cumulative function of the standard normal and z is the actual poverty line[6]. This approach is an *ex ante* vulnerability measure because it provides the probability of being poor at time $t+1$ for a household with a given distribution of consumption at time t. Cross-sectional data can be used in this case.

[6]The poverty lines in this study are calculated from the VHLSS and released by the GSO and the WB. The poverty line measure takes account of the regional price differences and monthly price changes over the survey periods. The poverty lines are 1917, 2077 and 2566 thousand VND/person/year for the years of 2002, 2004 and 2006, respectively.

As for policy implications, the comparison between estimated vulnerability and actually observed poverty is essential. This reflects the ability to predict poverty through estimated vulnerability. According to Zhang & Wan (2009), the accuracy of this prediction will vary depending on: first, the vulnerability threshold is suggested setting at 50 per cent to increase predictive power; second, using past weighted average income is preferable to using regression when calculating permanent income[7]; and third, the choice of the poverty line also affects the predictive ability.

Therefore, we decide to set the vulnerability line at 50 per cent. This is a reasonable choice because many other studies use this threshold. Unfortunately, there is not enough past income with the available dataset. We therefore continue deriving future income from regressions.

However, there are some assumptions that must be invoked in order to accurately interpret the vulnerability results (Hoddinott & Quisumbing 2003*b*). First, this approach assumes that the cross-sectional variation of consumption across households is a good proxy for the time-series variation of consumption of the household. Therefore, this measure requires a large sample in which some households experience a normal or good time while others are exposed to negative shocks. Second, this measure also assumes that the structure of the economy is fairly stable over time and, for that reason, variation in future consumption comes from only the uncertainty about the idiosyncratic shocks, e_i. Therefore, this measure is least likely to reflect unexpected large negative shocks when using cross-sectional date for a normal year. Also, it is assumed that all households observed in the cross-section receive draws from the same distribution of consumption changes (a homogeneity assumption). Moreover, by using the standard deviation as a measure of vulnerability, this measure weights negative shocks the same as possitve shocks (Kamanou & Morduch 2002).

Reference line as a poverty threshold

Having taken great interest in measuring vulnerability, Dutta et al. (2011) contradict the common findings that "the set of the poor will always be a subset within the broader set of the vulnerable" and "the factors determining poverty and vulnerability

[7] According to Friedman (1957, 1963) and Mansuri & Healy (2001), "the permanent expenditure is a good estimator of the mean of future expenditure". Also, Chaudhuri et al. (2002) and McCulloch & Calandrino (2003) indicate that "the mean and standard deviation of observed income or consumption are unbiased estimates of their future counterparts" (Zhang & Wan 2009).

are quite similar." The authors emphasize that "individuals may be vulnerable if they are unable to maintain in the future a certain minimum standard of living which may differ from the poverty line." Therefore, they suggest a reference line which is composed of the individual's current standard of living and the poverty line for each individual[8]. The reference line is the minimum living standard that individuals should maintain in the future to be considered as non-vulnerable. Vulnerability is defined as the shortfall from the reference line.

The reference line $R(z, y_t)$ reflects the fact that individuals consider both their current living standard (y_t) and the poverty line when estimating vulnerability. There are two possible scenarios in the Dutta paper. First, the reference line and the standard of living are positively correlated. This is because an individual with a higher current standard of living might want to maintain a similar level standard of living in the future and any deviation from that level is considered as vulnerable. This idea has been proven in an empirical study of Evason (1985) in which the category Protestant (with higher average income) is more likely to report loss due to unemployment compared to the category Catholic (with lower average income)[9]. In the second senario, the reference line and the standard of living are negatively correlated. This is because a higher living standard today would reduce the minimum income needed in the future, implying a lower vulnerability. This idea derived from a work of Sen (1981) in the context of the Bangladesh famine in 1974. In that contribution, Sen (1981) finds that landless laborers were the worst affected during the famine.

When y_t and $R(z, y_t)$ are positively correlated, the function form of the reference line is:

$$R(z, y_t) = z^{1-\alpha} y_t^{\alpha}, \tag{2.9}$$

and when y_t and $R(z, y_t)$ are negatively correlated, the function form of the reference line is:

$$R(z, y_t) = z^{1+\alpha} / y_t^{\alpha}, \tag{2.10}$$

With $0 \leq \alpha \leq 1$. When $\alpha = 0$, the measure becomes the standard expected FGT poverty index. When $\alpha = 1$, the measure is completely dependent on current and future income.

[8]This idea is raised in Foster (1998).
[9]For more details see Evason (1985).

A study of Celidoni (2013) demonstrates that the vulnerability measure proposed by Dutta et al. (2011) will give the best signal of poverty. We then modify the method of Chaudhuri et al. (2002) by replacing the poverty line with the reference line derived by Dutta et al. (2011), and we have the VEP index for Dutta et al's measure:

$$\widehat{v}_{i,Dutta} = \widehat{Pr}(lnc_i < lnR|X_i) = \Phi\left(\frac{lnR - \widehat{E}[lnC_i|X_i]}{\sqrt{\widehat{V}[lnC_i|X_i]}}\right), \tag{2.11}$$

where R is the reference line derived from the Equation (2.9) or (2.10).

Receiver Operating Characteristic curve (ROC)

To compare the predictive powers of Chaudhuri's and Dutta's measures, we apply the Receiver Operating Characteristics (ROC) curve, initially used in the field of engineering and disease diagnosis to analyze the extent to which a given signal can act as an indicator for an underlying condition. Madden (2011) is one of several authors using this approach to measure the degree of overlap between different dimensions of poverty.

In this study, the underlying condition is income poverty in time $t+1$ while the vulnerability indexes, estimated on information up to time t, are the symptom of poverty. To draw the ROC curve, we first partition households in the sample into categories of poor and non-poor, using the actual poverty line. We then assess the degree to which the vulnerable and non-vulnerable households would produce the same partition of the poverty status.

When households are both vulnerable and poor, they are called true positive (TP); and when households are classified as both non-vulnerable and non-poor, they are called true negative (TN). Those identified as vulnerable but non-poor in time $t+1$, are false positive (FP), while false negative (FN) includes households who are non-vulnerable, but are poor in income. The TP rate, $TP/(TP+FN)$, is called the sensitivity of the signal while the TN rate, $TN/(TN+FP)$, is known as specificity. The FP rate is one minus the TN rate and is $1 - TN/(TN+FP)$ (Figure 2.1).

The ROC curve is created by graphing the TP rate (on the vertical axis) against the FP rate (on the horizontal axis) for all possible values of the vulnerability threshold. The higher the sensitivity and the specificity, the nearer will be the curve

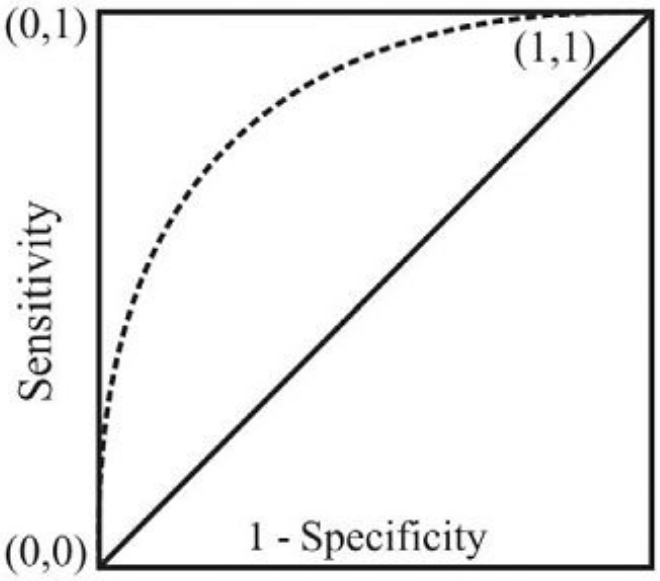

FIGURE 2.1: The ROC curve.

to the point (0,1) in Figure 1[10]. That means vulnerability can provide a better signal of poverty. To compare two indicators, an estimation of the area under the ROC curve is commonly used and presented as an index.

Determinant of poverty

Once we have estimated the probability of falling into, or remaining in, poverty, we extend the analysis by assessing the determinants of poverty. In this case, a probit model[11] is employed to estimate whether a household's per capita consumption expenditure is below the poverty line, conditioned on a vector of household and commune characteristics.

$$Pr(P_i = 1) = \Phi(X_i\psi'), \tag{2.12}$$

where $P_i = 1$ if $lnc_i < lnz$ and $P_i = 0$ otherwise. Then we can address the association between household vulnerability in earlier years and the probability of being poor in later years by adding VEP in earlier years in the regression for later years. In our analysis, we use the 2002 VEP for the 2004 regression, the 2004 VEP for the 2006 regression, and then add both VEP 2002 and VEP 2004 into the 2006 regression.

[10] When the curve lies below the 45^0 line, then it is effectively acting as a contra-indicator.

[11] According to Gujarati (2011), there is no compelling reason to choose a probit model over a logit model in practice. Probit and logit models generally give similar results.

The vulnerability index is the index generated from Dutta et als measure which provides a better prediction of falling into poverty.

Role of vulnerability on poverty shift across time

We expand our analysis by using a multinomial logit model (MLM)[12] to examine poverty transition over the period 2002-2006. In this way, we try to answer whether the vulnerability traps households into poverty (for the already poor), or increases the likelihood of falling into poverty (for the non-poor).

We use two separate panel data of the periods 2002-2004 and 2004-2006 for this task. With each period, there are four situations of poverty transition. For example, in 2002-2004:

$P1$ = those who were poor in both 2002 and 2004,

$P2$ = those who were poor in 2002, but non-poor in 2004,

$P3$ = those who were non-poor in 2002; but poor in 2004,

$P4$ = those who were non-poor in both 2002 and 2004.

In 2004-2006:

$P1$ = those who were poor in both 2004 and 2006,

$P2$ = those who were poor in 2004, but non-poor in 2006,

$P3$ = those who were non-poor in 2004, but poor in 2006,

$P4$ = those who were non-poor in both 2004 and 2006.

The multinomial logit model is written as:

$$Pr(P_i = j) = \frac{e^{(X_i\lambda_j + \tau_k \widehat{VEP_i})}}{\sum_{k=1}^{4} e^{(X_i\lambda_j + \tau_k \widehat{VEP_i})}}, j = 1, 2, 3, 4. \tag{2.13}$$

[12]In practice, multinomial logit models are more frequently used than multinomial probit models

The common practice in an MLM is to choose one category as the base case and set its coefficient values to zero. So we choose the fourth category (non-poor in all periods) and set $\lambda_j = 0$ and $\tau_k = 0$; we thus obtain the following estimates of the probabilities for the four categories:

$$Pr(P_i = j) = \frac{e^{(X_i\lambda_j + \tau_k \widehat{VEP_i})}}{1 + \sum_{k=1}^{4} e^{(X_i\lambda_j + \tau_k \widehat{VEP_i})}}, j = 1, 2, 3, \tag{2.14}$$

$$Pr(P_i = j) = \frac{1}{1 + \sum_{k=1}^{4} e^{(X_i\lambda_j + \tau_k \widehat{VEP_i})}}, j = 4. \tag{2.15}$$

Similarly, we employ a panel dataset created from three consecutive surveys of 2002, 2004, 2006 to examine the role of vulnerability to poverty shift from 2002 to 2006. We define four situations of poverty transition as follows:

$P1$ = those who were poor in both 2002, 2004 and 2006,

$P2$ = those who were non-poor in at least one year (except for whom belong to category $P3$),

$P3$ = those who were non-poor in 2002; but poor in 2004 and 2006. This is the case of falling into poverty and remaining there,

$P4$ = those who were non-poor in all three surveys.

2.6 Econometric results and discussion

Measuring vulnerability

The results of the consumption function are presented in Table 2.2, where the regression results for Equations 2.6 and 2.7 are shown continuously for surveys in 2002, 2004 and 2006. In general, the signs of the estimated coefficients are as expected, reflecting their effects on consumption as in the literature.

TABLE 2.2: Estimates of Vulnerability as Expected Poverty in Vietnam 2002, 2004, 2006

	2002		2004		2006	
Variable	Log(Cons)	Variance	Log(Cons)	Variance	Log(Cons)	Variance
headage	-0.015	-0.019	-0.013	-0.004	-0.009	0.019
	(-11.28)***	(-2.62)**	(-4.69)***	(-0.25)	(-3.04)**	(1.23)
headage2	0.000	0.000	0.000	0.000	0.000	-0.000
	(12.94)***	(3.82)***	(5.95)***	(1.07)	(3.94)***	(-0.53)
femaleshare	-0.992	-1.452	-0.873	-0.894	-0.932	-0.821
	(-18.75)***	(-4.85)***	(-7.95)***	(-1.37)	(-8.45)***	(-1.36)
femaleshare2	0.938	1.375	0.879	0.996	0.884	0.894
	(19.30)***	(4.99)***	(8.65)***	(1.64)	(8.80)***	(1.62)
dependshare	-0.378	-0.094	-0.411	0.043	-0.362	0.042
	(-30.95)***	(-1.43)	(-16.55)***	(0.30)	(-14.64)***	(0.31)
married	0.013	-0.057	0.040	-0.076	0.024	0.105
	(1.67)	(-1.30)	(2.42)*	(-0.78)	(1.50)	(1.23)
primary	0.041	-0.064	0.056	-0.132	0.030	-0.125
	(4.38)***	(-1.27)	(2.72)**	(-1.07)	(1.42)	(-1.05)
lowersecond	0.142	-0.096	0.149	-0.119	0.127	-0.384
	(14.74)***	(-1.85)	(7.20)***	(-0.96)	(6.10)***	(-3.29)**
uppersecond	0.291	0.018	0.272	0.034	0.269	-0.277
	(26.71)***	(0.30)	(11.62)***	(0.25)	(11.58)***	(-2.14)*
techschool	0.440	0.092	0.404	0.036	0.403	-0.157
	(33.67)***	(1.29)	(16.39)***	(0.25)	(16.55)***	(-1.15)
highedu	0.698	0.178	0.579	0.095	0.593	-0.115
	(48.44)***	(2.18)*	(17.87)***	(0.50)	(17.95)***	(-0.62)
agrhh	-0.143	-0.043	-0.127	0.041	-0.127	-0.110
	(-24.40)***	(-1.39)	(-11.44)***	(0.64)	(-11.26)***	(-1.83)
totalland	0.042	0.032	0.052	0.002	0.044	-0.014
	(12.86)***	(1.94)	(8.69)***	(0.06)	(8.16)***	(-0.50)
totalland2	-0.001	0.001	-0.000	0.000	-0.001	0.000
	(-6.48)***	(0.74)	(-6.33)***	(0.13)	(-5.34)***	(0.12)
urban	0.428	0.434	0.414	0.073	0.791	0.342

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Table 2.2 – continued from previous page

	2002		2004		2006	
Variable	Log(Cons)	Variance	Log(Cons)	Variance	Log(Cons)	Variance
	(56.90)***	(10.10)***	(3.73)***	(0.12)	(2.92)**	(0.21)
inland	-0.019	-0.127	0.000	-0.165	0.005	-0.182
	(-1.90)	(-2.24)*	(0.02)	(-1.32)	(0.24)	(-1.54)
hill	-0.102	-0.222	0.016	-0.016	0.016	-0.031
	(-7.42)***	(-3.01)**	(0.57)	(-0.10)	(0.54)	(-0.19)
lowmountain	-0.155	-0.251	-0.078	-0.026	-0.093	-0.266
	(-12.36)***	(-3.74)***	(-3.03)**	(-0.17)	(-3.63)***	(-1.91)
highmountain	-0.237	-0.245	-0.218	0.192	-0.261	-0.144
	(-16.06)***	(-3.13)**	(-7.37)***	(1.10)	(-8.85)***	(-0.89)
region2	0.012	-0.117	-0.037	0.071	-0.044	0.202
	(1.16)	(-2.16)*	(-1.70)	(0.57)	(-2.03)*	(1.77)
region3	-0.119	0.240	-0.207	0.471	-0.226	0.177
	(-6.92)***	(2.69)**	(-6.72)***	(2.62)**	(-7.37)***	(1.11)
region4	-0.116	-0.017	-0.160	0.464	-0.170	0.192
	(-12.51)***	(-0.34)	(-8.72)***	(4.47)***	(-9.10)***	(1.91)
region5	-0.015	-0.070	-0.047	0.013	-0.018	-0.109
	(-1.47)	(-1.31)	(-2.30)*	(0.12)	(-0.88)	(-1.05)
region6	-0.027	0.316	0.039	0.224	0.139	0.513
	(-1.74)	(3.82)***	(1.26)	(1.21)	(4.47)***	(2.98)**
region7	0.255	0.271	0.222	0.595	0.220	0.402
	(25.39)***	(4.82)***	(10.55)***	(4.95)***	(9.80)***	(3.21)**
region8	0.068	0.093	0.056	0.297	0.110	0.200
	(8.19)***	(2.08)*	(3.47)***	(3.24)**	(6.68)***	(2.29)*
electricity	0.086	-0.077	0.059	0.206	0.077	0.156
	(6.89)***	(-1.23)	(2.03)*	(1.25)	(2.20)*	(0.88)
distanceavg	-0.004	-0.012	-0.013	-0.012	-0.006	-0.003
	(-5.62)***	(-2.89)**	(-7.71)***	(-1.26)	(-4.54)***	(-0.36)
_cons	8.369	-2.258	8.489	-3.451	8.647	-3.584
	(206.14)***	(-10.38)***	(95.89)***	(-6.76)***	(95.61)***	(-7.52)***
N	28806	28806	6554	6554	6828	6828

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Table 2.2 – continued from previous page

	2002		2004		2006	
Variable	Log(Cons)	Variance	Log(Cons)	Variance	Log(Cons)	Variance
R^2	0.470	0.020	0.356	0.019	0.344	0.015
F	911.592	21.283	128.720	4.528	127.538	3.615
P	0.000	0.000	0.000	0.000	0.000	0.000

Notes: t statistics in parentheses

* p <0.05, ** p <0.01, *** p <0.001

As can be seen from Table 2.2, the coefficient of age of household head is negative and significant in all three years 2002, 2004 and 2006, confirming that a household with an older head tends to have lower per capita consumption. The pattern is similar for the share of female members in a household. A household with a higher share of females has lower per capita consumption, but the marginal effect becomes smaller as the estimated coefficients are negative, significant and nonlinear.

As expected, in all three surveys when the coefficients of dependency burden are negative and significant, a household with many old or many young members tends to have a lower level of consumption. The correlation between the married status of the household head and household consumption is unclear when the signs of the estimated coefficients are positive but statistically insignificant.

The estimated coefficients reflecting the highest level of education of household members are significantly positive, except for the dummy for primary education in 2006. Within each survey, the size of these coefficients increases when household members have a higher level of education. This reflects the fact that a household with a higher level of education has a higher per capita consumption.

Similar to the household head and female share, total land owned by a household has a nonlinear relationship with household consumption. The land coefficients are significantly positive, and show that having more land increases per capita consumption at a diminishing rate. However, agricultural households tend to have lower consumption, as the dummy coefficients are significant and negative.

At the commune level, the results of regional dummies illustrate the difference among geographical regions. Compared to households living in Red River Delta (region

1), households in the South East (region 7) and Mekong Delta (region 8) tend to have higher consumption, reflecting the fact that economic growth in these regions is more dynamic. Conversely, households living in the South West (region 3) and North Central Coast (region 4) have lower consumption per capita. The differences between Red River Delta (region 1), North West (region 2), South Central Coast (region 5) and Central Highland (region 6) are ambiguous because the estimated coefficients are small and mostly insignificant. Within regions, households living in high mountains are more likely to have a lower per capita consumption. The estimated coefficients of electricity and distance to market indicate that easier access to a power supply or market facilities contributes to a higher level of household consumption. From the estimates of consumption and variance of disturbance term in Table 2.2, we next adopt Chaudhuri's measure to calculate each households vulnerability using Equation (19). As the calculation of poverty and vulnerability are sensitive to the choice of poverty line and vulnerability threshold, we apply 100%, 120% and 80% of the poverty line of each year, as defined by the General Statistics Office (GSO).

With Dutta et al's measure, vulnerability is defined as the shortfall from the reference line. Hence, after estimating households' future consumption using the above regressions, we calculate the reference line which is interpreted as the minimum living standard that a household should maintain in the future to be considered not vulnerable. Next, two functional forms representing two situations where the reference line and current income are first positively correlated, and secondly negatively correlated, are used for estimation and comparison[13]. Since there is no certain α suggested in the literature when estimating reference lines, we use various values of α satifying $0 \leq \alpha \leq 1$[14]. We also choose the poverty line of 100%, 120% and 80% of the actual poverty line for each year. Assuming that log consumption has a normal distribution, we estimate the likelihood that a household future consumption is lower than the reference line using Equation 2.11.

In both cases, households who have an estimated probability higher than a threshold of 0.5 are considered vulnerable and presented in Table 2.3. As can be seen in this table, applying the 100% poverty line with Dutta's measure, we get a mean

[13]Equations 2.9 and 2.10 proposed by Dutta et al. (2011) satisfy the condition that changes in current income do not translate to equivalent changes in the reference line.

[14]Our paper is different to Dutta's and Celidoni's papers in two ways. First, we use a regression to gauge future consumption instead of past income. Second, we estimate vulnerability for cross-sectional data rather than panel data. Celidoni (2013) uses α=0.5 while we use =0; 0.25; 0.5; 0.75; 1.

Table 2.3: Actual poverty rate and estimated vulnerability rate (%)

	2002			2004			2006		
Poverty line	100%	120%	80%	100%	120%	80%	100%	120%	80%
Actual poverty rate	23.95	37.12	11.51	18.39	30.34	8.83	16.32	27.40	7.51
Vulnerability rate of Chaudhuri's measure	13.00	28.55	3.41	9.07	19.28	4.25	6.25	14.82	1.51
Vulnerability rate of Dutta's measure (negative)	16.51	32.18	5.11	12.74	24.20	6.03	9.14	19.38	2.84

Source: Author's calculation from VHLSS 2002, 2004, 2006

vulnerability of 16.51 per cent in 2002, 12.74 per cent in 2004 and 9.14per cent in 2006. This means, on average, that Vietnamese households had 16.51 per cent probability of falling into poverty in 2002 and 12.74 per cent in 2004, and this declined to 9.14 per cent in 2006. Mean vulnerability from Chaudhuri's measure is slightly lower than that of Dutta's measure for all years. From the surveys, actual poverty rates are 23.95 per cent in 2002, 18.39 per cent in 2004 and 16.32 per cent in 2006. These different statistics of actual poverty and estimated vulnerability show that vulnerable households might not simultaneously be poor, and that poor households are not necessarily vulnerable. These results support a statement of the World Bank (1997) that "subsistence farmers in remote areas are almost always poor but are not particularly vulnerable to macroeconomic shocks."

Receiver Operating Characteristic curve (ROC)

Table 2.4 reports a summary of the area under the ROC curve from two measures of Chaudhuri (2003) and Dutta et al. (2011). The ROC indexes are always higher in the Dutta et al measure. For instance, with a 100% poverty line in the period of 2002-2004, the ROC indexes in the Dutta et al measure are about 0.79 and 0.73, respectively to negative and positive relationship between current income and reference line while the ROC index in the Chaudhuri measure is only 0.68. The number 0.79 in Dutta et al measure indicates that vulnerable households, as identifed by this measure, will have a 0.79 probability of falling into poverty. Apparently, the vulnerability index proposed by Dutta et al. (2011) is better at predicting poverty

TABLE 2.4: Compare predictive power between measure of Chaudhuri and Dutta (ROC area)

	2002-2004			2004-2006		
Poverty line	100%	120%	80%	100%	120%	80%
Chaudhuri	0.6783	0.7094	0.5928	0.6112	0.6600	0.5459
	(0.0116)	(0.0094)	(0.0142)	(0.0107)	(0.0094)	(0.0112)
Dutta	0.7277			0.6694		
(Positive, =0)	(0.0114)			(0.0119)		
Dutta	0.7941			0.7618		
(Negative, =1)	(0.0105)			(0.0117)		

Source: Author's calculation. Standard error in brackets.

than Chaudhuri (2003). Therefore, in the next two sections, we use the vulnerability index generated from Dutta et al's measure (negative correlation between current income and reference line, $\alpha = 1$) for poverty dynamic analysis.

Determinant of poverty

Table 5 reports the results for the probit model used to estimate determinants of household *ex post* poverty and impact of vulnerability on poverty. Specifically, the results are the respective marginal effect of the probit model. Using two panel datasets for 2002-2004 and 2004-2006, we find that *ex ante* vulnerability in previous periods translated to *ex post* poverty in the subsequent periods. For example, based on the 100% poverty line, a 1 per cent increase in the *ex ante* probability of falling into poverty in 2002 increases the *ex post* probability of poverty in 2004 by 0.36 per cent. Similarly, a 1 per cent increase in vulnerability in 2004 would increase the probability of being poor in 2006 by 0.37 per cent. Although the estimated effects changed across the choice of poverty lines, the coefficients of vulnerability are strongly significant in all cases.

As expected, a household with an older head, a higher female share or a higher number of dependents is more likely to be poor in 2002, as the coefficients are firmly significant. Those coefficients in 2004 and 2006 show similar effects, but the coefficients of female share in 2004 and 2006 for the case of the 100% poverty line are not significant. This is probably because of the overlap influence of the vulnerability variable.

The education coefficients, which are negative and significant, show that the higher the level of education, the lower the probability of poverty. Moreover, the probability of poverty declines as the highest level of education increases. Households with income only from agricultural activities face a higher probability of being poor. However, owning more land (regardless of type) tends to reduce the probability of poverty, as the coefficients are mostly negative and strongly significant. The commune coefficients confirm that households living in rural or high altitude areas, with difficult access to electricity and a longer distance to market will have a higher likelihood of being poor.

