

## **OECD FOOD, AGRICULTURE AND FISHERIES PAPERS**

The OECD Food, Agriculture and Fisheries Papers series is designed to make available to a wide readership selected studies by OECD staff or by outside consultants. This series continues that originally entitled OECD Food, Agriculture and Fisheries Working Papers.

This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

This document has been declassified on the responsibility of the Working Party on Agricultural Policies and Markets under OECD reference number TAD/CA/APM/WP(2012)17/FINAL.

Comments on the series are welcome and should be sent to [tad.contact@oecd.org](mailto:tad.contact@oecd.org).

### **OECD FOOD, AGRICULTURE AND FISHERIES PAPERS**

are published on [www.oecd.org/agriculture](http://www.oecd.org/agriculture)

© OECD (2013)

---

You can copy, download or print OECD content for your own use, and you can include excerpts from OECD publications, databases and multimedia products in your own documents, presentations, blogs, websites and teaching materials, provided that suitable acknowledgment of OECD as source and copyright owner is given. All requests for commercial use and translation rights should be submitted to [rights@oecd.org](mailto:rights@oecd.org).

---

## Abstract

### SMALLHOLDER RISK MANAGEMENT IN DEVELOPING COUNTRIES

Dalila Cervantes-Godoy, Shingo Kimura  
and Jesús Antón, OECD

This paper addresses various aspects of risk and risk management for smallholders in developing countries, and presents a quantitative assessment of farm-level risks and risk management strategies in three emerging economies: Brazil, China and Viet Nam. The analysis covers production, income, and poverty risks. Institutional and political settings in developing countries are frequently less developed and this contributes to a greater incidence of market imperfections in key areas such as credit and insurance, and which in turn lowers farmers' access to risk management tools and strategies. The result is a widespread reliance on informal mechanisms and community strategies. The effects of risk and responses to risk are also different in developing countries, with smallholders often forced to rely on strategies that perpetuate poverty. When risk is an important consideration in a farm household's decision on sector transition, insurance or safety-net mechanisms could assist these households to make that transition. The analysis of two regions in Viet Nam shows that those households able to successfully transit to the non-farm sector continued to maintain small plots of land for self-consumption, suggesting that agriculture remains a kind of safety net.

**Keywords:** Agricultural risk, smallholders, developing countries, risk management strategies, agricultural policy.

**JEL classification:** O13, Q10, Q11, Q12, Q13, G21, G22, R38

#### *Acknowledgements*

The authors would like to thank Hiroaki Ogawa, Lee Crawford, Abhijeet Singh, Ke Wang and Alies Haveman for their contributions.

## *Table of contents*

Executive Summary .....	5
1. Introduction.....	7
2. Conceptual underpinnings of risk and risk management .....	8
2.1. Types of agricultural risk faced by farmers.....	8
2.2. Risk management and risk-coping strategies .....	10
2.3. A review of risk management policies .....	16
2.4. Poverty traps, risk implications, investment and risk management policies .....	21
3. Quantitative assessment of farm household risk exposure and risk management strategies in developing countries: Evidence from Brazil, China and Viet Nam.....	28
3.1. Data source and methodology of risk assessment .....	28
3.2. Assessment of agricultural production risk and risk management strategies in Brazil, China and Viet Nam .....	31
3.3. Assessment of farm household income risk and risk management strategies in China and Viet Nam.....	34
3.4. Risk management strategies in the Red River and Mekong regions of Viet Nam .....	37
4. Conclusions and policy implications.....	46
References .....	48
Annex A. Technical Background of Risk Assessment Methodology Applied in Viet Nam.....	53

### **Tables**

Table 2.1. Risks in agriculture.....	9
Table 2.2. Farm risk management instruments and strategies .....	11
Table 2.3. Risk layering: Optimal pattern of risk management strategies and policies.....	18
Table 3.1. Data source .....	29
Table 3.2. Agricultural and poverty indicators in Brazil, China and Viet Nam .....	30
Table 3.3. Correlation of income components in China and Viet Nam.....	36
Table 3.4. Characteristics of eight geographical regions in Viet Nam .....	38
Table 3.5. Characteristics of farm household in Red river and Mekong regions .....	39
Table A.1. Criteria of household grouping in Viet Nam .....	53

**Figures**

Figure 2.1.	Climate shock impact on assets and income levels .....	22
Figure 2.2.	The S-shape curve and the poverty trap .....	23
Figure 2.3.	Household investment and insurance decisions.....	26
Figure 3.1.	Comparison of price and yield risk.....	32
Figure 3.2.	Correlations of price and yield risk .....	33
Figure 3.3.	Correlation of crop revenues .....	33
Figure 3.4.	Comparison of wheat production risk between some OECD countries and Brazil and China .....	34
Figure 3.5.	Composition of farm household income in China and Viet Nam.....	35
Figure 3.6.	Variability of household income and its components.....	36
Figure 3.7.	Dynamics of poverty incidence in 2004, 2006 and 2008.....	40
Figure 3.8.	Dynamics of poverty by household head age group.....	41
Figure 3.9.	Poverty vulnerability of representative household by household type .....	43
Figure 3.10.	Level and variability of income by household type.....	43
Figure 3.11.	Decomposition of average income shock leading to scenarios of transitory poverty .....	44
Figure 3.12.	Transitory poverty shock scenario: The production side.....	45
Figure 3.13.	Transitory poverty shocks: The consumption side .....	46
Figure A.1.	Detrend data.....	54

**Boxes**

Box 1.	A graphical representation of desperation and vulnerability poverty traps and household investment and insurance decisions.....	26
--------	--	----

## Executive Summary

OECD work on risk management in agriculture has focused on OECD member countries. The holistic framework developed to analyse risk management places great importance on the need for differentiated responses to different layers of risk. Several country reviews have been undertaken using this framework analysis, and also included quantitative assessments of farm-level risks and risk management strategies and policies. To undertake a similar analysis of developing and emerging economies, however, specificities in terms of the impact of risks and how they are linked to poverty deserve additional analysis. As such, this paper adapts and extends the OECD's holistic approach to risk management by taking stock of the specific risks and consequences faced by smallholders in developing countries, and how the characteristics and implications of risks and risk management strategies differ from those in developed countries. It also examines the implications of risk management for household investment and provides a quantitative assessment of risk exposure at the most disaggregated level possible for three emerging economies: Brazil, China and Viet Nam. The application of the same risk analysis to different types of data available in these countries has highlighted the advantages of having household income and expenditure surveys available for risk analysis.

Most sources of agricultural risks affecting farmers in both developed and developing countries do not differ as they come basically from shocks in production (e.g. weather, pests, etc.), in prices (i.e. markets), and institutional and political settings, none of which are exclusive to any particular country. For instance, the quantitative analysis of the three emerging economies studied showed similar patterns (as the OECD countries studied before) of agricultural production and price risks for the crops analysed, where production and price risks have a similar dimension at the disaggregated or farm level and are negatively correlated. However, production and price risks can have different impacts on poverty: findings from the household survey analysis of the Red River and Mekong regions in Viet Nam showed that poverty shocks in farm households are driven more by yield shocks (decrease) than by price shocks (decrease), while poverty shocks in non-farm households are driven more by price shocks (increase) and subsequently low purchases of rice. In other words, for those households that fall into transitory poverty (less than five consecutive years), rice yield is a dominant source of agricultural risk, and not low prices. On the other hand, high rice price were observed to be an important source of risk for households that are net consumers of rice. These results could have important implications on the policy design of risk management.

The effects of risk and responses to risk are fundamentally different in developing countries. Smallholders are often forced to rely on strategies that perpetuate poverty. For example, households cope with shocks by depleting valuable assets which then causes it to fall into a poverty trap created by the resulting low level of assets. Risk and available risk management strategies play an important role to explain poverty traps as they could lead smallholders to select lower-risk/lower-return activities and undermine smallholders'

investment to move out of poverty. The risk assessment of China and Viet Nam suggests that there can be risks associated with non-farm opportunities. When risk is an important consideration in a farm household's decision on sector transition, insurance or safety-net mechanisms could assist these households to make that transition. Furthermore, results from the two regions of Viet Nam identified that those households able to successfully transit to the non-farm sector continue to maintain small plots of land for self-consumption, suggesting that agricultural land plays a safety net role. Agriculture would then play a risk management role in facilitating the successful transition of farmers to non-farm sectors.

In terms of risk management (*ex ante*), smallholders in developing countries diversify their economic activity across farm and non-farm work, build up savings and assets to compensate for missing credit markets, limit their experimentation with profitable but risky new technologies, strategically choose the structure of production relations, and engage with various informal savings institutions. In terms of risk coping (*ex post*), households respond by changing their work effort and labour supply, selling assets and running up debt, relying on social networks or migration, and by simply reducing consumption.

Institutions and political settings are frequently less developed in developing countries and thus contribute to a greater incidence of market imperfections in key areas such as credit and insurance. This lowers farmers' access to risk management tools and strategies, and, in turn, results in widespread reliance on informal mechanisms and community strategies, such as crop sharing, common property resource management, informal risk pooling. These strategies are crucial for smallholders to manage and cope with risk. In this sense, this paper has tried to extend the OECD holistic approach to include an informal - community risk layer of risk management strategies alongside with the household, market and government layers of risk management. Further analysis of this particular aspect would contribute to a better understanding of informal and community level strategies.

A reasonable policy objective would be to promote investments that help smallholders move out of poverty. Impediments to investment are highly related to access to financial services, in particular credit and insurance. Two types of constraints faced by smallholders have been identified: 1) limited access to credit; and 2) limited access to insurance or safety net. This latter constraint makes risk averse individuals restrain their demand for investment credit to avoid the risk of falling into an even worse poverty trap. The analysis of the two Vietnamese regions suggests that the incidence of poverty can be explained partly by limited access to credit and the lack of safety-net solutions.

## 1. Introduction

Agriculture is characterised by a high variability of returns such that farmers cannot predict with certainty the amount of output they will produce. Thus agricultural risk is associated with unpredictable circumstances which determine the final output, value and cost of any agricultural production process. These risks are influenced by several factors, ranging from weather variability, natural disasters, uncertainties in yields and prices, imperfect markets of financial services, institutional settings, personal risks, etc. In the case of developing countries, and more specifically that of smallholders<sup>1</sup>, farmers are likely to be particularly vulnerable to certain risks and the consequences of these can be extreme, in some cases even pushing resource-limited smallholders into deeper poverty<sup>2</sup>.

OECD work on risk has focused on OECD countries. This paper will try to extend this work by focusing on developing countries within the scope of current OECD policy analysis and address an important policy concern in these countries. It examines the kinds of risks faced by smallholders and considers the role of policy to help smallholders manage those risks. Agricultural risks play an important role in explaining poverty traps as they could lead smallholders to select lower-risk/lower-return activities which undermine their potential to invest and eventually move out of poverty.

OECD (2011) proposes a framework to design an effective risk management system to understand the interactions between: 1) the characteristics of risks that households face; 2) the available risk management instruments and policies; and 3) the household's choice of risk management strategies. The OECD framework also stresses the need for differentiated responses to different kinds of risks given that some risks can be managed by the household, some by the market, some may require government intervention, and

- 
1. The definition varies enormously taking into consideration their revenues, socioeconomic characteristics, land size, regions, countries, etc. (Proctor and Lucchesi, 2010). For example, the average farm size in many Asian countries is less than a hectare, whereas much larger operations in Latin America (ten hectares or more) may be considered as small. Narayanan and Gulati (2002), definition considers “a small farmer is a farmer (crop or livestock) practicing a mix of commercial and subsistence production or either, where family provides the majority of labour and the farm provides the principal source of income. Sometimes farmers may fit this description actually possess little land and livestock as compared with the particular regional average”. For the purpose of this paper, a defining characteristic of smallholders is that they struggle to be competitive and hence to provide an income to support themselves and their families and often live in poverty or extreme poverty conditions (e.g. incomes of 1.25 USD PPP per day); they also possess limited resource endowments, in particular land, and normally confront missing or under-developed markets.
  2. UN's World Summit on Social Development in 1995, described poverty as a condition characterised by severe deprivation of basic human needs, including food, safe drinking water, sanitation facilities, health, shelter, education and information. To measure poverty in more quantitative terms, the World Bank developed a way of measuring poverty using a common international definition. This method defines a poverty line based on the estimated money cost of a basket of goods considered necessary to cover basic needs - enough food for adequate nutrition and a minimum allowance for clothing and shelter. Those individuals whose spending or income is not enough to cover basic needs are considered to be below the poverty line and consequently to be poor (Chen and Ravallion, 2008). To measure progress against the Millennium Development Goals (MDGs) it is used the reference poverty line set at USD 1.25 per day at 2005 PPP. This corresponds to the mean of the national poverty lines for the 10-20 poorest countries of the world.

many others, in the case of developing countries, make extensive use of informal/community mechanisms.

This paper is divided into two parts. Part I adapts and extends the OECD's holistic approach to risk management to developing countries by taking stock of the specific risks and consequences faced by smallholders. It describes the characteristics and implications of risks and how risk management strategies may differ from those used by farmers in developed countries. The linkages between risk and farm household investment decisions that are at the core of some poverty traps and the role of policy to help smallholders manage those risks are also discussed.

In Part II, a quantitative assessment of farm-level risks and risk management strategies in a small selection of countries is undertaken. The analysis covers production, income, and poverty risks in three emerging economies: Brazil, China and Viet Nam. The results of this assessment are discussed in the light of the conceptual issues raised in Part I.

## **2. Conceptual underpinnings of risk and risk management**

### ***2.1. Types of agricultural risk faced by farmers***

Agriculture is characterised by high variability of production outcomes coming from unpredictable events. For agricultural producers it is difficult to predict with certainty the amount of output they will obtain, this is due mainly to several factors that are not within their control. Natural adversities like pests, diseases, weather, are a few examples.

Most sources of agricultural risks affecting farmers in both developed and developing countries do not differ as they come basically from weather, market, and institutional- and political-related risks and these are not exclusive to any particular country. However, agricultural risk implications and responses may differ fundamentally in developing countries. OECD (2009) presents an analytical framework for considering farm risk management strategies in OECD countries, with risks laid out as in (Table 2.1), the first distinction being the scope of the risk, whether it affects; a particular individual or household (micro); a group or community (meso), regions or nations (macro).

Table 2.1, developed by the OECD (2009), shows agricultural risks that combine the systemic characteristics from Holzmann and Jorgensen (2001), with four types of sources of risk identified in Harwood et al. (1999) covering most of the categories of risk identified by different authors. It singles out some events that could occur with some likelihood and affect the welfare of farm households. Idiosyncratic risks, such as personal hazards, are specific to individual farms or farmers and may actually be more important than systemic risks. Risks of a macroeconomic nature are typically systemic; they are often correlated across farms in a country and across sectors in the economy. They are not usually specific to agriculture. Macroeconomic risks can also be correlated with changes in input or output prices that may occur simultaneously with changes in interest rates (OECD, 2009).



Table 2.1. Risks in agriculture

	Micro (Idiosyncratic) Individuals / Households	Meso (Covariant) Groups / Communities	Macro (Systemic) Regions / Nations
Market/prices		- Changes in price of land, new requirements from food industry	- Changes in input/output prices due to shocks, trade policy, new markets, endogenous variability, exchange rates, etc.
Production	- Non contagious diseases, personal hazards (illness, death), etc.	- Rainfall, landslides, pollution	- Floods, droughts, hail, frost, pests, contagious diseases, technology, food shortage, etc.
Financial	- Changes in income from other sources (non-farm)	- Informal credit and insurance systems	- Changes in interest rates/value of financial assets/access to credit
Institutional/legal	- Liability risk	- Changes in local policy or regulations	- Changes in regional or national policy and regulations, environmental law, agricultural payments

Source: OECD 2009, adapted from Harwood et al. 1999 and Holzmann and Jorgensen, 2001.

Risks that farmers face in developing countries can be categorised using a similar scheme to that in OECD countries (2009). The micro risks in developing country agriculture that have been studied extensively are similar to the risks listed in Table 2.1: individual illnesses, idiosyncratic crop and livestock losses, death or disability of household members, and loss of other (non-agricultural) income sources. Meso risks affect communities; while this includes localised environmental shocks, it can also include policy changes and localised conflict. Macro risks affect entire regions or nations: this can include large-scale environmental shocks such as the Ethiopian famine of 1984, large-scale policy changes such as the Great Leap Forward in China, or relatively large-scale incidence of conflict such as the civil war in Rwanda and Burundi. The second typology, classifying shocks on the basis of their source into price shocks, production shocks, financial shocks, and institutional shocks is sufficiently general to be applied to developing countries.

There have been other risk typologies used for developing countries that relate to the OECD typology. For instance, Romer Løvendal and Knowles (2005) characterise risks according to *type, level, frequency, timing and severity*. The *type* category includes political, social, economic, health natural and environmental risks. The *level* relates to where risks can occur: whether at the individual, household or smallholder (micro); the community and regional (meso) levels; or the national (macro) and global/regional (super-macro) levels. The *frequency* classifies risks in transitory; trend related or structural. *Timing* suggests that shocks may have a more severe impact in times of recession. A major concern is with compounded risks. Finally, *severity* relates to situations where the greater the severity of a risk, the greater the capacities needed to manage it.