TABLE 2.5: Determinants of poverty (Probit results, dy/dx)

	Whether poor in 2002 (Probit results, dy/dx)			Whether poor in 2004 (probit results with VEP2002, dy/dx)			Whether poor in 2006 (probit results with VEP2004, dy/dx)		
Variable	100%	120%	80%	100%	120%	80%	100%	120%	80%
VEP				0.363***	0.531***	0.144***	0.366***	0.580***	0.153***
				(14.23)	(18.66)	(7.31)	(12.29)	(17.66)	(6.74)
headage	0.008***	0.011***	0.003***	0.004	0.008*	0.002	0.005	0.001	0.000
	(6.47)	(6.94)	(4.20)	(1.17)	(1.65)	(0.91)	(1.47)	(0.24)	(0.04)
headage2	-0.000***	-0.000***	-0.000***	-0.000	-0.000*	-0.000	-0.000	-0.000	-0.000
	(7.91)	(8.54)	(5.37)	(1.30)	(1.87)	(0.96)	(1.42)	(0.22)	(0.04)
femaleshare	0.488***	0.780***	0.206***	0.003	0.298	-0.005	0.146	0.274	0.104
	(10.07)	(12.42)	(7.41)	(0.03)	(1.53)	(0.08)	(1.22)	(1.52)	(1.44)
femaleshare2	-0.458***	-0.742***	-0.185***	-0.017	-0.312*	-0.048	-0.151	-0.274*	-0.086
	(10.39)	(12.96)	(7.35)	(0.14)	(1.76)	(0.75)	(1.40)	(1.67)	(1.36)
dependshare	0.240***	0.334***	0.096***	0.093***	0.177***	0.056***	0.065**	0.096**	0.022
	(21.59)	(22.91)	(14.87)	(3.08)	(4.00)	(3.50)	(2.38)	(2.29)	(1.42)
married	-0.023***	-0.034***	-0.010**	-0.015	-0.061**	-0.009	-0.039**	-0.036	-0.003
	(3.21)	(3.60)	(2.37)	(0.75)	(2.14)	(0.82)	(2.28)	(1.36)	(0.35)
primary	-0.024***	-0.022**	-0.020***	0.012	-0.030	-0.020**	-0.005	0.044	-0.009

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Table 2.5 – continued from previous page

	Whether poor in 2002 (Probit results, dy/dx)			Whether poor in 2004 (probit results with VEP2002, dy/dx)			Whether poor in 2006 (probit results with VEP2004, dy/dx)		
Variable	100%	120%	80%	100%	120%	80%	100%	120%	80%
	(3.07)	(2.03)	(5.20)	(0.59)	(0.92)	(1.98)	(0.27)	(1.31)	(0.88)
lowersecond	-0.088***	-0.106***	-0.055***	-0.007	-0.064*	-0.027**	-0.026	0.012	-0.030***
	(10.89)	(9.49)	(12.48)	(0.31)	(1.92)	(2.39)	(1.22)	(0.34)	(2.70)
uppersecond	-0.175***	-0.238***	-0.091***	-0.014	-0.068*	-0.050***	-0.081***	-0.011	-0.061***
	(17.99)	(18.54)	(15.71)	(0.51)	(1.70)	(3.30)	(3.14)	(0.28)	(4.12)
techschool	-0.285***	-0.391***	-0.126***	-0.084***	-0.192***	-0.060***	-0.116***	-0.105**	-0.076***
	(20.47)	(23.24)	(14.44)	(2.61)	(4.21)	(3.40)	(3.98)	(2.45)	(4.32)
highedu	-0.372***	-0.526***	-0.180***	-0.124*	-0.112		-0.150***	-0.152**	
	(17.04)	(22.31)	(10.93)	(1.88)	(1.64)		(2.85)	(2.19)	
arghh	0.099***	0.136***	0.044***	0.017	0.024	0.024***	0.014	-0.007	0.012*
	(19.10)	(20.22)	(14.23)	(1.22)	(1.17)	(3.00)	(1.07)	(0.35)	(1.66)
totalland	-0.021***	-0.031***	-0.007***	-0.031***	-0.056***	-0.013**	-0.017**	-0.035***	-0.003
	(9.47)	(10.34)	(5.83)	(2.81)	(3.58)	(1.96)	(2.34)	(3.08)	(0.89)
totalland2	0.000***	0.000***	0.000***	0.000**	0.000***	0.000	0.000	0.000	0.000
	(7.21)	(6.91)	(4.95)	(2.10)	(3.17)	(0.99)	(0.55)	(0.64)	(0.15)
urban	-0.169***	-0.251***	-0.071***	0.130	0.147		0.000	0.000	0.000

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Table 2.5 – continued from previous page

	Whether poor in 2002 (Probit results, dy/dx)			Whether poor in 2004 (probit results with VEP2002, dy/dx)			Whether poor in 2006 (probit results with VEP2004, dy/dx)		
Variable	100%	120%	80%	100%	120%	80%	100%	120%	80%
	(20.91)	(25.84)	(13.79)	(1.11)	(0.76)				
inland	0.012	0.023*	0.006	-0.005	-0.015	-0.003	-0.027	-0.010	-0.029**
	(1.25)	(1.91)	(1.00)	(0.18)	(0.40)	(0.23)	(1.12)	(0.25)	(2.20)
hill	0.036***	0.050***	0.020***	-0.057*	-0.090*	-0.036*	-0.023	-0.018	-0.017
	(2.79)	(3.00)	(2.71)	(1.65)	(1.83)	(1.71)	(0.73)	(0.37)	(0.95)
lowmountain	0.077***	0.103***	0.039***	0.020	-0.041	0.015	-0.020	-0.020	-0.005
	(6.83)	(6.87)	(6.11)	(0.66)	(0.92)	(0.91)	(0.72)	(0.46)	(0.34)
highmountain	0.136***	0.193***	0.066***	0.006	0.014	0.027	0.016	0.044	0.011
	(10.32)	(10.68)	(9.12)	(0.18)	(0.28)	(1.52)	(0.50)	(0.88)	(0.70)
region2	-0.013	-0.032**	-0.014***	0.041	0.053	-0.006	0.010	0.013	-0.000
	(1.26)	(2.40)	(2.61)	(1.51)	(1.41)	(0.44)	(0.40)	(0.35)	(0.04)
region3	0.082***	0.085***	0.059***	-0.004	0.122**	-0.016	0.097**	0.177***	0.071**
	(4.38)	(3.61)	(5.01)	(0.12)	(2.05)	(1.16)	(2.08)	(2.76)	(2.34)
region4	0.095***	0.107***	0.047***	0.056**	0.102***	0.042**	0.096***	0.144***	0.079***
	(9.35)	(8.92)	(7.28)	(2.33)	(3.08)	(2.37)	(3.62)	(4.20)	(3.94)
region5	-0.012	-0.024*	0.001	0.041	0.001	0.020	-0.022	-0.026	-0.007

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Table 2.5 – continued from previous page

	Whether poor in 2002 (Probit results, dy/dx)			Whether poor in 2004 (probit results with VEP2002, dy/dx)			Whether poor in 2006 (probit results with VEP2004, dy/dx)		
Variable	100%	120%	80%	100%	120%	80%	100%	120%	80%
	(1.23)	(1.95)	(0.10)	(1.53)	(0.03)	(1.12)	(1.04)	(0.81)	(0.58)
region6	0.024	-0.016	0.024***	-0.017	0.004	-0.006	-0.038	-0.068*	-0.006
	(1.59)	(0.81)	(2.75)	(0.65)	(0.09)	(0.41)	(1.64)	(1.76)	(0.47)
region7	-0.096***	-0.180***	-0.030***	0.004	0.025	-0.017	-0.001	-0.038	-0.007
	(11.99)	(16.69)	(6.52)	(0.14)	(0.66)	(1.33)	(0.06)	(1.09)	(0.57)
region8	-0.044***	-0.086***	-0.014***	0.023	0.069**	0.000	-0.027	-0.044*	-0.003
	(5.94)	(8.91)	(3.20)	(1.12)	(2.31)	(0.01)	(1.56)	(1.66)	(0.29)
electricity	-0.074***	-0.077***	-0.044***	0.030	-0.038	0.025	0.136***	0.138**	0.044**
	(7.05)	(5.00)	(8.37)	(0.96)	(0.79)	(1.43)	(3.39)	(2.28)	(2.31)
distanceavg	0.004***	0.008***	0.000	0.005**	0.009***	0.002*	0.003*	0.007***	0.000
	(4.97)	(7.43)	(1.41)	(2.53)	(2.71)	(1.91)	(1.94)	(2.99)	(0.70)
N	28,806	28,806	28,806	2,837	2,837	2,714	2,989	2,989	2,861

Notes: Vulnerability index using Dutta et al's measure. t statistics in parentheses

* p <0.05, ** p <0.01, *** p <0.001

TABLE 2.6: Summary contribution of *ex ante* vulnerability to *ex post* poverty (Probit model using 3-survey panel data from 2002-2006)

Variable	2002 to 2004	2002 to 2006	2004 to 2006	2002&2004 to 2006
VEP 2002 (100% poverty line)	0.375***	0.243***		0.184***
	(9.91)	(8.05)		(6.11)
VEP 2004 (100% poverty line)			0.323***	0.211***
			(7.52)	(5.36)
VEP 2002 (120% poverty line)	0.496***	0.399***		0.272***
	(12.78)	(11.54)		(7.06)
VEP 2004 (120% poverty line)			0.512***	0.349***
			(10.87)	(7.18)
VEP 2002 (80% poverty line)	0.146***	0.088***		0.062***
	(4.75)	(3.93)		(3.18)
VEP 2004 (80% poverty line)			0.102***	0.071***
			(3.67)	(3.03)

Notes:* p<0.1; ** p<0.05; *** p<0.01. Robust z statistics in parentheses.

Using the same approach for a longer panel dataset from 2002 to 2006, we find similar effects of vulnerability on poverty status in the later period (Table 2.6). All estimated coefficients of vulnerability are positive and significant. Using both the 2002 and 2004 vulnerability indexes for poverty determinant regression in 2006, we obtain a smaller effect in 2002 and a larger effect in 2004. For example, for the 100% poverty line, the effects are 0.184 and 0.211 respectively. This indicates that vulnerability may have a larger effect in the short term, and that effect tends to fall over time.

Role of vulnerability on poverty shift across time

Table 2.7 illustrates the movements in and out of poverty across surveys. In the panel sample extracted from the surveys of 2002 and 2004, the number of households escaping out of poverty is larger than the number falling into poverty. In particular, 421 households (around 53 per cent of the poor in 2002) moved out of poverty by 2004. In contrast, only 127 households (nearly 4 per cent of the non-poor in 2002) had fallen into poverty by 2004. Therefore, headcount poverty declined from 27.4 per cent to 17.3 per cent.

TABLE 2.7: Poverty transition matrix between 2002, 2004 and 2006

Status	Status in 2004			Status	Status in 2006		
in 2002	Poor	Non-poor	Total	in 2004	Poor	Non-poor	Total
Poor	375	421	796	Poor	316	249	565
	(12.93)	(14.51)	(27.44)		(10.31)	(8.12)	(18.43)
Non-poor	127	1,978	2,105	Non-poor	142	2,359	2,501
	(4.38)	(68.18)	(72.56)		(4.63)	(76.94)	(81.57)
Total	502	2,399	2,901	Total	458	2,608	3,066
	(17.30)	(82.70)	(100.00)		(14.94)	(85.06)	(100.00)

Source: Author's calculation based on the panel households in the sample data. Headcount ratio in the parentheses

In the panel sample extracted from the surveys of 2004 and 2006, headcount poverty decreased from 18.7 per cent to 14.94 per cent. A total of 249 households (approximately 44 per cent of the poor in 2004) had moved out of poverty by 2006. Conversely, 142 households, which account for 5.7 per cent of the non-poor in 2004, had fallen into poverty by 2006. In both panel samples, the proportion that moved into poverty is not large but the actual number of households falling into poverty from the first sample to the second sample doubled, implying that the contribution of vulnerability to poverty might be trivial but it had become increasingly important. A larger share of transient poverty (around 32 per cent moved both in and out of poverty in both periods) compared to chronic poverty (around 23 per cent) raises a concern that, given varying household consumption, the past governments achievement in poverty reduction could disappear if unexpected risks, both covariate and idiosyncratic, are to occur. According to World Bank (2000), between 1993 and 1998, the chronic poor accounts for 28.6 per cent of the population while the falling-into poor is about 4.8 per cent and the moving-out-of poor is 27.4 per cent totally. Compared to those results, chronic poverty in this study (at the period 2002 - 2006) is less serious but the speed of poverty reduction is slower. The effects of pro-poor programs on the near-poor are uncertain because the probability of falling into poverty fluctuates across surveys.

Tables 2.8 and 2.9 represent the major results of multinomial logit models used to examine the impact of vulnerability on poverty transitions across surveys. The base case is the category of household that is always non-poor in both surveys. Each table can be divided into three parts which correspond to three levels of the poverty line (100%, 120% and 80%).

Three columns in each panel contains two important pieces of information. Firstly, the coefficient presented in the third column of each panel is interpreted as the impact of vulnerability on the probability of transition from non-poor status in the previous survey to poor status in the next survey. Hence, a positive sign in the third column reveals a higher likelihood of falling into poverty. Secondly, the difference between the second and the first columns shows the probability of moving out of poverty relative to the probability of staying in poverty. A negative sign of the difference between the second column and the first column reflects less likelihood of moving out of poverty.

From 2002 to 2004, the coefficients of VEP are positive and highly significant in all columns (Table 2.8). These results in Column 3, which vary from 2.727 to 6.346, confirm that the higher vulnerability is, the greater the relative probability of falling into poverty. In addition, that the coefficient differences between the second and the first columns are negative in all cases suggests that a rise in vulnerability tends to reduce the relative probability of escaping poverty. The estimation for 2004 and 2006 obtains similar results (Table 2.9). The estimated coefficients for all levels of the poverty line are significant, except the coefficient of non-poor to poor for the case of 80% poverty line. The signs of third columns are positive and the differences between the second and the first columns are negative. In general, it could be argued that a policy alleviating vulnerability should not only prevent a household from slipping into poverty, but also encourage a household to escape from poverty.

Household characteristics and commune characteristics have slightly different impacts on poverty across the two periods. In the 2002-2004 period, marriage might help non-poor households not to fall into poverty but if households are already poor, the effect is insignificant. In contrast, having income from agriculture only increases the likelihood of slipping into poverty and non-poor households living in South West (region 3) and North Central Coast (region 4) are more likely to be poor compared to the Red River Delta (base case). (Table 2.8)

Akin to previous periods, econometric results from the 2004-2006 period shows that marriage and having more land appear to keep non-poor households from poverty. Similarly, the education level of household members tends to reduce the probability of being poor. Also, in this period, if non-poor households live in the South West (region 3), North Central Coast (region 4), they are more likely to fall into poverty (Table 2.9).

TABLE 2.8: Determinants of change in poverty status during 2002 and 2004 (multinomial logit)

Variable	100% Poverty line			120% Poverty line			80% Poverty line		
	poor→ poor	poor→ non-poor	non-poor→ poor	poor→ poor	poor→ non-poor	non-poor→ poor	poor→ poor	poor→ non-poor	non-poor→ poor
VEP	19.263***	16.173***	4.675***	18.403***	15.615***	2.727***	22.942***	20.167***	6.346***
	(0.935)	(0.856)	(0.772)	(0.836)	(0.772)	(0.497)	(1.582)	(1.491)	(1.377)
headage	-0.090*	-0.069	-0.033	-0.109**	-0.094*	0.010	0.052	0.087	-0.026
	(0.054)	(0.044)	(0.051)	(0.053)	(0.048)	(0.046)	(0.070)	(0.056)	(0.059)
headage2	0.001*	0.001	0.000	0.001**	0.001**	-0.000	-0.000	-0.001	0.000
	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
femaleshare	-9.268***	-5.336***	2.383	-11.443***	-9.638***	2.908	-6.550**	-4.730**	0.136
	(2.242)	(1.698)	(2.059)	(2.169)	(1.935)	(1.863)	(2.754)	(1.959)	(2.389)
femaleshare2	9.197***	5.215***	-2.052	10.306***	8.454***	-2.553	6.012**	4.824***	-1.193
	(2.073)	(1.586)	(1.878)	(2.009)	(1.809)	(1.659)	(2.583)	(1.807)	(2.333)
dependshare	-2.613***	-1.914***	1.013**	-3.912***	-3.668***	0.810*	-0.490	0.292	1.902***
	(0.565)	(0.434)	(0.499)	(0.553)	(0.505)	(0.434)	(0.724)	(0.488)	(0.636)
married	0.205	-0.100	-0.631**	0.176	0.213	-0.758***	0.530	0.375	-0.413
	(0.332)	(0.256)	(0.299)	(0.308)	(0.279)	(0.251)	(0.452)	(0.329)	(0.383)
primary	0.392	0.906**	-0.454	0.142	0.724**	-0.317	-0.329	0.337	-0.186

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Table 2.8 – continued from previous page

Variable	100% Poverty line			120% Poverty line			80% Poverty line		
	poor→ poor	poor→ non-poor	non-poor→ poor	poor→ poor	poor→ non-poor	non-poor→ poor	poor→ poor	poor→ non-poor	non-poor→ poor
	(0.386)	(0.365)	(0.330)	(0.351)	(0.367)	(0.299)	(0.389)	(0.326)	(0.371)
lowersecond	1.071***	1.717***	-0.544	1.308***	2.319***	-0.461	-0.415	0.380	-0.300
	(0.409)	(0.372)	(0.349)	(0.387)	(0.392)	(0.318)	(0.452)	(0.351)	(0.398)
uppersecond	1.405***	1.624***	-1.128**	2.826***	3.648***	-0.808**	-0.395	0.578	-2.237***
	(0.500)	(0.415)	(0.449)	(0.481)	(0.450)	(0.378)	(0.670)	(0.403)	(0.810)
techschool	0.857	1.487***	-0.997	3.349***	3.880***	-1.428**	-15.032	-0.443	-19.502
	(1.110)	(0.548)	(0.626)	(0.707)	(0.546)	(0.602)	(963.011)	(0.795)	(706.363)
highedu	-11.033	0.996	-14.583	4.171***	3.337***	-2.085**	-14.409	-0.657	-15.619
	(462.942)	(0.706)	(717.773)	(0.799)	(0.654)	(1.060)	(1,585.101)	(1.066)	(1,818.00)
arghh	-1.537***	-1.279***	0.539**	-2.287***	-2.392***	0.248	0.338	-0.117	0.477
	(0.271)	(0.205)	(0.223)	(0.279)	(0.258)	(0.204)	(0.417)	(0.221)	(0.293)
totalland	0.321***	0.323**	-0.126	0.369**	0.563***	0.066	0.052	0.066	-0.177
	(0.120)	(0.128)	(0.127)	(0.160)	(0.151)	(0.098)	(0.180)	(0.109)	(0.174)
totalland2	-0.007	-0.013	0.003	-0.012	-0.034**	-0.002	0.003	-0.001	0.012
	(0.006)	(0.012)	(0.006)	(0.016)	(0.016)	(0.005)	(0.011)	(0.006)	(0.012)
urban	-10.176	-12.785	1.484	6.268***	-7.361	-11.225	-13.769	-14.572	-14.451

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Table 2.8 – continued from previous page

Variable	100% Poverty line			120% Poverty line			80% Poverty line		
	poor→ poor	poor→ non-poor	non-poor→ poor	poor→ poor	poor→ non-poor	non-poor→ poor	poor→ poor	poor→ non-poor	non-poor→ poor
	(1,596.09)	(1,387.67)	(1.204)	(1.707)	(251.275)	(324.669)	(4,509.080)	(4,060.50)	(5,418.30)
inland	-0.305	0.011	-0.449	0.337	0.567	0.033	-0.983*	-0.414	-0.122
	(0.435)	(0.334)	(0.350)	(0.449)	(0.414)	(0.355)	(0.561)	(0.372)	(0.477)
hill	-1.379**	-0.990**	-0.826	-2.116***	-1.434**	-1.031*	-1.898**	-0.677	-0.882
	(0.635)	(0.475)	(0.538)	(0.633)	(0.581)	(0.537)	(0.949)	(0.565)	(0.842)
lowmountain	-1.470***	-1.546***	0.094	-2.371***	-2.146***	-0.250	-0.670	-0.537	0.395
	(0.547)	(0.453)	(0.415)	(0.564)	(0.538)	(0.437)	(0.665)	(0.467)	(0.539)
highmountain	-4.085***	-4.134***	-0.908	-3.740***	-3.849***	-0.456	-2.883***	-2.530***	0.301
	(0.720)	(0.649)	(0.603)	(0.668)	(0.659)	(0.599)	(0.861)	(0.693)	(0.636)
region2	0.413	0.438	0.691	-0.422	-0.377	0.928**	-0.347	0.670	-0.060
	(0.476)	(0.374)	(0.445)	(0.459)	(0.425)	(0.390)	(0.749)	(0.430)	(0.540)
region3	-4.431***	-4.157***	-1.412*	-1.770***	-2.195***	-0.398	-4.669***	-3.399***	-0.885
	(0.761)	(0.707)	(0.829)	(0.647)	(0.658)	(0.769)	(1.040)	(0.847)	(0.785)
region4	-1.184***	-1.412***	1.019***	-1.479***	-1.934***	0.929***	0.250	0.120	1.071**
	(0.426)	(0.347)	(0.386)	(0.405)	(0.380)	(0.344)	(0.626)	(0.376)	(0.434)
region5	-0.136	-0.530	0.475	-0.743*	-0.570	0.202	0.486	-0.254	0.305

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Table 2.8 – continued from previous page

Variable	100% Poverty line			120% Poverty line			80% Poverty line		
	poor→ poor	poor→ non-poor	non-poor→ poor	poor→ poor	poor→ non-poor	non-poor→ poor	poor→ poor	poor→ non-poor	non-poor→ poor
	(0.442)	(0.326)	(0.436)	(0.418)	(0.366)	(0.384)	(0.717)	(0.474)	(0.528)
region6	-2.594***	-2.390***	-0.383	-1.178*	-1.034*	-0.730	-1.928**	-1.425*	-0.057
	(0.703)	(0.646)	(0.694)	(0.630)	(0.628)	(0.719)	(0.944)	(0.752)	(0.666)
region7	-0.812	0.449	0.210	1.289***	1.422***	0.194	0.626	0.342	-1.893*
	(0.641)	(0.299)	(0.455)	(0.432)	(0.317)	(0.382)	(0.785)	(0.418)	(1.077)
region8	0.348	-0.026	0.410	0.696**	0.420	0.259	0.856	0.611*	-0.485
	(0.354)	(0.244)	(0.380)	(0.317)	(0.264)	(0.303)	(0.587)	(0.316)	(0.500)
electricity	-0.043	0.044	-0.589	-0.031	0.072	0.370	-0.055	0.268	-0.791*
	(0.470)	(0.444)	(0.427)	(0.444)	(0.449)	(0.508)	(0.552)	(0.475)	(0.431)
distanceavg	-0.048	-0.030	0.020	-0.011	-0.054	0.003	-0.041	-0.013	0.067**
	(0.035)	(0.033)	(0.034)	(0.035)	(0.036)	(0.036)	(0.045)	(0.038)	(0.034)
N	2,901	2,901	2,901	2,901	2,901	2,901	2,901	2,901	2,901

Notes: Base line case is *'non-poor'* in both surveys. Robust t statistics in parentheses

* p <0.05, ** p <0.01, *** p <0.001

TABLE 2.9: Determinants of change in poverty status during 2004 and 2006 (multinomial logit)

Variable	100% Poverty line			120% Poverty line			80% Poverty line		
	poor→ poor	poor→ non-poor	non-poor→ poor	poor→ poor	poor→ non-poor	non-poor→ poor	poor→ poor	poor→ non-poor	non-poor→ poor
VEP	21.845***	18.470***	4.150***	17.159***	14.096***	2.498***	27.930***	25.393***	4.426
	(1.364)	(1.308)	(1.192)	(0.839)	(0.780)	(0.633)	(2.557)	(2.512)	(3.112)
headage	0.070	0.123**	0.018	-0.009	0.038	-0.014	0.031	0.094	0.019
	(0.069)	(0.059)	(0.050)	(0.059)	(0.054)	(0.042)	(0.081)	(0.069)	(0.063)
headage2	-0.001	-0.001**	-0.000	0.000	-0.000	0.000	-0.000	-0.001	-0.000
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)
femaleshare	-3.482	-2.845*	3.021	-5.567***	-3.760**	0.371	-2.438	-3.601	4.091
	(2.194)	(1.682)	(1.900)	(1.952)	(1.694)	(1.575)	(3.089)	(2.223)	(2.663)
femaleshare2	2.727	2.360	-3.284*	5.320***	3.860**	-0.429	2.186	3.202	-3.391
	(2.002)	(1.551)	(1.714)	(1.800)	(1.550)	(1.447)	(2.804)	(2.050)	(2.278)
dependshare	-1.018*	-0.123	0.528	-2.378***	-1.815***	0.384	0.108	0.726	0.715
	(0.590)	(0.451)	(0.426)	(0.531)	(0.457)	(0.365)	(0.744)	(0.575)	(0.564)
married	-0.847***	-0.301	-0.517*	-0.492*	-0.245	-0.036	-0.256	-0.164	-0.777**
	(0.321)	(0.262)	(0.280)	(0.294)	(0.259)	(0.255)	(0.462)	(0.357)	(0.333)
primary	0.612	0.889**	-0.676**	0.594	1.171***	0.225	0.852*	0.667	-0.118

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Table 2.9 – continued from previous page

Variable	100% Poverty line			120% Poverty line			80% Poverty line		
	poor→ poor	poor→ non-poor	non-poor→ poor	poor→ poor	poor→ non-poor	non-poor→ poor	poor→ poor	poor→ non-poor	non-poor→ poor
	(0.430)	(0.386)	(0.291)	(0.399)	(0.400)	(0.284)	(0.488)	(0.436)	(0.360)
lowersecond	0.831*	0.946**	-0.992***	1.318***	1.684***	-0.315	0.206	0.723	-0.890**
	(0.445)	(0.393)	(0.296)	(0.413)	(0.406)	(0.292)	(0.529)	(0.452)	(0.392)
uppersecond	0.354	0.747*	-2.083***	1.695***	1.905***	-1.076***	-1.666*	-0.084	-1.542***
	(0.565)	(0.438)	(0.431)	(0.481)	(0.443)	(0.354)	(0.966)	(0.603)	(0.572)
techschool	0.818	0.808*	-1.896***	2.301***	1.923***	-1.353***	-0.260	0.561	-1.425**
	(0.588)	(0.472)	(0.454)	(0.506)	(0.470)	(0.392)	(0.790)	(0.584)	(0.620)
highedu	-11.677	-12.724	-14.914	-9.925	1.480**	-14.056	-12.873	-13.123	-14.588
	(328.140)	(371.328)	(467.327)	(190.555)	(0.598)	(288.975)	(604.777)	(621.683)	(747.564)
arghh	-0.510*	-0.154	0.259	-1.586***	-1.321***	0.039	0.153	0.708**	0.395
	(0.284)	(0.200)	(0.205)	(0.261)	(0.226)	(0.173)	(0.391)	(0.286)	(0.276)
totalland	0.398***	-0.063	-0.235*	0.572***	0.220	-0.098	0.588***	-0.104	-0.346*
	(0.148)	(0.138)	(0.139)	(0.206)	(0.142)	(0.149)	(0.174)	(0.163)	(0.187)
totalland2	-0.000***	-0.000	0.000	-0.000	0.000	0.000	-0.000**	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
inland	-0.201	-0.095	-0.617*	0.395	0.620	-0.336	-0.158	0.155	-0.994**

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Table 2.9 – continued from previous page

Variable	100% Poverty line			120% Poverty line			80% Poverty line		
	poor→ poor	poor→ non-poor	non-poor→ poor	poor→ poor	poor→ non-poor	non-poor→ poor	poor→ poor	poor→ non-poor	non-poor→ poor
	(0.470)	(0.363)	(0.345)	(0.438)	(0.394)	(0.303)	(0.634)	(0.581)	(0.431)
hill	-0.725	0.403	-0.805*	0.438	0.660	-0.484	-1.428	0.009	-1.482**
	(0.676)	(0.445)	(0.469)	(0.549)	(0.484)	(0.398)	(1.164)	(0.762)	(0.709)
lowmountain	-0.928	-0.420	-0.424	-1.121**	-0.837*	-0.429	0.058	0.627	-0.527
	(0.566)	(0.456)	(0.417)	(0.549)	(0.505)	(0.373)	(0.685)	(0.635)	(0.509)
highmountain	-3.748***	-3.348***	-0.184	-3.119***	-3.053***	-0.266	-1.057	-0.248	-0.358
	(0.725)	(0.650)	(0.483)	(0.662)	(0.629)	(0.452)	(0.765)	(0.710)	(0.573)
region2	0.060	0.076	0.252	0.192	0.340	0.484	0.473	1.203**	0.713
	(0.510)	(0.388)	(0.399)	(0.438)	(0.384)	(0.326)	(0.718)	(0.538)	(0.599)
region3	0.508	0.168	1.230**	1.589**	1.479**	1.955***	1.341*	1.338**	2.218***
	(0.712)	(0.634)	(0.519)	(0.662)	(0.643)	(0.470)	(0.802)	(0.676)	(0.659)
region4	1.193***	0.566*	0.860***	1.387***	0.931***	0.972***	2.210***	1.459***	1.564***
	(0.385)	(0.294)	(0.316)	(0.324)	(0.279)	(0.257)	(0.583)	(0.462)	(0.476)
region5	-0.184	-0.068	-0.557	-0.121	0.102	-0.294	-0.038	0.170	-0.827
	(0.492)	(0.360)	(0.459)	(0.403)	(0.332)	(0.338)	(0.754)	(0.611)	(0.825)
region6	-0.171	0.208	-0.835	-0.330	0.349	-0.434	-0.122	0.663	0.839

Continued on next page

Table 2.9 – continued from previous page

Variable	100% Poverty line			120% Poverty line			80% Poverty line		
	poor→ poor	poor→ non-poor	non-poor→ poor	poor→ poor	poor→ non-poor	non-poor→ poor	poor→ poor	poor→ non-poor	non-poor→ poor
	(0.784)	(0.706)	(0.659)	(0.669)	(0.640)	(0.521)	(0.869)	(0.712)	(0.708)
region7	-0.534	-0.270	0.135	-0.908*	-0.464	-0.307	-0.161	-0.487	-0.314
	(0.617)	(0.415)	(0.403)	(0.492)	(0.393)	(0.343)	(0.857)	(0.780)	(0.739)
region8	-0.584	0.361	-0.390	-0.205	0.343	-0.428	-1.115	0.913*	0.150
	(0.442)	(0.284)	(0.341)	(0.343)	(0.264)	(0.267)	(0.819)	(0.475)	(0.516)
electricity	3.688***	2.391***	0.631	3.033***	2.107***	0.774	2.627***	1.898**	0.568
	(0.837)	(0.802)	(0.557)	(0.570)	(0.573)	(0.515)	(0.884)	(0.811)	(0.583)
distanceavg	-0.107**	-0.093**	0.089***	-0.121***	-0.152***	0.018	-0.248***	-0.223***	0.027
	(0.044)	(0.042)	(0.034)	(0.037)	(0.038)	(0.031)	(0.058)	(0.055)	(0.037)
N	2,989	2,989	2,989	2,989	2,989	2,989	2,989	2,989	2,989

Notes: Base line case is *'non-poor'* in both surveys. Robust t statistics in parentheses

* p <0.05, ** p <0.01, *** p <0.001

2.7 Policy implication and conclusion

Vulnerability is distinct from poverty. Vulnerability is considered an *ex ante* measure. Therefore, understanding vulnerability is important for poverty alleviation policies in understanding the causes for the poor retaining that status, and the non-poor falling into poverty.

Using two panel data extracted from the Vietnam Household Living Standard Surveys in 2002, 2004 and 2006, this paper analyzes vulnerability as expected poverty in Vietnam. We firstly measure household vulnerability in Vietnam across three separate surveys from 2002 to 2006. Then we examine the determinants of *ex post* poverty as well as *ex ante* vulnerability, and finally we evaluate the role of *ex ante* vulnerability on movement into/out of poverty during the sample periods.

Our main findings are that, (i) Vulnerability estimation using the reference line is more appropriate than using the actual poverty line for poverty prediction in the case of Vietnam; (ii) *ex ante* vulnerability in previous periods can translate to *ex post* poverty in subsequent periods, though both vulnerability and the incidence of poverty tend to fall over time; (iii) vulnerability of the poor is likely trap them in poverty; and (iv) vulnerability of the non-poor can propel them into poverty.

In line with previous research, this sudy confirms the close connection between *ex ante* vulnerability and *ex post* poverty. Therefore, this study suggests that targeted interventions for poverty reduction in Vietnam should take account of household vulnerability because poverty based on static indicators are likely to be ineffective if covariate and idiosyncratic shocks considerably affect household living standards. Since the vulnerable may not be the same group as the poor, the interventions should differ to ensure the non-poor do not fall into poverty and the poor can find a way to get out of poverty. In addition, our study proves that easier access to a power supply or market facilities contributes to a higher level of household consumption. Hence, pro-poor policies should focus on the infrastructure use of households and be integrated with the migration policies.

In the next study, we will measure vulnerability as low expected utility (VEU) so that we can have a clearer view of negative shocks affecting household consumption and their coping strategies. This information is also essential for poverty alleviation policies.

Chapter 3

Household vulnerability as low expected utility and responses to risks in rural Vietnam

3.1 Introduction

Households around the world are confronted with different types of negative shocks or risks. These risks can be idiosyncratic, and happen to individuals or households – for example illness, death, or a family member's loss of income. They might also be covariate, occurring in entire communities and regions, such as natural disasters or variations in commodity prices. In developing countries where formal insurance and access to credit are often absent or limited, risks or adverse shocks cause a devastating impact on households. Therefore, an important strand of development economics studies risks and their outcomes in developing countries. The term 'vulnerability' in the literature has emerged from this context and has been associated with interest in measuring vulnerability. For the purpose of intervention policies which aim to improve household's welfare, a full set of five crucial questions related to vulnerability should be assessed: 1) what is the extent of vulnerability? 2) who is vulnerable? 3) what are the sources of vulnerability? 4) how do households respond to shocks? and 5) what are the gaps between risks and risk management mechanisms? (Hoddinott & Quisumbing 2003*b*). However, very few studies to date have attempts to address all these issues in a single study. Therefore, household welfare under risks

has probably not been depicted comprehensively and there is real need for further studies integrating both vulnerability estimation and coping strategy analysis.

Vietnam is a developing country with a high need for vulnerability assessment, due to its high potential risks and the inadequacy of its social safety nets. The country's relatively high growth rates have been followed by a high level of income inequality. Unemployment insurance commenced in 2009, but few people have benefited from because of the bureaucratic procedures. In addition, few households have access to the formal credit market as a consequence of asymmetric information on the financial market. Commercial banks favor giving commercial loans over personal loans. Credit cards are usually only for high and stable income individuals. Also, households in some regions frequently suffer from droughts, floods and tropical storms. Consequently, household consumption levels vary considerably and sadly, low-income households are more likely to fall into, or stay in, poverty. That is why it is necessary to have studies which include both vulnerability assessment and coping strategies in response to negative shocks.

This study responds to a gap in literature and the need for anti-poverty policies in the Vietnam context. We first adopt the approach of Ligon & Schechter (2003) to measure vulnerability as low expected utility (VEU). One advantage of this approach is that we can distinguish sources of vulnerability. Second, we apply the multivariate probit model to investigate household response to shocks. Finally, we look into the effectiveness of the existing risk management mechanism. To the best of our knowledge, this paper is the first analysis using the data set from Vietnam Access to Resources Household Survey (VARHS) to estimate vulnerability as low expected utility (VEU) in Vietnam. Also, this is the first work that combines vulnerability estimations, sources of vulnerability and responses to risks in a single paper.

The rest of the paper is structured as follows. Section 2 is a literature review focusing on concepts of vulnerability and previous studies. Section 3 briefly summarizes an overview of risk and coping strategies in Vietnam. Section 4 describes the data and analytical framework used in the empirical analysis. Section 5 presents the results, and the conclusion with policy implications is the last section.

3.2 Literature review

Concepts of vulnerability

The concept of vulnerability is interpreted in various ways in different contexts. In economics, the concept of vulnerability emerges from that of poverty. From the traditional view of poverty as reflected in World Development Report 1990, the notion of poverty consists of material deprivation and low achievement in education and health (World Bank 1990). Later, the term 'vulnerability' is mentioned when examining the relationship between poverty and uncertainty of income (Morduch 1994). Since then, 'vulnerability' is often used to extend the traditional concept of poverty. While poverty measurement is based on fixed standards such as income or expenditure during a short period of time, vulnerability broadens the poverty notion by including the potential risk of adverse shocks such as income loss, bad health (idiosyncratic risks) and natural disasters (covariate risks). For example, in the work of Glewwe & Hall (1998) and Cunningham & Maloney (2000), vulnerability is defined as exposure to negative shocks to welfare. It is also defined as "the probability or risk today of being in poverty or to fall into deeper poverty in the future" (World Bank 2001) or "the ex-ante risk that a household will, if currently non-poor, fall below the poverty line, or if currently poor, will remain in poverty" (Chaudhuri 2003).

In an excellent summary of risk and vulnerability, Hoddinott & Quisumbing (2003*b*) classify approaches to assessing vulnerability into three methods according to their distinct definitions: vulnerability as expected poverty (VEP); vulnerability as low expected utility (VEU); and vulnerability as uninsured exposure to risk (VER). All three methods predict changes in welfare, but with different welfare measurements. The difference between VEP and VEU lies in their definitions of welfare: in VEP consumption is regarded as welfare, while VEU uses utility derived from consumption. While VEP and VEU commonly use a benchmark for a welfare indicator (z) and estimate the probability of falling below this benchmark (p), VER evaluates whether downside risks or observed shocks result in welfare loss. In other word, VER assesses the household's ability to smooth or insure consumption when faced with income shocks, while maintaining a minimum level of assets.

In this paper, we employ the methodology that is used in the VEU estimation[1]. This is well known through the work of Ligon & Schechter (2003) and summarized in the review paper of Hoddinott & Quisumbing (2003*b*)[2]. Surprisingly, there are few studies using the VEU approach, and the major reason being that researchers do not have panel data of the quality required for this approach. Following is summary of a selection of influential empirical works.

VEU in previous studies

The VEU measure is merely the difference between the utility a household would derive from consuming some particular bundle with certainty and the household's expected utility of consumption. With this measure, vulnerability can be decomposed into distinct components such as poverty, covariate risk, idiosyncratic risk, and unexplained risk plus measurement error. Unfortunately, there are few empirical works that apply or modify the VEU method in order to measure vulnerability, and the mixed results across studies largely depend on the duration of the panel data sets and the actual environments at the time of the surveys.

Ligon & Schechter (2003) apply their own method with a data set from Bulgaria which includes 2,287 households in a monthly panel data conducted over one year. They choose food spending as the measure of consumption and find that the welfare of the average Bulgarian household is 11 per cent less than it would be if there was no inequality, and an additional 3 per cent less than it would be if there was no aggregate risk. Idiosyncratic risk originating from observed sources such as income shocks, unemployment incidence, changes in pensions is significant, but not important, in terms of magnitude. Later, Ligon & Schechter (2004) conduct Monte Carlo experiments with both Vietnamese and Bulgarian data sets to compare the performance of different vulnerability measures and suggest that when the environment is stationary and consumption spending is measured without error, the most appropriate estimator is one suggested by Chaudhuri (2003). The authors also suggest that if the vulnerability measure is sensitive to risk, but consumption is measured with error, the estimator recommended by Ligon & Schechter (2003) often obtains

[1]The methodology of VEP estimation from Chaudhuri (2003) is adopted in Chapter 2 of the thesis.

[2]Recently, most empirical works have been derived from these papers, so they have presented similar reviews on methodology (Jadotte 2011, Jha et al. 2010, 2013). The review of methodology in this paper is drawn from the above papers.

the best results. However, if the distribution of consumption is non-stationary, a modified estimator proposed by Pritchett et al. (2000) is preferable. This finding confirms our choices of vulnerability estimators as we use the VEU approach of Ligon & Schechter (2003) to complement the VEP approach of Chaudhuri (2003).

A study by Ersado (2006) analyses rural vulnerability in Serbia using panel data for the period 2002-2003 and finds that risk contributes 30 per cent of household vulnerability, while poverty accounts for 70 per cent. Households and regions where agriculture is the main activities and the major source of income are more likely to be at risk of vulnerability than those with a higher income share from non-agricultural sources. The author also determines that vulnerability to poverty and risk is considerably linked with durable asset ownership and access to communications services. The study confirms the association between vulnerability and weather shocks and topography in rural Serbia.

Gaiha & Imai (2008) apply VEU for a panel of 183 households to measure vulnerability in rural India. They decompose household vulnerability into poverty, covariate risks, and idiosyncratic risks. According to the authors, idiosyncratic risks represent the largest share (37%), ahead of poverty (35%) and covariate risks (22%). The landless and small farmers are seriously vulnerable, despite some degree of risk-sharing. However, a study by Jha et al. (2010) in Tajikistan shows that poverty and inequality determined 81 per cent of the vulnerability. This paper also finds that household idiosyncratic risk is moderate and, surprisingly, covariate shocks are favorable and reduce vulnerability.

One of the rare studies integrating both vulnerability estimation and coping strategies analysis is the interesting work of Jha et al. (2013). The authors use VEU to measure vulnerability in rural India during the period of 1999-2006, and demonstrate that poverty and idiosyncratic components account for the largest portion of household vulnerability. To cope with risks, households depend heavily on informal instruments such as their own savings, transfers or capital depletion. They also choose to participate in government programs to alleviate the adverse effect of covariate risks. This study highlights that household consumption and income exhibit correlated variation, implying that existing informal insurance instruments are inadequate to sustain household consumption against income shocks. The paper proves that a coping strategy exploiting government programs has reduced vulnerability induced by idiosyncratic risks.

Coping strategies in previous studies

There have been several studies focusing on the effect of a particular shock and the resultant household coping strategies. One of the interesting illustrations of the impact of shocks comes from a study of Carter et al. (2007). Figure 3.1 – extracted from that study – confirms the view that a random event (flood, drought, illness, a period of unemployment) can have a permanent effect on a household (Calvo & Dercon 2005, Dercon 2004). Take, for example, a wealthier household w has asset stock at A_{bw} while a poor household p has asset stock at A_{bp}. If there are no shocks, asset stocks of both households will follow the dash lines and finally converge. In the wake of the shock, the rich household and the poor household are left with asset stocks A_{sw} and A_{sp}, respectively. In this case the asset stock level of the poor household falls below the poverty trap threshold A. The shock may also reduce the current income by an amount of ε. Consequently, a poor household with less ability to cope with the shock will be unable to accumulate assets and thus remain in the poverty trap, while a wealthier household can recover to the normal path of asset stock.

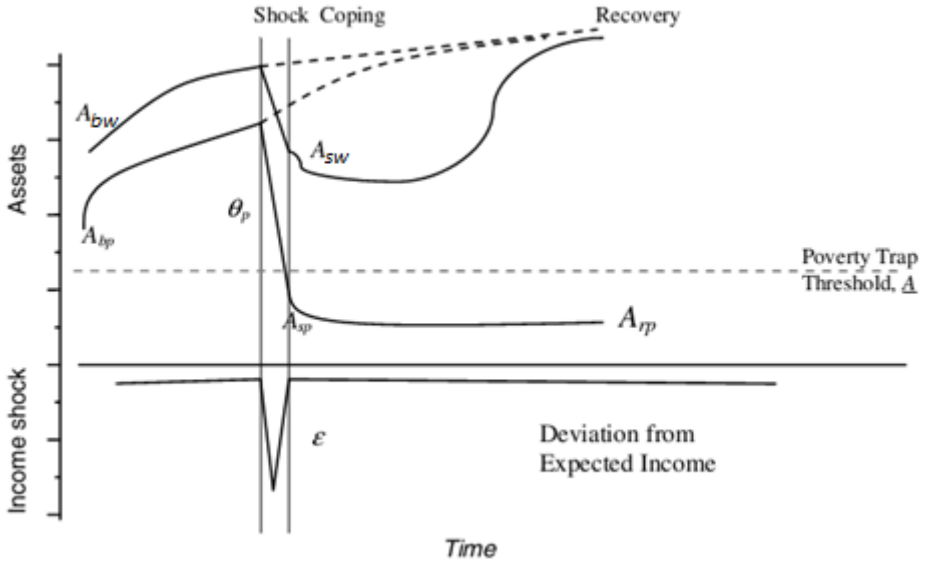

FIGURE 3.1: Assets shocks and poverty traps.
Source:Carter et al. (2007)

Empirical studies have been conducted using various approaches and for various countries. For example, Carter & Lybbert (2012) show that low-income households in Burkina Faso smoothed their asset, but not their consumption, in response to

weather shocks, and then fell into poverty traps. This result is similar to the findings of Kazianga & Udry (2006). They find little evidence of consumption smoothing. The analysis shows that there is almost no mechanism for sharing risk, and households have to adjust grain stocks in order to smooth out consumption fluctuations. Their research concludes that consumption smoothing in Burkina Faso is far from complete smoothing. A cross-sectional study of Knight et al. (2015) reveals that health shocks (death or serious illness) and economic shocks (unexpected price increments for basic necessities) are among the most common shock types for households in KwaZulu-Natal, South Africa. To cope with shocks, most households adopt behaviour-based coping strategies such as reduced consumption and spending, and other changes to work or living arrangement while assistance-based and asset-based strategies are limited. The fact that households are not able to smooth their consumption directly affect children's nutrition intake and potentially results in their long term developmenal and eductional progress.

Similar research has been done in Britain (Scott & Walker 2012). The authors examine the interwar strategies that working-class British households used to smooth consumption over time, and to guard against negative contingencies such as illness, unemployment, and death. They find that "households made extensive use of expenditure-smoothing devices. Families' reliance on expenditure-smoothing is shown to be inversely related to household income, while the family life cycle, especially the years immediately after new household formation." Other research conducted for a developed country is the work of James et al. (2007). The authors merge U.S. data from over 20 cross-section surveys based on nearly identically-worded questionnaires, and collect more than 32,000 working-class families interviewed between 1879 and 1909. They decompose annual income into permanent and transitory components for each worker in the sample. Their analytical results present strong evidence that working class American households used their own savings to smooth consumption in the face of volatile incomes before social insurance.

Gerry & Li (2008) apply a bootstrapped quintile regression to the Russian Longitudinal Monitoring Survey data to investigate how individuals cope with fluctuations in consumption. Their results indicate that small households residing in urban areas with married and educated heads are more capable of smoothing consumption. They show that the labor market is an important channel because it not only allows households to smooth their consumption but also exposes them to job loss risk. Both

transfers from relatives or friends, and home production can be viewed as important coping strategies for the most vulnerable.

Skoufias (2004) uses a panel of households in Bulgaria with monthly data collected in 1994 to investigate the extent to which households are able to smooth their consumption from income fluctuations. This analysis shows that only a part of consumption is maintained against idiosyncratic risks to income. In most situations, households choose to adjust their non-food expenditures and to borrow from credit markets. This study also indicates that inter-household transfers have limited impact on protecting consumption. Fluctuations in food prices have a larger influence on food consumption than fluctuations in household income. Similar research was done by the same author in the context of Russia (Skoufias 2003).

Using a panel data for Indonesia, Gertler & Gruber (2002) demonstrate that major illness induces significant economic costs, and is associated with the fall in consumption. Similarly, Gertler et al. (2009) prove that micro-financial savings and lending institutions can help Indonesian families smooth consumption after a major illness. Jalan & Ravallion (1999) observe, unsurprisingly, that wealthier Chinese households are better able to insure consumption against income shocks. Studies by Rosenzweig & Wolpin (1993) and Fafchamps et al. (1998) find that the sale of stocks can help insure consumption. Empirical results across countries also advocate that households find it difficult to cope with all income shocks, especially those with low assets (Harrower & Hoddinott 2004, Skoufias & Quisumbing 2005).

VEU and coping strategies in Vietnam

Only a few papers use VEU to estimate vulnerability in Vietnam, but a number of studies explore risks and household responses to risks. Unfortunately, there is no paper combining vulnerability estimation and coping strategies analysis, even though these two issues are highly correlated.

Tran (2014) uses data in three provinces collected in 2007, 2008 and 2010 in Vietnam with a discrete time proportional hazard model to examine which household groups recover quickly from negative shock and the effectiveness of coping strategies on the recovery. The author demonstrates that natural disasters and crop losses are the major shocks for rural households but business and health shocks bring more losses and are harder to recover. Shocks cause more adverse effects on poor households

because their livelihoods are more dependent on natural conditions, their assets are more exposed to shocks, and their asset stocks are too small to stay stable when shocks occur. The author notes that a households physical assets have positive effects on the recovery, but a households human capital has weak or insignificant effects on the recovery.

Tuyen (2013) investigates the relationship between farmland loss (due to urbanization and industrialization) and households' livelihood strategies in a sub-urban district of Hanoi, Vietnam. The results provide evidence that land loss is associated with a higher probability of adopting a single nonfarm activity, such as informal paid jobs or household businesses. The adaption helps mitigate their dependence on farmland and help improve their welfare.

Montalbano & Magrini (2012) estimate vulnerability from trade openness using two different sets of Vietnamese household surveys (VLSS and VHLSS) in the period of 1992-2008. The empirical results prove that vulnerability to poverty had a decreasing trend in this period, along with the decreasing trend of poverty. An adjusted VEU estimation shows that the share of poverty component of vulnerability reduced, but the share of risks increased, especially in trade related sectors. The authors assert that trade openness induced vulnerability.

Wainwright & Newman (2011) use household level panel data in three rural provinces from Vietnam to examine household's smooth consumption overtime, and how this depends on the presence of insurance and saving instruments. In general, they find that households deplete their stock of liquid assets when they are exposed to either covariate or idiosyncratic income shocks. The ability to cope with covariate shocks depends on their receipt of public and private transfers. The ability to cope with insurable idiosyncratic income shocks depends on insurance claims serving to reduce the disposal of livestock holdings. The authors suggest that household savings in the form of cash and gold have an important role in consumption smoothing in the event of idiosyncratic shocks. Borrowing is increased in both covariate and idiosyncratic shocks, especially for wealthier households. The analysis also confirms the role of the insurance market and the need to improve the activities of this market.

Hasegawa (2010) examines risk-coping strategies against various types of shocks using the Vietnamese Household Living Standard Survey in 2002 and 2004. The results suggest that productive fixed assets such as perennial crops, gardens and aqua-culture farms are disposed due to medical shocks, while non-productive liquid

assets such as bicycles, radios/cassettes and furniture are used in coping with income shocks or food-lack shocks. As the non-productive liquid assets can easily be sold, they are considered as precautionary savings for income shocks in farm households. This types of precautionary saving might be encouraged by the lack of financial institutions in rural areas, distrust of currency and high economic growth. Hence, health shocks might be more catastrophic than income shocks because loss of productive assets will seriously ruin a household's economy in the long run. However, neither monetary saving nor gold are utilized forms of coping with risks in farm households.

Other studies exploring poverty dynamic and vulnerability in Vietnam include Giang & Pfau (2009), Povel (2010), Imai et al. (2011) and especially studies from the project 'Impact of shocks on the vulnerability to poverty: Consequences for development of emerging Southeast Asian economies' by the German Research Foundation with its many contributing authors (Klasen & Waibel 2010).

3.3 Overview of the risks and coping strategies in Vietnam

This section summarizes the causes and consequences of common idiosyncratic and covariate shocks in Vietnam. Major information comes from a Vietnam development report of World Bank (1999). The findings in that report was based on the first and the second large scale household surveys in Vietnam (VLSS93 and VLSS98) implemented by the World Bank, as well as Participatory Poverty Assessments across regions undertaken by Oxfam and Action Aid Vietnam. The actual level of shocks and their consequences might be different now, but the pattern is very similar.

Idiosyncratic shocks

A chronic illness or death of a household member is one of the most common causes of households' extreme hardship. The cost of treatment is relatively much higher for the poor, especially when they have to go beyond the commune health center to receive treatment for a serious illness. On average, an individual in the poorest quantile has to pay 22 per cent of his/her annual nonfood expenditure for one remedial visit to a public hospital, while the equivalent figure for an individual in the richest quantile

is only about 5 per cent. The VLSS98 data shows that households in the lowest quantile spent 30 per cent of their nonfood expenditure on healthcare services and the opportunity cost due to poor health was around 25 per cent of their annual per capita consumption expenditure. Newly formed households are particularly vulnerable to the health problems (World Bank 1999).

The risk of failure can discourage households from investment which could have expanded the sources of income and reduced vulnerability in the future. In a typical case, households take a loan to invest in new production activities. However, if the investment is not successful, households have to compensate for the income deficit by other means, such as taking another loan, or selling assets, and their wellbeing would consequently deteriorate. Unfortunately, available options to diversify the farming activities in rural Vietnam also carry risk of failure: livestock is susceptible to disease and theft; crops are sensitive to bad weather and vermin; fruit trees and coffee trees can be ruined by frost in the highland areas; and farming profit can fluctuate rapidly and wildly, along with market conditions (World Bank 1999).

The risk can be reduced by better extension services and veterinary services. However, poorer households with less education often find it difficult to approach these types of services. An analysis of VLSS98 reveals that just only about 9 per cent of rural households in the lowest quantile reside in a commune with an agricultural extension agent. The problem is more serious in the case of highland areas which have limited access to many types of agriculture services (World Bank 1999).

Covariate shocks

In the rural villages of Vietnam, economic shocks and crises occur in two major forms: Loss of crops as a result of drought, flood, storms, wind damage, landslides and pest damage; and loss of livestock owing to epidemics. In urban areas, households also face fluctuations in the labor market (World Bank 1999).

The Vietnam National Committee for the International Decade for Natural Disaster Reduction (VNCIDNDR) has estimated the respective frequency of floods and typhoons as high and droughts as medium. On average, the Vietnams coast annually experiences four to six typhoons, which predominantly affect the center and north of the country (VNCIDNDR 1994). This phenomenon explains the slower growth in the Central and Northern provinces. An official document in 1992 reported that 62

per cent of the population and 44 per cent of the country were regularly influenced by typhoons, with around 250 persons killed each year (Vietnam MWR and UNDP 1992)[3]

Livestock accounts for an important part of household assets, so livestock death and disease are considered as main factors leading to poverty. A common report appear in the Participatory Poverty Assessments (PPAs) in different rural provinces is that: *"when your buffalo dies, it may take you as long as five years for the household to recover"* (Action Aid Vietnam 1999).

The slowdown in national and regional economic growth due to macroeconomic shocks, seems to have a limited effect on rural households because they earn little income from the farm. However, urbyan households notice the remittances falling immediately, and unskilled labor find it harder to have a job due to the cutbacks of local enterprises (Bond 1999).

Coping strategies

According to the results of the Participatory Poverty Assessments (PPA)[4] reported in World Bank (1999), in general, for poor households the first coping strategy is to search for help from their family, friends, neighbors. Next, some program from local communes might be of help. Households' coping strategies can be arranged in order such as: borrowing money or food, reducing expenditure (suffering illness at home or talking children out of school), searching for jobs (even for children), and selling assets (cattle or land).

Borrowing money or food is one of the most common ways to cope with a sudden drop in household properties. The borrowing is mainly from the informal sector because loans from the formal sector are not readily available to the poor and the procedures are too complicated to make funds available quickly. The easiest way for poor households to cope in troubled times is to reduce consumption and living with

[3]In the period from 1971 to 1994, more than six million tons of rice production was lost due to flood and typhoon damage in Vietnam (Benson, 1997). In five years from 2002-2006, natural disasters killed 1,700 people and caused losses estimated at VND 75,000 billion of assets. More on the impact of natural disasters can be found in National Strategy of Natural Disaster Prevention, Response and Mitigation by 2020, which can be downloaded at `http://www.isgmard.org.vn/NationalPrograms.asp`.

[4]Four provinces chosen to implement PPA were Ho Chi Minh City, Tra Vinh, Ha Tinh, Lao Cai.

ill-health. For example, they reduce the number, size and quality of daily meals. People can also be found to be living with ill-health in order to avoid the cost if consultations and treatment.

Poor households in Vietnam often shift labor from agricultural tasks to cash-earning tasks to respond to negative shocks affecting well-being. Day labor is the major source of cash for poor households, but the demand for labor is seasonal and unstable. Poor households have additional incentive to pull children out of school in order to supplement labor deficiency. Child labor not only results in more cash (by working for cash or helping adult labor with household chores) but it also reduces the costs of fees, books, pens as well as other contributions to student insurance and school construction funds. For primary production laborers in the case where they cannot find a job, migration to other places is another solution. Households then immediately reduce food intake and depend largely on the remittances sent back. In fact, some regions have very high percentages of either temporary or permanent migrant workers.

Households with livestock or land have to sell these assets in times of hardship. In urban areas, households tend to sell their houses if they own one. Cash savings have a trivial role in coping with shocks since the facilities for saving cash are not popular in rural areas, and thus households habitually keep livestock as a form of saving. Some very poor households turn to common property as a last resort. For example, they cut wood from forests to make extra money.

At the same time, the formal safety net has low coverage and is only partly targeted, while the formal financial sector is underdeveloped so that households cannot save or borrow money easily. In the case of household specific shocks, the community can help to some extent, but as poor households frequently reside in poor communities, the amount of financial assistance from friends, relatives and other informal networks is very limited. Consequently, households have to depend mainly on their own resources to cope with unexpected shocks.

3.4 Data and analytical framework

Vietnam Access to Resources Household Surveys (VARHS)

Data for this empirical analysis is extracted from four waves of Vietnam Access to Resources Household Survey (VARHS) implemented in 2006, 2008, 2010 and 2012. The VARHSs are longitudinal datasets which have been collected biannually by the University of Copenhagen (Denmark) in collaboration with the Central 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).

These surveys were conducted in rural areas of 12 provinces[5] of Vietnam in the summer of each year, creating a balanced panel of 2,045 households spread across 161 districts and 456 communes. They were all carried out during the same three-month period each year to maintain consistency and to facilitate appropriate comparisons over time. The VARHS investigates several issues relating to access to resources of Vietnamese rural households as well as the obstacles to improve their livelihood situation. Together with detailed demographic information on household members, the surveys contain questions on household assets, savings, credit (both formal and informal), formal insurance, shocks and risk response, informal safety nets and the networks of social capital (Wainwright & Newman 2011). There is also various information on communes where the households were living at the time they were surveyed.

There are approximately 3,000 households in each survey, of which around 2,000 households were interviewed repeatedly in all four surveys. However, after investigating outliers[6], checking missing data and matching household data with commune

[5]They are evenly distributed throughout Vietnam, in seven out of eight regions, with Ha Tay in Red River Delta; Lao Cai and Phu Tho in Northeast; Lai Chau and Dien Bien in Northwest; Nghe An in North Central Coast; Quang Nam and Khanh Hoa in South Central Coast; Dac Lac, Dac Nong and Lam Dong in Central Highland; and Long An in Mekong River Delta. These provinces represent the regional climate and geography throughout the country. However, while the sample is statistically representative at the provincial, it is not so at the national level (Markussen et al. 2012)

[6]We follow Deaton (1997) to investigate outliers that do not relate to the main body of the data. Specifically, we drop all households with total income less than or equal to zero. We also eliminate households with total income higher than 200 thousand VND (2006); 300 (2008); 400 (2010); 500 (2012). These levels are simply too high for even average households in urban areas.

data, we have a balanced panel containing 1,215 households over four surveys, creating 4860 observations[7]. A brief description of the explanatory variables used in this analysis is provided in Table B.1 of Appendix B.