Some risks may be negatively correlated, such as prices and yields in closed markets. Others may have compound impacts – for example, households affected by poor health may be more vulnerable to the effects of drought or price shocks. Private agents (individuals, households or communities) seek to reduce their exposure and vulnerability to risk via risk management strategies.

While the typology of risk in developing countries is similar to that in OECD economies, the frequency of numerous hazards facing smallholders in developing countries, many potentially catastrophic, is considerably greater. For example, the institutional and political settings are often characterised by unstable political systems and weak institutions. This increases the range of risks faced by farmers. Institutional and political constraints could lead to farmers being significantly less able to cope with risks, even in the case of individual and household-level idiosyncratic shocks. Weaknesses in political institutions may also lead to substantial risks for the economy. Recent work has shown, for example, that exports by the Kenyan flower industry fell by 24% as a result of the election violence in 2007 (Ksoll, Macchiavello and Morjaria, 2009).

Another difference is that disease-related hazards are both more prevalent in developing countries and more intense when they do occur. Diseases such as tuberculosis, malaria and HIV/AIDS affect significant portions of the population, and remain an important and considerable risk for farmers and non-farmers alike. Tropical environments and poor animal/plant health systems contribute to a greater variety of pests that cause crop damages and storage losses. Therefore, even when sources of risk are the same, the frequency and range are not. Furthermore, as this paper will show, risk implications are quite different between, OECD and developing countries.

## **2.2. Risk management and risk-coping strategies**

How households manage risks will be a function of various factors. These include: 1) their decisions on production and consumption (including which crops and livestock products to produce and in which proportions); 2) the allocation of household labour (diversifying income sources); 3) the management of household assets; 4) the use of informal institutional arrangements (e.g. community risk-sharing); 5) the use of insurance, credit or other market mechanisms; 6) the uptake of government programmes (including safety nets). A key point is that these decisions are inter-related, and specific decisions and outcomes are likely to vary according to a country's structural and institutional characteristics, as well as its general level of development (Romer Løvendal and Knowles, 2005).

At the most general level there are two approaches to deal with risk: *ex ante risk management* and *ex post risk coping*. Measures taken to avoid, transfer or reduce risks or exposure to risk are considered *ex ante risk strategies*. Measures taken after the shocks to mitigate or insulate the welfare impacts of the shocks are called *ex post shock coping strategies*. While the *ex ante* risk coping strategies are long-term, the *ex post* shock coping strategies are short-term survival adjustment (Lekprichakul, 2009). Risk can be dealt through different types of agents or institutions such as the farm/household, the market, and the government. OECD (2009) presents a framework for an efficient management of risk across different actors (Table 2.2). The assumption is that normal and frequent risks which do not imply large losses should be retained by the farmer. Risks that are infrequent but generate a large amount of damage to farm income (i.e. farmers' livelihood) are likely to fall under the catastrophic risk layer, for which market failure is most likely and government intervention is necessary. Between these two layers there are intermediate risks for which some insurance or market solutions can be developed. It is important to allow solutions to each type of layer to develop so that a variety of instruments is available to farmers.

Table 2.2. Farm risk management instruments and strategies

		Farm/ Household	Market	Community/ Informal	Government
<i>Ex ante</i>	<b>Risk Reduction</b>	-Technological choice <b>Developing countries</b> -Avoiding risk -Household size -Income diversification -Low-risk, low-return cropping patterns -Production techniques	-Training on risk management	Crop sharing	- Macroeconomic policy - Disaster prevention (e.g. flood control) - Prevention of animal diseases
	<b>Risk Mitigation</b>	-Diversification in production <b>Developing countries</b> -Savings in the form of liquid assets (crops) and buffer stocks -Crop diversification -Inter-cropping -Plot diversification	- Futures and options - Insurance - Vertical Integration - Production/marketing - Contracts - Spread sales - Diversified financial investment - Off-farm work	Common property resource management -Social reciprocity -Informal risk pooling -Rotating savings/credit	- Tax system income smoothing - Counter-cyclical programmes - Border and other measures in case of contagious disease outbreak
<i>Ex post</i>		- Borrowing from neighbours / family - Intra-community charity			
	<b>Risk Coping</b>	<b>Developing countries</b> -Sale of assets -Reallocation of labour/child labour -Reduce consumption -Borrowing from relatives -Migration	- Selling financial assets - Saving/borrowing from banks - Off-farm income	-Sale of assets -Transfers from mutual support networks	- Disaster relief - Social assistance - Other agricultural support programmes

Source: Adapted from OECD (2009), based on Holzmann and Jorgensen (2001), OECD (2001), Jaffee et al. (2010), and World Bank (2001).

Smallholders in developing countries manage risk using formal and informal strategies. Informal strategies are usually characterised by arrangements between individuals or households, or groups as communities or villages. Formal strategies, on the other hand, are those market-based activities and/or publicly provided mechanisms. A new layer of informal strategies is added into the OECD framework in order to capture the range of mechanisms used in developing countries (Table 2.2). The community/informal column represents community shared ex ante and ex post arrangements for dealing with risk, sharecropping, common property resource management, social reciprocity being some of the most frequent ex ante activities used. It has also been added to the framework informal mechanisms managed at the household level.

In terms of risk management, households in developing countries diversify their economic activity across farm and non-farm work, build up savings and assets to compensate for missing credit markets, limit their experimentation with profitable but risky new technologies, strategically choose the structure of production relations, and engage with various informal savings institutions. In terms of risk coping, households

respond by changing their work effort and labour supply, selling assets and running up debt, relying on social networks or migration, and by simply reducing consumption. Some *ex ante* and *ex post* risk management strategies are described next.

### *Ex ante strategies*

*Avoiding risk.* One strategy producers can employ is simply to avoid specific risks. Given the poverty conditions under which poor farmers live they often avoid activities that involve more risk but which frequently could bring more income gains. This inability to manage risk and accumulate and retain wealth can lead to a poverty trap (World Bank, 2001).

*Household size.* The formation of households is by itself an important risk-sharing strategy. Single-person households are rare in rural areas of developing countries. It is common to observe high fertility rates in rural areas, and households often span several generations. Large households allow for economies of scale in food preparation, risk sharing in food production, and care in case of sickness. Subjective assessments of poverty are often associated with isolated individuals: orphans, widows, and disabled people (Fafchamps, 1999).

*Diversification of economic activities.* Different activities in both the farm and non-farm sectors are frequently taken up as a strategy to reduce total income risk through diversification (Reardon et al. 1992; Walker and Ryan, 1990). In general, farmers in developing countries are more likely to also engage in non-farm business and off-farm wage labour, part of which is due to considerations of risk management and, in some cases, *ex post* risk coping. Households in Burkina Faso that diversified their income into non-farm activities were better able to cope with droughts during the 1980s (Webb and Reardon 1992). Being able to mitigate risk in this way may allow, to a certain extent, farmers to adopt riskier high-return crops (Lanjouw and Lanjouw 1995, 2001). Income diversification is also part of risk management strategies observed in Viet Nam, as will be discussed in section 3 of the paper. Other informal mechanisms of risk management at the farm level are the inter-cropping where farmers produce in the same plot more than one single crop; the mixed farms where crop and livestock production activities are combined; spatial plot diversification; and crop diversification. These activities are a common means to reduce the risk of crop failure due to adverse weather events, crop pest or insect attacks.

*Savings and asset accumulation.* Deaton (1991) discussed the use of savings and asset holdings as a means to smooth consumption as an optimal response when agents face borrowing constraints. The underlying economic rationale behind these mechanisms is that households wish to have a smooth consumption pattern; to safeguard this, they save in good times in anticipation of bad times. The absence of formal savings mechanisms means that this precautionary saving is frequently in the form of assets and buffer stocks.

Fafchamps, Udry and Czukas (1998) found that, while the role of livestock was less prominent as a source of consumption smoothing in West Africa, there was evidence of it helping partial smoothing of consumption due to village-level shocks. Park (2006) similarly used Chinese data to study the household use of grain management as a strategy to cope with high yield and price risk coupled with high transactions costs. Giles and Yoo (2007) documented, also for rural China, that about 10% of total savings by rural farm households were accounted for precautionary motive; this rose to 15% of total savings for households with consumption per capita below the poverty line.

*Technology and agricultural investment.* Coupled with limited access of credit and insurance markets and the lack of other assets, risk in developing countries sometimes could act as a significant barrier to technology adoption (Jack, 2009). Households may not undertake technological investments that may be profitable in expectation of a bad harvest and subsequently low consumption. Dercon and Christiaensen (2011) looked at the adoption of fertiliser in rural Ethiopia and, using historical rainfall distributions to identify weather-linked consumption shocks combined with panel data on rural households, showed that not just *ex ante* credit constraints but also the possibly low consumption outcomes when harvests fail discourages the application of fertiliser. Fafchamps and Pender (1997) found for rural India that this effect was also present for large lumpy investments and disproportionately for those investments that were irreversible. While households may be able to sell bullocks to smooth consumption when shocks arise from yield risk (as in Rosenzweig and Wolpin, 1993), they are not able to sell wells and therefore well construction is likely to be under-invested even when the households may have had the resources to self-finance the construction.

*Sharecropping and other production relationships.* Sharecropping is an agricultural production system in which farmland is supplied by a landowner through leasing, licence, or the like to a tenant who farms the land, in return for a portion (e.g. 50%) of the crop harvested. Sharecropping has been used for a long time as a risk sharing strategy. Its efficiency has greatly been studied, and it appears to create some loss in total production, particularly because there are significant differences between the input and output intensities of owned plots and sharecropped plots, indicating a production inefficiency in the latter as the tenant seems to decrease his efforts (Shaban, 1987). However, it continues to be widely used in many countries. Sharecropping is only one specific example of production relations that could incorporate risk sharing; the set of such relations would also include other aspects such as cost-sharing, productive asset sharing, and bonded labour, and various types of tenancy agreements.

*Informal risk-sharing institutions.* The use of informal risk-sharing arrangements is widespread. Common institutions found in many countries are savings clubs, also known as Rotating Credit and Savings Associations (ROSCAs) (Besley, Coate and Loury, 1993) or Accumulating Savings and Credit Associations (ASCAs). In the simplest kind of group members come together once a week and deposit a certain amount of money, the total collected amount of which is given immediately to one member of the group. The fund thus “rotates,” with the first person to receive the collected funds effectively taking a loan, and the last making a saving. Where there is little access to financial services these groups allow for a way to build some capital, but they are not flexible instruments which can easily respond to an idiosyncratic shock facing one household, nor are they able to respond to a collective community-wide shock. More sophisticated groups may allow for some borrowing from the group account, but these face significant constraints inherent to informality in terms of trust and legal enforcement.

*Market strategies* are mostly formal mechanisms and usually less available to smallholders in developing countries. For example, futures markets which are used to deal with price risks are widespread across OECD countries. For the case of developing countries this instrument is not widely accessible and it is mostly used by commercial agriculture. Insurance is another instrument that helps to deal with production risks, less available but relevant for small-scale agriculture as seen in the next section. Contract farming has been used for many years as one market activity that helps to manage farm risk. It is understood as a relationship or co-ordination between farmers and buyers

(e.g. agribusiness firms) where the characteristics of the product, such as price, quantity, quality, are set by the parties involved before the time of delivery.

### *Ex post strategies*

*Sale of assets.* Smallholders accumulate savings and assets in order to safeguard against economic shocks. The difference from OECD countries is only in the nature of the saving which is much less likely to be liquid financial saving and more likely to be in the form of assets such as livestock or grain reserves. Dissaving could potentially include the sale of productive assets, such as agricultural tools, land and livestock, which have long-term consequences for productivity and the welfare of the household. This strategy may be associated with the accumulation of debt which is a common coping response.

*Labour supply.* Households' labour supply choices are dynamic and may change in response to shocks. To safeguard consumption levels in the face of a negative shock, previously economically inactive household members may choose to join the labour market, and previously active members may choose to increase the labour supplied and they may choose to change the nature of labour supplied, for example from a family farm to casual wage labour. For instance, Kochar (1995) documented that in India small negative agricultural shocks were correlated with an increase in the total reported wage incomes by households, indicating a labour supply response to the shock. In subsequent work, Kochar (1999) documented that males increased their hours of labour in response to unexpected variations in crop incomes.

A study on Ethiopia, Porter (2012) identified potential coping strategies of households in terms of their alternative earned income sources. She found that off-farm income played the role of insurance or that of a safety-net after a shock. While income from agricultural activities was negatively and significantly affected by agricultural shocks, the non-farm income (from wage labour or self-employment) rose. Non-farm income increments cancelled out the negative impacts of a shock on farm income. It is important to note that land, and more precisely, formal entitlements to land, could also play an important role as a safety net for farmers looking for non-farm incomes. These entitlements whether they are communal or individual could have a buffering role, allowing farmers to cover their needs if non-farm jobs ended or were not available. This is particularly true for the case of Viet Nam, where there is some evidence of this role (Section 3).

In the same fashion, Rose (2001) tested for both *ex ante* and *ex post* labour supply responses to risk by Indian farmers using the data of more than 2 000 households across 13 states. She documented that *ex ante*, households facing riskier distributions of rainfall were more likely to participate in the labour market; *ex post*, unexpected bad weather and low rainfall increased labour force participation. Similarly, Giles (2006) documented that exposure to shocks from agricultural production reduced autarkic village communities in China with greater integration to labour markets. Adjustments in labour supply in response to shocks were not restricted to adult members of the household; Beegle, Dehejia, and Gatti (2009), for instance, found an increase in child labour due to economic shocks in rural areas of Tanzania.

Changes in the institutional structure of rural economies also leads to changes in the instruments used for risk management and risk coping. Giles (2006) documented in China the process of integration of previously isolated villages into wider labour markets in the late-1980s and the 1990s allowed for more effective risk management in the face of adverse shocks through the access to off-farm opportunities. He showed that off-farm

labour markets were not only useful to smooth shocks *ex post*, but that increased access to the off-farm market led to reduced exposure to shocks. He interpreted these results as suggesting that policies which reduced the cost of participating in off-farm employment, or promoted circulation of information on opportunities to potential migrants, could be useful to reduce the vulnerability of farm households in poor areas and remote regions of the developing world. This will be corroborated in the quantitative section of this paper (Section 3), where the transition from farm to non-farm activities has played an important role in reducing poverty not only in China but also in Viet Nam.

*Reduction in consumption.* While households try to smooth income and, therefore, consumption, such smoothing is rarely perfect and expenditures often decline in the face of economic shocks. The reduction in expenditures can happen in areas with significant long-term implications, such as a reduction in schooling, a response documented for agricultural shocks in rural India by Jacoby and Skoufias (1996). If households are not able to manage *ex post* the consequences of agricultural shocks, they may be forced to enter into long-term contracts, such as debt and bonded labour which have lasting consequences (Fafchamps, 1999).

*Support networks.* A set of *ex post* risk-coping mechanisms utilises the social networks of the affected households; transfers from unaffected households to affected households help smooth out consumption in the face of income shocks from agriculture. These transfers are especially important in the context of migration from the original communities as shocks are less likely to be covariant. Yang and Choi, (2007) showed that remittances by international migrants to Filipino households served as insurance by moving in the opposite direction of income shocks. These networks are frequently purposively put in place by households as part of their *ex ante* risk management. Rosenzweig and Stark (1987), for example, found that daughters in rural India were frequently married to geographically dispersed yet kinship-related households as an implicit contractual arrangement geared towards risk sharing. Family networks provide a more credible network for risk sharing and reciprocal transfers over time and their use for risk sharing has been widely documented in a variety of contexts.

Furthermore, households in a community rely on one another for insurance, if a household encounters an idiosyncratic shock, the village (i.e. other households) helps this household to cope, and reciprocity is expected. Townsend (1994) found in some Indian villages that household consumptions co-moved with village average consumption. In other words, that household consumptions were not much influenced by contemporaneous own income, sickness, unemployment, or other idiosyncratic shocks, but by village consumption; showing the effective insurance provided at the community level. Households in poor villages do not completely share the risks they face, but they do achieve a significant amount of insurance (Chiappori, *et. al.* 2012).

Networks risk management activities are not limited to gift exchanges or loans between households in different communities; it is also used commonly as a response to cope with idiosyncratic shocks more generally. In another study of the Philippines, Fafchamps and Lund (2003) found that risk was shared between Filipino households through flexible zero-interest informal loans, rather than through gift exchanges. Similarly, Udry (1994) documented in northern Nigeria that credit contracts formed an important part of risk pooling arrangements between households. Repayment schedules and implicit interest rates responded to adverse shocks to either the borrowing or lending households and, importantly, these transactions were overwhelmingly carried out in the restricted social space of neighbours and relatives.