That the number of households in the panel is much smaller than in a single survey is a cause for concern for sample attrition or selection bias. Therefore, we check the presence of attrition bias by comparing the mean of the main variables of dropped samples with that of the final panel data (Sparrow et al. 2012), or compare the means of variables between full sample and the panel (Jha et al. 2013) and confirm that households were randomly excluded from the final panel data set and that this does not lead to a selection biased problem.

Vulnerability as expected utility (VEU)

Ligon & Schechter (2003) define vulnerability as the variation between the utility derived from a certainty-equivalent consumption (z_{ce}) at and above which the household would not be considered vulnerable and the expected utility of consumption. This certainty-equivalent consumption is similar to the poverty line. Consumption of household (c_i) has a distribution that illustrates different states of the world, so the form of vulnerability measure is given below:

$$V_i = U_i(z_{ce}) - EU_i(c_i) \tag{3.1}$$

where U_i is a weakly concave, strictly increasing function. The equation can be rewritten as:

$$V_i = [U_i(z_{ce}) - U_i(Ec_i)] + [U_i(Ec_i) - EU_i(c_i)] \tag{3.2}$$

The first bracketed term is the variation between utility at z_{ce} and utility at expected consumption (c_i) of household i. The second term captures the risk (both covariate and idiosyncratic risks) faced by household i. It can be decomposed as shown below:

$$\begin{aligned} V_i = [U_i(z_{ce}) - U_i(Ec_i)] & \quad \text{[Poverty or inequality]} \\ +[U_i(Ec_i) - EU_i(E(c_i|x_t))] & \quad \text{[Covariate or aggregate risk]} \\ +[EU_i(E(c_i|x_t)) - EU_i(c_i)] & \quad \text{[Idiosyncratic risk]} \end{aligned} \tag{3.3}$$

[7] A large number of households are dropped because we could not match them with commune data. This is a common issues when matching household data with the spatially referenced data (Hoddinott & Quisumbing 2003*a*)

where E($c_i|x_t$) is the commune expected value of consumption, conditional on a vector of covariant variables (x_t).

The authors take unexplained risk and measurement error out of idiosyncratic risk and assume that the poverty line (z) is the mean consumption. So Equation 3.3 can be rewritten as:

$$\begin{aligned} V_i = [U_i(z_{ce}) - U_i(Ec_i)] & \quad \text{[Poverty or inequality]} \\ +[U_i(Ec_i) - EU_i(E(c_i|x_t))] & \quad \text{[Covariate or aggregate risk]} \\ +[EU_i(E(c_i|x_t)) - EU_i(c_i|x_t, x_{it})] & \quad \text{[Idiosyncratic risk]} \\ +[EU_i(c_i|x_t, x_{it}) - EU_i(c_i)] & \quad \text{[Unexplained risk and measurement error]} \end{aligned} \tag{3.4}$$

where E($c_i|x_t, x_{it}$) is the household expected value of consumption, conditional on a vector of covariant variables (x_t) and household's characteristics (x_{it}).

Ligon & Schechter (2003) normalize the expenditure and income per capita so that the average expenditure and income per capita over all households in all periods becomes unity, and therefore z in the above equation equals one. Thus, households do not have vulnerability if resources are distributed in a way that households receive the expected consumption expenditure with certainty.

This VEU approach is useful because it reveals the contribution of each major factor on household vulnerability to poverty. However, it needs a panel data and the result may be sensitive to the function form of utility and the utility measurement[8].

Ligon and Schechter (2003) propose a particular form for utility:

$$U(c) = \frac{c^{1-\gamma}}{1-\gamma} \tag{3.5}$$

Where γ is household coefficient on relative risk aversion or household sensitivity to risk and inequality. From the empirical literature, γ=2 is a good approximation of this measure.

Components of Equation 3.4 can be estimated by applying restricted least squares for expected consumption and then substituting each of them into utility function

[8]Hoddinott & Quisumbing (2003*b*) agrue that the relative components of the decomposition are not likely to be affected by function even though the results may be.

3.5:

$$Ec_{it} = \frac{1}{T}\sum_{t=1}^{T} c_{it} \tag{3.6}$$

$$E(c_{it}|\bar{X}_t) = \alpha_i + \eta_t \tag{3.7}$$

$$E(c_{it}|\bar{X}_t, X_{it}) = \alpha_i + \eta_t + \beta X_{it} \tag{3.8}$$

where α_i capture the effect of household fixed characteristics; η_t capture the impact of changes in covariates or aggregates which are the same across households; and β reflects effects of household characteristics or other observable factors on consumption.

In Equation 3.8, the income variable may be endogenous if it is treated as an explanatory variable for consumption because there may be a feedback relationship between income and consumption. Therefore, we employ the instrumental variable (IV) estimation for Equation 3.8 in which income is perceived as an endogenous variable.

Choice of coping strategies to respond to risks

Once we have estimated and decomposed vulnerability, we extend the analysis by investigating household response to shocks. For that purpose, the multivariate probit model is utilized due to the fact that households can choose various coping instruments simultaneously when they confront shocks, and the model allows for a correlation among choices.

According to Cappellari & Jenkins (2003), the multivariate probit model can be described as below:

$$R^*_{im} = \beta_m X_{im} + \varepsilon_{im} \tag{3.9}$$

where ε_{im}, $m = 1,...,M$ are error terms distributed as multivariate normal, each with a mean zero, and variance-covariance matrix V, where V has values of 1 on the leading diagonal and correlations $\rho_{jk} = \rho_{kj}$ as off diagonal elements (Cappellari & Jenkins 2003). Next, R_{im} represents outcomes for M different choices of coping strategies at the same point in time. Thus, $R_{im} = 1$ if $R^*_{im} > 0$, and 0 otherwise. And X_{im} represents a household's characteristics.

Note that the use of coping strategies depends not only on household characteristics, but also on the types of risks which a household encounters. Therefore, the model

includes a vector of dummy variables representing shocks. In the case of Vietnam, these shocks are: (i) natural disasters (typhoons, droughts), and epidemics (pest infestation and crop disease); and (ii) health problems (serious illness, injury or death of household members). Other shocks with a minor incidence include a change in crop prices or input prices, unemployment, unsuccessful investment, loss of land, robbery or theft, and family disputes (VARHS data).

The household coping strategies in Vietnam can be classified into six categories: (i) saving; (ii) program (from government or NGO); (iii) borrow/transfer (from bank or other, assistance from relative or friend); (iv) capital depletion (sold land, sold asset, sold livestock); (v) reduced consumption and (vi) other (worked more, took children out of school, received an insurance payment, postponed investment or payment, and other)

Effectiveness of existing insurance schemes on consumption

Full insurance implies that household-level consumption should be perfectly correlated with aggregate consumption but uncorrelated with household level changes in income (Nelson 1994). Theoretically, households can make an effort to choose their *ex ante* and *ex post* responses through formal and informal risk management instruments. However, the quality of an existing mechanism will determine the size of consumption smoothing. Hence, to estimate the effectiveness of a current insurance mechanism, we examine the extent to which households can smooth their consumption to cope with shocks by the following specification:

$$\Delta lnc_{ivt} = \phi + \gamma \Delta lny_{ivt} + \psi \Delta \overline{(lny_{vt})} + \delta X_{ivt} + \Delta \varepsilon_{ivt} \tag{3.10}$$

where Δlnc_{ivt} and Δlny_{ivt} represent the growth rate of household consumption and income respectively; $\Delta \overline{(lny_{vt})}$ denotes the growth rate of average community (or village) income and it is treated as a proxy of covariate shocks (Townsend 1994); and $\Delta \varepsilon_{ivt}$ is a household-specific error term including variations in the unobservable components of household preferences.

Using this empirical specification, we assume that change in household income is a proxy for all the idiosyncratic shocks experienced by the household. Under conditions of complete consumption smoothing, we would expect changes in income have no effect on consumption. The coefficient on income change γ should therefore be

zero. Thus, the higher value of γ is evidence of insufficient consumption insurance against income risks (Harrower & Hoddinott 2004, Skoufias 2003, 2004, Skoufias & Quisumbing 2005).

The estimate of ψ which has been used in empirical literature indicates whether partial insurance and risk-sharing takes place among households within the same community. If the growth rate in average community income has a significant influence on the growth rate of household consumption (i.e., $\psi \neq 0$), we can admit the hypothesis that some risk sharing is present within communities. There is only food consumption spending in our data sets, but neither total consumption nor non-food consumption, so we use it as the dependent variable in the empirical estimation. In the literature, food consumption is often used as a measure of welfare in regions where a considerable fraction of the population allocates more than three quarters of their expenditure for food (Deaton 1997). In such regions, it is anticipated that households maintain their consumption expenditure at a conservative level. This explains why food expenditure is less likely to be correlated simultaneously with income than other parts of consumption expenditure. In Vietnam, an average household uses up 53 per cent of total expenditure for food (Hoang 2009) and this high share suggest that households are more likely to maintain their food consumption against the negative shocks.

3.5 Econometric results and discussion

Vulnerability as expected utility (VEU)

The results of the consumption estimation in Equation 3.7 are presented in Table 3.1. From this table, it is clear that communes with a higher population might have higher food consumption because there must be more purchasing activities or more food shops (even small shops). The positive and significant coefficient of a regular market probably supports this explanation. If a commune has a regular market, its average food consumption will increase. In contrast, the estimated coefficients of poverty rate and distance to a bus station are significantly negative. This implies that if a commune has a higher level of poverty or more difficulty in getting to transport, it will face a lower than average level of food consumption. Surprisingly, having a secondary school in the commune might reduce its level of food consumption as the

TABLE 3.1: Covariate risk component (Panel random effect)

Variable	Per capita food consumption
totalhousehold	0.0000436
	(2.26)**
targetcommune	0.0195943
	(1.00)
povertyrate	-0.5555182
	(-6.68)***
regularmarket	0.0760658
	(3.07)***
secondaryschool	-0.0676216
	(-1.65)*
distance2bus	-0.0008778
	(-5.81)***
_cons	0.9691212
	(13.08)***
Number of observations	4848
Number of groups	1215
Join significance	Wald $chi^2(6)$=164.55
	Prob>chi^2=0.0000
Hausman test: fixed vs random effect*	$chi^2(6)$=24.53
Prob>chi^2=0.0004	

Notes: p<0.1; ** p<0.05; *** p<0.01. Standard error adjusted for 1215 clusters. Robust z statistics in parentheses.

* The Hausman test supports the use of fixed effect regression. However, according to Clark & Linzer (2014), when the independent variable exhibits only minimal within-unit variation, the random-effects model will tend to produce superior estimates of β when there are few units or observations per unit, and when the correlation between the independent variable and unit effects is relatively low. An increase in efficiency can offset an increase in bias.

coefficient is significant and negative. In the case of Vietnam, having a primary and secondary school in a rural commune is nationally common, so the effect of school on the commune consumption might depend on other types of school which are not available in the data set.

Table 3.2 provides the results from the panel IV estimation for Equation 3.8. Since some explanatory variables are time-invariant we can only use a random effect regression[9]. In the first stage, total land area owned by a household and per capita of productive assets (including feed grinding machine, rice milling machine, grain harvesting machine, tractor and plough) are used as instruments for income. It is reasonable that these variables firstly affect income, and then indirectly affect consumption. These instruments for income are also specified in Gaiha & Imai (2008),Jha et al. (2010) and Jha et al. (2013). The Hansen-Sargan statistic of over-identification test shown in Table 3.2 indicates that the instruments used in this situation are valid.

Results in the first stage estimation show strong evidence of a relationship between productive assets and household income. Similarly, having more land increases household income as expected. Other household characteristics also contribute to the level of household income. For example, a household with an older head tends to have a higher income. The negative sign of the head age squared coefficient implies that the marginal effect of age on income will reduce as the head becomes older. If the head is married or any household member has experienced a better education, then household income tends to increase. However, a household with a higher share of females or dependents will face a lower level of per capita income. Also, if a household has income from only agriculture, it might receive a lower income.

As can be seen from Table 3.2, in the second stage, the income coefficient is highly significant and positive. This result suggests that per capita income largely determines household food consumption. The marital status of the household head and the education level of household members affect household food consumption positively, while having dependents and agriculture as the only source of income are factors that reduce food consumption. Living in a more populated area contributes slightly to a higher level of household food consumption. In addition, when households reside in a commune with a regular market or a short distance to a bus station, their food consumption may increase.

The results obtained from Equation 3.7 and Equation 3.8 are used to derive $E(c_{it}|(\bar{X}_t))$ and $E(c_{it}|(\bar{X}_t), X_{it})$. We then calculate the mean of normalized food consumption to obtain Ec_{it} as shown in Equation 3.6. Finally, we use the utility function 3.5 to

[9]The random effect regression has been used previously to calculate VEU in Gaiha & Imai (2008) and Jha et al. (2010).

TABLE 3.2: Idiosyncratic risk component (Panel random effect IV model)

Variable	First stage (pc income)	Second stage (pc consumption)
ntotalincome		0.3308974
		(7.61)***
headage	0.0217744	0.0097173
	(2.78)***	(1.56)
married	0.2259467	0.1453146
	(6.31)***	(4.80)***
headage2	-0.000179	-0.0000767
	(-2.52)**	(-1.36)
femaleshare	-0.156438	-0.0601291
	(-2.29)**	(-1.10)
dependshare	-0.2691709	-0.1019256
	(-4.79)***	(-2.21)**
highestedu	0.1140928	0.0557627
	(8.58)***	(4.86)***
agrhh	-0.0959593	-0.1819714
	(-3.35)***	(-8.13)***
totalhousehold	0.0000172	0.0000368
	(1.17)	(3.19)***
targetcommune	0.0977055	-0.003703
	(4.05)***	(-0.19)
povertyrate	-1.344953	-0.1215578
	(-15.02)***	(-1.33)
regularmarket	0.0275375	0.0451281
	(1.02)	(2.13)**
secondaryschool	-0.1165961	-0.0167442
	(-2.89)***	(-0.52)
distance2bus	-0.0010388	-0.0004843
	(-5.26)***	(-3.03)***
totalland	0.0894654	
	(14.73)***	
productiveasset	0.9205927	
	(9.02)***	
_cons	0.3520787	0.1937129
	(1.50)	(1.04)
Number of observations	4841	4841
Join significance	Wald $chi(15)$=984	Wald $chi^2(14)$=639.16
Prob>chi^2	0.0000	0.0000
Hausman test: fixed vs random effect	Wald $chi^2(11)$=23.07	
Prob>chi^2=0.0173		
Sargan-Hansen test for	$Chi^2(1)$=0.667	
over-identification restriction	Prob>chi^2=0.4141	

Notes: p<0.1; ** p<0.05; *** p<0.01. Robust z statistics in parentheses.

Table 3.3: Decomposition of average vulnerability

VEU	Poverty	Covariate risk	Idiosyncratic risk	Unexplained risk
0.7141	0.2566	-0.1883	0.3591	0.2864

Source: Author's calculation from VARHS 2006, 2008, 2010, 2012.

estimate four components of Equation 3.4. Household VEU is the sum of four separate components. The aggregate VEU and its components are presented in Table 3.3. The estimate of average VEU (0.7141) is our estimate of the vulnerability of all households. This implies that the utility of the average household in our sample is approximately 71 per cent less than the hypothetical situation in which resources could be redistributed so as to eliminate all inequality and risk in consumption. This level of utility vulnerability is lower than the estimation of Gaiha & Imai (2008) which is 0.7476, but much higher than the estimation of Ligon & Schechter (2003) and Jha et al. (2013) which are around 0.1972 and 0.3016, respectively. The most serious shocks that contribute to household vulnerability are idiosyncratic shocks (approximately 50 per cent). However, the negative sign of the aggregate risk component indicates that economic growth cancels out the negative covariate shocks and even reduces the vulnerability. We may argue that the utility loss would be more serious if there had been less economic growth in rural Vietnam during the period of 2006-2012.

Choice of coping strategies to respond to risks

Table 3.4 reports the results for the multivariate probit model used to investigate the choice of household coping strategy. The independent variable is the household's choice of coping strategy. The explained variables in the model are the same as in Table 3.2. The Huber-White sandwich estimator is used to overcome heteroskedasticity. The likelihood ratio test rejects the hypothesis that the correlation among choices is zero, and therefore confirms that the use of the multivariate probit model is more efficient than separate probit estimations for each choice of coping strategies.

Vietnamese rural households facing natural disasters and health problems tend to withdraw money from their own savings because the estimated coefficients are significantly positive. Similar results show that households depend even more heavily on programs of government or non-governmental organizations to recover from health

problems and natural disasters such as floods, droughts and typhoons. Only the health problem coefficient has a significantly positive impact on the act of borrowing money from others. Health problems, including serious illness, injury or death of a household member, probably seem to be a legitimate reason for asking money from relatives or friends. Households rarely sell assets such as land and livestock to cope with negative shocks. The probability of this strategy is even affected negatively by natural disasters and other shocks such as increasing food prices, investment loss, land loss or crime. This is probably because these types of shocks deteriorate household assets. The probability of reducing consumption increases in the case of natural disasters or other shocks, but it decreases if households suffer livestock disease and health problems. Other coping instruments such as taking children out of school and forcing them to work, or postponing investment, are used frequently. Unfortunately, these types of coping instruments, along with food consumption reduction, can be considered as sorts of capital depletion. Therefore, they might generate a negative long term effect on household welfare which is similar to the consequences of capital depletion.

When households suffered from natural disasters they use various types of coping strategies, with the exception of borrowing money, but they tend to depend on subsidy programs to recover. Assistance from friends and relatives is rare and difficult because others may be experiencing the same hardships. Evidence of limited use of money borrowing as a coping strategy also shows the ineffectiveness of the financial system in rural Vietnam. With health problems, households use almost all the coping strategies they have, but the most often used instrument comes from relatives and friends. This fact also implies that health problems may be one of the most serious shocks to households in rural Vietnam. With other types of shock, reducing consumption seems to be the only way available for households to manage their risks.

Effectiveness of existing insurance schemes on consumption

Table 3.5 provides the estimate for the measure of insurance in which the instrumental variable (IV) technique is used. In this case, the variation of household income is considered as endogenous and is represented by the productive asset and the ratio of working members on total household members. The average community income is the mean income of all households living in the same commune. The upper panel of Table 3.5 presents the results of the first stage estimation of IV estimation and

TABLE 3.4: Multivariate probit model: Household coping strategy (shock variables: total number)

HH coping strategies	Saving	Program	Borrow or Transfer	Capital depletion	Reduce consumption	Others
Natural disaster	0.1829 (3.92)***	0.7094 (7.45)***	0.0888 (1.58)	-0.3252 (-4.89)***	0.1744 (4.68)***	0.1017 (1.83)*
Livestock diseases	-0.0016 (-0.62)	-0.0014 (-0.26)	-0.0004 (-0.14)	0.0015 (0.41)	-0.0049 (-2.29)**	0.0098 (3.38)***
Health problem	0.3787 (6.21)***	0.5333 (4.26)***	1.0847 (17.86)***	0.00002 (0.00)	-0.2909 (-5.54)***	0.7430 (11.53)***
Other shocks	-0.1319 (-2.21)**	-0.1872 (-1.09)	-0.0854 (-1.20)	-0.3759 (-4.60)***	0.3479 (7.98)***	0.0717 (1.12)
Observation	6886					
Wald $chi^2(102)$	1351.94					
Prob $>chi^2$	0.0000					

Notes: * p<0.1; ** p<0.05; *** p<0.01. Robust z statistics in parentheses.

the lower panel shows the second stage estimation. The results of the Durbin-Wu-Hausman test for endogeneity and over-identification test endorse the application of the IV estimation and instrumental variables.

As discussed earlier, under the condition of complete consumption insurance we would expect changes in income to have no effect on consumption. Therefore, the coefficient on income changes should be zero, after controlling for covariate shocks (Skoufias 2003). Table 3.5 shows that the coefficient, or elasticity of changes in consumption given income shocks, while statistically significant, is 0.59. That means household income shocks are considerably covariate with household consumption, suggesting that even though households depend heavily on informal risk coping strategies, those instruments employed by households are not effective enough.

According to Deaton (1997), Ravallion & Chaudhuri (1997) and Skoufias & Quisumbing (2005), in a completely autarkical world, where pooling of resources and risk sharing does not exist, the growth rate of the average community income should have no influence on the growth rate of household consumption. In contrast, if some risk sharing is found within communities, the coefficient of the growth rate of average community income would be non-zero and statistically significant. Our results show that the negative and significant coefficient estimate (-0.44) in the variation of

average community income indicates that there is no risk sharing mechanism within communities. These results confirm the previous findings of Eozenou (2008).

3.6 Policy implications and conclusion

Vulnerability as an *ex ante* estimation of poverty is generated by various shocks. Therefore, understanding sources of vulnerability, the existing coping strategies and the effectiveness of the current insurance system are desirable for poverty alleviation policies. Using a unique panel data set extracted from Vietnam Access to Resources Household Surveys (VARHS) in 2006, 2008, 2010 and 2012, this paper has analyzed vulnerability as low expected utility and response to shocks of rural households in Vietnam. We first adopted the approach of Ligon & Schechter (2003) to measure vulnerability as low expected utility (VEU) and then decomposed the sources of vulnerability. Second, we applied the multivariate probit model to investigate household responses to shocks. Finally, we looked into the effectiveness of the existing risk management mechanism.

Our main findings are that, (i) the utility of the average household is 71 per cent less than the hypothetical situation without any risk or inequality in consumption, and idiosyncratic shocks contribute 50 per cent of the loss; (ii) to overcome the negative impact of shocks, most households depend on informal coping strategies such as food consumption reduction, savings withdrawal, taking children out of school or capital depletion. Households can have assistance through transfer from relatives or friends in the case of having health problems. Borrowing money from formal institutions is limited, while subsidies from the government or NGOs are available only in cases of natural disaster; and (iii) household consumption and household income exhibit highly correlated variation, implying that existing informal insurance schemes are not effective enough.

This study provides evidence of the need for designing strong safety nets in rural Vietnam. The limited availability of government programs as a coping strategy suggests an expansion of this type of formal assistance would reduce household vulnerability. Also, formal financial institutions located in rural areas should be encouraged. The impact of participation in social groups on access to credit need to be examined so that we can discover an effective mechanism to reduce the negative impacts of

TABLE 3.5: Measure of consumption insurance (IV estimation)

	First stage (Δpc income)	Second stage (Δpc food consumption)
Δpcincome		0.5900
		(2.89)***
Δcomincome	0.7219	-0.4421
	(30.68)***	(-2.92)***
headage	-0.0053	-0.0004
	(-0.74)	(-0.04)
married	-0.0485	0.0318
	(-1.52)	(0.79)
headage2	0.00002	0.00001
	(0.35)	(0.18)
femaleshare	-0.0434	0.0912
	(-0.71)	(1.18)
dependshare	-0.0312	-0.0510
	(-0.58)	(-0.75)
highestedu	-0.0037	0.0174
	(-0.31)	(1.17)
agrhh	-0.0428	-0.0921
	(-1.67)*	(-2.89)***
totalhousehold	-0.00003	0.00001
	(-2.35)**	(0.79)
targetcommune	0.0296	-0.0170
	(1.36)	(-0.61)
povertyrate	-0.5175	0.4089
	(-5.93)***	(2.72)***
regularmarket	-0.0442	0.0042
	(-1.81)*	(0.13)
secondaryschool	0.0277	-0.0386
	(0.75)	(-0.83)
distance2bus	-0.0005	0.0005
	(-0.69)	(0.60)
productiveasset	0.3007	
	(3.32)***	
laborshare	0.2476	
	(5.00)***	
_cons	0.3337	0.0565
	(1.55)	(0.20)
Number of observations	3623	3623
Join significance	Wald $chi(16)$=1099	Wald $chi^2(14)$=32.26
Prob>chi^2	0.0000	0.0059
Hausman test: fixed vs random effect		
Sargan-Hansen test	$Chi^2(1)$=0.458	
for overidentification restriction		
Prob>chi^2=0.4987		

Notes: * p<0.1; ** p<0.05; *** p<0.01. Robust z statistics in parentheses.

shocks. In addition, targeted interventions should take into account the household idiosyncratic shocks which seriously affect household vulnerability. Health problems as a special form of shocks seem to be the overriding concern of rural households as they try various coping strategies. This finding suggests that social health insurance for rural households would improve their utility. Ultimately, intervention programs should find ways to reduce capital depletion in rural households. This would not only help households to overcome their hardships in the short run, but would also sustain their welfare in the long run.

Chapter 4

Risk aversion and the impact of health insurance on household vulnerability: New evidence from rural Vietnam

4.1 Introduction

One of the worst shocks to households is a serious illness of one of its members. This has a negative and significant effect on consumption and income. Illness raises two important economic costs: the cost of medical care and income loss due to reduced labor supply. The unpredictable nature of these two costs makes households unable to smooth their consumption over periods of major illness. This is particularly true in developing countries where few individuals have health insurance. In addition, households in developing countries find it difficult to access the formal credit market. Therefore, they have to rely on informal coping mechanisms such as drawing on savings, selling assets, transfers from other families or social support networks. Low-income households who cannot use these channels to smooth their consumption are more likely to fall into a poverty trap. In other words, the burden of health care pushes individuals experiencing illness into poverty or forces them into deeper poverty.

There are a huge number of studies investigating the impact of health insurance on health status, health service use or out-of-pocket payment. Scholars have also conducted several studies that focus on the relationship between health insurance coverage and *ex-post* poverty. Recently, some studies have examined the impact of money transfers such as microfinance and remittance on *ex-ante* vulnerability. However, there is no study for any country that measures the impact of health insurance coverage on household vulnerability. This paper attempts to fill this gap in the empirical literature and in this case health insurance has been considered as one of the crucial strategies for coping with vulnerability arising from idiosyncratic shocks. In this sense, this paper is the first to investigate the role of health insurance in mitigating vulnerability[1].

Using the propensity score matching method and data from Vietnam Access to Resources Household Surveys (VARHS) during 2010-2012, we investigate whether having health insurance coverage has any impact on the probability of falling into poverty (VEP) and the magnitude of utility loss (VEU). In particular, households risk preference has been taken into account when measuring health insurance demand. Our estimates show that health insurance helps rural households in Vietnam reduce the idiosyncratic component of utility loss by 81 per cent. In addition, health insurance helps rural households in Vietnam reduce the probability of becoming poor by about 19 per cent. In addition, the reverse effect of the risk aversion on health insurance enrollment implies not only a potential 'rigidity' effect on health insurance demand but also deficiencies in the health insurance market. Therefore, the study suggests implications for both demand side and supply side of the health insurance market so that the government is able to reach its goal of universal health insurance coverage.

The remainder of the paper is structured as follows. Section 2 reviews studies on the topic of vulnerability and health insurance impact. Section 3 provides an overview of health insurance schemes in Vietnam. Section 4 and Section 5 are dedicated to data description and analytical framework, respectively. Section 6 discusses the results and the last section concludes the paper.

[1] *"Research into alternative health care financing strategies and related mechanisms for coping with the direct and indirect costs of illness is urgently required to inform the development of appropriate social policies to improve access to essential health services and break the vicious cycle between illness and poverty."* (McIntyre et al. 2006)

4.2 Literature review

Concepts of vulnerability

The concept of vulnerability is interpreted in various ways in different contexts. In economics, the concept of vulnerability emerges from that of poverty. From the traditional view of poverty as reflected in World Development Report 1990, the notion of poverty consists of material deprivation and low achievement in education and health (World Bank 1990). Later, the term 'vulnerability' is mentioned when examining the relationship between poverty and uncertainty of income (Morduch 1994). Since then, 'vulnerability' is often used to extend the traditional concept of poverty. While poverty measurement is based on fixed standards such as income or expenditure during a short period of time, vulnerability broadens the poverty notion by including the potential risk of adverse shocks such as income loss, bad health (idiosyncratic risks) and natural disasters (covariate risks). For example, in the work of Glewwe & Hall (1998) and Cunningham & Maloney (2000), vulnerability is defined as exposure to negative shocks to welfare. It is also defined as "the probability or risk today of being in poverty or to fall into deeper poverty in the future" (World Bank 2001) or "the ex-ante risk that a household will, if currently non-poor, fall below the poverty line, or if currently poor, will remain in poverty" (Chaudhuri 2003).

In an excellent summary of risk and vulnerability, Hoddinott & Quisumbing (2003*b*) classify approaches to assessing vulnerability into three methods according to their distinct definitions: vulnerability as expected poverty (VEP); vulnerability as low expected utility (VEU); and vulnerability as uninsured exposure to risk (VER). All three methods predict changes in welfare, but with different welfare measurements. The difference between VEP and VEU lies in their definitions of welfare: in VEP consumption is regarded as welfare, while VEU uses utility derived from consumption. While VEP and VEU commonly use a benchmark for a welfare indicator (z) and estimate the probability of falling below this benchmark (p), VER evaluates whether downside risks or observed shocks result in welfare loss. In other word, VER assesses the household's ability to smooth or insure consumption when faced with income shocks, while maintaining a minimum level of assets.

Health insurance and household vulnerability

The relationship between health insurance coverage and household vulnerability emerges from the impact of health shocks on poverty and vulnerability. Illness, a major part of idiosyncratic shocks, can push non-poor household into poverty, or poor households into extreme poverty (Calvo & Dercon 2005, Carter et al. 2007, Dercon 2004)[2]. According to World Bank (2003*b*), illness pushes households into poverty, through lost wages, high spending for catastrophic illness, and repeated treatment for other illnesses. Moreover, health shocks are not only one of the most sizable, but also one of the least predictable shocks (Gertler & Gruber 2002)[3]. Although several empirical studies show that households are able to fully or partially insure themselves against production shocks and weather shocks, they are less able to cope with health shocks (Fafchamps & Lund 2003). With production shocks, households tend to choose less risky activities and with weather shocks, households try to learn and understand them in order to deal with them to some extent. However, this is not the case with health shocks which are likely to make households more vulnerable than other types of shocks (Duflo 2005).

Most studies on health problems and health insurance impact focus on financial loss and healthcare service usage while other papers measure the impact of health insurance on household poverty status. For instance, McIntyre et al. (2006) finds that health care payments place a considerable stress on households in low- and middle- income countries. The burden of health care payments pushes individuals experiencing illness into poverty or forces them into deeper poverty.

One of the main strategies adopted by many agricultural families who face high costs of health care is to sell livestock. Another strategy is using intra-household labor substitution to compensate for labor lost. Also, inter-household transfers of resources might take a small role (Sauerborn et al. 1996). Similarly, a study for Russia shows

[2]The authors show that a random event (e.g. a flood, a drought, an illness, an unemployment spell) can have a permanent effect for households, pushing them into poverty.

[3]Using a panel data for Indonesia, Gertler & Gruber (2002) demonstrate that major illness induces significant economic costs and is associated with a fall in consumption. Similarly, Gertler et al. (2009) prove that micro-financial saving and lending institutions can help Indonesian families smooth consumption after a major illness. Moreover, Jalan & Ravallion (1999) observe that wealthier Chinese households are better able to insure consumption against income shocks. Studies of Rosenzweig & Wolpin (1993) and Fafchamps et al. (1998) present that sale of stocks can help insure consumption. Empirical results across countries also advocate that households find difficult to cope with all income shocks, especially those with low assets (Harrower & Hoddinott 2004, Skoufias & Quisumbing 2005).

that chronic diseases resulted in higher levels of household healthcare expenditure in Russia and productivity losses are significantly attributed to reduced labor supply and reduced household labor income. The authors find that households in Russia depend on informal coping mechanisms in the face of chronic diseases, irrespective of insurance cover (Abegunde & Stanciole 2008).

Another piece of research shows that about 25.9 per cent of households in forty low- and middle-income countries borrow money or sell items to pay for health care. The health shocks are more severe among the poorest households and in countries with less health insurance. Healthcare systems in developing countries have been failing to insure families against the financial risks of seeking health care (Kruk et al. 2009).

Literature on health shocks has proved the importance of health insurance. For example, a study for India highlights the fact that community-based health insurance schemes in India can protect poor households from the unpredictable risk of medical expenses (Kent 2002). Another study using an Indonesian panel data set suggests that public insurance or subsidies for medical care may improve household welfare by providing consumption insurance (Gertler & Gruber 2002).

However, there is currently no study investigating the impact of health insurance on household vulnerability. Some attempts has been made to examine the measure the impact of microfinance on vulnerability or household consumption over time (Khandker 1998, Morduch 1999, Zaman 1999). A study of Swain & Floro (2012) indicate that vulnerability of members of the Indian Self Help Group (SHG) is not significantly higher than in non-SHG members, although the SHG members experience a high incidence of poverty. Nevertheless, the SHG members for more than one year face significantly reduced vulnerability. Another study by Puhazhendi & Badatya (2002) suggests that microfinance allows consumption smoothing and helps households mitigate the negative effects of shocks.

Health insurance impact in Vietnam

A large number of studies using Vietnam data have been conducted to look at the incidence of out-of-pocket for health care as well as the effects of health insurance on various types of household spending. For example, Wagstaff & Doorslaer (2003), using the data set of 1993-1998, find that 80 per cent of health spending in Vietnam was paid out-of-pocket in 1998. The out-of-pocket spending is mainly non-hospital

expenditure rather than inpatient care expenses. This primarily forces poor households to become poorer rather than leading non-poor households into poverty. Later, Wagstaff (2007) shows that the incomes of urban households are more vulnerable to health shocks than rural households. The author suggests that transfers from relatives, friends or neighbors partially offset income losses and extra medical spending, even among insured households. The paper also finds that households with a health shock consume less food, but spend more on items such as housing and electricity.

Nguyen (2010) reviews Vietnam's policies on health services and provides an assessment of public health facilities and the access of people to health care services in Vietnam. He finds that the poor and ethnic minorities are most likely to be enrolled in health insurance than other groups of people. Health insurance helps to boost health services utilization and reduces out-of-pocket spending of the insured. The density of medical staff is also positively associated with outpatient health services utilization. Nevertheless, the quality of health services and the access to health services continue to be limited in impoverished and isolated areas (Nguyen 2010).

Chaudhuri & Roy (2008) use data drawn from the 199293 and 199798 Vietnam Living Standard Surveys (VLSS) and the 2002 Vietnam Household and Living Standards Survey (VHLSS) to estimate the probability that an individual will seek treatment and the determinants of out-of-pocket payments. They show that the rich are more able to use health insurance effectively with low out-of-pocket payments than are those with lower incomes. In contrast, the poor suffer higher out-of-pocket payments and are thus discouraged from seeking treatments until their ailment become serious. When pro-poor policies are instituted, the healthcare inequality becomes less serious (Chaudhuri & Roy 2008). Further, the insured patients, especially those at lower income levels, are more likely to use outpatient facilities and public providers (Jowett et al. 2004).

In a study on how households in Vietnam cope with health care expenses, Kim et al. (2011) examine a rural commune in Hanoi and show that households of all income levels borrow to finance treatment costs but the poor and near-poor are more heavily dependent. The likelihood of reducing food consumption to pay for extremely high-cost treatment versus low-cost treatment increases most for the poor in both inpatient and outpatient contexts. Decreased funding and increased costs of health care rendered Dai Dong's population vulnerable to the consequences of detrimental coping strategies such as debt and food reduction (Kim et al. 2011).

Thanh et al. (2010) indicate that Vietnam's health care funds for the poor (HCFP) significantly reduces the health care expenditure (HCE) as a percentage of total expenditure, and increases the use of the local public health care among the poor. However, the impact of HCFP on the use of the higher levels of public health care and the use of go-to-pharmacies are not significant (Thanh et al. 2010). Sepehri et al. (2006) use Vietnam Living Standard Surveys 1993 and 1998 to show that health insurance reduces out-of-pocket expenditure by around 36 per cent to 45 per cent. Sepehri et al. (2011) find that insurance reduces out-of-pocket expenditures more for those enrollees using district and higher level public health facilities than those using commune health centers. Compared to the uninsured patients using district hospitals, compulsory and voluntary insurance schemes reduce out-of-pocket expenditure by 40 per cent and 32 per cent, respectively. However, for contacts at the commune health centers, both the compulsory health scheme and the voluntary health insurance scheme have little influence on out-of-pocket spending, while the HCFP reduces out-of-pocket spending by about 15 per cent.

In summary, the evaluation methods used in these studies are propensity score matching (PSM), double difference and triple difference methods. Authors try to eliminate any biases in the estimated insurance coefficient arising from the unobservable factors that are correlated with both insurance status variable and the outcomes of interest. Most studies find a limited impact of insurance on out-of-pocket payments, with the exception of Jowett et al. (2003) on a voluntary program in Hai Phong. The differences impact of health insurance among studies are attributed to differences in methods and target groups and the outcomes of interest. For examples, both Bales et al. (2007) and Wagstaff (2007) use data from VHLSS 2002 and 2004 to estimate impacts of free health insurance on the poor. They find a significant positive impact of the program on the reduction of out-of-pocket health care spending. However, while Wagstaff (2007) finds a positive impact of the health insurance on health care utilization, Bales et al. (2007) does not. This might be the reason why Wagstaff re-conducted the research using different methods in 2010. This time, the results suggest that the HCFP has had no impact on use of services, but has substantially reduced out-of-pocket spending (Wagstaff 2010).

Unfortunately, there is no paper measuring the impact of health insurance coverage on household vulnerability even though there are a number of studies exploring risks and household responses to risks in Vietnam. These studies include Hasegawa (2010), Klasen & Waibel (2010), Imai et al. (2011), Wainwright & Newman (2011),

Montalbano & Magrini (2012), and Tuyen (2013). Therefore, this study will contribute to the empirical literature by filling this gap.

Choice under risk and health insurance demand

According to Phelps (2013), people seem to dislike risk and prefer a less risky situation to a more risky situation, other things being equal. They are thus risk averse and are willing to pay for insurance in order to eliminate the chance of really risky losses. Therefore, a household's purchase of health insurance in this study is regarded as a choice under risk and uncertainty, partially reflecting the households risk preference. This section summarizes the literature on risk preference as the framework for risk aversion measures used in this study.

Since Bernoulli (1954) provided the foundations for the concepts of expected utility and risk aversion, individual risk preference has become a fundamental building block of a huge range of economic theory (Isaac & James 2000). A comprehensive review of choice under risk theories can be seen in Starmer (2000). In general, they are classified into two major groups: expected utility theory and non-expected utility theory. Therefore, risk preference or risk aversion which is derived from theory can be estimated in two different ways. First, the conventional way to estimate risk aversion comes primarily from an idea of expected utility theory that assumes individuals optimize their preference function when they make choices among prospects (or uncertain outcomes). The studies following this concept include Von Neumann & Morgenstern (1944); Friedman & Savage (1948); and Rothschild & Stiglitz (1970). Among empirical studies are the works of Pratt (1964) and Arrow (1965), who employed a concave utility function U to derive formal measures of absolute risk aversion. Second, the prospect theory provides another framework to calculate risk aversion. This theory assumes that individuals make their choices by decision heuristics, or rules, under particular conditions. In other words, problem context is an important determinant of choice-rule selection. Two of the most widely discussed studies are Kahneman & Tversky (1979) and Tversky & Kahneman (1992). The studies of Gächter et al. (2010) and Abdellaoui (2000) are two empirical studies that follow this path.

The relationship between individuals' risk preference and health insurance demand has been investigated in Friedman (1974), Bleichrodt & Pinto (2000, 2002) and

Barseghyan et al. (2013)[4]. In addition, the relationship of risk preference and other aspects of health choice has been studied in Nightingale & Grant (1988), Nightingale (1988), Richardson (1994), Bleichrodt & Gafni (1996), Bridges (2003), Picone et al. (2004), Lusk & Coble (2005), Zhang & Rashad (2008), Andersen et al. (2008), and Einav et al. (2010). These studies explain why we choose to add a risk aversion index into the probit model for estimating health insurance coverage.

4.3 Overview of the health insurance system in Vietnam

Health insurance system in Vietnam

After 1986, when the government launched economic reforms, the healthcare system in Vietnam was transformed from a centralized one of free universal access to a user-pay system. The pharmaceutical industry was also privatized. Out-of-pocket spending on health care went up rapidly. It reached 71 per cent of health spending (mostly on drugs) in 1993 and 80 per cent in 1998, creating a huge burden for ill households, especially the poor (Wagstaff & Lieberman 2009).

In 1993, Vietnam introduced a compulsory health insurance (CHI) program, which was initially aimed at the formal sector worker. A voluntary health insurance scheme was later added to cover the self-employed, informal sector employees, and dependents of CHI members. Later, all employees in the formal sectors were required to enroll, rather than only those in large institutions.

In the early 2000s, other important changes in health insurance were introduced: copayments were scrapped and the benefit package made more generous, and the insurer was permitted to contract with private providers. The health sector was decentralized and much of the revenue was raised locally. Some hospitals were given greater autonomy. In 2002, the insurance system was reformed. The central government launched the Health Care Fund for the Poor (HCFP) program, to provide

[4]The relationship between an individuals' economic behaviour and risk aversion has been investigated in many empirical studies. For example, Bowman et al. (1999), Heidhues & Kőszegi (2008) with consumption behaviour; financial markets (Benartzi & Thaler 1995, Odean 1998, Haigh & List 2005); trade policy (Tovar 2009); labor supply (Camerer et al. 1997, Goette et al. 2004, Fehr et al. 2007).

insurance coverage for the poor and other disadvantaged groups. Later, the government continued to expand coverage through a decree called Decision 139, which asked local governments to provide free health care to the poor, ethnic minority households living in the remote areas and households living in communes officially classified as "special poor"[5]. However, service provision proved to be poor due to the troublesome application process, limited funds, and lack of public awareness of the scheme itself. Households still suffered from high out-of-pocket spending.

In 2008, the government enacted the Health Insurance Law that became effective in 2009. It is an attempt to make health financing systems more equitable and increase health insurance coverage to the entire population. Under the provision of the Law, children under 6 years old and the near poor are included in the compulsory group. Later in 2010, students and pupils (who are previously in the voluntary group) were included. Moreover, farmers, workers in agriculture, forestry, fisheries, and salt production sectors were targeted to be included in 2012 (Matsushima & Yamada 2014).

According to JAHR (2013), the share of household OOP payment in total health spending in Vietnam is considerably higher than the WHO recommendation (30-40%)[6]. Households without health insurance cards, households in rural areas and poor households have lower OOP spending on health care, but higher catastrophic spending and impoverishment because of health spending. Since 2010, in Vietnam the OOP payment share and the proportion of population facing poverty as a result of unexpected health spending have steadily declined in comparison with previous years. The health insurance benefits and the volume of medical services reimbursed by insurance have both expanded over time. That results has their roots from some recent social and health policies, and particularly, the Law on Health Insurance that commenced in 2009.

[5]In October 2002, Vietnam's government introduced a new health care fund program for the poor through Decision 139. This decision mandated all provincial governments to provide free health care to three groups: households defined as poor according to official government poverty standards introduced in November 2000; all households regardless of their own assessed income living in communes covered by a program set up as a result of another policy known as Decision 135 dating from 1998, which provides support and services to especially disadvantaged communes; and ethnic minorities living in the province of Thai Nguyen and the six mountainous provinces designated by Decision 186 as facing special difficulties.

[6]Household out-of-pocket payment rangesfrom 8.3 to 11.0% of household capacity to pay and about 4.6 to 6.0% of total household expenditure. There were 3.9 to 5.7% of households, or around 1 million households encountering catastrophic spending and 2.5 to 4.1% of households, or around 600,000 households confronting poverty because of unexpected health spending during 2002 – 2010.

Vietnam has a goal of universal health insurance, and many policies on health insurance have been circulated and effectively executed (Somanathan 2014). The Joint Annual Health Review (JAHR 2013) shows that the government completely subsidizes health insurance premiums for approximately above 27 million people under social assistance schemes, including the poor and children under age 6; and it has unceasingly expanded benefit packages and raised health insurance premium subsidies for the near poor, pupils and students. In 2012, around 59.31 million people had a health insurance card, representing for 66.8% of the population[7]. In some remoted areas with a large number of poor and ethnic people, the coverage ratio was above 75%. Hospital utilization reimbursed by insurance reached 2.02 visits per person while inpatient visits were about 15.6 out of every 100 people in the population. The most important financing source for health care is the health insurance fund. In 2012, this fund reimbursed facilities for medical services worth about 33,419 billion VND (1.7 billion USD). This fund has also contributed to improving the health service delivery network, the range of pharmaceutical benefits and the amount of technical services available at health care facilities (JAHR 2013).

Health Insurance schemes

Currently, Vietnam has two insurance schemes: a compulsory health insurance and a voluntary scheme. The compulsory scheme initially included two groups: (a) formal workers (both state and private sectors) and civil servants; and (b) retirees, dependents of military and police officers, members of Parliament, Communist Party officials, war heroes, and meritorious people. This scheme later included children younger than 6 years, and from 2003, also covered the poor, ethnic minority households living in the remote areas, and households living in communes officially classified as "special poor". Since 2010, students in schools, colleges and universities, who used to be in the voluntary insurance group, have also been included. From 2012, the near poor, farmers, workers in the sectors of agriculture, forestry, fisheries, and salt producers have been targeted for inclusion. Voluntary health insurance is intended for the remaining population.

Since 1992, the health insurance coverage rate has increased considerably. In 1993, only 5.4 per cent of the total population were covered. The figure in 2010 was around 60 per cent, but by 2012, the figure had grown to 66.8 per cent. Around

[7]The uninsured are largely the near poor and rural inhabitants.

60 per cent of the insured have been completely or partially financed by the state budget (Matsushima & Yamada 2014, JAHR 2013). However, as can be seen in Table 4.1, Vietnam health insurance policies faced difficulties in reaching those non-poor workers and their families in the informal sector, who belong to the voluntary group. Using the statistics in 2010, the enrollment rate was only 53.4 per cent for the private enterprises. While most of the poor and the recipients of social allowance were covered, about 20 per cent of children under 6 years old remained uninsured despite the fact that their enrolment costs were fully paid by the state budget. Similarly, the enrollment rate for the near poor was just 11.38 per cent, although this targeted group was eligible for at least 50 per cent of subsidies from the government. More importantly, the coverage for the unemployed remained zero. Therefore, there were still many vulnerable people left without health insurance (Matsushima & Yamada 2014).

Health insurance premiums and subsidies

According to the Health Insurance Law 2008, the contribution rate for most groups is 4.5 per cent[8] of the monthly minimum salary[9] or the monthly contract salary depending on their sources of income (Matsushima & Yamada 2014). In 2010, the premium was about 380,000 VND per person per year. The government subsidized 100 per cent of premiums for the very poor and for children under 6 years of age, and subsidizes at least 50 per cent of the premium for the near poor and at least 30 per cent of premiums for students. For the formal sector workers, employers contributed 3 per cent of the minimum salary and the employees paid 1.5 per cent. The voluntary group paid 4.5 per cent of the minimum salary but the premium rate could reduce to 3 per cent of the minimum salary if the enrollees were dependents of salaried workers or civil servants (Tien et al. 2011)[10].

Benefits

Patients can select the community health center or district hospital they prefer to be treated within the given options by the government (JAHR 2009). The insurance is

[8]In the period 1992-2009, this figure is 3% (Tien et al. 2011)

[9]The minimum salary is determined by the government and serves as a reference for many other calculation, especially payments from the state budget. In 2009, the minimum salary level is equivalent to US$ 35. In case of health insurance, minimum salary is used to calculate the premium of the poor, the near poor, children under 6, the meritorious people, students

[10]More detail in Table 3 of Tien et al. (2011)

Table 4.1: Breakdown of the insured population in 2010

Target groups	Target populations (thousand)	Covered people (thousand)	Percent covered (%)
Total	85,666	51,903	59.64
Compulsory groups	67,114	47,176	70.29
Employees of enterprises and other companies	11,911	6,361	53.40
Civil servants	3,142	3,142	100.00
Foreign students	3	3	100.00
Part-time officers at commune level	182	0	0.00
Pensioners	920	920	100.00
Recipients of social allowances	1,305	1,254	96.09
Unemployed people	80	0	0.00
Local authorities	41	40	97.56
Meritorious people	2,113	2,113	100.00
Veterans	374	350	93.58
Members of national assembly and peoples council	123	119	96.75
Privileged social groups	843	384	45.55
The poor	13,945	13,511	96.89
Dependents of meritorious people	869	0	0.00
Dependents of army and police officers	1,281	297	23.19
Children under 6	10,103	8,183	81.00
Near poor people	6,081	692	11.38
Students and pupils	13,798	9,807	71.08
Voluntary groups	18,552	3,917	21.11
Relatives of employees	6,820	0	0.00
Farmers, self-employees, members of cooperatives	11,732	3,917	33.39

Source: VSS (2011) cited in Tien et al. (2011).

valid when the insured utilize medical care servicesat the community health center or district hospital where they are registered officially, or at higher-level health facilities to which they are transfered. In the case of an emergency, the treatment will be given for free at any health facilities. However, if the insured wish to use services at unregistered health facilities, they must pay the hospital directly, and claim for the out-of-pocket payment later at their place of residence. The insured can opt for private clinics and receive limited benefit from the health insurance scheme.

When the insured utilize health care services at the registered health facilities, different benefits apply depending on the category of the insured. Some insured groups can receive free medical consultation and treatment but others have to pay parts of the bill as the co-payment system has been commenced from January 2010. The

Table 4.2: Benefits for basic medical services

100% medical consultation and treatment costs	95% of medical consultation and treatment costs	80% of the cost
– Specialized technical officers – Specialized technical non-commissioned officers – Professional officers – Professional non-commissioned officers of the People's Public security – Meritorious persons – Children under 6	– Persons on pension or monthly working capacity loss allowance – People on monthly social welfare allowance as prescribed by law – Poor household members, ethnic minorities living in areas with difficult or exceptionally difficult socio-economic conditions – Other categories of the insured	– Other categories of the insured

Source: VSS (2010) cited in Matsushima & Yamada (2014).

level of the costs covered by the SHI depends on the group with a variation of 100% - 95% - 80% of the total health expenditure (For details of the groups see Table 4.2). People who are not covered for 100 per cent must pay the balance directly to the hospital (VSS 2010).

In 2013, the co-payment paid by the insured was 14.76 per cent of the total health insurance-covered medical care cost nationwide. The out-of-pocket payment accounts for almost 60 per cent of the total health expenditure. The Government of Vietnam wants to take progressive steps to reduce out-of-pocket payments made by patients to under 40 per cent by 2015 (Rousseau 2014). Health insurance also covers for technologically advanced medical services including dialysis, transplants, certain types of cancer treatments and cardiovascular operations etc. However, there is a ceiling which is defined as 40 months of minimum salary (VSS 2010, Tien et al. 2011). In 2012, the minimum salary is between VND 1.4 million to 2 million depending on residential area. The ceiling is equivalent to US$ 2,682.8 to US$ 3,838.8 (US$=VND 20,865.50) and therefore the technologically advanced treatment could result in extremely high out-of-pocket expenditure (Matsushima & Yamada 2014).

Providers

Health care providers are both public and non-public. Prior to November 2011, all public providers were automatically approved to participate in social health insurance, while private providers needed certification and permission. The private sector has grown steadily during the recent years, but mainly provides outpatient health

services and is still much smaller than the public sector, especially for inpatient treatment (World Health Organization, 2009)[11]. In 2014, Vietnam Social Security (VSS) contracted with 1,627 public establishments and 484 private ones (Rousseau 2014). Thus, the uninsured prefer private health care services to public health services. Estimation from the 2006 VHLSS reveals that the ratio of the number of outpatient contacts in private hospitals to the total number of outpatient contacts was 43% for people without health insurance while this figure is only 23% for people having voluntary health insurance. Due to the fact that the public health facilities provide inpatient treatments dominantly, the ratio of private inpatient contacts to the total inpatient contacts was just about 1.2% and 3.6% for the insured and uninsured people, respectively (Nguyen 2012).

4.4 Data

Vietnam Access to Resources Household Surveys (VARHS)

Data for this empirical analysis is extracted from two waves of Vietnam Access to Resources Household Survey (VARHS) implemented in 2010 and 2012. The VARHSs are longitudinal datasets that have been biannually conducted 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).

These surveys were carried out in rural areas of 12 provinces[12] of Vietnam in the summer of each year, producing a balanced panel of 2,045 households spread over 161 districts and 456 communes. They all were conducted during the same three-month

[11]There has been significant growth in the number of private hospitals in Vietnam since the Government of Vietnam allowed private investment in the health sector. The number of private hospitals more than doubled between 2004 and 2008 to reach 82 by 2008. However, this number constituted only 7% of total hospitals, and 4.4% of total hospital beds. Private hospitals were located mainly in urban and wealthy areas (Hort 2011)

[12]They are evenly distributed throughout Vietnam, in seven out of eight regions, with Ha Tay in Red River Delta; Lao Cai and Phu Tho in Northeast; Lai Chau and Dien Bien in Northwest; Nghe An in North Central Coast; Quang Nam and Khanh Hoa in South Central Coast; Dac Lac, Dac Nong and Lam Dong in Central Highland; and Long An in Mekong River Delta. Therefore, these provinces can represent the regional climate and geography throughout the country. However, The sample is statistically representative at the provincial but not at the national level (Markussen et al. 2012).

period each year to ensure consistency and facilitate reasonable comparisons across time. The VARHS investigates issues surrounding Vietnamese rural household's access to resources and the constraints that these households face in managing their livelihoods. Along with detailed demographic information on household members, the surveys include sections on household assets, savings, credit (both formal and informal), formal insurance, shocks and risk-coping, informal safety nets and the structure of social capital (Wainwright & Newman 2011). There is also a variety of information on communes where households lived at the time they were surveyed.

Health insurance

In Section 9 of the VARHS questionnaires, there are questions about all the types of insurance that a household held at the time of interview. They include health insurance (voluntary and compulsory for labor[13]), free health insurance for the poor and free health insurance for children under 6 year old. Other types of insurance consist farmer insurance, fire insurance, life insurance, social insurance, unemployment insurance, education insurance and vehicle insurance. In this study, we focus on the impact of health insurance in general (both voluntary and compulsory for labor) which is essential for universal health insurance policy in Vietnam. However, other types of insurance are mentioned in the later discussion on the impact of risk attitude on health insurance demand.

Risk attitudes

In VARHS 2010 and 2012, there are three questions that enable the derivation of risk aversion for each individual. The first question is a simple unpaid lottery experiment in which respondents are required to accept or to reject each of six lotteries with different payoffs. In each lottery, the winning prize is unchanged at VND 6,000 and the loss varies from VND 2,000 to VND 7,000 (Table 4.3).

That exact question in the questionnaire is:

> *"You are given the opportunities 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). In each case choose whether you would accept or reject the option of playing:"*

[13]There is no way to separate these two types of health insurance.

TABLE 4.3: Questionaires about risk preference in VARHS

	Lottery	Accept	Decline
a.	You have a 50% chance of losing 2,000 VND and a 50% chance of winning 6,000 VND	◯	◯
b.	You have a 50% chance of losing 3,000 VND and a 50% chance of winning 6,000 VND	◯	◯
c.	You have a 50% chance of losing 4,000 VND and a 50% chance of winning 6,000 VND	◯	◯
d.	You have a 50% chance of losing 5,000 VND and a 50% chance of winning 6,000 VND	◯	◯
e.	You have a 50% chance of losing 6,000 VND and a 50% chance of winning 6,000 VND	◯	◯
f.	You have a 50% chance of losing 7,000 VND and a 50% chance of winning 6,000 VND	◯	◯

Source: VARHS 2010 and 2012.

The VARHS dataset in 2010 and 2012 also contain information that we can use to estimate absolute risk aversion. The exact two questions in the VARHS questionnaire are:

> *"Consider an imaginary situation where you are given the chance of entering a state-run lottery where only 10 people can enter and 1 person will win the prize. How much would you be willing to pay for a 1 in 10 chance of winning a prize of 2,000,000 VND?"*

and,

> *"How much would you be willing to pay for a 1 in 10 chance of winning a prize of 20,000,000 VND?"*

The answers to these questions are regarded as reservation prices above which households reject the lottery.