*Migration* may be a risk-coping mechanism after the incidence of a shock. While the link from an economic shock to out-migration may seem direct, it is frequently less evident than expected. Yang (2008), focusing on out-migration following earthquakes in El Salvador, showed that the link between risk and out-migration depends crucially on whether the shock is an aggregate shock or an idiosyncratic shock due to the high fixed costs of migration, which frequently require support from other network members. An aggregate economic shock by reducing the access to credit from other members of the community also leads to a decline in the total amount of migration. In the case of an idiosyncratic shock, out-migration increases.

In sum, which risk coping strategies (or combinations of strategies) are used depends crucially on the institutional features of the particular rural setting. As Fafchamps and Lund (2003) discussed, in the presence of complete and perfect markets, the choice between transfers, loans and credit as a means of risk sharing is irrelevant and indeterminate in theory. In real-world settings, however, the choice of instruments and the efficiency level that can be achieved depend on the nature of market imperfections and institutions; if insurance markets are absent, so is gift-giving, and thus risk management takes the form of precautionary savings. If accumulated savings are insufficient to smooth the shocks, then credit performs as an instrument of insurance, depending on the households' capacity to borrow. Finally, when community or family networks work, transfers and remittances can act as a mechanism of informal insurance.

### **2.3. A review of risk management policies**

The overall challenge for policy makers is to find the appropriate mix of policies that helps deal with farm risks. As noted in OECD (2001), there is a moral hazard issue in that the more government assumes a role in risk management, the lower the incentives for agents to manage their own risks. As a result, government schemes may "crowd out" private risk management arrangements (OECD, 2009). OECD (2009) identified roles for government support in risk management and risk coping based on policy measures used in OECD countries. OECD (2011) evaluated the appropriateness of specific measures in a selection of OECD countries.

Potential governmental interventions are indicated in OECD (2011) where the role of governments is divided into two main areas: 1) the development of market institutions; and 2) support for risk reduction, mitigation, and coping. Policies for the development of market institutions are based on the premise that missing markets for risk management can be improved by governments which provide a stable macroeconomic and business environment framework and regulations. Some examples of these policy measures are: risk management training for farmers; facilitating information sharing on risks; and increased competition in the insurance market. On the other hand, policies that support risk reduction, mitigation and coping, the OECD (2011) refer to the role of government in reducing the probability and/or the adverse impact of hazardous/catastrophic events. Some examples of such policy measures are: disaster prevention (e.g. flood control); prevention of animal diseases (domestic and border measures); legal form of farms; R&D of new varieties or breeds; countercyclical programmes; tax system for income smoothing; and *ad hoc* payments for quick recovery.

The OECD (2011) lays out a framework for good governance in the case of risk management strategies by the government. It suggests two main aspects that policy makers should consider. The first is that policy design must give attention to the interactions and trade-offs among all risks, strategies and policies, and avoid a narrow



focus on a single risk or risk management tool as there is evidence of significant interaction between risks and responses. Secondly, is the need for a policy approach with differentiated responses to different types of risk. Not all risks require the same policy, and some may not require a policy response at all. Efficient policies for normal, marketable and catastrophic risk layers will differ. For example, normal risk is frequent but not too damaging and is typically managed at the farm or household level.

Table 2.3 shows the above mentioned framework where risks can be represented through a distribution of income loss with three risk layers: high frequency/low damage normal risk; low frequency/high damage catastrophic risks; and marketable risks with intermediate levels of frequency and damage. These layers are represented in the horizontal axis of the figure, while four categories of risk management responses are represented in the vertical axis. The most efficient responses is the “good governance” diagonal in the centre. There will always be normal risks that should remain the responsibility of a farmer and that need no policy response. There are also risks that can potentially be managed through market tools, such as insurance or futures markets, and for which the policy challenge is to create the conditions for the development of these markets. Finally, there are catastrophic risks to which market responses may fail and governments will need to respond to social demands for assistance.<sup>3</sup> In this case, good policy governance is required.

A question that arises is the applicability of this framework to developing countries. In general terms, it could be suitable but with some caveats. Market imperfections are more likely to prompt the use of community/informal management mechanisms. As such, it is necessary to assess the robustness of institutional structures and government systems, and their influence on the prevalence of informal risk management strategies as these strategies play a crucial role for farmers. Therefore, managing and coping with risks, whether they are normal or catastrophic, may require a more nuanced balance between government intervention, market mechanisms and community/informal risk management tools. This may imply that the good governance diagonal of the OECD framework (Table 2.3) needs to be expanded to include a new layer in which these informal strategies are taken into account. Risks of all frequencies (from small damage but frequent, to rare high damage and systemic) and importance (from normal to catastrophic) are also dealt within these strategies. Public policies should note, consider and use when possible and suitable these informal risk management mechanisms.

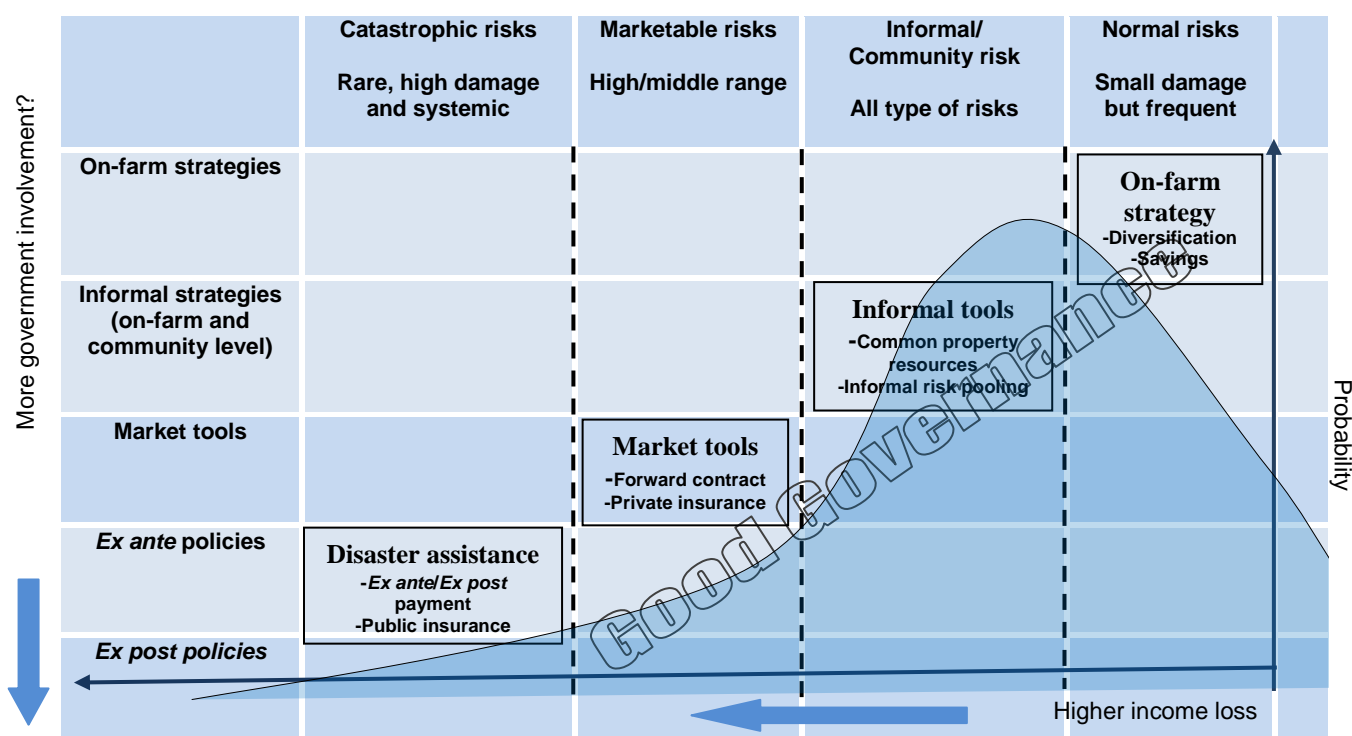
Government intervention should consider that the ability of households to save and to access insurance and credit markets is often central to their ability to manage and cope with risk in any context. However, in many developing countries the existence of a complete set of markets cannot be taken for granted. Households may have very restrictive opportunities to save or borrow, insurance markets may be missing, and even land and asset markets may be very thin. For example, Chaia et al. (2010) and Demirguc-Kunt and Klapper (2012) estimated that approximately half of the world’s population is “unbanked,” or has no access to formal financial services of any kind. This figure is around 80% in Sub-Saharan Africa, 67% in Arab States, 65% in Latin America, 59% in East Asia, 58% in South Asia, 49% in Central Asia and Eastern Europe, and only 8% in OECD countries. The most commonly reported barriers to formal financial access

3. For example, the distribution of price risks can include frequent variations of prices, but only some of these shocks are downside and highly damaging in general. However, the distribution of prices is subject to uncertainty and sometimes difficult to infer from the information about the past (OECD 2009).

are high cost, physical distance, lack of proper documentation, and high transaction costs in general. CGAP (2010) reported that although financial inclusion and consumer protection are increasingly on the policy agenda, enforcement and implementation of regulations are still lacking.

Three main areas of government intervention for risk management and coping that have been studied broadly in developing countries are: insurance, saving/credit and safety nets. Next a brief review of the experience of these policies is presented.

**Table 2.3. Risk layering: Optimal pattern of risk management strategies and policies**



Source: OECD (2011).

### Insurance policies

Traditional public crop insurance schemes in developing countries (and in several developed countries) have been largely unsuccessful. Imperfect information and high transactions costs have proven to be destabilising, and there are no easy solutions. Subsidised insurance has been developed in several OECD countries as a device to provide disaster assistance, but they have not fully substituted ad-hoc payments and they often cover non-catastrophic risks (OECD, 2011). A more recent and growing body of work looks at alternative mechanisms for the provision of insurance to farmers, and its potential to reduce risk exposure. One mechanism that has received much recent attention is the prospect of weather-indexed insurance. In this case, the insurer pays out in the event of adverse weather shocks, as measured objectively by meteorological stations. The indexing of insurance to the weather allows circumvention of the frequently severe problems of moral hazard that make traditional models of crop insurance difficult to implement in developing countries. Moreover, index insurance is unable to cover the basis risk, which reduces the demand. The goal of such insurance is to insulate income

and consumption against aggregate shocks that are plausibly exogenous to the household (Gine et al., 2007).

Weather-indexed insurance has seen a large increase in recent years. Cole et al. (2010) reported at least 36 pilot projects evaluating similar schemes across the world. However, despite its general appeal to policy makers and to development economists, take-up of these schemes has often been very low. Gine et al. (2007) reported a 4.6% take-up only among eligible households during the pilot programme of a rainfall insurance scheme in two districts of Andhra Pradesh state in India, an area dependent on timely and adequate rainfall for much of its agricultural production. They found that richer households (less credit constrained) and more risk-taking households (which grew riskier crops) were more likely to take the product. Participating households were likely to have better social networks, be less risk-averse, and more likely to have been a previous customer of the microfinance institution which administered the programme.

Cole et al. (2010) examined this evidence further, in addition to looking at pilot evidence from a different Indian state (Gujarat); they reported similar patterns. Specifically, they reported that trust in the agency providing the insurance is particularly important, especially given the low levels of financial literacy and education in the sample. They reported that take-up was higher when the insurance “educator” was referred to the household by a trusted local agent, when there was a previous history of payouts in the village, and when the household had previous experience with insurance. Each of these factors indicated that uncertainty about the product (and whether the provider was trusted to pay out) was a significant determinant of the low take-up rate of the financial product. Financial literacy was also important; take-up was higher among households with higher financial literacy and greater facility with probability concepts. The same is documented in Banerjee and Duflo (2011). Karlan et al. (2010) reported, for example, that the take-up of insurance and loans offered to Ghanaian farmers was significantly higher for farmers with higher cognitive scores and a previous history of having borrowed from a formal institution. Furthermore, liquidity constraints are also very important. In cross-sectional regressions in Cole et al. (2010), wealthier households were more likely to buy insurance.

There is also the possibility that as supply of formal insurance becomes more commonplace and farmers become more familiar with the concept, demand for insurance will increase. For supply to increase substantially there are important regulatory steps which need to be taken, including legal protection for policyholders and the development of reinsurance markets (Wiedmaier-Pfister and Chatterjee 2006 and Dercon 2005). Karlan and Morduch (2010) argued that the absence of insurance markets is primarily due to traditional supply-side constraints around asymmetric information (moral hazard and adverse selection), high transactions costs, and enforcement problems.

### *Savings/credit policies*

While the direct provision of insurance is perhaps the most straight-forward policy intervention geared towards risk management, farmers in practice also use precautionary savings and credit as means to manage and cope with risks. One set of interventions looks at offering commitment savings to farmers. Being able to save for future consumption requires the ability to delay today’s spending; however, if preferences are present-biased, this may be difficult. Commitment savings products allow households to commit to saving by restricting their ability to withdraw their savings from their bank account until the maturation date or until a set goal is reached. Presenting evidence from the

Philippines, Ashraf et al. (2009) found out that take-up of commitment savings products was higher among women and access to the product resulted in significantly higher savings one year later. In a direct application of similar principles to smallholder farmers, Brune et al. (2011) offered commitment savings products to farmers in rural Malawi; they found that access to a commitment treatment led to increases in deposits at the partner bank, and over the next agricultural year caused increases in agricultural input use, crop sales, and household expenditures. Thus it seems that commitment savings devices could play a role in boosting agricultural households' ability to save, which can play an important role in their ability to smooth consumption in the face of agricultural risk.

It is important, however, not to overstate the potential impact of this scheme. While the "lock-in" of funds may commit households to save more, this lack of flexibility could also lead to a lack of liquidity at a time of an adverse shock. The evidence in Brune et al. (2011) was particularly striking in this regard. Even households which opted to open commitment savings account put only a small portion of their savings in commitment accounts, preferring to use ordinary accounts for the larger share of their savings. Households seem to value the flexibility of withdrawal and it is plausible that this is due to considerations of risk.

Credit provision may also allow for better risk coping. However, the history of previous agricultural credit schemes has not been propitious and government action through the provision of credit, has a chequered history at best. Cole (2009), for example, studied agricultural lending by government banks in India and found significant election-year effects. As he comments, "Politically motivated loans are costly: they are less likely to be repaid, and election year credit booms do not measurably affect agricultural output." On the other hand, Gertler and Gruber (2002) reported that households in rural Indonesia that were closer to financial institutions were better able to self-insure against severe health shocks. The effect is similar for private financial institutions and government microfinance institutions and they conclude that "government promotion of microfinance and microsaving programmes can be useful in helping families cope with major health shocks, especially in areas where private credit is not available." Islam and Maitra (2012) showed, using panel data from Bangladesh, that households most commonly coped with health shocks through the sale of livestock but that households having access to microcredit were not likely to sell productive assets (livestock) in response to idiosyncratic health shocks. Microfinance institutions have recently faced a barrage of criticism from policy makers in Asia particularly, India and Bangladesh for leading farmers into debt-traps with long term welfare consequences (Banerjee et al., 2010).

### *Safety nets policies*

Evidence on different social protection programmes in developing countries detail how the negative impacts of agricultural shocks can be ameliorated significantly through the availability of these programmes. Uninsured risk results in welfare losses and the poor usually do not have the opportunity to insure themselves, which, according to Dercon (2005), presents a justification for public action to foster more social protection. Ravallion (1988), reviewing evidence on the performance of workfare schemes in South Asia, discussed the stabilisation benefits of such schemes with universal coverage. He reported that rural public works have a long and generally successful history as instruments of seasonal stabilisation of incomes and famine relief in India. In bad years, such as the poor monsoon of 1987, demand for employment under such programmes rose dramatically.

Some evaluations of safety net programmes suggest a positive impact at the household level. For instance, Singh, Park and Dercon (2012) found in India that while a significant drought caused significant deterioration in the nutrition of young children in rural areas, this deterioration was entirely compensated for by a national school meals programme for the children who had access to it. A recent review of evidence on cash transfer programmes (DFID, 2011) found that “one of the strongest and most consistent findings regarding the impact of cash transfer programmes was their contribution to reducing hunger and food insecurity.”

Macours, Premand and Vakis (2012) also evaluated a safety net programme to better protect farmers against drought shocks using randomised control trials (RTC),<sup>4</sup> in Nicaragua. They found that enhancing the basic cash transfers with productive interventions (i.e. the basic cash transfer programme with either a scholarship for training to develop new marketable skills or a lump-sum grant to develop a non-agricultural business), proved to be an effective strategy to help households successfully develop other income-generating activities to overcome bad weather and smooth out the shocks to consumption that occurred when crops fail. This new modality of productive safety nets helped households to protect against shocks and provide opportunities for higher earnings in the longer-term. On the other hand, the basic cash transfer scheme only helped households to maintain consumption in the short-run when the shock hit, but had no impact on future earnings.

It is also important to acknowledge the existence of policies beyond credit, insurance and safety nets that contribute directly or indirectly to reduce and better management of risk for smallholders. For instance, policies tied to good agricultural practices, sanitary and phytosanitary measures, extension services, technical assistance, rural infrastructure and more general policies that provide the right environment for agricultural development can have equal or sometimes greater positive impacts in the way poor small-scale farmers deal with risk.

Agricultural risk policies in developing countries have tried to address primarily the issue of imperfect markets, particularly in the financial sector. However, government interventions on insurance and credit markets have been, in several cases, inefficient and costly, which suggests a better policy design. Households whose consumption levels are close to subsistence tend to devote a larger share of land to safer, traditional varieties of crops than to riskier high-yielding varieties. Thus it may be the case that the vulnerability of poorer farm households, especially in the absence of credit and insurance markets and social security schemes, may lead to poverty traps.

#### ***2.4. Poverty traps, risk implications, investment and risk management policies***

Risks in agriculture are usually more severe in developing countries than OECD countries. Smallholders in developing countries are often forced to rely on strategies that perpetuate poverty and households cope with shocks by depleting valuable assets to allow

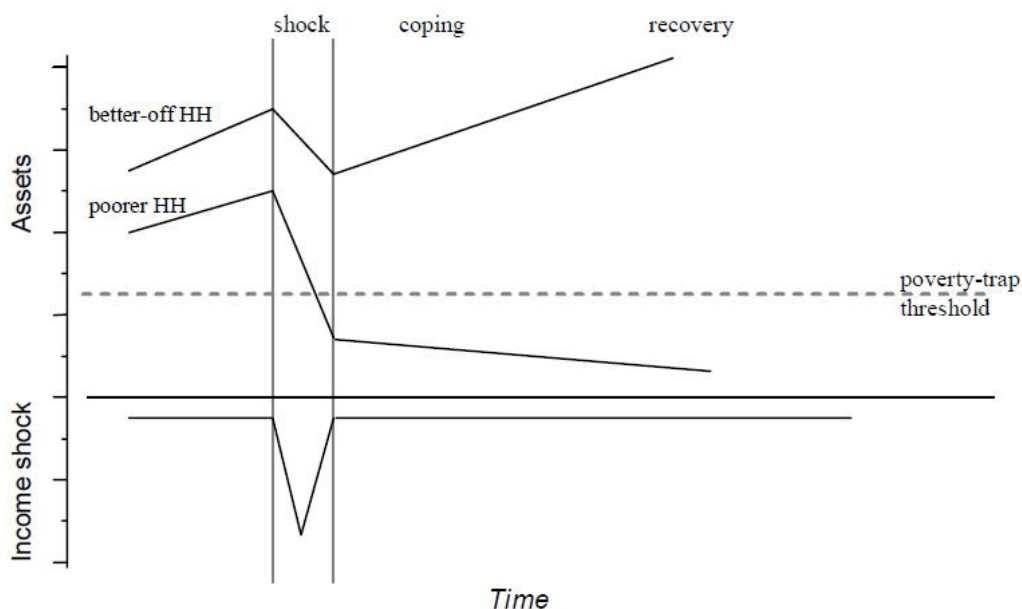
---

4. Randomised control trials (RTC), is a programme evaluation method, where groups of households or communities are randomly assigned to different “treatments” (different programmes or variations of the same programme); it usually incorporates the “control group” (the group of households that did not receive the benefit of the programme). The main argument with this method is that as households are randomly assigned the programme, and differences between groups is the effect of the treatment (Banerjee and Duflo, 2011; Macours, Premand and Vakis, 2012; Macours, 2012).

the family to maintain a certain level of consumption in the aftermath of a shock (e.g. floods or drought). This, however, can eventually cause the family to fall into a poverty trap created by low assets levels. The fear of being trapped in long-term destitution leads households to protect assets at all costs, and the cost can be very high. To maintain its assets, the household reduces consumption which can have long-term ill effects on the household's health and capacity. Whether a shock is sudden or prolonged, most households, both the wealthiest and the poorest, experience a loss of assets and a reduction of disposable household income. In the case of smallholders, the main aspect to consider is that they are often mired in deep poverty and when shocks occur, they are likely to face the more devastating consequences. Such a situation calls for better and more efficient risk management tools.

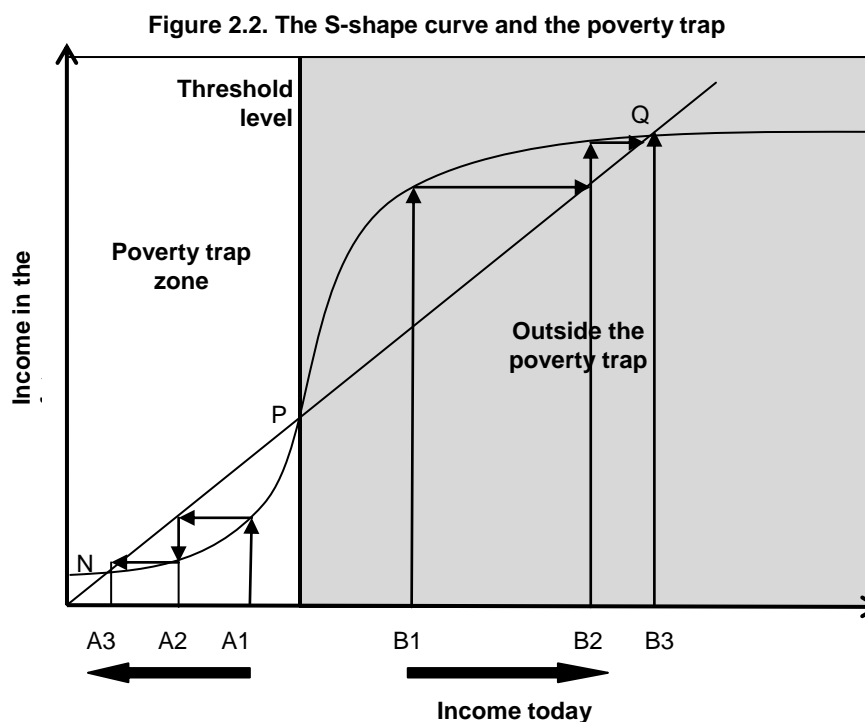
According to Carter et al. (2005) poverty trap is a critical minimum asset threshold, below which households are unable to build up productive assets, educate their children, and improve economically over time. Poverty traps are most likely to be problematic in areas where markets are thin or weak and households are unable to borrow against future earnings to build up their assets. In the face of a poverty trap, short-lived shocks can have permanent long-term consequences. If an environmental shock destroys a family's assets, it may push them below the minimum asset threshold and into a poverty trap from which they cannot escape, even over time. Figure 2.1 illustrates the effects of a shock like flooding or hurricane on a household, and how it can push a poor family's asset stock below the poverty-trap threshold and may leave them in a permanently lower wealth situation, especially since the asset loss is usually combined with a corresponding loss of income.

Figure 2.1. Climate shock impact on assets and income levels



Source: Carter et al. 2005.

Banerjee and Duflo (2011) also describe the poverty trap. Their main argument is that income today influences the income of tomorrow. In other words, an individual's income today determines how much he spends on food, medicine or on his children's education, and whether or not he buys fertiliser or improved seeds for his farm. All of this determines his wellbeing of tomorrow. Therefore, if an individual's current income is situated within the poverty trap zone of Figure 2.2, he will enter into a vicious circle of diminishing income. However, if an individual's initial income is situated in the shaded area (outside the poverty trap), and if a positive event takes place, he could enter into a virtuous circle of increasing income and ultimately move away from poverty.



Source: Banerjee and Duflo, 2011.

Risk plays an important role in explaining poverty traps. Risk can induce households to select low-risk/low-return economic activity because the downside for the poor is worse than for the non-poor or because the poor face higher risk. Shocks tend to push households into poverty. Illness, unemployment, macroeconomic and financial crises, conflict, policy change or natural disasters are associated with a higher incidence of poverty among the affected households. Incidence of poverty following shocks is higher among households with fewer buffers to protect their living standards. Poorer household with fewer assets and entitlements are more exposed to the possibility that shocks will make them even poorer. Shocks generate poverty, and uninsured shocks are more likely to lead to poverty than insured ones (Barrientos, 2007).

Empirical evidence shows that major hazards facing smallholders in developing countries, many with high frequency, can often have severe or devastating effects. Uninsured transitory shocks can have a permanent effect on the welfare of households. Maccini and Yang (2009), for instance, reported using a sample of women in Indonesia that higher rainfall in their birth year leads to a lower incidence of (self-reported) poor health, greater terminal height, remained in school longer, and had accumulated more assets when they were between 25 and 50 years old. Alderman et al. (1992) found that a

drought in Zimbabwe had serious long-term implications for children aged 12-24 months, lowering their height and grade accomplishment later in life. Dercon and Hoddinott (2003) observed the impacts of large shocks such as drought on child and adult health, particularly in Zimbabwe and Ethiopia. They concluded that there were substantial fluctuations in body weight and growth retardation in response to shocks and that adult women were often worse affected by these shocks. For children, there was no full recovery, affecting their health as adults and their education outcome, as well as lifetime earnings.

These shocks also have an immediate impact on food security of farm households in developing countries. For example, Rosenzweig and Binswanger (1993) found the transmission from a fall in agricultural profits due to weather shocks to a fall in food consumption in India. Not only is there evidence that food consumption moves with economic shocks to agricultural households in developing countries; this effect can be discerned even in the health and nutrition indicators separately. For example, Singh, Park and Dercon (2012) documented that exposure to a severe drought in 2002 had a large and significant negative impact on the height-for-age and weight-for-age of 5-6-year old children in 2007.

Many risk coping mechanisms have potential consequences for equity. Where consumption or expenditures need to be reduced, the burden of the risk may fall disproportionately on the poorest households or on household members of a certain age group or gender. Dercon and Krishnan (2000), looking at risk sharing in poor households of southern Ethiopia, showed that the burden of illness risks is borne disproportionately by women. Similarly, Maccini and Yang (2009) showed that negative and positive rainfall shocks in the year of birth only affect long-term outcomes for women and not men, a pattern consistent with gender bias especially during times of hardship.

People might also be affected due to their age at the time of the incidence of a particular shock. There is now considerable evidence that health and nutrition shocks in-utero, infancy or early childhood have long and persistent impacts on future outcomes (Almond and Currie, 2011). Similarly, reductions in human capital investments in children in response to the incidence of agricultural shocks to the household will also have long-term impacts on the child. For example, Jacoby and Skoufias (1997) found that after an adverse shock, households withdraw their children from school. This is detrimental to the individual life prospects of these children but may also be detrimental to future agricultural productivity. For example, education may be an important input to allow households to invest in productive agricultural technology.

Risk impacts also influence the choices and results of production, investment and consumption simultaneously. Risk management strategies taken to guard against the possibility of incipient shocks could involve, for example, a decrease in consumption in favour of precautionary savings, underinvestment in productive technologies such as fertiliser or livestock, and taking up modes of production that could involve low productivity such as sharecropping. Similarly, the incidence of shocks may lead to a forced decrease in consumption, and the sale of productive assets which implies that not only current yields will be low due to the shock, but future yields as well due to the lack of complementary assets required in the production process.

Banerjee (2005) analyses poverty traps as the household's inability to invest in more profitable activities. Investment can allow households to move out of poverty but he identifies several factors that impede them from doing so: failing financial markets and the lack of access to financial services (i.e. credit and insurance), as well as the limited



possibilities of farmers to borrow funds and manage risks. Basically, Banerjee describes two stylised types of poverty traps: “desperately poor households” that are *credit constrained* and “vulnerable poor households” that are *insurance constrained*. These two situations and their policy implications are more formally represented in Figure 2.3 (Box 1).

The “*desperately*” poor are willing to invest, but cannot access the necessary credit. Banks are unwilling to lend because they are likely to default when their consumption drops below a minimum. This *credit constraint poverty trap* can be conceptualised as an investment cap due to credit constraints, a cap which is more constraining for the poor because of transaction costs and moral hazard: they have little asset value to lose in the case of default. There is no credit for the poor because *supply is constrained* by the banks. An insurance or safety net policy will not necessarily solve this problem because it is likely to exacerbate moral hazard. Banks will be even more restrictive with households that have less to lose in case of a default because they have insurance or social protection. It is under such conditions that credit policies can solve a major problem faced by smallholders: liquidity constraints to carry out farm or non-farm investments.

A second poverty trap is associated with “*vulnerability*” with respect to risks that may derive from an investment decision. If something goes wrong, the risk of a sudden drop in consumption could be exacerbated. This fear decreases the willingness of poor households to invest and demand credit as they prefer to restrict their investment to low-risk/low-return activities. In this case, the poverty trap arises because they have too much to lose if things go wrong when compared with the safe non-investment scenario. The risk of falling into an even worse poverty trap will discourage investment and lead to the *insurance constraint poverty trap*, or as Wood (2003) states, “staying secure by staying poor.” In this situation, there is no credit for the poor because, there is a *demand restraint*. Under this setting, a safety net or insurance policy can help induce demand for credit and therefore for investment because, with the safety net, the household has less to lose if the investment fails.

A reasonable policy objective would be to promote investments that help smallholders become more productive. It is necessary to develop a form of government intervention that takes into account risk management and risk coping strategies, particularly where there are market imperfections in the credit and insurance markets as is often the case in developing countries. The empirical evidence discussed throughout this paper has shown that credit, insurance and safety nets have been crucial for farmers to overcome risk shocks that would otherwise perpetuate or make worse their poverty status. However, these financial services policies have not always been efficient nor have they worked properly.

Banerjee and Duflo (2011) have acknowledged the importance of knowing the precise characteristics of households before granting entitlement of one or the other policy. In other words, they suggest more customised policies where the specificities of households are considered to select those for which each type of policy instrument can make a difference in investment decisions. For instance, households whose binding constraint is credit should benefit from loan policies, while households affected by a vulnerability constraint would benefit from access to a safety net (Box 1). This is an appealing approach for policy design. However, implementation costs might be considerable even if more refined survey data could help to distinguish the different needs of the households. Policies designed with self-selection mechanisms are preferable so that each household chooses the policy instrument that better fits its needs. In any case, it is important not to

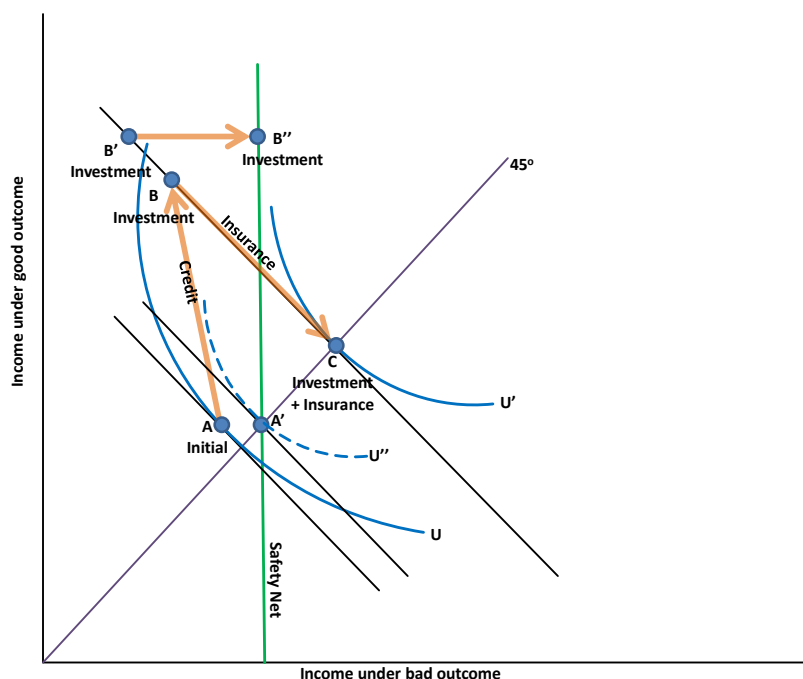
overlook other important roles for governments, in particular the need to implement more general policies (e.g. infrastructure, extension services, etc.) that create the right environment for agricultural development and investment. This broader, more favourable environment would help smallholders to better manage risk, enhance investment, and ultimately overcome poverty.

**Box 1. A graphical representation of desperation and vulnerability poverty traps and household investment and insurance decisions**

Investment decisions by a farm household can be represented in a stylised way as having two simultaneous consequences: it can increase the returns of their activity while at the same time increase the consumption damage if things go wrong. Figure 2.3 takes the analysis of Banerjee (2005) further and shows the optimal decisions of a household undertaking an investment or buying insurance. Decisions are represented in a space of contingent outcomes that, for simplicity, are defined as a bad outcome when investment goes wrong and a good outcome when things go well. The 45 degree line represents equal income in both contingencies and the further the choices are from this line, the riskier they are (Rothschild and Stiglitz, 1976). For simplicity the representation in the graph assumes equal probability for the good and the bad outcomes.

The household's *status quo* is represented by point A as a situation of low returns (represented by the low position of the decreasing straight line of expected returns) and low risk (represented by its proximity to the 45 degree line). An investment opportunity that could lead the household out of poverty is characterised by point B with higher expected returns (represented by the higher parallel straight line) and higher risk (represented by its greater distance to the 45 degree line). An economics benchmark is the situation of equilibrium with perfect insurance and credit markets, and no transactions costs. This unrealistic situation would always allow the household to access credit to B and buy insurance to C, which represents greater returns and lower risk for the farm household.