4.5 Analytical framework and methodology

Building on household economics literature and our previous paper on sources of vulnerability and household coping strategies in Vietnam, we suggest in this article

that health insurance can help households reduce the accidental financial loss due to healthcare cost. Households therefore do not have to reduce consumption as an inevitable coping strategy. In addition, health insurance reduces the probability of selling productive assets that are necessary to generate future household income. As well, household members do not have to suffer their illness without medical treatment due to their difficult financial situation[14]. This section describes how we measure vulnerability, risk aversion and finally estimate the impact of health insurance and risk aversion on vulnerability.

Vulnerability as Expected Poverty (VEP)

Vulnerability as expected poverty is a vulnerability measure which was first proposed and applied to Indonesian household data by Chaudhuri (2003). This household vulnerability is defined as the likelihood that a household will fall into poverty in the next period. VEP can be estimated through the following procedures, beginning with the consumption function:

$$lnc_i = \alpha + \beta X_i + e_i \tag{4.1}$$

where c_i is per capita consumption expenditure for household i, X_i reprerents a vector of observable household characteristics and commune characteristics (e.g. characteristics of head, location, assets, shocks), β is a vector of parameters to be estimated, and e_i is a mean-zero disturbance term that captures idiosyncratic shocks that lead to different levels of per capita consumption.

The variance of the disturbance term is:

$$\sigma^2_{e,i} = \theta X_i \tag{4.2}$$

Chaudhuri et al. (2002) and Chaudhuri (2003) acknowledge that the error term (e_i) is not the same for all households (heteroskedasticity). Therefore, we adopt the three-step Feasible Generalized Least Squares (FGLS) technique proposed by Amemiya (1977).

[14]We consider if health insurance affects both idiosyncratic and covariate shocks. Zimmerman & Carter (2003), Morduch (2004) and Dercon (2005) show that the impact of microfinance on the latter is likely to be weak.

Firstly, we estimate Equation 4.2 by employing the ordinary least squares (OLS) technique. Next we predict the residuals from the regression and regress the predicted residuals on the same covariates included in the specification of the consumption process. Then we have the error variance estimating process as follows:

$$\widehat{e}^2_{i,OLS} = \rho + \widehat{\delta} X_i + \eta_i \tag{4.3}$$

The prediction of Equation 4.3 is used to weight the previous equation, thus leading to the transformed version:

$$\frac{\widehat{e}^2_i}{\widehat{e}^2_{i,OLS}} = \frac{\rho}{\widehat{e}^2_{i,OLS}} + \frac{\widehat{\delta} X_i}{\widehat{e}^2_{i,OLS}} + \frac{\eta_i}{\widehat{e}^2_{i,OLS}} \tag{4.4}$$

According to Chaudhuri (2003), the OLS estimation of Equation 4.4 generates an asymptotically FGLS estimate, δ^{FGLS}, and thus e_i^2 is a consistent estimate of the variance of the idiosyncratic component of household consumption. Having obtained an efficient estimate of the variance as the predicted value of Equation 4.4, $(\widehat{\delta}^2_{i,FGLS})$, we now take the square root and transform Equation 4.1 as follows:

$$\frac{lnc_i}{\widehat{\delta}_{i,FGLS}} = \frac{\alpha}{\widehat{\delta}_{i,FGLS}} + \frac{\beta X_i}{\widehat{\delta}_{i,FGLS}} + \frac{e_i}{\widehat{\delta}_{i,FGLS}} \tag{4.5}$$

An OLS estimation of Equation 4.5 generates a consistent and asymptotically efficient estimate of α^{FGLS}, β^{FGLS}. Once we obtain these estimates, it is possible to predict both the expected log consumption and its variance:

$$\widehat{E}[lnC_i|X_i] = \alpha^{FGLS} + \beta^{FGLS} X_i \tag{4.6}$$

$$\widehat{V}[lnC_i|X_i] = \rho^{FGLS} + \delta^{FGLS} X_i \tag{4.7}$$

Chaudhuri (2003) assumes that lnc_i is normally distributed. Then the estimated probability that a household will be poor in the future (for example, at time $t+1$) is given by:

$$\widehat{v}_{i,Chaudhuri} = \widehat{Pr}(lnc_i < lnz|X_i) = \Phi\left(\frac{lnz - \widehat{E}[lnC_i|X_i]}{\sqrt{\widehat{V}[lnC_i|X_i]}}\right) \tag{4.8}$$

where $\Phi(.)$ is the cumulative function of the standard normal and z is the actual poverty line[15].

Unfortunately, household consumption expenditure is not available in the VARHS. As a result, we decide to use total income as a substitution for household consumption. The poverty lines used in this study are the national poverty line generated from household income by MOLISA[16]. Then the vulnerability index is the probability of falling into poverty according the national standard.

Vulnerability as low Expected Utility (VEU)

Ligon & Schechter (2003) define vulnerability as the variation between the utility derived from a certainty-equivalent consumption (z_{ce}) at and above which the household would not be considered vulnerable and the expected utility of consumption. This certainty-equivalent consumption is similar to the poverty line. Consumption of household (c_i) has a distribution that illustrates different states of the world, so the form of vulnerability measure is given below:

$$V_i = U_i(z_{ce}) - EU_i(c_i) \tag{4.9}$$

where U_i is a weakly concave, strictly increasing function. The equation can be rewritten as:

$$V_i = [U_i(z_{ce}) - U_i(Ec_i)] + [U_i(Ec_i) - EU_i(c_i)] \tag{4.10}$$

The first bracketed term is the variation between utility at z_{ce} and utility at expected consumption (c_i) of household i. The second term captures the risk (both covariate and idiosyncratic risks) faced by household i. It can be decomposed as shown below:

$$\begin{aligned} V_i &= [U_i(z_{ce}) - U_i(Ec_i)] && \text{[Poverty or inequality]} \\ &+[U_i(Ec_i) - EU_i(E(c_i|x_t))] && \text{[Covariate or aggregate risk]} \\ &+[EU_i(E(c_i|x_t)) - EU_i(c_i)] && \text{[Idiosyncratic risk]} \end{aligned} \tag{4.11}$$

[15]The poverty lines in this study are calculated from the VHLSS and released by the GSO and the WB. The poverty line measure takes account of the regional price differences and monthly price changes over the survey periods. The poverty lines are 1917, 2077 and 2566 thousand VND/person/year for the years of 2002, 2004 and 2006, respectively.

[16]There are two parallel approaches to poverty measurement in Vietnam using national poverty lines. The first approach developed and led by the Ministry of Labor, Invalids, and Social Affairs (MOLISA), is based on income and is used primarily for targeting social programs. The second was developed by the General Statistical Office and the World Bank, is based on consumption and is used chiefly for monitoring poverty over time.

where $\mathrm{E}(c_i|x_t)$ is the commune expected value of consumption, conditional on a vector of covariant variables (x_t).

The authors take unexplained risk and measurement error out of idiosyncratic risk and assume that the poverty line (z) is the mean consumption. So Equation 4.11 can be rewritten as:

$$\begin{aligned} V_i = [U_i(z_{ce}) - U_i(Ec_i)] & \quad \text{[Poverty or inequality]} \\ +[U_i(Ec_i) - EU_i(E(c_i|x_t))] & \quad \text{[Covariate or aggregate risk]} \\ +[EU_i(E(c_i|x_t)) - EU_i(c_i|x_t, x_{it})] & \quad \text{[Idiosyncratic risk]} \\ +[EU_i(c_i|x_t, x_{it}) - EU_i(c_i)] & \quad \text{[Unexplained risk and measurement error]} \end{aligned} \tag{4.12}$$

where $\mathrm{E}(c_i|x_t, x_{it})$ is the household expected value of consumption, conditional on a vector of covariant variables (x_t) and household's characteristics (x_{it}).

Ligon & Schechter (2003) normalize the expenditure and income per capita so that the average expenditure and income per capita over all households in all periods becomes unity, and therefore z in the above equation equals one. Thus, households do not have vulnerability if resources are distributed in a way that households receive the expected consumption expenditure with certainty.

This VEU approach is useful because it reveals the contribution of each major factor on household vulnerability to poverty. However, it needs a panel data and the result may be sensitive to the function form of utility and the utility measurement[17].

Ligon and Schechter (2003) propose a particular form for utility:

$$U(c) = \frac{c^{1-\gamma}}{1-\gamma} \tag{4.13}$$

Where γ is household coefficient on relative risk aversion or household sensitivity to risk and inequality. From the empirical literature, γ=2 is a good approximation of this measure.

Components of Equation 4.12 can be estimated by applying restricted least squares for expected consumption and then substituting each of them into utility function

[17]Hoddinott & Quisumbing (2003*b*) agrue that the relative components of the decomposition are not likely to be affected by function even though the results may be.

4.13:

$$Ec_{it} = \frac{1}{T}\sum_{t=1}^{T} c_{it} \tag{4.14}$$

$$E(c_{it}|\bar{X}_t) = \alpha_i + \eta_t \tag{4.15}$$

$$E(c_{it}|\bar{X}_t, X_{it}) = \alpha_i + \eta_t + \beta X_{it} \tag{4.16}$$

where α_i capture the effect of household fixed characteristics; η_t capture the impact of changes in covariates or aggregates which are the same across households; and β reflects effects of household characteristics or other observable factors on consumption.

In Equation 4.16, the income variable may be endogenous if it is treated as an explanatory variable for consumption because there may be a feedback relationship between income and consumption. Therefore, we employ the instrumental variable (IV) estimation for Equation 4.16 in which income is perceived as an endogenous variable.

Risk aversion calculation

Three questions in the VARHS data enable us to measure individual risk aversion in two ways. The observed choices of individuals in the lottery enables us to classify respondents with regard to their level of risk aversion.

First, we derive individual risk aversion from the lottery choice by applying the cumulative prospect theory of Tversky & Kahneman (1992). According to these authors, individuals will be indifferent between accepting and rejecting the lottery if:

$$w^{+}(0.5).v(G) = w^{-}(0.5)\lambda^{risk}v(L) \tag{4.17}$$

where G is the gain and L is the loss in a given lottery; $v(x)$ is the utility of the outcome, $x \in [G, L]$; λ^{risk} is the coefficient of risk aversion in the choice task; $w^{+}(0.5)$ and $w^{-}(0.5)$ represent the probability weights for the 0.5 chance of gaining G or losing L, respectively (Gächter et al. 2010). Then we can produce the cumulative risk aversion by the formula below:

$$\lambda^{risk} = \frac{w^{+}(0.5)}{w^{-}(0.5)} \times \frac{v(G)}{v(L)} \tag{4.18}$$

In this study, we only consider monotonic acceptance decisions (99.47% of respondents in our analytical data show monotonicity). The results of risk aversion estimation are presented in the Table A.4, using a different assumption on probability weighting and diminishing sensitives for gains and losses. In the model (1), or the benchmark model, both probability weighting and diminishing sensitivity are not important. Model (2) assumes the same probability weighting for gains and losses, or $w^+(0.5)/w^-(0.5) = 1$, but allows for diminishing sensitivities for gains and losses (this study uses the median estimates of Booij & Van de Kuilen (2009) where $\alpha = 0.95$ and $\beta = 0.92$). Model (3) assumes indifferent diminishing sensitivity but allows for differences in probability weights for gains and losses. We use the estimates from Abdellaoui (2000) in which $w^+(0.5) = 0.394$ and $w^-(0.5) = 0.456$ for the median individual, implying $w^+(0.5)/w^-(0.5) = 0.86$. This probability weighting difference is one of the largest gaps between gains and losses in the literature, providing an upper bound for our estimation. Model (4) simultaneously assumes that both probability weighting and diminishing sensitivities are essential.

We also estimate risk aversion under the expected utility theory by employing the methods of Pratt (1964) and Arrow (1965). Following these studies, we assume that households are initially endowed with income w and have a twice differentiable, concave utility function U so that $U'(w) > 0$ and $U"(w) < 0$. The prize of the lottery is defined by z and the probability of winning that prize is α. The maximum price that an individual is willing to pay for the lottery ticket, or the reservation price, is λ. Therefore, the initial wealth will become $w - \lambda$ after purchasing the lottery ticket and increase to $w - \lambda + z$ if he or she wins the prize.

To deduce the value of the Pratt-Arrow measure of absolute risk aversion $A(w) = -U"(w)/U'(w)$, the expected utility theory implies that the utility of wealth w, without participation in the lottery, is equal to expected utility when participating at reservation price λ (Hartog et al. 2002):

$$U(w) = (1 - \alpha)U(w - \lambda) + \alpha U(w - \lambda + z) \tag{4.19}$$

A second order of the Taylor series expansion of $U(w - \lambda)$ and $U(w - \lambda + z)$ around $U(w)$ gives:

$$U(w) = U(w) + \alpha z U'(w) - \lambda U''(w) + 0.5U''(w)[(1 - \alpha)\lambda^2 + \alpha(z - \lambda)^2] \tag{4.20}$$

After solving for $A(w)$, we have the Pratt-Arrow measure of absolute risk aversion as:

$$A(w) = -\frac{U''}{U'} = \frac{\alpha z - \lambda}{0.5\lambda^2 + 0.5\alpha z^2 - \alpha\lambda z} \tag{4.21}$$

Risk aversion estimated results are provided in Table C.5 of the Appendix C. We expect a close relationship between the risk aversions estimated from the two approaches. The pairwise correlation between risk parameters is calculated and presented in the Table C.8. Apparently, there is a strong correlation between the risk parameters calculated by the prospect theory and by expected utility theory. We also classify households into groups of high, medium and low aversion and summarize the results in Table C.6 and Table C.7 of the Appendix C.

Propensity score matching

For an accurate estimation of a program impact, panel data with at least one survey serves as baseline data in which all participants have not yet received the benefit from the program. In our data, we do not have the true baseline data. Households might have health insurance in both the 2010 and 2012 surveys. Dropping households who have health insurance in 2010 then applying the difference-in-difference method to estimate the average treatment effect on the treated (ATT) for the year 2012 would lead to a biased estimate. Therefore, we employ the method of propensity score matching which has been previously applied by Nguyen (2012).

Let denotes H_{2010} and H_{2012} as the binary variables of health insurance in the years 2010 and 2012 respectively. In 2010, Y_1^{2010} and Y_0^{2010} denote potential outcomes with and without health insurance, respectively. Similarly, in 2012, Y_1^{2012} and Y_0^{2012} denote outcomes with and without health insurance.

The impact of health insurance on vulnerability can be presented as below:

$$ATT_{2012} = E(Y_1^{2012}|H_{2012} = 1) - E(Y_0^{2012}|H_{2012} = 1) \tag{4.22}$$

The equation can be rewritten as:

$$ATT_{2012} = Pr(H_{2010} = 1|H_{2012} = 1)ATT_{2012a} + Pr(H_{2010} = 0|H_{2012} = 1)ATT_{2012b} \tag{4.23}$$

where $Pr(H_{2010} = 1|H_{2012} = 1)$ and $Pr(H_{2010} = 0|H_{2012} = 1)$ are the proportion of households with and without health insurance in 2010 among households who have health insurance in 2012. The ATT_{2012a} and ATT_{2012b} are defined as follows:

$$ATT_{2012a} = E(Y_1^{2012}|H_{2012} = 1, H_{2010} = 1) - E(Y_0^{2012}|H_{2012} = 1, H_{2010} = 1) \quad (4.24)$$

$$ATT_{2012b} = E(Y_1^{2012}|H_{2012} = 1, H_{2010} = 0) - E(Y_0^{2012}|H_{2012} = 1, H_{2010} = 0) \quad (4.25)$$

Here ATT_{2012a} is the average effect of health insurance on people who have health insurance in both 2010 and 2012, whereas ATT_{2012b} represents the average effect of health insurance on the newly insured households in 2012. ATT_{2012a} and ATT_{2012b} will be equal to ATT_{2012} under an assumption that the enrolment in health insurance in 2010 is not correlated with the enrolment in health insurance in 2012. If the assumption does not hold, we need to make other assumption to identify ATT_{2012}.

First, we can write ATT_{2012} conditional on X as follow:

$$\begin{aligned} ATT_{2012,X} = {} & Pr(H_{2010} = 1|X, H_{2012} = 1)[E(Y_1^{2012}|X, H_{2012} = 1, H_{2010} = 1) \\ & - E(Y_0^{2012}|X, H_{2012} = 1, H_{2010} = 1)] \\ & + Pr(H_{2010} = 0|X, H_{2012} = 1)[E(Y_1^{2012}|X, H_{2012} = 1, H_{2010} = 0) \\ & - E(Y_0^{2012}|X, H_{2012} = 1, H_{2010} = 0)] \end{aligned} \quad (4.26)$$

$ATT_{2012,X}$ can be seen as the weighted average of the impact of health insurance on the newly insured households in 2012 and the impact of health insurance on the insured households in both 2010 and 2012 (conditional on X)

We suggest two identification assumptions as follows:

$$\begin{aligned} & E(Y_0^{2012}|X, H_{2010} = 0, H_{2012} = 1) - E(Y_0^{2012}|X, H_{2010} = 0, H_{2012} = 0) \\ & = E(Y_0^{2010}|X, H_{2010} = 0, H_{2012} = 1) - E(Y_0^{2010}|X, H_{2010} = 0, H_{2012} = 0) \end{aligned} \quad (4.27)$$

$$\begin{aligned} & E(Y_0^{2012}|X, H_{2010} = 1, H_{2012} = 1) - E(Y_1^{2010}|X, H_{2010} = 1, H_{2012} = 1) \\ & = E(Y_0^{2012}|X, H_{2010} = 1, H_{2012} = 0) - E(Y_1^{2010}|X, H_{2010} = 1, H_{2012} = 0) \end{aligned} \quad (4.28)$$

The first assumption shows that difference in the non-health-insurance outcome (conditional on X) between households uninsured in both the years and those insured only in the year 2012 is constant overtime. The second assumption indicates that

difference between the non-health-insurance outcome in the year 2012 and the health-insurance outcome in the year 2010 is the same for households insured in both ears and those insured in 2010 but not in 2012.

Rearrange and then substitute two assumptions (29) and (30) into (28) to get:

$$\begin{aligned} ATT_{2012,X} = Pr(H_{2010}=1|X,H_{2012}=1) \times \begin{pmatrix} [E(Y_1^{2012}|X,H_{2010}=1,H_{2012}=1) \\ -E(Y_0^{2012}|X,H_{2010}=1,H_{2012}=0)] \\ -[E(Y_1^{2010}|X,H_{2010}=1,H_{2012}=1) \\ -E(Y_1^{2010}|X,H_{2010}=1,H_{2012}=0)] \end{pmatrix} \\ + Pr(H_{2010}=0|X,H_{2012}=1) \times \begin{pmatrix} [E(Y_1^{2012}|X,H_{2010}=0,H_{2012}=1) \\ -E(Y_0^{2012}|X,H_{2010}=0,H_{2012}=0)] \\ -[E(Y_0^{2010}|X,H_{2010}=0,H_{2012}=1) \\ -E(Y_0^{2010}|X,H_{2010}=0,H_{2012}=0)] \end{pmatrix} \end{aligned} \tag{4.29}$$

$ATT_{2012,X}$ is identified because all terms in the equation are observed. We can then rearrange it as follows:

$$\begin{aligned} ATT_{2012,X} = & \begin{pmatrix} Pr(H_{2010}=1|X,H_{2012}=1)E(Y_1^{2012}|X,H_{2010}=1,H_{2012}=1) \\ +Pr(H_{2010}=0|X,H_{2012}=1)E(Y_1^{2012}|X,H_{2010}=0,H_{2012}=1) \end{pmatrix} \\ & - \begin{pmatrix} Pr(H_{2010}=1|X,H_{2012}=1)E(Y_0^{2012}|X,H_{2010}=1,H_{2012}=0) \\ +Pr(H_{2010}=0|X,H_{2012}=1)E(Y_0^{2012}|X,H_{2010}=0,H_{2012}=0) \end{pmatrix} \\ & - \begin{pmatrix} Pr(H_{2010}=1|X,H_{2012}=1)E(Y_1^{2010}|X,H_{2010}=1,H_{2012}=1) \\ +Pr(H_{2010}=0|X,H_{2012}=1)E(Y_0^{2010}|X,H_{2010}=0,H_{2012}=1) \end{pmatrix} \\ & - \begin{pmatrix} Pr(H_{2010}=1|X,H_{2012}=1)E(Y_1^{2010}|X,H_{2010}=1,H_{2012}=0) \\ +Pr(H_{2010}=0|X,H_{2012}=1)E(Y_0^{2010}|X,H_{2010}=0,H_{2012}=0) \end{pmatrix} \end{aligned} \tag{4.30}$$

Conditional on X and H_{2010}, we can express ATT_{2012} as follows:

$$\begin{aligned} ATT_{2012,X,H_{2010}} = & [E(Y_1^{2012}|X,H_{2010},H_{2012}=1) - E(Y_0^{2012}|X,H_{2010},H_{2012}=0)] \\ & - [E(Y^{2010}|X,H_{2010},H_{2012}=1) - E(Y^{2010}|X,H_{2010},H_{2012}=0)] \end{aligned} \tag{4.31}$$

Where Y^{2010} are the observed outcomes in 2010. This suggests a simple way of matching. The treatment group includes households who have health insurance in 2012. The control group includes households who do not have health insurance in 2012, but have the observed characteristics (X variables) and health insurance status

in 2010 (H_{2010} variable) similar to those of the treatment group. In this case, we control not only X but also H_{2010}.

Then we employ Rosenbaum & Rubin (1983) to match the uninsured and the insured using the probability of being assigned into the program, which is called the propensity score. In this study, the propensity score is the probability of being insured in 2012 given variables X and H_{2010}. With different estimators, we have different number of the uninsured who are matched with the insured. In this study, we use kernel matching estimators. The standard errors are calculated using bootstrap techniques.

The validity of propensity score matching (PSM) depends on two conditions: unconfoundedness or conditional independence (or unobserved factors do not affect participation) and sizable common support or overlap in propensity score across treatment and control groups (or enough nonparticipants to match with participants). Therefore, the PSM estimation is more accurate when only observed characteristics are believed to affect the enrollment and baseline data with a wide range of preprogram characteristics are available.

In this paper, data with various characteristics in 2010 are used as the baseline data. Risk aversion indexes, which possibly affect both health insurance enrollment and vulnerability, are employed to limit the unobserved selection. The common support is checked through the propensity score estimation. The difference-in-difference method is used to control the unobserved time-invariant characteristics. Finally, an indirect test for potential confounders is provided to confirm the use of PSM.

Model specification for robustness analysis

To check the robustness of the matching method, we treat the data set as a panel data set (Jones et al. 2013). Then the impact of owning health insurance on the utility loss of households can be addressed by adopting the following specification:

$$V_{it} = \alpha + \beta HI_{it} + \gamma HS_{it} + \delta.RA_{it} + \lambda S_{it} + \mu_{it} + C_t + \varepsilon_{it} \tag{4.32}$$

where: V_{it} denotes the idiosyncratic vulnerability index which is estimated by vulnerability as low expected utility (VEU); i refers to the household; t denotes the time when data was collected.

HI_{it} represents the number of health insurance cards that a household has over the study period. From the data set, households might have health insurance in two surveys, or they may not have any health insurance in both surveys. They can also have insurance in only one surveys. Therefore, in this study, we assign this variable different values. It can be the total health insurance in two surveys, or it can be a dummy reflecting whether households have health insurance or not in a certain survey[18]. β reflects the impact of health insurance coverage on vulnerability.

HS_{it} denotes the health status, and is measured by the total number of days household members could not work because of illness within the 12 months prior to the interview.

RA_{it} is the risk aversion index, showing how much a household dislike risk. Both absolute risk aversion index and cumulative risk aversion index are used.

S_{it} is used to control for impact of covariate shocks that a household experienced in the past three years. Those shocks include droughts, floods, epidemics, livestock diseases, and other shocks.

X_{it} is the vector of baseline characteristics of households at the time of interview. They include household per capita income, asset, head age, marital status, female share, dependent share, education, agricultural job.

C_t represents any commune impact. This includes total number of households in the commune, whether a commune is poor or not, poverty rate, distance to the regular market, having a secondary school or not, distance to the bus station.

In general, simultaneity bias exists if there is a positive correlation between health insurance coverage and unobserved factors that lead to changes in the vulnerability index. For example, sick vulnerable households have more incentive to have health insurance. In addition, high-income households and risk-averse households might try to buy health insurance. As a result, we would over-estimate the causal effect of health insurance on household vulnerability. However, by adding health status, risk aversion and income into the model, there is a small possibility of causal effects from correlation between health insurance coverage and household vulnerability and the simultaneity bias is least likely to present.

[18]In our sample of VARHS 2012 there are four households that have two voluntary health insurances (these account for 0.2% of sample); we decided to treat these households as if they had only one health insurance. The category representing health insurance therefore defines whether a household has at least one health insurance.

Also, the panel data has several observations per individual. The individual's error term may have some common components that are present for each period. The error terms for each individual may show an inter-correlation within the "cluster" of observations specific to the individual. To relax the usual assumption of zero error correlation over time for the same individual, we can adjust the estimator using cluster corrected standard errors. This also relaxes the assumption of homoscedasticity (Adkins & Hill 2011).

Theoretically, this specification can be estimated by fixed effects model, random effect model, or first difference depending on the assumption of the error term ε_{it}. However, our panel data set has only two waves and households might have health insurance card in both years. As a result, when we use a dummy to represent the health insurance enrollment in each year, the fixed effect and first difference method will treat households who are insured in both year and households who are uninsured in both years the same. Therefore, the best estimator is in this case is the random effect estimator although we can also employ the between estimator. For the random effect estimation to be consistent, we assume that the composite error term ε_{it} is not correlated with any of the explanatory variables included in the model (Gujarati 2011, Jones et al. 2013).

4.6 Econometric results and discussion

Measuring vulnerability as expected poverty (VEP)

The results of the income function are presented in Table 4.4, where the FGLS regression results for Equations 4.6 and 4.7 are shown for surveys in 2010 and 2012 continuously. In general, the sign of estimated coefficients are as expected, reflecting their effects on income as in the literature.

As can be seen from Table 4.4, the coefficient of age of household head was positive and significant in both 2010 and 2012, confirming that a household with an older head tends to have higher per capita income. A household with a higher share of females has a lower per capita income, as the estimated coefficients are negative and significant. As expected, the coefficients of dependency burden are negative and significant in both surveys, showing that a household with many old or many young members tends to have lower level of income. The correlation between the

TABLE 4.4: Estimates of Vulnerability as Expected Poverty in Vietnam 2002, 2004, 2006

	2010		2012	
Variable	Log(Cons)	Variance	Log(Cons)	Variance
headage	0.017*	0.055*	0.029**	0.019
	(1.74)	(1.70)	(2.52)	(0.55)
married	0.042	0.026	0.056	-0.239
	(0.80)	(0.15)	(1.05)	(-1.11)
headage2	-0.0001	-0.0005	-0.0002**	-0.0001
	(-1.55)	(-1.57)	(-2.04)	(-0.34)
femaleshare	-0.249***	0.149	-0.217**	0.224
	(-2.61)	(0.52)	(-2.45)	(0.72)
dependshare	-0.651***	-0.048	-0.534***	-0.929***
	(-8.57)	(-0.19)	(-6.27)	(-3.60)
highestedu	0.145***	0.028	0.108***	0.068
	(7.43)	(0.50)	(5.45)	(1.14)
agrhh	0.108**	0.153	0.265***	0.083
	(2.47)	(1.35)	(5.65)	(0.61)
totalhousehold	0.00002	0.0001	-0.000	-0.00004
	(0.61)	(1.43)	(-0.12)	(-0.61)
targetcommune	0.088	0.083	0.090*	0.402
	(1.64)	(0.65)	(1.81)	(3.08)
povertyrate	-1.378***	0.126	-0.983***	-0.462
	(-6.35)	(0.21)	(-5.83)	(-1.38)
regularmarket	-0.076	-0.024	-0.106	0.172
	(-1.52)	(-0.17)	(-1.58)	(0.97)
secondaryschool	0.153*	0.095	0.093	0.060
	(1.71)	(0.44)	(1.15)	(0.33)
distance2bus	-0.004**	-0.008*	-0.002	-0.002**
	(-2.25)	(-1.91)	(-3.26)	(-2.31)
_cons	8.785***	-4.096***	8.214***	-2.918**
	(28.49)	(-4.12)	(22.74)	(-2.51)
N	1975	1975	1977	1977
R^2	0.2195	0.0081	0.1950	0.0228
F	30.46	1.04	20.62	2.99
Prob>F	0.000	0.4076	0.000	0.0003

Note: t statistics in parentheses
* p <0.05, ** p <0.01, *** p <0.001

Table 4.5: Summary of estimated VEP in 2010 and 2012

	VEP 2010	VEP 2012
Observation	1942	1944
Mean	0.1295347	0.2736287
Standard Deviation	0.1911949	0.2527675
Min	0.00000183	0.0009027
Max	0.9881003	0.9997653

Source: Author's calculation from VARHS 2010 and 2012

marital status of a household head and household income is unclear when the signs of estimated coefficients are positive, but statistically insignificant. The estimated coefficients reflecting the highest level of education of household members are significantly positive, reflecting the fact that a household with a higher level of education has a higher per capita income. In this study, agricultural households are more likely to have a higher income as the dummy coefficients are significant and positive. This might be because all households in this data set are from rural areas. The results also suggest that households living in communes with higher incidence of poverty or residing in areas far away from bus station tend to have lower income.