**Figure 2.3. Household investment and insurance decisions**



A more realistic situation emerges when markets are imperfect and do not allow poor households access to credit or insurance. The lack of credit could impede investing from A to B. The lack of insurance

could impede insuring the investment risk from B to C. In this situation, the household can get into a poverty trap due either to desperation or vulnerability.

In the case of imperfections or constraints in the credit market, the investment opportunity would not take place and the individual would stay in A with a “*desperation type of poverty trap*.” B and C are not achievable because of the lack of credit; this result is independent of the availability of insurance or other risk management tools. The appropriate policy instrument to break this poverty trap should focus on relaxing credit constraints by facilitating access to loans.

Suppose now that there is no insurance market or any way to manage the investment risk. If credit is available, an investment like B would still be implemented. This is because, according to Figure 2.3, B corresponds to a higher level of expected utility (represented by a higher utility curve) than A. There is no poverty trap in this case.

However, contrary to what is represented in Figure 2.3 poor households are usually more risk averse or the investment opportunity is riskier than B, for instance B'. B' is below the initial expected utility of A and, therefore, too risky for the individual to borrow and invest. The household will restrain its demand for credit and, even if credit is available, investment will not take place. The individual will stay at A with a “*vulnerability type of poverty trap*”. In this case, the constraint is not occurring in the credit market, but in the insurance market.

An investment opportunity like B' could be implemented if there was insurance because the individual can move from B' to C. The appropriate policy instrument should focus on insurance and safety nets to break the vulnerability poverty trap and allow the individual to cover the risk of investing.

This analysis has implications in terms of policy responses that aim to increase investment in agriculture.

*Insurance policies* should focus on the creation of an insurance market (e.g. index insurance), but often leads to subsidised insurance provided by the government. This type of policy cannot help the *desperately poor* because the limiting factor is the lack of access to credit, not insurance. It can help the *vulnerable poor* who were not able to take advantage of the investment opportunity B' due to lack of insurance. An insurance policy may allow these individuals to cover some investment risks of B' and ultimately move towards point C. However, nowadays more credit programmes are linked to insurance, which could decrease the risks for banks. As a result they could potentially provide more credit, but this might not always be the case.

*Safety net policies* can substitute for insurance to a certain extent. For instance, in Figure 2.3 a safety net is reflected in the vertical line indicating a minimum income guaranteed by government policy in the case of a bad outcome. The existence of a safety net makes investment less risky and would move the investment opportunity of the *vulnerable poor* from B' to B", making the investment opportunity B' attractive. For the *desperately poor*, the safety net can marginally improve their situation if the level of the safety net is greater than their initial income under a bad outcome (as is the case in Figure 2.3). This would move them from A to A', by increasing expected income and reducing risk. But in the situation of credit constraints, the safety net would not induce the household to make the investment and the poverty trap will prevail. Thus, safety net policies are more likely to help the *vulnerable poor* to increase their level of investment and may bring them out of the poverty trap. However, a safety net policy will be less likely to solve the problem of the *desperately poor* who will not invest due to lack of credit. Furthermore, if the safety net is too generous, it could eliminate the incentives to invest for both types of households.

*Credit policies* relax credit constraints and facilitate the flow of credit for investment. The *desperately poor* would receive the credit they requested, invest and move to either B (without insurance) or C (with insurance). But it would not necessarily help the *vulnerable poor* who continue to have no access to insurance to cover the risk of a possible bad investment.

*A combination of credit and safety net policies (insurance)* would focus on the double constraints in the insurance and credit markets that are often faced by the poor. However, it is most likely that only one of these constraints is directly binding and constraining the investment decision. The combination of policies proposed to all households will help to invest and insure, but only in some households will it truly create new investment. In some households, the investment would have taken place with only one of the policies or even with none. This is why a combined policy can be expensive and inefficient if beneficiaries are not well targeted.

In sum, credit policies could facilitate the flow of credit for investments to farmers who face credit constraints; however, such policies do not necessarily benefit insurance-constrained farmers and may

crowd out private credit. A safety-net/insurance policy is more likely to help farmers who are insurance-constrained, although this policy will not solve the problem of farmers with no access to credit. In addition, this safety net policy, if big enough, could dilute the incentive to invest. A combined policy must be well targeted in order to avoid inefficiencies.

### 3. Quantitative assessment of farm household risk exposure and risk management strategies in developing countries: Evidence from Brazil, China and Viet Nam

This section empirically assesses the degree of farm households' exposure to risks and their management strategies. It also tests some of the risk implication to poverty and the strategies of households in developing countries as presented in the previous section. An efficient and effective policy approach to risk management in agriculture needs to consider the interactions and trade-offs among different risks (OECD, 2011). As farm households are the decision making units that optimise their risk management strategies based on available information on their risk environment, a quantitative assessment of household exposure to risk and strategies is an important step towards effective risk management systems in developing countries.

This section applies the quantitative agricultural risk assessment methods applied to OECD countries by Kimura et al. (2010). While household consumption decisions of farm households in OECD countries tend to be independent from agricultural production decisions due to well developed credit markets and social security systems, it is often observed in developing countries that the household production and consumption decisions cannot be separated. As such, this section extends the analytical scope to the whole farm household, including non-farm income, expenditure and consumption, exploring an additional dimension of the risk and risk management strategies of poverty at the household level.

OECD (2008) concluded that assessment of risk exposure required an historical series of farm-level data. Thus, this study carries out risk assessments based on the empirical data from three emerging economies: Brazil, China and Viet Nam. The first part of section 3 begins with an assessment of agricultural production risk in these three emerging economies and compares them with the results obtained from an earlier risk assessment study of OECD countries (Kimura et al., 2010). The second part quantifies farm household income risk and analyses farm household income risk management strategies in China and Viet Nam. The last part extends the analysis to poverty risks and finds evidence that reinforces the conceptual discussion developed in the previous section, particularly risk implication to poverty in Viet Nam.

#### 3.1. Data source and methodology of risk assessment

Table 3.1 describes the disaggregated data used for the risk assessment observations made of Brazil, China and Viet Nam. Due to the different levels and coverage of available data, different methodologies of risk assessment are applied for each country.<sup>5</sup>

---

5. The samples are not necessarily representatives of the three countries due to the limitation of the size and coverage of household or municipality level panel data. In particular, farm household data in China are not representative of China as only five provinces are covered. Although the assessed risks are a best estimate of risk exposure at the household level based on available data, the assessed production and income risks are not fully comparable across the three countries due

The data in China covers only certain type of farms in selected provinces and does not represent the farm households of the whole country.

**Table 3.1. Data source**

	<b>Brazil</b>	<b>China</b>	<b>Viet Nam</b>
Name	PAM-Pesquisa Agricola Municipal	Rural Fixed Point Observation Survey	Vietnamese Household Living Standard Survey
Level	Municipality	Household	Household
Sample size	5 592	574	840
Regional coverage	All regions	Five provinces (Jiangsu, Shandong, Henan, Sichuan and Shanxi)	All regions
Household type	n.a.	Farm households engaging in crop farming	Farm households and Non-farm households
Data coverage	Agricultural production	Agricultural production and household income	Agricultural production, household income and consumption
Year	1975-2010	2003-09	2004, 2006 and 2008

Indicators of agriculture and poverty in the three countries are summarised in Table 3.2. The share of agriculture in their economy is much higher than most OECD countries, in particular its share in total employment. Small size family farms play an important role in all three countries. The average farm size in Brazil is much larger than in China and Viet Nam. Large farms in Brazil dominate export-oriented agricultural production and the share of farms operating less than two hectares of land makes up only one-fifth of total farms. The agricultural sector in China and Viet Nam is dominated by small sized family farms. The prevalence of poverty is also a distinctive feature in all three countries compared to OECD countries. Small family farms, which produce mainly for own consumption, are more likely to be mired in poverty. However, all three countries have succeeded in reducing poverty incidence and experienced high growth rate in the last decade. Brazil, China and Viet Nam are good examples to assess the risk exposure of smallholders and risk management strategies in the context of rapid economic development.

In Brazil, as household level data is not available for either agricultural production or consumption, this study uses municipal level data collected monthly by the Brazilian Institute of Geography and Statistics to assess agricultural production risks, such as yield, price and revenue risk of certain crops. The data is a panel of 5 592 municipalities in Brazil between 1975 and 2010.

to the different representativeness of the data as well as the different methodologies of risk assessment that were used.

**Table 3.2. Agricultural and poverty indicators in Brazil, China and Viet Nam.**

	Brazil	China	Viet Nam
Average farm size (hectare)	64.0	0.60	0.89
% of farms less than two hectare	20.3	n.a.	94.1
Agricultural share in GDP (%)	5.6	10.3	20.9
Agricultural share in total employment (%)	17.0	39.6	51.7
Poverty headcount ratio at USD 2 a day (PPP) (% of population)	11.3	29.8	43.4
Average annual GDP growth between 2004 and 2008	3.7	11.0	6.6

1. Farm size data in Brazil and Viet Nam is in 2006 based on Agricultural Census. The data in China is in 2009.
2. Agricultural share in GDP and total employment are in 2009 except for agricultural share of employment in Viet Nam (2006): *World Development Indicators*.
3. Poverty headcount ratio is in 2008: *World Development Indicators*.

The risk assessment methodology is adapted to the long time series database. To remove the structural trends resulting from the long-time series, the variability of yield, price or revenue is calculated comparing the number in a given year with a five-year moving average in each municipality. This average is a rough estimation of the expected yield, price or revenue for a specific year. The variability is then calculated with respect to a five-year moving average. The difference between the observed yield in a specific year with the corresponding moving average gives the anomaly of that year. The standard deviation and the coefficient of variation of the “anomalies” across the year are indicators of the variability in each municipality.

In China, a panel of 572 farm households, which are engaging in crop farming, is available between 2003 and 2009.<sup>6</sup> Rural Fixed Point Observation Survey is an official farm household survey conducted by the Ministry of Agriculture. The available data covers five provinces in China, ranging from coastal to inland provinces along the Yangtze River. The available database includes agricultural production and household income information. However, data on consumption and farm household size are not available, thus limiting the scope of risk assessment to agricultural production and farm household income. The methodology as described in Kimura and Le Thi (2011) is applied to assess farm-level risk exposure: the structural trends in yield and income growth were first removed from the longitudinal database, and the risks were measured by individual farm households in term of coefficients of variation and correlation of risk variables.

Unlike the database in Brazil and China, the household survey data in Viet Nam includes both farm and non-farm households and covers several aspects of households, allowing risk assessment on agricultural production, income, and poverty. However, the length of time series data is small. While the household level estimation of risk exposure requires at least five years of longitudinal data, the available database in Viet Nam has only three years of observation points. To overcome this shortcoming, this study adopted an alternative methodology of risk assessment using cross-section data developed by Lanjouw and Lanjouw (2001), Pritchett et al. (2000), Chaudhuri et al. (2002), and McKay and Lawson (2003). Instead of measuring a risk exposure by an individual farm household, this methodology estimates the risk faced by a homogenous group of farm households. The shocks experienced by individual farm households during two periods

6. The analysis of the data is conducted in collaboration with the Agricultural Information Institute of the Chinese Academy of Agricultural Science.

(2004-06 and 2006-08) are normalised and pooled within the group, assuming that households in a homogenous group are exposed to the same random shock that are reflected in the cross-section variability. The standard deviation and coefficients of correlation of the shocks pooled across the homogenous household group is a measurement of risks, which is comparable with the assessment results in other countries. Annex A presents the technical background of this methodology.

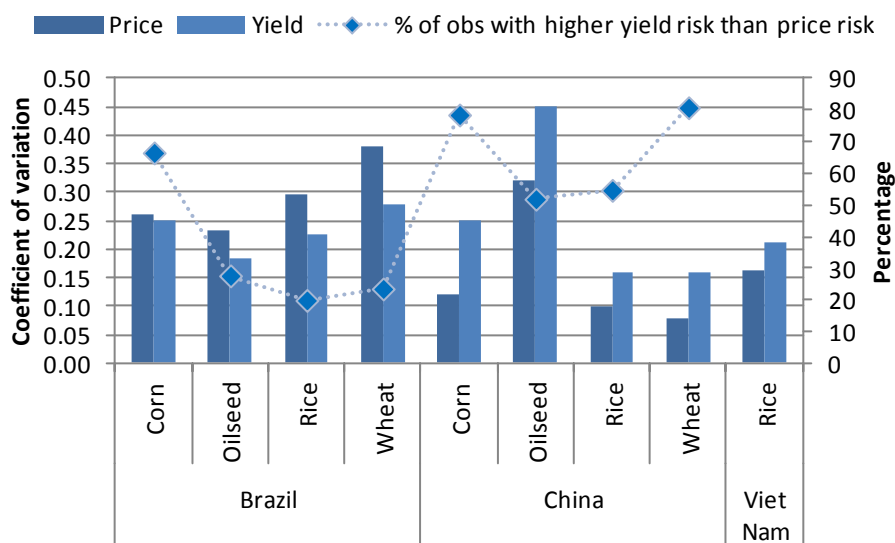
### ***3.2. Assessment of agricultural production risk and risk management strategies in Brazil, China and Viet Nam***

Based on the methodology of risk assessment in three emerging economies, agricultural production risk as recorded in micro data and uses coefficient of variation and correlation as statistical indicators of risk exposure is assessed here. A quantitative comparison with wheat production risk between these emerging countries and OECD countries is then made.

For many farmers, production (mainly due to weather) and price (due to markets) are the two main variables that are the main sources of risk (OECD, 2011). The previous study finds that the yield risk observed at the micro level tends to be higher than at the aggregate level, whereas observed price risk is comparable between micro and aggregate levels (e.g. OECD 2011). This is because yield risk tends to be location specific: a favourable yield in one location is offset by an unfavourable yield in another location within the aggregate level (Coble et al. 2007). The comparison of price and yield risks at the micro level shows that yield risk dominates price risk on average for all crops in China and Viet Nam, while observed price risk is higher in Brazil. In China, the data shows that 60% to 80% of farm households are exposed more to yield than to price risk, whereas 20% to 30% of communities experienced higher yield than price risk in Brazil with the exception of corn for which almost 70% of communities recorded higher yield risk. The different results observed in Brazil are most likely due to the assessment based on community level data. If the yield risk varies significantly within the same community, the degree of exposure to yield risk at the individual farm level could be higher than the observation and could make a higher proportion of households more exposed to yield than to price risk (Figure 3.1).

Although the different risk assessment methodology in the three countries requires careful interpretation when comparing yield and price risks across these countries, both price and yield risks are observed to be higher in Brazil for many crops. In China, observed price risk is much lower for wheat, rice and corn. This may reflect price intervention policies in place. The minimum purchase price policy was introduced for rice in 2004 and for wheat in 2006. Moreover, *ad hoc* intervention has been conducted for a number of commodities with the intention to stabilise the domestic market price in China.

Figure 3.1. Comparison of price and yield risk



Correlations between uncertain variables are important for the producer's risk management strategy because farmers can benefit from some correlations to reduce the joint variability of income (OECD, 2011). Two circumstances can be considered in which producers can benefit from such relations of risks. First, if components of income are negatively correlated, the variability of one component partially offsets the variability of other components (e.g. price and yield, revenue and cost). Second, if total income is composed of several sources, imperfect correlation (coefficient of correlation less than unity) between different sources allows producers to potentially reduce the total variability of income. Figures 3.2 and 3.3 present correlations between price and yield, and those between different crop revenues.

The average coefficients of correlation between price and yield are negative for all the crops in the three countries except for wheat in Brazil. Similarly, the majority of observations shows negative price and yield correlations except for wheat in Brazil. This is consistent with the findings in OECD countries (Kimura et al. 2011). The majority of producers benefit from the natural hedging effect of negative price and yield correlations.

Coefficients of correlation between different crop revenues are found to be positive, but less than unity in Brazil and China. This assessment result shows that imperfect correlation between different crop revenue helps stabilise total agricultural income. As a result, the variability of diversified agricultural revenue would be lower than the variability of each crop revenue. In fact, the risk assessment for China shows that in most cases the coefficient of variation of diversified agricultural revenue is lower than that of individual crop revenue.



Figure 3.2. Correlations of price and yield risk

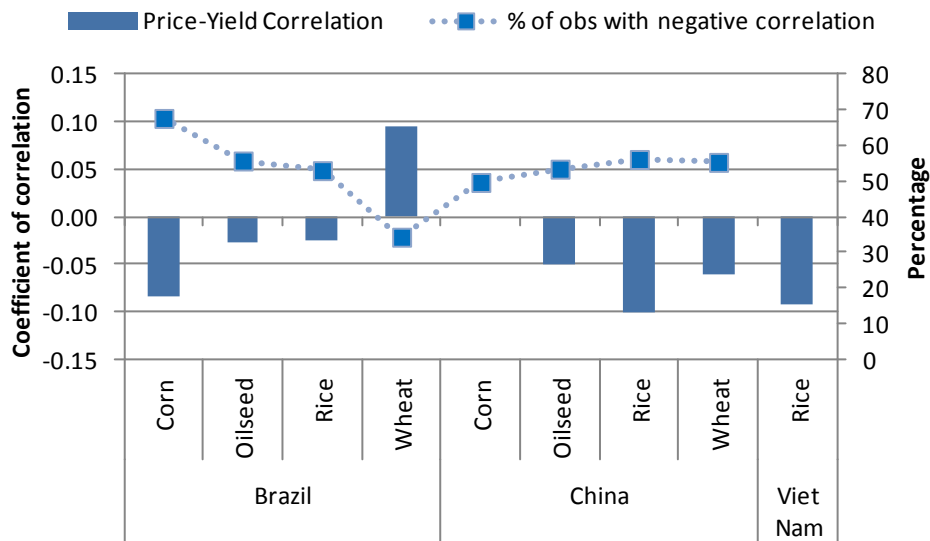
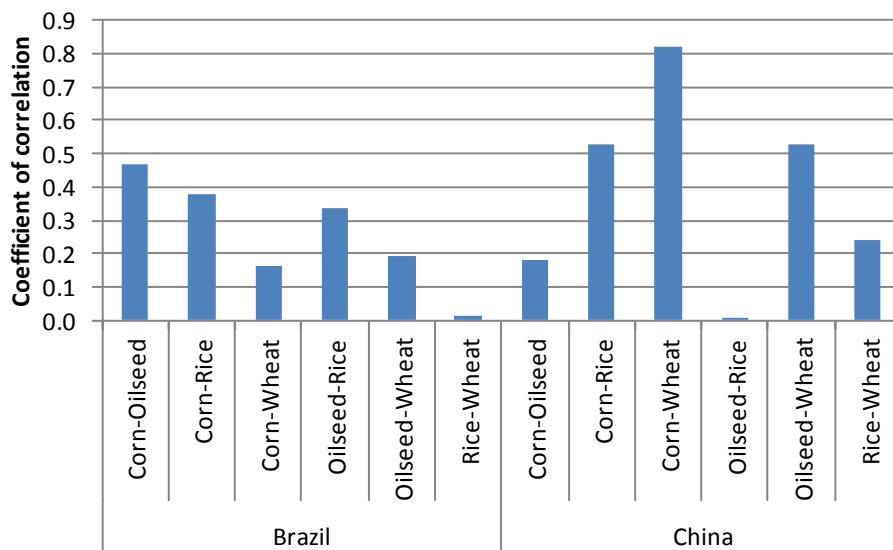
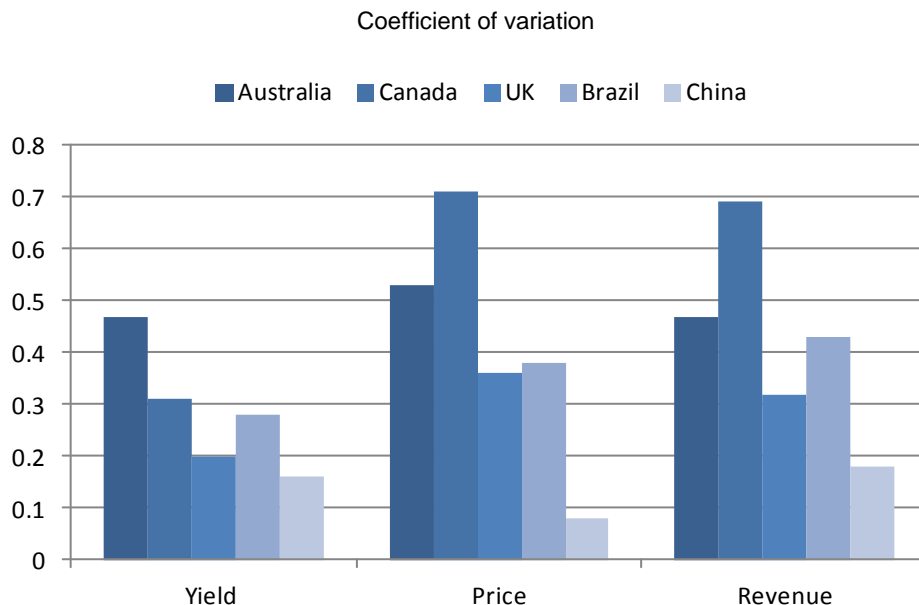


Figure 3.3. Correlation of crop revenues



Lastly, wheat production risk is compared between three OECD countries (Australia, Canada and the United Kingdom), and Brazil and China. The coefficient of variation shows that in the case of wheat the production risks in Brazil and China are not higher than those in OECD countries. Moreover, both yield and price risks are on average higher in Australia and Canada than in Brazil and China. The comparison of production assessment in OECD countries and Brazil and China indicates that wheat producers are exposed to comparable agricultural production risks (Figure 3.4). These assessment results could suggest that the type of agricultural production risk faced by farmers may not be fundamentally different between OECD countries and these emerging economies, which corroborates what has been seen in Section 2 above.

**Figure 3.4. Comparison of wheat production risk between some OECD countries and Brazil and China**

### 3.3. Assessment of farm household income risk and risk management strategies in China and Viet Nam

The assessment of agricultural production risk in the previous section suggests that farm households could use production diversification to manage production risk. By diversifying income sources, farm households have an opportunity to manage their income risk. Indeed, non-farm income is an important source of income for farm households in OECD countries, accounting for more than half of the farm household income in many countries, depending on the definition of farm households (OECD, 2009). In China and Viet Nam, rapid economic growth is largely led by the non-farm sector and in most regions of these two countries, the main income opportunity comes from employment in non-farm sectors. Under this process of economic growth and industrial structural adjustment, farm households face the risk that they will not attain the same income levels of non-farm sectors if subsistence farming, which tend to generate a stable but much lower level of income, is their sole source of income.

In order to assess the farm household income risk, this section classifies the components of farm household income into four categories. First, agricultural income is defined as the total value of sales and own consumption of agricultural production minus the total cash cost (labour cost and fixed cost). Second, local non-farm income includes local off-farm wage and self-employment incomes in both agriculture and non-agricultural sectors. Third, transfer income includes both private and public transfers. While public transfers are a social support or agricultural payment from the government, private transfers are mainly a remittance from household members who have migrated to cities. Finally, residual income contains returns to assets, such as interest, dividends and rental receipt.

Figure 3.5 presents the composition of farm household income. The average share of agricultural income in household income is less than 50% in China and Viet Nam. The share of local wage income in Viet Nam is 45% on average, which is much higher than in China. The results may reflect the difference in local wage income definition in these two

countries. The data shows that farm households in China tend to find non-farm employment opportunities away from local municipalities. It is expected that a large part of the transfer income, and asset and residual income in China is a remittance from household members or other members who have permanently migrated to cities to obtain non-farm employment.

**Figure 3.5. Composition of farm household income in China and Viet Nam**

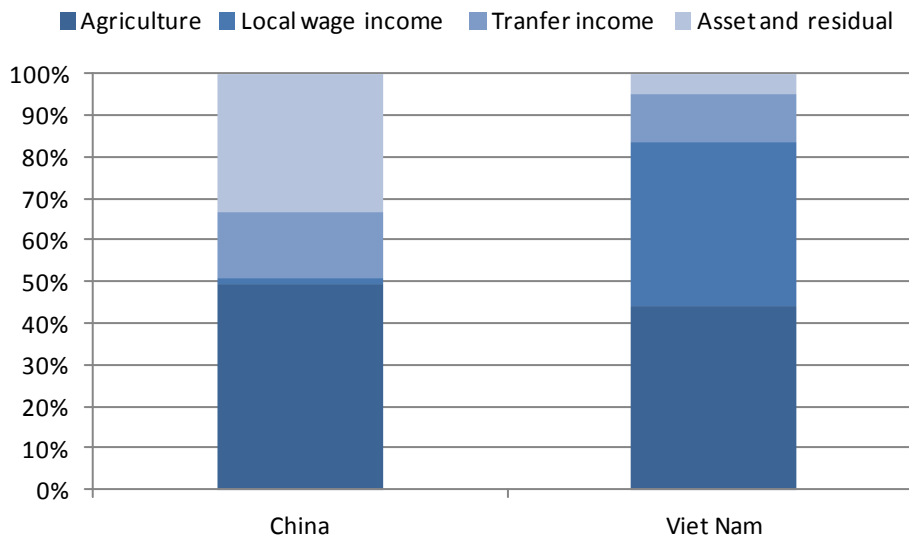


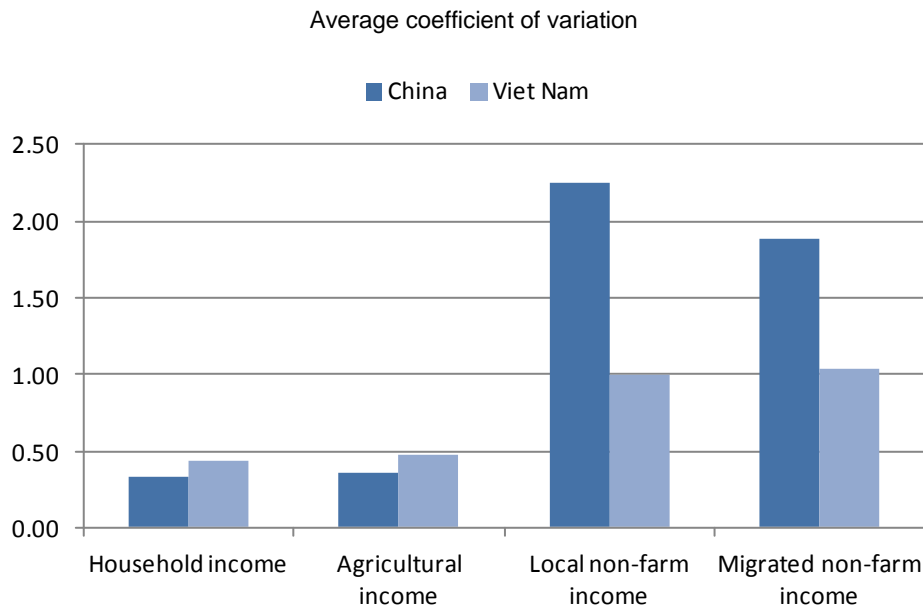
Figure 3.6 and Table 3.3 compare average coefficients of variation of the farm household income components and the coefficients of correlations between these components, respectively, in China and Viet Nam. The variability is calculated as a deviation from regional trends to remove the effect of structural income growth in both countries. The coefficients of variation of the overall household income are lower than those of each household income components, indicating that income diversification to non-farm sector reduces the overall variability of household income. In particular, agricultural income and other income components have weak or slightly negative coefficients of correlations, showing the importance of income diversification between agricultural and non-agricultural sources in reducing household income risk. Strong negative correlation between residual income and other income sources implies that the remittances from family members who live permanently in cities are complementing income losses.

On the other hand, comparison of coefficients of variation shows that variability of non-farm income is higher than that of agricultural income in China and Viet Nam. This may reflect the household's decision to work off-farm temporarily depending on the availability of labour, rather than face unexpected income risk or an exogenous shock. But it may also reflect the heterogeneous opportunity of non-farm income in a growing non-farm sector particularly in the case of Viet Nam where the variability of non-farm income partly captures the cross-section variability related to human capital and other factors.<sup>7</sup> The risk of non-farm income in the two countries can be based on whether the

7. The variability of non-farm income is computed across farm households which have non-farm income for consecutive periods. The cross-section variability of non-farm income between those who obtain non-farm income and those who do not is not a part of the measured variability.

households can increase income through job opportunities in the fast growing non-farm sector. The non-farm sector provides higher income opportunity, but its returns can vary considerably depending on the households and may be subject to other uncertainties. The local wage employment opportunities are often seasonal or contractual employment in construction of roads and other infrastructure, factories, and commercial farms. Long-term migration is also common, but it also exposes households to new risks such as unsanitary and dangerous working conditions, and social exclusion and discrimination linked to their origin and lack of residential status (FAO, 2004).

**Figure 3.6. Variability of household income and its components**



**Table 3.3. Correlation of income components in China and Viet Nam**

	China	Viet Nam
<b>Agriculture income and...</b>		
Local wage income	0.12	-0.15
Migrated non-farm income	0.06	-0.05
Residual income	-0.12	0.05
<b>Local wage income and...</b>		
Migrated non-farm income	0.40	0.15
Residual income	-0.68	-0.03
<b>Migrated non-farm income and...</b>		
Residual income	-0.57	-0.11

The assessment of farm household income risk in China and Viet Nam shows that the household's transition to non-farm sectors could bring higher income opportunities, but it may also expose households to more risk. While agricultural income provides low return but relatively stable income source, non-farm sectors offer high income opportunities but the return can be uncertain and uneven across households. Some farm households may be reluctant to make this transition and decide to remain in subsistence farming to maintain their livelihood. Where risk is an important consideration in a farm household's decision

on sector transition, insurance or safety-net mechanisms could assist these households to make that transition. Moreover, the transition to non-farm sectors mostly likely requires farmers to invest in human capital. The conceptual discussion on the credit and insurance constraints to investment developed in Section 2.4 is applicable to the household transition to non-farm sector in China and Viet Nam. The following section finds more empirical evidence in two regions of Viet Nam on the constraints to investments by farm households that would otherwise allow them to escape from poverty.

### ***3.4. Risk management strategies in the Red River and Mekong regions of Viet Nam***

#### *Descriptive statistics of household characteristics and poverty incidence*

In developed countries, it is rare that production and income risk affect the food consumption decision of farm households. However, in developing and emerging countries, production and income risks may lead to temporary or permanent situations of poverty or food insecurity. The risk and availability of risk management instruments (e.g. credit, safety-net) play a role in household investment decisions and the opportunities to escape poverty. This section assesses the household exposure to poverty risk, and characterises poverty risk scenarios in the case of two representative regions in Viet Nam.

Viet Nam is composed of eight geographical regions with diverse income levels and industrial compositions (Table 3.4). The Red River and Mekong regions are two representative regions of rapid economic development with contrasting growth paths. These regions are situated in the delta of two major river systems and are among the most successful regions in reducing poverty incidence (Cervantes-Godoy and Dewbre, 2010). They have achieved the highest level of household income as well as the lowest poverty incidence, following the South East region which hosts the rapidly industrialising Ho Chi Minh City. They are also the two major rice producing regions, accounting for more than 70% of rice production in Viet Nam, with the Mekong region being the major exporter of rice. Around 90% of households are still farm households in both regions. They have contrasting economic growth paths; while growth in the Red River region is mainly led by industrialisation around the capital city of Hanoi, the Mekong region depends on export-oriented commercial rice farming. Indeed, the largest average farm size among the eight regions in Viet Nam is found here. Due to the rapid transition of the economy, the data set in these two regions is particularly rich in the variety of households engaging in different economic activities as well as in the types of poverty incidences. Thus, the analytical focus on the Red River and Mekong regions is useful in analysing risk implications to transitory poverty and household risk management strategies in the course of economic development.

**Table 3.4. Characteristics of eight geographical regions in Viet Nam**

Average of 2004, 2006 and 2008

	Red River	Mekong	North East	North West	North Central Coast	South Central Coast	Central Highlands	South East
<b>Household income (1000 VND per adult)</b>	14 087	16 153	11 605	7 758	11 699	12 425	12 072	18 697
<b>% share of farm households</b>	88.4	91.3	94.5	97.8	86.7	87.7	98.0	62.9
<b>Average farm size (hectare)</b>	0.68	2.04	0.95	1.79	0.86	0.84	1.71	1.05
<b>% share of agricultural income in household income</b>	37.8	41.3	55.3	64.1	39.1	37.4	62.8	28.0
<b>Poverty incidence (%)</b>	11.6	4.1	14.3	39.3	20.1	19.7	19.4	4.3

Table 3.5 presents the characteristics of farm households in these two regions. Households fall into one of four categories based on their main economic activity and farm type.<sup>8</sup> In Mekong, almost all farm households are categorised as commercial farm households. Rice production strongly dominates agricultural production in both regions. The farm size of the Red River region is significantly smaller than in the Mekong, reflecting that the population density is double in the Red River region. Farm households in the Mekong region operate on areas of land that are four times larger than for the same type of households in Red River. All types of Red River farm households consume the majority of rice they produce.

The level of household income is significantly higher and the poverty incidence is lower in the Mekong region. This region also recorded higher income growth between 2004 and 2008. Real income grew by more than 20% annually for the mainly commercial farming households in the Mekong region, due partly to the high price of rice in 2008. The Mekong region produces more than half of Viet Nam's agricultural production and there are at present several export-oriented large commercial farmers who have grown out of chronic poverty. The income opportunity in the Mekong region is predominantly in commercial rice production. On the other hand, the lowest income level and the highest poverty incidence were observed households which primarily farmed in the Red River region where in contrast to the Mekong region, the scope for farm size expansion is limited and income opportunity lies outside agriculture. Although non-farming households are dependent on agriculture for a quarter of their income, they tend to keep a small piece of land for their own consumption. It is most likely that these households consider that to leave rice farming would be a risky decision because the small-scale

8. Farm households are categorised as farming if the majority of income comes from farming. The definition of commercial farm households varies across countries. It is typically defined as a farm household which has more than certain value of annual market sales. In this section, commercial households are defined as those which market more than a quarter of annual rice production. See Annex A for the criteria of household groupings adopted in this section.

staple production would insure against high income risk in non-agricultural sectors. They prefer to keep a small piece of land as a safety net.