From the estimates of consumption and the variance of disturbance term in Table 4.4, we adopt Chaudhuri's measure to calculate each household's vulnerability using Equation 4.8. Assuming that the log consumption has a normal distribution, we estimate the likelihood that a household's future income is lower than the poverty line. The poverty line used in this study are the national poverty line generated from household income by MOLISA[19]. Next, the vulnerability index is the probability of being poor according to the national standard. A summary of the estimated VEP in 2010 and 2012 is presented in Table 4.5. On average, rural households in Vietnam had a 12.95 per cent probability of falling into poverty in 2010 and this number increased to 27.36 per cent in 2012.

[19]During 2010 - 2012, the MOLISA income poverty line is VND 4.8 million/person/year (equivalent USD 240).

Measuring vulnerability as low expected utility (VEU)

The consumption estimation for Equation 4.16 is presented in Table 4.6. As can be seen from this table, communes with a higher population might have higher food consumption because there must be more purchasing activities or more food shops. The positive and significant coefficient of the regular market variable probably supports this explanation. If a commune has a regular market, its average food consumption will increase. Similarly, communes with a secondary school can be expected to have a higher level of food consumption, as the coefficient is significant and positive. In contrast, the estimated coefficients of both the target commune and poverty rate are significantly negative. These imply that when a commune is one of the targeted communes or has a higher incidence of poverty, it will experience a lower average level of food consumption.

Table 4.7 provides the results from the Panel IV estimation for Equation 19. Since some explanatory variables are time-invariant, we can only use the random effect regression[20]. In the first stage, total land area owned by a household, and per capita of productive assets (including feed grinding machine, rice milling machine, grain harvesting machine, tractor and plough) are used as instruments for income. It is reasonable that these variables firstly affect income, and then indirectly affect consumption. These instruments for income are also specified in Gaiha & Imai (2008), Jha et al. (2010) and Jha et al. (2013). The Hansen-Sargan statistic of the over-identification test shown in Table 4.7 indicates that the instruments used in this situation are valid.

Results in the first stage estimation show strong evidence of a relationship between productive assets and household income. Similarly, having more land would increase household income as expected. Other household characteristics also contribute to the level of household income. For example, households with an older head tend to have higher incomes. The negative sign of the head age squared coefficient implies that the marginal effect of age on income will reduce when the head becomes older. If the head is married or any household member experienced a better education, then household income tends to increase. However, a household with a higher share of females or dependents will face a lower level of per capita income. As can be seen from Table 4.7, in the second stage, the income coefficient is highly significant and

[20]The random effect regression has been used previously to calculate VEU in (Gaiha & Imai 2008) and (Jha et al. 2010).

TABLE 4.6: Covariate risk component (Panel random effect)

Variable	Per capita food consumption
totalhousehold	0.0000496
	(3.33)***
targetcommune	-0.0662523
	(-2.96)***
povertyrate	-0. 6435118
	(-9.22)***
regularmarket	0.0479312
	(1.70)*
secondaryschool	0.0818515
	(1.86)*
distance2bus	-0.0005328
	(1.33)
_cons	0.908447
	(12.16)***
Number of observations	3963
Number of groups	1988
Join significance	Wald $chi^2(6)$=250.01
	Prob>chi^2=0.0000
Hausman test: fixed vs random effect*	$chi^2(6)$=24.53*
	Prob>chi^2 = 0.0004

Notes: p<0.1; ** p<0.05; *** p<0.01. Standard error adjusted for 1988 clusters. Robust z statistics in parentheses.

* The Hausman test supports the use of fixed effect regression. However, according to Clark & Linzer (2014), when the independent variable exhibits only minimal within-unit variation, the random-effects model will tend to produce superior estimates of β when there are few units or observations per unit, and when the correlation between the independent variable and unit effects is relatively low. An increase in efficiency can offset an increase in bias.

positive. This result suggests that per capita income largely determines household food consumption. Marital status of the household head and the education levels of household members both affect household food consumption positively while dependents and agriculture as the only source of income are factors which reduce food consumption. Living in a more populated area contributes slightly to a higher level of household food consumption. In addition, if households reside in a commune with a regular market, their food consumption may increase. As expected, households in poorer communes and targeted communes have lower food consumption. Surprisingly, distance to a bus station is positively correlated with food consumption.

TABLE 4.7: Idiosyncratic risk component (Panel random effect IV model)

Variable	First stage (pc income)	Second stage (pc consumption)
ntotalincome		0.3191125
		(6.71)***
headage	0.0326934	0.0103375
	(4.53)***	(1.59)
married	0.2094052	0.1413307
	(5.71)***	(4.13)***
headage2	-0.0002982	-0.0000812
	(-4.51)***	(-1.36)
femaleshare	-0.2029016	-0.0313423
	(-3.00)***	(-0.52)
dependshare	-0.1901757	-0.136678
	(-3.35)***	(-2.69)***
highestedu	0.0967099	0.0868081
	(6.86)***	(6.63)***
agrhh	0.0066595	-0.1872426
	(0.25)	(-8.02)***
totalhousehold	0.0000121	0.0000405
	(0.95)	(3.64)***
targetcommune	0.135024	-0.1037634
	(5.53)***	(-4.48)***
povertyrate	-1.01589	-0.3393418
	(-13.44)***	(-4.21)***
regularmarket	-0.0011191	0.0565362
	(-0.04)	(2.12)**
secondaryschool	0.0356218	0.06378
	(0.88)***	(1.79)*
distance2bus	-0.0017999	0.001261
	(-2.81)***	(2.23)**
totalland	0.1040897	
	(17.11)***	
productiveasset	0.4654674	
	(4.93)***	
_cons	-0.0316537	0.1290584
	(-0.14)	(0.66)
Number of observations	3952	3952
Join significance	Wald $chi(15)$=884	Wald $chi^2(14)$=663.15
Prob>chi^2	0.0000	0.0000
Sargan-Hansen test for	$Chi^2(1)$=1.210	
over-identification restriction	Prob>chi^2=0.2713	

Notes: p<0.1; ** p<0.05; *** p<0.01. Robust z statistics in parentheses.

TABLE 4.8: Decomposition of average vulnerability during 2010-2012

VEU	Poverty	Covariate risk	Idiosyncratic risk	Unexplained risk
0.7108	0.4314	-0.3410	0.4288	0.1905

Source: Author's calculation from VARHS 2010 and 2012.

The results obtained from Equation 4.15 and Equation 4.16 are used to derive $E(c_{it}|\bar{X}_t)$ and $E(c_{it}|\bar{X}_t, X_{it})$. We then calculate the mean of normalized food consumption to obtain Ec_{it} as shown in Equation 4.14. Finally, we use the utility function 4.13 to estimate four components of Equation 4.12. A household's VEU is the sum of four separate components. The aggregate VEU and its components are presented in Table 4.8. The estimate of the average VEU (0.7108) is our estimate of the vulnerability of the whole households. This implies that the utility of the average household is 71 per cent less than the hypothetical situation without any risk or inequality in consumption. This level of utility vulnerability is lower than the estimation of Gaiha & Imai (2008) which is 0.7476 but much higher than the estimation of Jha et al. (2013) which is around 0.3016. Idiosyncratic shocks contribute considerably to the utility loss (approximately 60 per cent). However, the negative sign of the aggregate risk component indicates that economic growth cancels the negative covariate shocks and even reduce the vulnerability. We may argue that the utility loss would be more serious if there had been less economic growth in rural Vietnam during the period of 2010-2012.

Impact of health insurance on VEU and VEP

To estimate the impact of health insurance on vulnerability, we first calculate the propensity scores for households covered in the data set. The probit regression is employed to estimate the propensity score by default[21]. The dependent variable is health insurance coverage which is represented by a dummy taking the value of one for the treatment group and zero for the control group. There are two requirements for the explanatory variables in order to get an accurate estimation of the propensity scores. First, the independent variables need to be exogenous to the health insurance variable used as the dependent variable (Heckman & Vytlacil 1999, Ravallion 2001). Therefore, we decide to choose explanatory variables from the 2010 VARHS rather

[21]The Stata command *pscore* is employed in this study and the probit is used to estimate propensity score by default. The balancing test is also provided. The estimated results are similar with the Stata command '*psmatch2*' (Table C.1).

than from the 2012 VARHS. Second, the independent variables should affect both the vulnerability index and health insurance coverage (Ravallion 2001). In this study, these variables include health insurance status in 2010, health status, risk aversion, income, asset, age of household head, marital status of the head, female share of the household, dependent share of the household, occupation and distance to the nearest bus station. Other commune variables representing the covariate shocks that might affect health insurance decision such as drought, flood, epidemic, livestock disease and other shocks are also added to the regression. They are all for the year 2010[22].

One might have a concern that compulsory and voluntary health insurance schemes are treated equivalently in our analysis. However, during the time span of the data, the difference between the two schemes would be trivial because of certain reasons: First, the compulsory health insurance scheme in Vietnam is not strictly compulsory and therefore, the coverage rate of this scheme is not 100 per cent for all groups of households (Table 4.5). Households who are not fully subsidized in compulsory groups will go through a decision making process similar to what households in voluntary groups will do. In addition, the premium is quite small in comparison with other types of consumption; then although households in compulsory groups are partly subsidized, the amount of money they have to pay for a health insurance card is not much different from that of households in voluntary scheme. Also, health insurance for the poor and health insurance for children under six years of age, who are compulsorily insured and fully subsidized, are excluded to keep the incentive gap at the minimal level. For households with labor contract, they are supposed to receive health insurance card from their employers. But if employers refuse to provide health insurance illegally and intentionally, employees can choose to stay or find a better job with health insurance (Monheit & Vistnes 2008). Hence, their probability of having a health insurance card might depend on their risk preference or factors representing their negotiating power such as education, age rather than types of health insurance schemes.

Table 4.9 shows the results of the probit regression on health insurance. As can be seen from the table, the insured and the uninsured household are statistically different in several characteristics. For instance, households who have health insurance in 2010 are more likely to have health insurance in 2012. Households with a higher income tend to own at least one health insurance in 2012. Households with higher

[22]The balancing property is satisfied for 7 blocks with the *pscore* Stata command.

proportion of females increase the probability of purchasing health insurance. Similarly, households living in an area with a high incidence of epidemics tend to have health insurance. However, living in a commune with a high incidence of drought and livestock disease reduce the probability of purchasing health insurance. This might be because these types of risks do not affect household member's health status. Also, households with agricultural jobs or with a higher dependent share have less demand on health insurance. In our study, health status defined by the number of days on sick leave during past 12 month (in survey 2010) does not affect health insurance status in 2012.

In our paper, it seems that risk aversion indexes (both the cumulative risk aversion and the absolute risk aversion) do not affect the decision to purchase health insurance because the estimated coefficients are negative and insignificant (Table 4.9)[23]. This result contrasts with Condliffe & Fiorentino (2014) where individuals who are more likely to engage risk behavior are less likely to carry health insurance. There are four possible reasons for this. First, risk aversion effect in our paper is offset by 'rigidity effect' that individuals are least likely to change their current insurance plan. Several previous studies have pointed out that individuals tend to appreciate the value of their current health insurance plan; therefore, they are less likely to purchase health insurance if they have never bought it before (Costa-Font & Garcia-Villar 2009, Friedman 1974, Marquis & Holmer 1996)[24]. In our result, the impact of health insurance status in 2010 was positive and strongly significant. Therefore, we have reason to believe that the 'rigidity effect' exists. Second, households might prefer other types of insurance over health insurance because the gain from health insurance is uncertain and ambiguous (Marquis & Holmer 1996)[25]. Third, the effect of individual risk aversion might be stronger for decisions taken in the near future and then might reduce considerably in next two years (which is the duration between the two surveys). Once we try to estimate the impact of risk aversion on any type of insurance coverage, we find the positive and significant effects in the same year but not significant in the next two years (Table C.3 and Table C.4 in Appendix C)[26].

[23]In Table C.2 in the Appendix C, we classified households into three different groups of risk attitude and found that households with low risk aversion (i.e. prefer taking risk) are more likely to have health insurance.

[24]Thaler (1980) calls this the "endowment effect"; Samuelson & Zeckhauser (1988) call this a "status quo" bias; and Costa-Font & Garcia-Villar (2009) call this the "captive preference".

[25]Vietnamese newspapers note that in Phuong (2013) and Trang (2012).

[26]However, we cannot deny that simultaneous bias with this specification because independent variable and dependent variables in the probit model are collected in the same survey.

Similarly, Bernstein (2009) shows that risk preference does not explain the disparity in health insurance coverage and any increase in insurance coverage is closely associated with changes that result in insurance being more affordable and accessible such as in socio-economic circumstances, incomes, marital status and education. Four, this might reflect the fact that the market for health insurance is limited and mainly provided by few state companies. A health insurance purchasing decision is restrained not only by limited health insurance choices, but also by the complicated purchasing process. For instance, households are strictly required to enroll all household members who have a name on the household certificate, despite the fact that some members had migrated to other places. The complexity for enrolment criteria and process hinders the increase of the coverage as pointed out in Matsushima & Yamada (2014).

Table 4.10 reports the health insurance impact on vulnerability using propensity score matching and the difference-in-difference method. The kernel-matching estimator is applied with a bandwidth of 0.06 for interpretation[27]. The first and second columns present the difference between treatment and control groups in 2012 and 2010, respectively. They are estimated components of $ATT_{2012,X,H_{2010}}$. Therefore, the difference-in-difference estimates in the last column are attributed to the health insurance impact, or $ATT_{2012,X,H_{2010}}$. Table 4.10 shows that health insurance coverage has significantly reduced household vulnerability. More specifically, the impact of health insurance on the idiosyncratic component of VEU is -0.35. Now recall that in the estimates from our whole sample, idiosyncratic component causes around 0.43 (or 43 per cent) of utility loss (Table 4.8). That means health insurance reduces 35 percentage points of utility loss caused by idiosyncratic shocks. In other words, on average, health insurance helps rural households in Vietnam reduce the idiosyncratic component of utility loss by 81 per cent. In addition, the impact of health insurance on the probability of falling into income poverty (VEP) is -0.05 (or -5 per cent). From our previous estimates in Table 4.5, on average, households in 2012 have a 27 per cent probability of falling into poverty. That means health insurance helps rural households in Vietnam reduce the probability of being poor by about 19 per cent.

[27]Bootstrapping for the nearest neighbour matching may not provide accurate standard errors (Abadie & Imbens 2008) even though the nearest neighbour matching and the kernel matching yield similar results.

TABLE 4.9: Logit regression of health insurance (with risk aversion index)

	Cumulative risk aversion index		Absolute risk aversion index	
insurance20121	Coefficient	Std. Err.	Coefficient	Std. Err.
insurance20101	0.4493***	0.1096	0.4529***	0.1093
healthstatus	-0.0001	0.0004	-0.0002	0.0004
riskaversion1	-0.0123	0.0284		
abriskaversion1			-0.0716	0.0606
lpcincome	0.2422***	0.0461	0.2428***	0.0460
headage	0.0061	0.0196	0.0060	0.0196
married	0.1101	0.0978	0.1111	0.0978
headage2	0.0001	0.0002	0.0001	0.0002
femaleshare	0.3939**	0.1867	0.3981**	0.1868
dependshare	-0.3992***	0.1543	-0.4028***	0.1543
agrhh	-0.2118***	0.0748	-0.2154***	0.0749
distance2bus	-0.0048	0.0030	-0.0047	0.0030
asset	-0.0890	0.0590	-0.0881	0.0590
drought	-0.0126**	0.0051	-0.0127**	0.0050
flood	-0.0016	0.0039	-0.0018	0.0039
epidemic	0.1712*	0.0891	0.1664*	0.0890
livestock	-0.0114***	0.0042	-0.0112***	0.0042
othershock	0.0197	0.0131	0.0195	0.0131
_cons	-3.2029***	0.6870	-3.1893***	0.6843
Number of obs	1988		Number of obs	1988
LR $chi^2(17)$	195.46		LR $chi^2(17)$	196.65
Prob $>chi^2$	0.0000		Prob $>chi^2$	0.0000
Log likelihood	-1100.671		Log likelihood	-1100.074
Pseudo R^2	0.0815		Pseudo R^2	0.0820

Notes: t statistics in parentheses
* p <0.05, ** p <0.01, *** p <0.001

TABLE 4.10: Impact of health insurance on vulnerability

	2012	2010	Difference-in-difference
Covariate risk	0.16***	0.22***	-0.06***
	(4.941)	(6.976)	(-13.338)
Idiosyncratic risk	-0.51**	-0.16***	-0.35**
	(-2.131)	(-4.202)	(-2.243)
VEP	-0.08***	-0.03***	-0.05***
	(-9.446)	(-4.736)	(-7.95)

Notes: *pscore*-Kernel matching with bandwidth of 0.06

Robustness analysis

We examine the robustness of the matching method by treating the data set as a panel data set. The independent variable in the regression is utility loss index due to idiosyncratic shocks because health problems are classified into idiosyncratic shocks. Therefore, the regression is an attempt to estimate the effect of health insurance coverage on idiosyncratic shocks when applicable. The random effect estimator is used because some explanatory variables are time-invariant or have minimal within-unit variation[28]. One example is our key explanatory variable representing health insurance coverage. Risk aversion index is used as an explanatory variable in addition to other household characteristics and commune characteristics so that we can minimize the possible correlation between error term and explanatory variables.

Table 4.11 reports the results for the models used to estimate the impact of health insurance coverage on household vulnerability. Absolute risk aversion index is used as an explanatory variable in this case[29]. Without control variables, the estimated coefficient of health insurance is -0.26 and significant. This implies health insurance coverage helps to reduce utility loss by 26 percentage points. Using the between estimator for panel data, we have larger impact of health insurance at -0.56. If we add household characteristics and commune characteristics into the regression, the random effect estimator produces an impact of health insurance of about -0.23 and the between estimator gives an impact of around -0.49.

Because of the data collection timing, we do not know when households bought health insurance. It could have been at the beginning or at the end of the year. Therefore, we assume that the impact of health insurance coverage should be the impact of total health insurance during the time between the two surveys. Therefore, in our regression, the explanatory variable becomes the total health insurance that a household has during 2010 and 2012. The number is the sum of health insurance they have in the 2010 survey and in the 2012 survey. Dependent variables are the

[28] P values in Hausman tests ranges from 0.0641 to 0.1145, showing that we cannot reject the REM at 5%. However, we take the results from the Hausman test with caution for some reasons: 1) According to Jones et al. (2013), in a finite sample, a standard application of the Hausman test may not lead to a reliable test statistic. 2) According to Clark & Linzer (2014), when the independent variable exhibits only minimal within-unit variation, the random-effects model will tend to produce superior estimates of β when there are few units or observations per unit, and when the correlation between the independent variable and unit effects is relatively low. An increase in efficiency can offset an increase in bias even the Hausman test supports the use of fixed effect regression.

[29] Results with cumulative risk aversion index are also provided in the Table C.9 and C.10 of Appendix C. Hausman tests favour REM because p-values vary from 0.0771 to 0.1321.

TABLE 4.11: Impact of health insurance coverage on idiosyncratic VEU
(health insurance at the time of interview, absolute)

	Random effect	Between variation	Random effect	Between variation
Health insurance	-0.261***	-0.558***	-0.231***	-0.486**
(Yes/No at the time of interview)	(0.043)	(0.160)	(0.069)	(0.167)
Absolute risk aversion	-0.164*	-0.082	-0.129*	-0.104
	(0.088)	(0.165)	(0.076)	(0.163)
Health status	-0.030	-0.009	-0.068	-0.067
	(0.032)	(0.065)	(0.059)	(0.066)
Per capita income (log)	-0.270***	-0.251***	-0.174***	-0.163**
	(0.058)	(0.060)	(0.045)	(0.066)
Household characteristics	No	No	Yes	Yes
Commune characteristics	No	No	Yes	Yes
N	3952	3952	3952	3952
R^2		0.019		0.066
F		9.524		5.991
p	0.000	0.000	0.000	0.000

Notes: Standard errors in parentheses
* p <0.05, ** p <0.01, *** p <0.001

same. As seen in Table 4.12, with the random effect estimator, having a health insurance will reduce utility loss about -0.21. Similarly, with the between estimator, the impact of health insurance is about -0.24. Although these results are not exactly the same as the estimates from the matching method, they reinforce our findings about the negative and significant impact of health insurance coverage on household vulnerability.

Although we have captured various factors in our model specification and the difference-in-difference method helps to eliminate the impact of unobserved time-invariant factors, there is still a concern about other unobserved variables that might affect both health insurance enrolment and vulnerability. If this situation exists, our matching estimators violate the conditional independence or unconfoundedness assumption (CIA) and may lead to a hidden bias. In this paper, we adopt a sensitivity analysis proposed by Ichino et al. (2008), building on Rosenbaum & Rubin (1983) and Rosenbaum (1987). They suggest that if the CIA is not satisfied given observables but it is satisfied if one could observe an additional binary variable (confounder), then this potential confounder could be simulated in the data and used as an additional

TABLE 4.12: Impact of health insurance coverage on idiosyncratic VEU
(total health insurances across surveys, absolute)

	Random effect	Between variation	Random effect	Between variation
Health insurance	-0.274***	-0.269***	-0.214***	-0.235**
(Total insurance across surveys)	(0.044)	(0.080)	(0.057)	(0.084)
Absolute risk aversion	-0.164*	-0.082	-0.133*	-0.105
	(0.088)	(0.165)	(0.077)	(0.163)
Health status	-0.029	-0.008	-0.070	-0.066
	(0.032)	(0.065)	(0.059)	(0.066)
Per capita income (log)	-0.239***	-0.251***	-0.161***	-0.163**
	(0.055)	(0.060)	(0.043)	(0.067)
Household characteristics	No	No	Yes	Yes
Commune characteristics	No	No	Yes	Yes
N	3952	3952	3952	3952
R^2		0.018		0.065
F		9.273		5.961
p	0.000	0.000	0.000	0.000

Notes: Standard errors in parentheses
* p <0.05, ** p <0.01, *** p <0.001

covariate in combination with the preferred matching estimator. The comparison of the estimates obtained with and without matching on the simulated confounder shows to what extent the baseline results are robust to specific sources of failure of the CIA, since the distribution of the simulated variable can be constructed to capture different hypotheses on the nature of potential confounding factors (Nannicini 2007).

In this study, we use two covariates to simulate the confounder namely: young (age of household head is less than 47, or in the 25^{th} centile of age distribution) and low education (with no diploma). These covariates are selected to capture the effect of unobservable factors like ability and experience. If the ATT estimates change dramatically with respect to these confounders, our results might be not robust. We employ the kernel matching algorithm with between-imputation standard errors. Since our outcome variable is continuous, the confounders is stimulated on the basis of the binary transformation of the outcome along the 75^{th} centile. The results of the sensitivity analysis are presented in Table 4.13 and Table 4.14. For both confounders, the simulated ATT estimated are very close to the baseline estimates.

TABLE 4.13: Simulation-based sensitivity analysis for matching estimators (2010, confounders: young and low education)

	ATT_{2010}	Standard error	Outcome effect	Selection effect
Young	-0.147	0.008	1.623	0.456
Low education	-0.154	0.004	3.552	0.582

Notes: Based on the sensitivity analysis with kernel matching algorithm with between-imputation standard error. The binary transformation of the outcome is along the 75 centile. Young variable (=1 if age is less than 41 years, or the 25 centile) and low education (=1 if households do not have any certificate). Both the outcome and the selection effect are odds ratios from logit estimations.

TABLE 4.14: Simulation-based sensitivity analysis for matching estimators (2012, confounders: young and low education)

	ATT_{2012}	Standard error	Outcome effect	Selection effect
Young	-0.512	0.043	1.206	0.440
Low education	-0.508	0.039	2.572	0.565

Notes: Based on the sensitivity analysis with kernel matching algorithm with between-imputation standard error. The binary transformation of the outcome is along the 75 centile. Young variable (=1 if age is less than 41 years, or the 25 centile) and low education (=1 if households do not have any certificate). Both the outcome and the selection effect are odds ratios from logit estimations.

The outcome and selection effect on vulnerability is positive but not very large. The results confirm a robustness of the matching estimates.

4.7 Policy implication and conclusion

Health shocks are one of the major cause of vulnerability and poverty in Vietnam. Therefore, the government of Vietnam has endeavored to increase the health insurance enrollment in order to attain its goal of universal health insurance coverage. This paper is an attempt to provide empirical evidence for an effective health policy in Vietnam. To the best of our knowledge, this study is the first empirical paper measuring the impact of health insurance coverage on household ex-ante vulnerability.

Using the propensity score matching method and data from Vietnam Access to Resources Household Surveys (VARHS) during 2010-2012, we investigate whether health insurance coverage has any impact on the probability of falling into poverty

(VEP) and the magnitude of utility loss (VEU). In particular, household's risk behavior has been taken into account when measuring health insurance demand. Our estimates show that health insurance helps rural households in Vietnam reduce the idiosyncratic component of utility loss by 81 per cent. In addition, health insurance helps rural households in Vietnam reduce the probability of being poor by about 19 per cent.

The study's findings suggest that the expansion of health insurance enrollment should be encouraged to reduce household vulnerability. The fact that higher income increase probability of purchasing health insurance suggests that government's subsidies for health insurance purchasers will boost the enrollment expansion. However, the reverse effect of the risk aversion on health insurance enrollment implies not only a potential 'rigidity' effect on health insurance demand but also deficiencies in health insurance market. Therefore, to expand the breadth of coverage from the demand side, the government should enrich information, education and communication about health insurance. Simultaneously, from the supply side, the government should issue health insurance card along with reduction of unnecessary bureaucracy.

Finally yet importantly, although we have reasons to believe the estimation bias in this paper is minimal, future studies could improve upon our results if the data improves in certain regards. First, the two identification assumptions in the PSM method can be checked. In addition, questionnaires about the household health insurance coverage can help to differentiate between compulsory and voluntary schemes; and questionnaires about risk attitudes should be designed to increase the payoff and therefore, draw attention to the answers.

Chapter 5

General Conclusion

Vulnerability is distinct from poverty. Vulnerability is considered an *ex ante* measure. Therefore, understanding vulnerability is important for poverty alleviation policies where it is desirable to know the causes for the poor retaining that status, and the non-poor falling into poverty. Drawing upon the Vietnam Household Living Standard Surveys and the Vietnam Access to Resources Household Surveys, this thesis investigates the association between vulnerability and household welfare in Vietnam.

5.1 Main findings of the thesis

I begin in Chapter 2 by analyzing vulnerability as expected poverty in Vietnam and reveal that, (i) vulnerability estimated using the reference line is more appropriate than when estimated using the actual poverty line for poverty prediction in the case of Vietnam; (ii) *ex ante* vulnerability in previous periods might translate to *ex post* poverty in the following periods though both vulnerability and the incidence of poverty tend to fall over time; (iii) the vulnerability of the poor may trap them in poverty; and (iv) the vulnerability of the non-poor could propel them into poverty.

Further analysis on household vulnerability in Vietnam, Chapter 3 investigates sources of household vulnerability and responses to risks in rural Vietnam using data from Vietnam Access to Resources Household Surveys (VARHS). The main findings are that: (i) the utility of the average household is 71% less than the hypothetical

situation without any risk or inequality in consumption, and idiosyncratic shocks contribute 50% of the loss; (ii) households depend heavily on informal coping strategies such as food consumption reduction, savings withdrawal, taking children out of school, or capital depletion. The opportunity to borrow money from formal institutions is limited, while subsidies from the government or NGOs are available only in cases of natural disaster; and (iii) household consumption and income exhibit highly correlated variation, implying that existing informal insurance instruments are less effective than expected.