**Table 3.5. Characteristics of farm household in Red river and Mekong regions**

Average of 2004, 2006 and 2008

Main economic activity	Red river				Mekong	
	Farming		Non-farming		Farming	Non-farming
<b>Rice marketing position</b>	Commercial	Non-commercial	Commercial	Non-commercial	Commercial	
<b>Agricultural Production</b>						
Operated area of land (ha)	1.0	0.8	0.7	0.5	4.5	2.1
% share of rice in land use	87.6	74.0	91.8	86.8	95.6	98.8
% share of rice self consumed	57.2	91.5	58.8	92.8	30.1	20.7
% change in real producer price of rice between 2004 and 08	23.0	18.5	19.3	25.9	30.8	20.1
<b>Farm household income</b>						
Household income (1000VND/adult)	10 533	11 120	16 687	13 183	19 889	19 201
% share of agriculture income	67.3	65.6	23.9	26.0	73.3	33.6
% share of local wage income	21.1	25.6	64.8	52.4	13.8	52.3
% share of transfer income	7.9	7.6	10.1	11.6	5.8	6.8
Annual growth rate of real income between 2004 and 08	8.6	6.7	5.1	2.5	21.5	16.8
<b>Poverty incidence</b>						
% poverty incidence	17.5	24.1	7.4	9.3	5.8	4.2
<b>Number of observation</b>	76	58	54	135	79	32

1. USD = 15.8 VND thousand in 2004.

2. Poverty incidence is measured using expenditure based poverty line set by the government of Viet Nam.

### *Dynamics of poverty incidence*

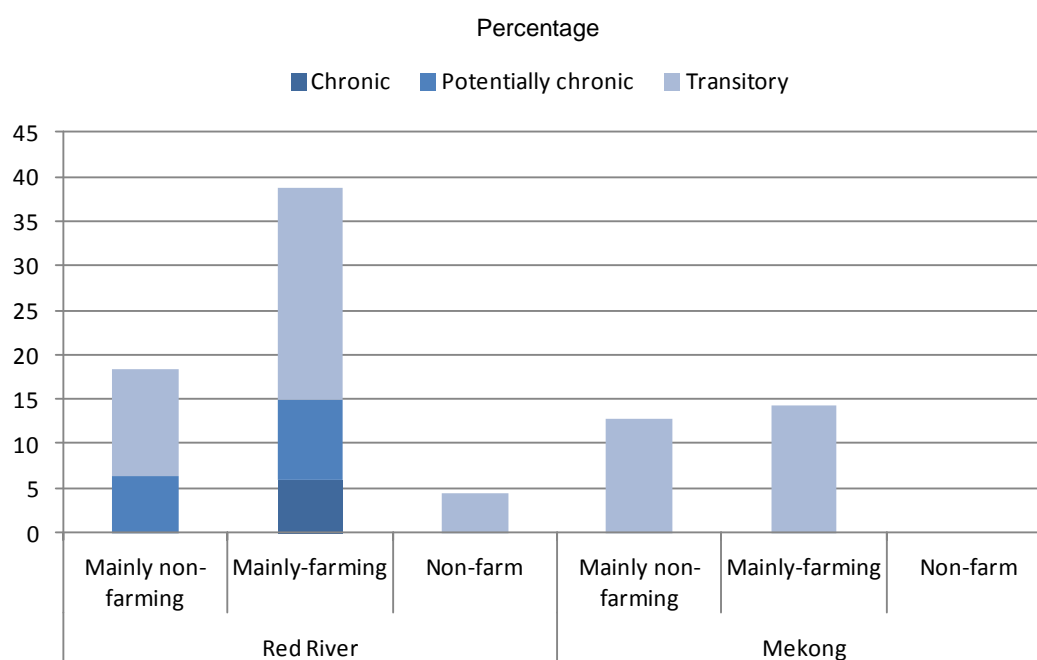
The most commonly used approach to measure welfare and poverty is to look at a snapshot of wellbeing at a single moment in time. Measures are typically based on a value of household consumption, with poverty lines set at a minimum acceptable consumption level (Foster, Greer and Thorbecke, 1984). Consumption rather than income is typically used because although the two are on average equal, consumption is more stable due to consumption-smoothing and can be measured with less error. Alternative multidimensional approaches to measuring poverty based on the notion of “capabilities” have also been proposed (Alkire and Foster, 2011). All these measures are still fundamentally static conceptions of welfare.

However, a three-year panel data in Viet Nam allows to track a household’s incidence of poverty across years. The dynamic incidence of poverty can be categorised as chronic and transitory poverty. It can be defined that a household in chronic poverty has a mean expenditure (or income) below the poverty line and remains in poverty for at least five consecutive years. Households in transitory poverty have higher mean expenditure (or income) above the poverty line, but fall into poverty for less than five consecutive years. Following a formal definition of poverty incidence, this study classifies households as being in chronic poverty if poverty incidence is observed for the three available years (2004, 2006 and 2008), assuming the households remained below the poverty line

between 2004 and 2008. The households which experienced poverty for two consecutive observations (2004 and 2006 or 2006 and 2008) are potentially experiencing chronic poverty, which lasts for five and more consecutive years. The households are considered to be in transitory poverty if poverty incidence was observed in one year only or two non-consecutive years (2004 and 2008).<sup>9</sup>

Figure 3.7 describes the dynamics of poverty incidence by household type and by economic activity. The data shows that the poverty experienced by the majority of households was transitory in these two regions of Viet Nam. The incidence of chronic poverty is found only in Red River farm households which depended mainly on farming. Thirty-eight per cent of this type of farm household in Red River experienced poverty at least once in three years. The incidence of chronic poverty only in households engaging mainly in agriculture may reflect that they remained in subsistence agriculture and could not obtain non-farm income to get out of poverty. These households may have faced constraints to make an investment needed to transit into non-farm activities. Once an investment is made these households can become mainly non-farming and therefore have less chance to be in chronic poverty. Insurance solutions can help farm households to avoid falling into worse poverty traps.

**Figure 3.7. Dynamics of poverty incidence in 2004, 2006 and 2008**



In the two sample regions, the main risk of farmers remaining in poverty is related with this transition. There is a need for investment to enter into activities in the non-farm sector or, where geographical conditions are favourable, in commercial agricultural production. Two types of constraints to investment can be considered: credit and insurance. The subsistence farm households may face a credit constraint to make an investment to transit to the non-farm sector. A potential form of credit is training offered

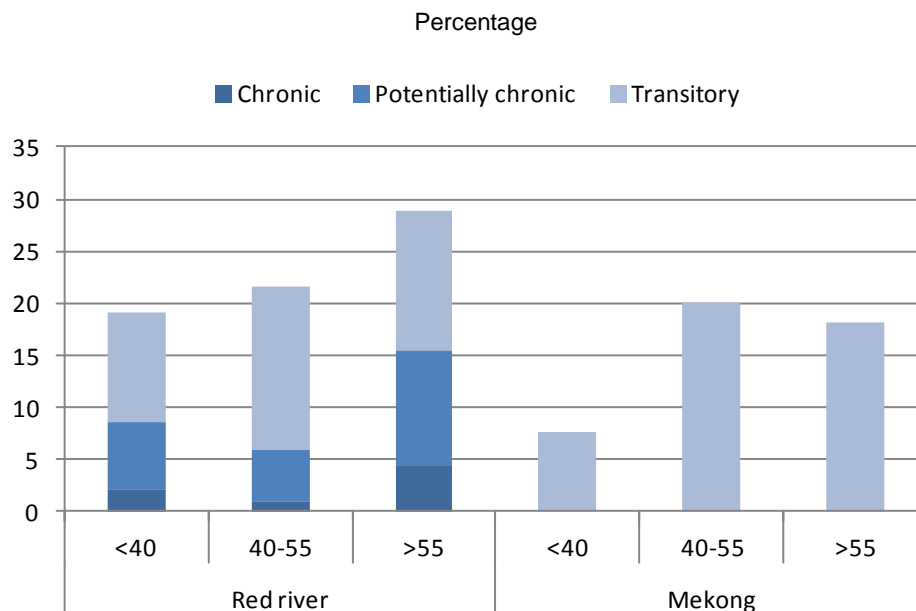
9. Three years of data imposes a limitation to apply a formal definition of chronic poverty which lasts five consecutive years. Potential bias should be taken into account in interpreting the results.



by non-farm enterprises as non-farm manufacturing enterprises generally need to train new employees to develop necessary skills. This type of credit usually favours young workers from whom it can be expected to receive higher and stable returns from the training invested in. The dynamics of poverty incidence determined by the age of the household head show that the older the person, the greater the frequency of chronic poverty, and thus the more likely they are to face credit constraints (Figure 3.8).

Another potential constraint to investment is insuring against poverty risk. The descriptive data shows that farm households tend to keep a small piece of land for self-consumption even when they obtain most of their income from non-farm activities (Table 3.5). This implies that they count on the land as a safety net against income risk in the non-farm sector. Subsistence staple production could insure households from food security risk. The households with elder head may also face this insurance constraint because they have less chance to count on other family members in the households to maintain food production.

**Figure 3.8. Dynamics of poverty by household head age group**



### *Transitory poverty risk scenarios and household risk management strategies*

The descriptive analysis of poverty incidence shows that the majority of poverty incidence is transitory in the Red River and Mekong regions. The households in transitory poverty are, on average, above poverty thresholds but are exposed to the risk of falling back into poverty should there be an adverse income shock. A key concept from the standpoint of smallholders is that of vulnerability. Smallholders, and indeed other households, may be vulnerable to food insecurity in the sense that an adverse shock can lead them to fall below a given threshold for food security. This impact can be measured in a variety of ways, such as the probability of a household's income or consumption falling below a threshold level, the probability of the share of food expenditures in total expenditures exceeding a given ratio, or according to the household's ownership of assets. Bringing these concepts together, risk affects mainly the stability dimension of food security, with exogenous shocks leaving smallholders vulnerable to food insecurity.

In order to consider the relationship between risk and welfare, dynamic measures are needed which project into the future how likely the non-poor will become poor. Various approaches have been developed to measure “vulnerability” or the probability that someone might become poor at some point in the future (Thorbecke, 2004). Most of these measures are based on the simple consumption-based measure of poverty rather than a more complex multidimensional measure. Pritchett et al. (2000) define vulnerability as the risk that a household experiences poverty within a certain defined future time period. They use panel data from Indonesia to demonstrate how this approach can be operationalised, finding that if the headline poverty rate is 20%, an additional 10-30% of the population can be classified as vulnerable and at risk of experiencing poverty by this definition. McCullough and Calandrino (2003) conduct a similar exercise using panel data on rural China, calculating estimates of the overall mean level of consumption, as well as the standard deviation of household consumption over time in order to understand variability and therefore vulnerability. They find that households remain vulnerable to poverty even when their average consumptions level is well above the static poverty line. Ligon and Schechter (2002) define vulnerability in terms of expected utility rather than poverty, but otherwise take a fundamentally similar approach.

Measures of vulnerability capture those who are above the poverty line but are at risk of falling below it. An analytical distinction can be made within the group of those beneath a poverty line between those who are chronically poor and unlikely to escape poverty and the transient/transitory poor – those who fall below the poverty line but whose income fluctuates above and below the line depending on the shock. Ravallion (1988) applies this definition to data on rural India and finds that around half of all poverty is transient or consists of people who can expect to leave poverty in the next period, leaving the other half in chronic poverty. Similarly, Jalan and Ravallion (1996) find around half of the poverty gap in a sample of rural China to be transient.

Following the concept of vulnerability to poverty developed in the literature, this section assesses the vulnerability to poverty in Viet Nam and analyses the household poverty risk management strategies. Three representative households are calibrated in each region, which have an average income in a household group for each period. All representative households have higher than threshold poverty income.<sup>10</sup> Vulnerability is measured as the probability of representative households falling into poverty in the following two periods (2004-06 and 2006-08 periods).<sup>11</sup>

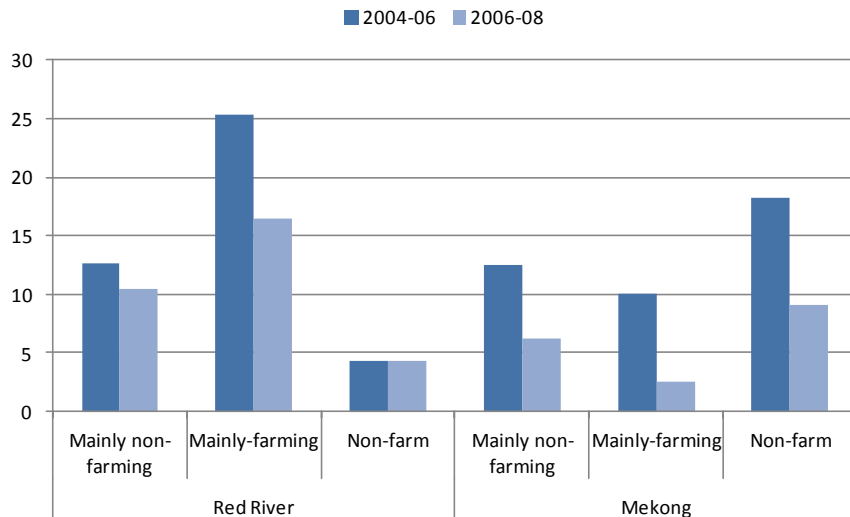
Figure 3.9 shows the average vulnerability for two periods by household type. The households in the Red River region whose main economic activity was farming are exposed to the highest vulnerability rate of 25% and 17% in 2004-06 and 2006-08, respectively. The vulnerability to poverty depended on two factors: level and variability of income. The mainly farming households in the Red River region were the most vulnerable due to their lower level of income as well as their higher variability of income. The households with a relatively high level of income were vulnerable if the variability of income was higher. This was the case for non-farm households in the Mekong region, where non-farm income presented higher variability. The vulnerability decreased considerably over the two periods for most types of households. Higher income growth in

10. Instead of applying official expenditure measured poverty line, the analysis here employs a relative poverty line which is set at the lowest 25 percentile income of the year in all samples in Viet Nam to assess income risks that lead to transitory poverty.

11. See Annex A for the measurement of vulnerability to poverty.

these two regions and lower variability of income both contributed to a lower level of vulnerability to poverty. In particular, the largest reduction of poverty vulnerability was observed in commercially-oriented farm households in Mekong, suggesting that households engaging mainly in farming benefited from higher rice prices in 2008 (Figure 3.10).

**Figure 3.9. Poverty vulnerability of representative household by household type**  
Probability of average households falling into poverty (%)



**Figure 3.10. Level and variability of income by household type**

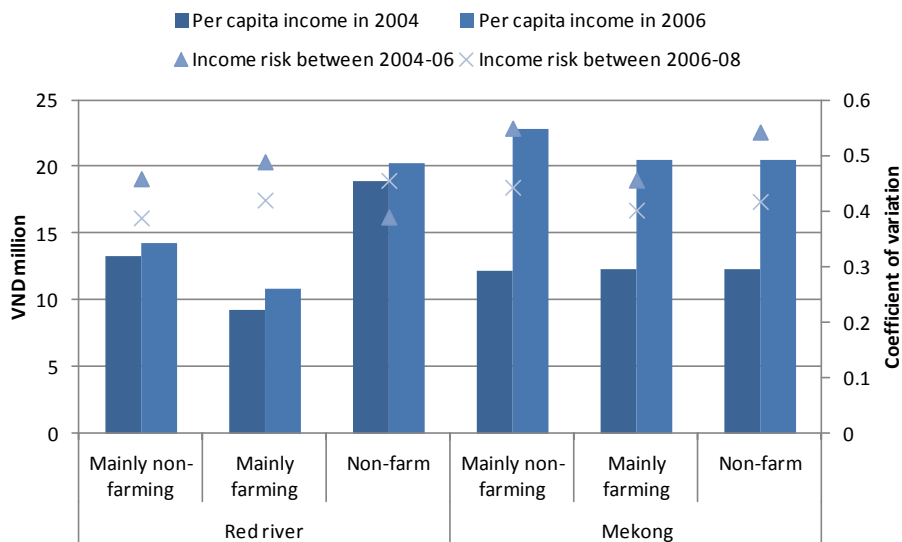
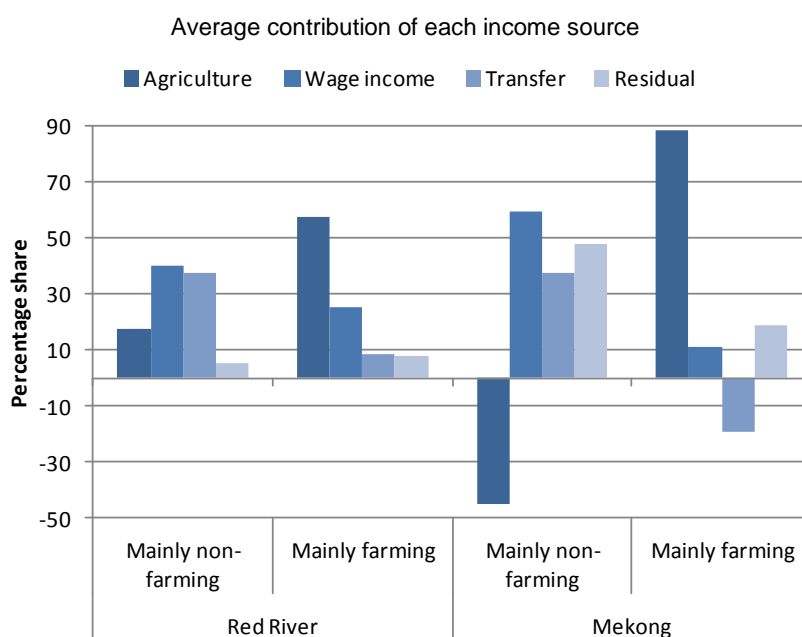


Figure 3.11 decomposes income losses that lead to transitory poverty. The analysis first identifies the incidences of income losses which cause representative households to fall into poverty. The income losses are then decomposed into four income sources: agriculture, wage income, transfer and residual. Figure 2.11 presents average contribution of each income sources to the income losses leading to transitory poverty. The sum of the

contributions of each income sources is 100 by each farm type. For households whose main economic activity is farming, the majority of risks come from negative income shocks in agriculture. This is particularly true for the commercially-oriented agricultural farms of the Mekong region, where agriculture accounts for nearly 90% of income losses leading to poverty. As expected, however, agricultural income is a marginal source of poverty shock for farm households that engage mainly in non-farming activities. In fact, agricultural income gains partly offset income losses from other sources for mainly non-farming households in this region.