Finally, Chapter 4 provides new evidence on the impact of health insurance coverage on household vulnerability using Vietnam Access to Resources Household Surveys (VARHS) undertaken during 2010-2012. The outcomes of interest are the probability of falling into poverty (VEP) and the magnitude of utility loss (VEU). The estimates show that health insurance coverage helps rural households in Vietnam reduce the idiosyncratic component of utility loss by 81% and has the added benefit of reducing the probability of being poor by about 19%. The reverse effect of the risk aversion on health insurance enrollment implies that not only is there a potential 'rigidity' effect on health insurance demand, but also that there are deficiencies in health insurance market.

5.2 Policy implications

The findings of this thesis provide insight into poverty reduction policies, which are not only applicable to Vietnam but also for other developing countries that are striving for the elimination of poverty. This is the first study to provide evidence that targeted interventions for poverty reduction in Vietnam should consider taking account of household vulnerability because poverty measures based on static indicators are unlikely to be effective if covariate and idiosyncratic shocks have a considerable effect on household living standards. Since the vulnerable may not be the same group as the poor, the interventions should be different so that the non-poor do not fall into poverty, and the poor can find a way to get out of poverty. In addition, pro-poor policies should focus on the infrastructure use of households and be integrated with the migration policies.

The findings of the second study (Chapter 3) provide evidence of the need to design strong safety nets in rural Vietnam. The limited availability of government programs as a coping strategy suggests an expansion of this type of formal assistance would reduce household vulnerability. Also, formal financial institutions located in rural areas should be encouraged. Ultimately, targeted interventions should take into account the household idiosyncratic shocks which seriously affect household vulnerability. Specifically, intervention programs should find ways to reduce capital depletion in rural households. This would not only help households to overcome their hardships in the short run, but would also sustain their welfare in the long run.

The third study's findings (Chapter 4) suggest that the expansion of health insurance enrollment should be encouraged to reduce household vulnerability. The fact that a higher income increases probability of purchasing health insurance suggests that government's subsidies for health insurance purchasers will boost the enrollment expansion. However, the reverse effect of risk aversion on health insurance enrollment implies that there is not only a potential 'rigidity' effect on health insurance demand, but also deficiencies in the health insurance market. Therefore, to expand the breadth of coverage from the demand side, the government should enrich information, education and communication about health insurance. Simultaneously, from the supply side, the government should issue health insurance card along with reduction of unnecessary bureaucracy.

5.3 Contributions to the literature

This thesis has contributed to the improvement of the vulnerability measures and a better understanding of the relationship between vulnerability and household welfare. In terms of vulnerability measures, this thesis is the first to adopt the reference line in measures of vulnerability, along with cross-sectional data. In order to gain an understanding of vulnerability, one chapter in the thesis is the first to decompose sources of vulnerability in rural Vietnam. Together with other estimations, the thesis provides a complete set of vulnerability assessments in Vietnam. More importantly, the third study in this thesis is the first in the literature to investigate the impact of health insurance coverage on household vulnerability. And finally, this thesis has been able to improve the specifications for the models used in previous attempts.

5.4 Future directions for research

Finally yet importantly, although we have provided a complete assessment of vulnerability in Vietnam, there are still spaces for future studies. First, with the first topic in chapter 2, one may have interest in particular groups of household such as middle-class group or ethnic minority group. So vulnerability analysis for these groups are necessary and important. In addition, role of participation in social group as a form of the social capital on household vulnarability are important. Actually, the VARHS data includes various information using to measure social capital, then this data is appororiate for further research on social capital in rural Vietnam. I am myself conducting a separate study on that for the case of Vietnam.

Besides, with the second topic in the chapter 3, we have not known the effectiveness of household coping strategies one by one although we provided the general analysis for the existing informal instruments. Therefore, if questions about the household recovery status are available as in the project of Klasen and Waibel (2010), the vulnarability analysis will provide a more interesting picture. Another important topic I wish to add to this study is the impact of households coping strategies on their childrens development.

Although we have reasons to believe the estimation bias in the study is minimal in chapter 4, future studies could improve upon our results if the data for analysis improves in certain regards. First, the two identification assumptions in the PSM method can be checked. In addition, questionnaires about the household health insurance coverage can help to differentiate between compulsory and voluntary schemes; and questionnaires about risk attitudes should be designed to increase the payoff and therefore, draw attention to the answers.

Appendix A

Appendix Chapter 2

TABLE A.1: Data sections of VHLSS 2002, 2004 and 2006

	VHLSS 2002	VHLSS 2004	VHLSS 2006
Household			
Section 1	Household members	Household members	Household members
Section 2	Education of household members	Education of household members	Education of household members
Section 3	Health of household members	Health and disability of household members	Health and disability of household members
Section 4	Income and employment	Income and employment	Income and employment
Section 5	Consumption expenditure	Consumption expenditure	Consumption expenditure
Section 6	Fixed assets and durables	Fixed assets and durables	Fixed assets and durables
Section 7	Housing	Housing	Housing
Section 8	Credit and participation in poverty reduction programs	Credit and participation in poverty reduction programs	Credit and participation in poverty reduction programs
Section 9	Agriculture, forestry, and aquaculture activities		
Section 10	Business, non-agriculture, non-forestry, and non-aquaculture activities		
Commune			
Section 1	Basic characteristics of commune	Basic characteristics of commune	Basic characteristics of commune

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Table A.1 – continued from previous page

	VHLSS 2002	VHLSS 2004	VHLSS 2006
Section 2	Economic situation and assistance programs	Economic situation and assistance programs	Economic situation and assistance programs
Section 3	Non-farm employment	Non-farm employment	Non-farm employment
Section 4	Agriculture	Agriculture	Agriculture
Section 5	Infrastructure	Infrastructure	Infrastructure
Section 6	Education	Education	Education
Section 7	Health	Health	Health
Section 8	Social issues	Social issues	Social issues

Note: Base line case is *'non-poor'* in both surveys. Robust t statistics in parentheses

* p <0.05, ** p <0.01, *** p <0.001

TABLE A.2: Descriptive Statistics of VHLSS 2002

		2002				
Variable	Definition	Obs	Mean	SD	Min	Max
lnpcexp2rl	Log of per capita household expenditure in food and non-food items	28806	7.992	0.607	5.785	11.328
headage	Age of head of the household	28806	47.596	14.309	16.000	107.00
femaleshare	Share of number of female members in total number of household members	28806	0.512	0.201	0.000	1.000
dependshare	Share of household members under 15 years or above 65 years in total household members	28806	0.358	0.248	0.000	1.000
married	Whether the household head is married or not	28806	0.819	0.385	0.000	1.000
primary	Whether the highest level of education of household members is primary school or not	28806	0.241	0.428	0.000	1.000
lowersecond	Whether the highest level of education of household members is lower school or not	28806	0.320	0.466	0.000	1.000
uppersecond	Whether the highest level of education of household members is upper school or not	28806	0.171	0.376	0.000	1.000
techschool	Whether the highest level of education of household members is technical	28806	0.084	0.277	0.000	1.000

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Table A.2 – continued from previous page

		2002				
Variable	Definition	Obs	Mean	SD	Min	Max
	school or not					
highedu	Whether the highest level of education of household members is college or university	28806	0.071	0.256	0.000	1.000
arghh	Whether main source of income is agriculture or not	28806	0.434	0.496	0.000	1.000
totalland	Total land area owned by household members	28806	0.607	1.479	0.000	93.000
urban	Whether the household is located in rural areas (=1) or urban areas (=0)	28806	0.233	0.423	0.000	1.000
inland	Whether the household is located in inland delta	28806	0.565	0.496	0.000	1.000
hill	Whether the household is located in hills	28806	0.070	0.256	0.000	1.000
lowmountain	Whether the household is located in low mountains	28806	0.152	0.359	0.000	1.000
highmountain	Whether the household is located in high mountains	28806	0.134	0.341	0.000	1.000
region1		28806	0.215	0.411	0.000	1.000
region2		28806	0.146	0.353	0.000	1.000
region3		28806	0.034	0.182	0.000	1.000
region4		28806	0.115	0.320	0.000	1.000
region5		28806	0.093	0.290	0.000	1.000
region6		28806	0.058	0.234	0.000	1.000
region7		28806	0.124	0.330	0.000	1.000
region8		28806	0.214	0.410	0.000	1.000
electricity	Whether the household belongs to the commune	28806	0.936	0.245	0.000	1.000

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Table A.2 – continued from previous page

		2002				
Variable	Definition	Obs	Mean	SD	Min	Max
	with power supply					
distanceavg	Average distance to road, water transportation, passenger pick-up point, commune headquarter, commune centre, post office, telephone service provider, daily market and weekly market (km2)	28806	2.327	3.687	0.000	37.778

Source: VHLSS 2002

TABLE A.3: Descriptive Statistics of VHLSS 2004

		2004				
Variable	Definition	Obs	Mean	SD	Min	Max
lnpcexp2rl	Log of per capita household expenditure in food and non-food items	6554	8.078	0.507	6.369	10.438
headage	Age of head of the household	6554	48.667	14.167	15.000	98.000
femaleshare	Share of number of female members in total number of household members	6554	0.509	0.194	0.000	1.000
dependshare	Share of household members under 15 years or above 65 years in total household members	6554	0.352	0.255	0.000	1.000
married	Whether the household head is married or not	6554	0.828	0.378	0.000	1.000
primary	Whether the highest level of education of household members is primary school or not	6554	0.246	0.431	0.000	1.000
lowersecond	Whether the highest level of education of household members is lower school or not	6554	0.329	0.470	0.000	1.000
uppersecond	Whether the highest level of education of household members is upper school or not	6554	0.161	0.368	0.000	1.000
techschool	Whether the highest level of education of household members is technical	6554	0.122	0.327	0.000	1.000

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Table A.3 – continued from previous page

		2004				
Variable	Definition	Obs	Mean	SD	Min	Max
	school or not					
highedu	Whether the highest level of education of household members is college or university	6554	0.041	0.198	0.000	1.000
arghh	Whether main source of income is agriculture or not	6554	0.497	0.500	0.000	1.000
totalland	Total land area owned by household members	6554	0.816	1.619	0.000	37.870
urban	Whether the household is located in rural areas (=1) or urban areas (=0)	6554	0.002	0.048	0.000	1.000
inland	Whether the household is located in inland delta	6554	0.527	0.499	0.000	1.000
hill	Whether the household is located in hills	6554	0.071	0.257	0.000	1.000
lowmountain	Whether the household is located in low mountains	6554	0.160	0.367	0.000	1.000
highmountain	Whether the household is located in high mountains	6554	0.175	0.380	0.000	1.000
region1		6554	0.228	0.419	0.000	1.000
region2		6554	0.150	0.357	0.000	1.000
region3		6554	0.055	0.229	0.000	1.000
region4		6554	0.122	0.327	0.000	1.000
region5		6554	0.089	0.284	0.000	1.000
region6		6554	0.062	0.242	0.000	1.000
region7		6554	0.091	0.287	0.000	1.000
region8		6554	0.203	0.402	0.000	1.000
electricity	Whether the household belongs to the commune	6554	0.962	0.192	0.000	1.000

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Table A.3 – continued from previous page

		2004				
Variable	Definition	Obs	Mean	SD	Min	Max
	with power supply					
distanceavg	Average distance to road, water transportation, passenger pick-up point, commune headquarter, commune centre, post office, telephone service provider, daily market and weekly market (km2)	6554	2.846	3.398	-1.444	36.833

Source: VHLSS 2004

Table A.4: Descriptive Statistics of VHLSS 2006

		2006				
Variable	Definition	Obs	Mean	SD	Min	Max
lnpcexp2rl	Log of per capita household expenditure in food and non-food items	6828	8.345	0.520	6.530	10.619
headage	Age of head of the household	6828	48.866	13.825	17.000	97.000
femaleshare	Share of number of female members in total number of household members	6828	0.518	0.196	0.000	1.000
dependshare	Share of household members under 15 years or above 65 years in total household members	6828	0.331	0.267	0.000	1.000
married	Whether the household head is married or not	6828	0.829	0.376	0.000	1.000
primary	Whether the highest level of education of household members is primary school or not	6828	0.232	0.422	0.000	1.000
lowersecond	Whether the highest level of education of household members is lower school or not	6828	0.318	0.466	0.000	1.000
uppersecond	Whether the highest level of education of household members is upper school or not	6828	0.170	0.376	0.000	1.000
techschool	Whether the highest level of education of household members is technical	6828	0.135	0.342	0.000	1.000

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Table A.4 – continued from previous page

		2006				
Variable	Definition	Obs	Mean	SD	Min	Max
	school or not					
highedu	Whether the highest level of education of household members is college or university	6828	0.040	0.197	0.000	1.000
arghh	Whether main source of income is agriculture or not	6828	0.472	0.499	0.000	1.000
totalland	Total land area owned by household members	6828	0.781	1.683	0.000	45.010
urban	Whether the household is located in rural areas (=1) or urban areas (=0)	6828	0.000	0.021	0.000	1.000
inland	Whether the household is located in inland delta	6828	0.526	0.499	0.000	1.000
hill	Whether the household is located in hills	6828	0.070	0.255	0.000	1.000
lowmountain	Whether the household is located in low mountains	6828	0.174	0.379	0.000	1.000
highmountain	Whether the household is located in high mountains	6828	0.158	0.365	0.000	1.000
region1		6828	0.223	0.416	0.000	1.000
region2		6828	0.150	0.357	0.000	1.000
region3		6828	0.052	0.222	0.000	1.000
region4		6828	0.125	0.330	0.000	1.000
region5		6828	0.086	0.280	0.000	1.000
region6		6828	0.060	0.238	0.000	1.000
region7		6828	0.089	0.285	0.000	1.000
region8		6828	0.215	0.411	0.000	1.000
electricity	Whether the household belongs to the commune	6828	0.976	0.152	0.000	1.000

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Table A.4 – continued from previous page

		2006				
Variable	Definition	Obs	Mean	SD	Min	Max
	with power supply					
distanceavg	Average distance to road, water transportation, passenger pick-up point, commune headquarter, commune centre, post office, telephone service provider, daily market and weekly market (km^2)	6828	3.208	4.199	-1.556	43.667

Source: VHLSS 2006

Appendix B

Appendix Chapter 3

TABLE B.1: Summary statistics of variables in VARHS 2006, 2008, 2010, 2012

Variables	Definition	Obs	Mean	SD	Min	Max
lpcincome	Log of per capita household income (2006 price)	4860	8.713	0.845	3.178	12.457
lpcfoodconsumption	Log of per capita household food consumption (2006 price)	4858	7.346	0.728	3.951	9.379
headage	Age of head of the household	4860	51.780	12.639	22	97
married	Whether the household head is married or not	4859	0.848	0.359	0	1
femaleshare	Share of number of female members in total number of household members	4860	0.502	0.180	0	1
dependshare	Share of household members under 15 years or above 65 years	4860	0.278	0.256	0	1
highestedu	Highest certificate of household head	4854	1.310	0.881	1	6
arghh	Whether the income sources of household is purely from agriculture or not	4860	0.225	0.418	0	1
totalland	Total land area owned by household members	4860	0.868	1.974	0	76.621
productiveasset	Total number of productive asset	4860	0.043	0.115	0	1.500
laborshare	Ratio of working members over total members	4860	0.718	0.235	0	1.250
totalhousehold	Total number of households in the commune	4860	1834.98	868.182	314	17767
targetcommune	Whether the commune belongs to any list of targeted programs or not	4860	0.512	0.500	0	1
povertyrate	Poverty headcount rate of the commune	4860	0.170	0.150	0	0.960
regularmarket	Whether the commune has a regular market or not	4848	1.729	0.445	1	2
secondaryschool	Whether the commune has a secondary school or not	4850	1.096	0.295	1	2
distance2bus	Distance to nearest bus station	4860	26.553	61.755	0	990

Appendix C

Appendix Chapter 4

TABLE C.1: Impact of health insurance on vulnerability (*psmatch2*)

	2012	2010	Difference-in-difference
Covariate risk	0.14***	0.20***	-0.06***
	(3.42)	(4.63)	(-7.30)
Idiosyncratic risk	-0.49***	-0.14***	-0.35***
	(-3.67)	(-2.93)	(-2.79)

Notes: *psmatch2*-Kernel matching with bandwidth of 0.06

TABLE C.2: Logit regression of health insurance (group dummy)

	Cumulative risk aversion group		Absolute risk aversion group	
insurance20121	Coefficient	Std. Err.	Coefficient	Std. Err.
insurance20101	0.4548***	0.1095	0.4369***	0.1100
healthstatus	-0.0002	0.0004	-0.0003	0.0004
riskavermed	-0.0967	0.0728		
riskaverlow	0.3544***	0.1187		
abrisk1med			0.0378	0.0652
abrisk1low			0.7912***	0.1806
lpcincome	0.2454***	0.0462	0.2436***	0.0461
headage	0.0079	0.0196	0.0083	0.0197
married	0.1161	0.0978	0.1166	0.0984
headage2	0.0001	0.0002	0.0001	0.0002
femaleshare	0.3698**	0.1873	0.4365**	0.1880
dependshare	-0.3897**	0.1546	-0.4091***	0.1546
agrhh	-0.2007***	0.0750	-0.2091***	0.0751
distance2bus	-0.0060**	0.0030	-0.0047	0.0030
asset	-0.0913	0.0593	-0.0900	0.0594
drought	-0.0124**	0.0051	-0.0108**	0.0051
flood	-0.0016	0.0039	-0.0026	0.0039
epidemic	0.1797**	0.0890	0.1522*	0.0900
livestock	-0.0120***	0.0043	-0.0121***	0.0043
othershock	0.0209	0.0131	0.0211	0.0132
_cons	-3.3036***	0.6868	-3.3697***	0.6880
Number of obs	1988		1988	
LR $chi^2(17)$	207.61		214.82	
Prob $>chi^2$	0.0000		0.0000	
Log likelihood	-1094.593		-1090.989	
Pseudo R^2	0.0866		0.0896	

Notes: t statistics in parentheses
* p <0.05, ** p <0.01, *** p <0.001

TABLE C.3: Logit regression of health insurance
(Cumulative risk aversion with any type of insurance)

	Any insurance in 2010		Any insurance in 2012	
insurance20121	Coefficient	Std. Err.	Coefficient	Std. Err.
insurance20101			0.4029**	0.1656
healthstatus	-0.0002	0.0006	0.0004	0.0006
riskaversion1	0.1050***	0.0399	0.0179	0.0360
lpcincome	-0.1352**	0.0635	-0.1593***	0.0572
headage	-0.1126***	0.0331	0.0081	0.0251
married	0.2267*	0.1254	0.1407	0.1203
headage2	0.0009***	0.0003	-0.0001	0.0002
femaleshare	0.1404	0.2579	0.2070	0.2351
dependshare	-0.0381	0.2161	0.7460***	0.2019
agrhh	-0.0659	0.1036	-0.0416	0.0932
distance2bus	0.0030	0.0038	0.0122***	0.0042
asset	0.5673***	0.1252	0.0428	0.0754
drought	0.0356***	0.0079	0.0159**	0.0067
flood	-0.0060	0.0058	-0.0157***	0.0049
epidemic	0.0472	0.1358	0.1470	0.1407
livestock	0.0179***	0.0067	0.0009	0.0054
othershock	0.0702**	0.0338	-0.0090	0.0166
_cons	4.7493***	1.0812	2.0446**	0.8773
Number of obs	1832		1988	
LR $chi^2(17)$	146.95		79.63	
Prob $>chi^2$	0.0000		0.0000	
Log likelihood	-497.0802		-624.2814	
Pseudo R^2	0.1288		0.060	

Notes: t statistics in parentheses
* p <0.05, ** p <0.01, *** p <0.001

TABLE C.4: Logit regression of health insurance
(Absolute risk aversion with any type of insurance)

	Any insurance in 2010		Any insurance in 2012	
insurance20121	Coefficient	Std. Err.	Coefficient	Std. Err.
insurance20101			0.4116**	0.1659
healthstatus	-0.0001	0.0006	0.0005	0.0006
abriskaversion1	0.2542***	0.0714	-0.1267	0.0869
lpcincome	-0.1485**	0.0636	-0.1579***	0.0573
headage	-0.1093***	0.0331	0.0098	0.0251
married	0.2174*	0.1255	0.1380	0.1203
headage2	0.0009***	0.0003	-0.0001	0.0002
femaleshare	0.1333	0.2592	0.2261	0.2357
dependshare	0.0058	0.2156	0.7531***	0.2019
agrhh	-0.0605	0.1039	-0.0527	0.0932
distance2bus	0.0015	0.0038	0.0122***	0.0042
asset	0.5386***	0.1236	0.0435	0.0756
drought	0.0355***	0.0079	0.0163**	0.0067
flood	-0.0058	0.0058	-0.0164***	0.0050
epidemic	0.0661	0.1347	0.1496	0.1408
livestock	0.0173***	0.0067	0.0017	0.0054
othershock	0.0649**	0.0331	-0.0110	0.0166
_cons	4.9514***	1.0811	2.1412**	0.8736
Number of obs	1832		1988	
LR $chi^2(17)$	152.27		81.64	
Prob $>chi^2$	0.0000		0.0000	
Log likelihood	-494.4184		-623.2763	
Pseudo R^2	0.1334		0.0615	

Notes: t statistics in parentheses
* p <0.05, ** p <0.01, *** p <0.001

TABLE C.5: Summary of risk aversion in 2010 and 2012

		2010				2012			
Variable	Obs	Mean	SD	Min	Max	Mean	SD	Min	Max
riskaversion1	1988	3.2334	1.1089	0.8571	4	3.2097	1.0804	0.8571	4
riskaversion2	1988	3.8019	1.2262	1.1266	4.6477	3.7771	1.1950	1.1266	4.6477
riskaversion3	1988	2.7807	0.9536	0.7371	3.44	2.7603	0.9291	0.7371	3.44
riskaversion4	1988	3.2697	1.0545	0.9688	3.9970	3.2483	1.0277	0.9688	3.9970
abriskaversion1	1988	0.8198	0.4959	-1.6471	1	0.7533	0.1957	0.1110	1
abriskaversion2	1988	0.8756	0.4437	-1.6471	1	0.9533	0.0864	0.2759	1

Table C.6: Cumulative risk aversion in groups

	2010		2012	
Cumulative risk aversion	Freq.	Percent	Freq.	Percent
high	1,305	65.64	1,214	61.07
medium	542	27.26	638	32.09
low	141	7.09	136	6.84
Total	1,988	100.00	1,988	100.00

Table C.7: Absolute risk aversion in groups

	2010		2012	
Cumulative risk aversion	Freq.	Percent	Freq.	Percent
high	1,154	58.05	108	5.43
medium	776	39.03	1,880	94.57
low	58	2.92		
Total	1,988	100.00	1,988	100.00

Table C.8: Pairwise correlation of risk parameters in 2010

Variable	riskaver1	riskaver2	riskaver3	riskaver4	abriskaver1	abriskaver2
riskaversion1	1					
riskaversion2	1.0000*	1				
riskaversion3	1.0000*	1.0000*	1			
riskaversion4	1.0000*	1.0000*	1.0000*	1		
abriskaversion1	0.3349*	0.3339*	0.3339*	0.3339*	1	
abriskaversion2	0.2552*	0.2560*	0.2552*	0.2560*	0.7104*	1

Notes: * Statistically significant at 5 percent.

TABLE C.9: Impact of health insurance coverage on idiosyncratic VEU
(total health insurances across surveys, cumulative)

	Random effect	Between variation	Random effect	Between variation
Health insurance	-0.273***	-0.269***	-0.213***	-0.235**
(total insurances across surveys)	(0.045)	(0.080)	(0.057)	(0.084)
Cumulative risk aversion	-0.007	0.011	-0.002	-0.005
	(0.026)	(0.053)	(0.027)	(0.054)
Health status	-0.029	-0.009	-0.070	-0.066
	(0.034)	(0.066)	(0.061)	(0.066)
Per capita income	-0.242***	-0.252***	-0.162***	-0.165**
	(0.056)	(0.060)	(0.043)	(0.066)
Household characteristics	No	No	Yes	Yes
Commune characteristics	No	No	Yes	Yes
N	3952	3952	3952	3952
R^2		0.018		0.065
F		9.221		5.943
p	0.000	0.000	0.000	0.000

Notes: Standard errors in parentheses
* p <0.05, ** p <0.01, *** p <0.001

TABLE C.10: Impact of health insurance coverage on idiosyncratic VEU
(health insurance at the time of interview, cumulative)

	Random effect	Between variation	Random effect	Between variation
Health insurance	-0.259***	-0.559***	-0.234***	-0.486**
(Yes/No at the time of interview)	(0.043)	(0.160)	(0.070)	(0.167)
Cumulative risk aversion	-0.009	0.011	-0.003	-0.005
	(0.026)	(0.053)	(0.027)	(0.054)
Health status	-0.030	-0.010	-0.068	-0.067
	(0.034)	(0.066)	(0.060)	(0.066)
Per capita income	-0.272***	-0.251***	-0.175***	-0.165**
	(0.058)	(0.060)	(0.045)	(0.066)
Household characteristics	No	No	Yes	Yes
Commune characteristics	No	No	Yes	Yes
N	3952	3952	3952	3952
R^2		0.019		0.065
F		9.472		5.972
p	0.000	0.000	0.000	0.000

Notes: Standard errors in parentheses
* p <0.05, ** p <0.01, *** p <0.001

TABLE C.11: Impact of health insurance coverage on idiosyncratic VEU (health insurance in 2012 and 2010, absolute)

	Random effect	Between variation	Random effect	Between variation
Health insurance 2012	-0.281***	-0.281**	-0.238**	-0.264**
	(0.055)	(0.099)	(0.074)	(0.102)
Health insurance 2010	-0.257***	-0.236	-0.153**	-0.164
	(0.043)	(0.167)	(0.049)	(0.168)
Absolute risk aversion	-0.164*	-0.083	-0.134*	-0.106
	(0.088)	(0.165)	(0.077)	(0.163)
Health status	-0.029	-0.007	-0.070	-0.066
	(0.032)	(0.065)	(0.059)	(0.066)
Per capita income	-0.239***	-0.252***	-0.162***	-0.165**
	(0.056)	(0.060)	(0.044)	(0.067)
Household characteristics	No	No	Yes	Yes
Commune characteristics	No	No	Yes	Yes
N	3952	3952	3952	3952
R^2		0.018		0.065
F		7.425		5.721
p	0.000	0.000	0.000	0.000

Notes: Standard errors in parentheses
* p <0.05, ** p <0.01, *** p <0.001

TABLE C.12: Risk attitude from different lotteries and *implied* λ^{risk}= $\omega^*(6000\alpha/\text{Loss}\beta)$, ω=$w^+(0.5)/w^-(0.5)$

	Risk behavior (Lottery choice category)	Percent in year		Implied acceptable loss	Implied ^{risk} under different assumptions of probability weights and diminishing sensitivities for gains and looses			
				Thousand VND	(1)	(2)	(3)	(4)
		2010	2012		$\omega = 1$ $\alpha = 1$ $\beta = 1$	$\omega = 1$ $\alpha = 0.95$ $\beta = 0.92$	$\omega = 0.86$ $\alpha = 1$ $\beta = 1$	$\omega = 0.86$ $\alpha = 0.95$ $\beta = 0.92$
1.	Reject all lotteries	68.00	61.60	<2	>3	>3.57	>2.58	>3.07
2.	Accept lottery a, reject lotteries b to f	3.85	9.63	2	3	3.57	2.58	3.07
3.	Accept lotteries a and b, reject lotteries c to f	12.22	11.90	3	2	2.46	1.72	2.11
4.	Accept lotteries a to c, reject lotteries d to f	9.40	9.96	4	1.5	1.89	1.29	1.62
5.	Accept lotteries a to d, reject lotteries e to f	4.07	4.75	5	1.2	1.54	1.03	1.32
6.	Accept lotteries a to e, reject lotteries f	1.66	0.19	6	1	1.30	0.86	1.12
7.	Accept all lotteries	0.78	1.97	≥7	≥0.86	≥1.13	≥0.74	≥0.97

Notes: The strategy of Gächter et al. (2010) is adopted to choose sensitivity parameter. Parameters on diminishing sensitivity are extracted from Booij & Van de Kuilen (2009) and parameters on ω are from Abdellaoui (2000). (1) Benchmark parameters: no probability weighting, and no diminishing sensitivity. (2) No probability weighting, but diminishing sensitivity. (3) Probability weighting, but no diminishing sensitivity. (4) Probability weighting, and diminishing sensitivity.

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