The agricultural sector is more likely to provide investment opportunities to help farm households to get out of poverty in regions like the Mekong that have established export-oriented commercial rice farming due to favourable geographical conditions and larger per capita land endowment. In the Red River region, non-farm jobs seem to be the main type of investment opportunity to move away from poverty as it is a region where the non-farm sector is growing rapidly and the scope of farm size expansion is limited due to small per capita land endowment.

**Figure 3.11. Composition of income losses leading to transitory poverty**



The characteristics of risks associated with income losses leading to a situation of transitory poverty could infer the potential scenarios of transitory poverty. The transitory poverty can be analysed through the corresponding external shocks and household simultaneous decisions in agricultural production and food consumption, thus helping to reveal household risk management strategies. Figure 3.12 summarises price and yields shocks and household's response in rice marketing when experiencing transitory poverty, presenting the average percentage changes in rice yield, rice producer price and share of rice marketed. For Red River farms, the income shocks that lead to transitory poverty are, on average, inversely correlated with rice yields except for mainly non-farming households in the Mekong region where agricultural income gain mitigates losses by other income sources. Households in transitory poverty experience positive shocks in the producer price of rice, but the negative shock in rice yields exceeds the price shock for

mainly farming households in both regions. Losses in farm income for mainly farming households are most likely to be explained by rice yield risk.

The incidences of income losses, however, leading to transitory poverty are associated with lower share of rice marketed, except for mainly farming households in the Mekong region, meaning that households are increasing the share of rice that they consume when experiencing transitory poverty. This is most likely reflecting the household's risk management strategy when they face large income losses. In Viet Nam, the households whose main income source is from non-farming activities tend to keep a small piece of land mainly to produce rice for self-consumption. Maintaining a staple production can play a role of safety net or risk management strategy when vulnerable to poverty. It also suggests that smallholder agriculture may have a role in facilitating development of the non-farming sector in the economic development process by providing a safety-net for those who enter in higher returns but riskier non-farm activities.

**Figure 3.12. Transitory poverty shocks: The production side**

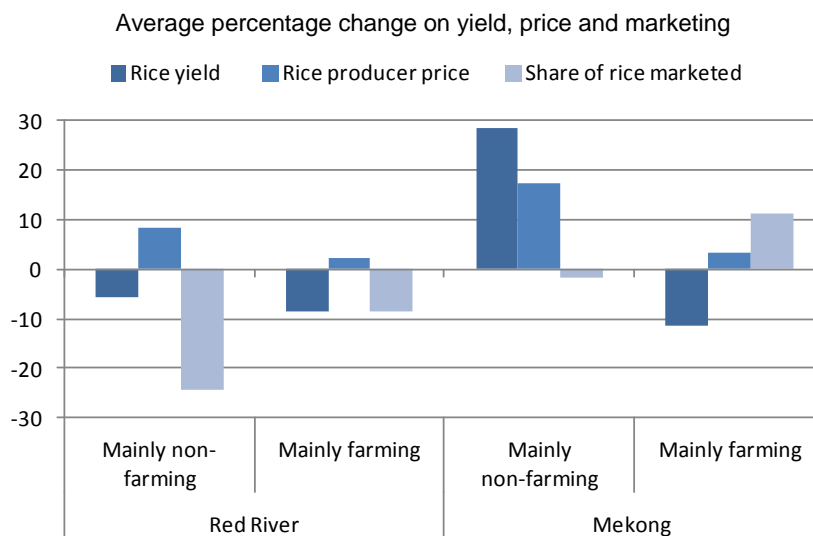
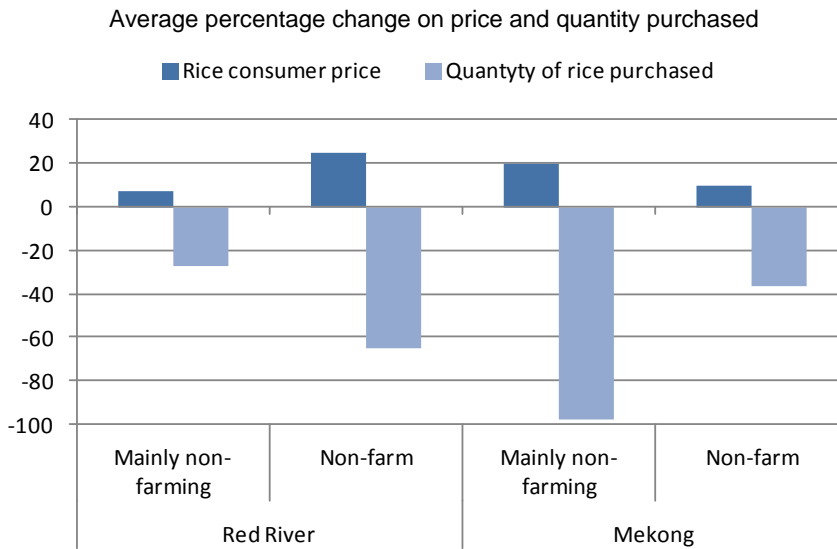


Figure 3.13 presents rice price risks and consumption decisions associated with income risks leading to transitory poverty.<sup>12</sup> The situations of transitory poverty correspond to positive shocks in rice consumer prices for all types of households, implying the potential effect of high rice price on the prevalence of transitory poverty. The increase in the consumer price of rice is most likely because households had no choice other than purchasing rice from markets at high price. Similarly, transitory poverty risks are negatively associated with the quantity of rice purchased. For mainly non-farming households, this can be explained partly by an increasing share grown rice being reserved for self consumption. Non-farm households may be reducing their consumption of rice due to high rice prices and negative income shocks. Higher rice prices reduced the vulnerability to poverty for most farm households, but some farm households suffered from the higher consumer prices of rice (i.e. those that were net buyers of food). Transitory poverty scenarios often imply higher consumer prices of rice for non-farm households or farm households that are net buyers of rice.

12. Mainly farming households are excluded from the analysis because almost all of them are net producer of rice.

**Figure 3.13. Transitory poverty shocks: The consumption side**

#### 4. Conclusions and policy implications

This paper has addressed different aspects of risk and risk management for smallholders in developing countries. It has described the type of risks they face, their implications and how risk management strategies may differ from those used by farmers in developed countries. It identifies and analyses the links between risk management and household investment. It also includes a quantitative assessment of risk exposure at the most disaggregated level possible for three emerging economies (Brazil, China and Viet Nam). This assessment addressed three aspects of risks for the farm households: agricultural production, household income and poverty. While methodology of risk assessment applied to the three countries is different and prevents straightforward comparisons, they partly overcame the limitation of the availability of household level data and revealed the characteristics of risks faced by farm households. A full risk characterisation would require substantial field work that is beyond the scope of this work.

Most sources of agricultural risks affecting farmers in both developed and developing countries do not differ as they come basically from shocks in production (e.g. weather, pests, etc.), in prices (i.e. markets), and institutional and political settings, none of which are exclusive to any particular country. For instance, empirical data in the three emerging economies analysed showed no significant difference in the characteristics of agricultural production risks for the crops studied (corn, rice oilseed, and wheat) coming from production (e.g. weather, pests, etc.) or prices (markets). Furthermore, the risk assessment of farm household income risk in China and Viet Nam indicates that income diversification plays an important role in managing household income risk, a phenomenon commonly observed in OECD countries.

The poverty assessment of the Red River and Mekong regions of Viet Nam showed that poverty shocks in farm households are driven more by yield shocks (decrease) than by price shocks (decrease), while poverty shocks in non-farm households are driven more by price shocks (increase) and subsequently low purchases of rice. In other words, for those farm households falling into transitory poverty (falling into poverty for less than five consecutive years) rice yield is a dominant source of agricultural risk, not low prices.

On the other hand, a high rice price was observed to be an important source of risk for households that are net consumers of rice. These results could have important implications on policy design as different type households have different needs.

Institutional and political settings in developing countries are frequently less developed and thus contribute to a greater incidence of market imperfections in key areas such as credit and insurance. This lowers farmers' access to risk management tools and strategies, and, in turn, results in widespread reliance on informal mechanisms and community strategies such as crop sharing, common property resource management, among others. Informal strategies seem to be crucial for smallholders to manage and cope with risk. In this sense, this paper tried to extend the OECD holistic approach by considering a new layer of risk management strategies where informal/community strategies were taken into account. However, a comprehensive analysis of these informal mechanisms is beyond the scope of this paper.

Effects of risk and responses to risk are fundamentally different in developing countries. Smallholders are often forced to rely on strategies that perpetuate poverty. For example, households cope with shocks by depleting valuable assets which in turn causes them to fall into a poverty trap created by the resulting low level of assets. Risks prompt households to choose low-risk/low-return economic activities. The risk assessment of China and Viet Nam suggests that there can be risks associated with non-farm opportunities. When risk is an important consideration in a farm household's decision on sector transition, insurance or safety-net mechanisms could assist these households to make that transition. The analysis of the two regions in Viet Nam identified that those households that were able to successfully transit to the non-farm sector continued to maintain small plots of land for self-consumption, suggesting that agriculture remains a kind of safety net. Agriculture could thus play a role in facilitating the successful transition of farmers to non-farm sectors, particularly when land is used as a safety net strategy. This assessment also shows that those households which experienced transitory poverty increased the share of rice reserved for self-consumption.

Income diversification in agriculture and outside of agriculture could contribute to reduce risk. Hence, investment in either agriculture or non-agriculture sectors can play an important role for smallholders to get out of poverty. Obstacles to investment are highly related to access to financial services, in particular credit and insurance. In this regard, two types of constraints faced by smallholders have been identified: 1) a credit supply constraint which limits the individuals' access to credit; and 2) an insurance constraint which makes risk averse individuals decide not to invest (to avoid the risk of falling into an even worse poverty trap) in the absence of insurance or a safety net. For instance, the analysis of the two regions of Viet Nam identified that poverty is mainly transitory in nature and that farm households where the head of the household is aged have higher incidence of poverty. This can be explained partly by their limited access to credit and the lack of safety-net solutions.

## References

- Alderman, H., C.H. Paxson and DEC (1992), “Do the poor insure? A synthesis of the literature on risk and consumption in developing countries”, *Policy Research Working Paper Series* 1008, The World Bank.
- Alkire, S. and J. Foster (2011), “Counting and multidimensional poverty measurement”, *Journal of Public Economics*, Volume 95, Issues 7–8, August 2011, pp. 476-487, ISSN 0047-2727.
- Almond, D. and J. Currie (2011), “Killing me softly: The fetal origins hypothesis”, *Journal of Economic Perspectives*, Volume 25, No. 3, pp. 153-172.
- Ashraf, N., X. Giné and D. Karlan (2009), “Finding missing markets (and a disturbing epilogue): Evidence from an export crop adoption and marketing intervention in Kenya”, *American Journal of Agricultural Economics*, Agricultural and Applied Economics Association, vol. 91(4), pp. 973-990.
- Banerjee, A.V. (2005), “The two poverties”, Chapter 3 in Dercon (2005).
- Banerjee, A. and E. Duflo (2011), “Poor economics: A radical rethinking of the way to fight global poverty”, Public Affairs, New York.
- Banerjee, A. et al. (2010), “The miracle of microfinance? Evidence from a randomized evaluation”, *Bread Working Paper* No. 278.
- Barrientos, A. (2007), “Does vulnerability create poverty traps?”, *CPRC Working Paper* 76, Chronic Institute of Development Studies (IDS) at the University of Sussex.
- Beegle, K., R. Dehejia and R. Gatti (2009), “Why should we care about child labor?: The education, labor market, and health consequences of child labor”, *Journal of Human Resources*, University of Wisconsin Press, vol. 44(4).
- Besley, T., S. Coate and G. Loury (1993), “The economics of rotating savings and credit associations”, *American Economic Review*, American Economic Association, vol. 83(4), pp. 792-810, September.
- Brune, L. et al. (2011), “Commitments to save: A field experiment in rural Malawi”, *World Bank Policy Research Working Paper*, No. 5748, The World Bank, Washington, DC.
- Carter, M. et al. (2005), “The long-term impacts of short-term shocks: Poverty traps and environmental disasters in Ethiopia and Honduras”, *BASIS CRSP Collaborative Research Support Programme*, No. 28.
- Cervantes-Godoy, D. and J. Dewbre (2010), “Economic importance of agriculture for sustainable development and poverty reduction: The case study of Vietnam”, Global Forum on Agriculture, OECD, Headquarters, Paris, France.
- CGAP (2010), *Financial Access 2010: The State of Financial Inclusion through the Crisis*, The World Bank, Washington, DC.
- Chaia, A. et al. (2010), “Half the world is unbanked”, Financial Access Initiative Framing Note.
- Chaudhuri, S., J. Jalan and A. Suryahadi (2002), “Assessing household vulnerability to poverty from cross-sectional data: A methodology and estimates from Indonesia”, *Discussion Papers* 0102-52, Columbia University, Department of Economics.



- Chen, S. and M. Ravallion (2008), “The developing world is poorer than we thought, but no less successful in the fight against poverty”, *World Bank Policy Research Working Paper Series*, August 1, 2008.
- Chiappori, P., K. Samphantharak, S. Schulhofer-Wohl and R. Townsend (2012), “Heterogeneity and Risk Sharing in Village Economies”, *Working Paper* 683.
- Coble, K., R. Dismukes and S. Thomas (2007), “Policy implications of crop yield and revenue variability at different levels of disaggregation”, selected paper in the American Agricultural Economics Association Annual Meeting, Portland, Oregon, July-August 2007.
- De Janvry, A. et al. (2006), “Can conditional cash transfer programs serve as safety nets in keeping children at school and from working when exposed to shocks?”, *Journal of Development Economics*, Elsevier, vol. 79(2), pp. 349-373, April.
- Deaton, A. (1991), “Saving and liquidity constraints”, *Econometrica*, 59(5): 1221-1248.
- Demirguc-Kunt, A. and L. Klapper (2012), “Measuring financial inclusion: The global index database”, *World Bank Policy Research Working Paper* 6025.
- Dercon, S. (2005), “Vulnerability: A micro perspective”, *QEH Working Papers* 149, Queen Elizabeth House, University of Oxford.
- Dercon, S. (ed.) (2005), *Insurance Against Poverty*, Oxford University Press.
- Dercon, S. and L. Christiaensen (2011), “Consumption risk, technology adoption and poverty traps: evidence from Ethiopia”, *Journal of Development Economics*, Elsevier, vol. 96(2), pp. 159-173, November.
- Dercon, S. and J. Hoddinott (2003), “Health shocks and poverty persistence”, in S. Dercon (ed.), *Insurance Against Poverty*, Oxford: Oxford University Press.
- Dercon, S. and P. Krishnan (2000), “In sickness and in health: Risk-sharing within households in Ethiopia”, *Journal of Political Economy*, Vol. 108, No. 4 (August), 688–727.
- DFID (2011), “Cash transfers: Evidence paper”, Policy Division.
- Fafchamps, M. (1999), “Rural poverty, risk and development”, *FAO Economic and Social Development Paper* No. 144, Food and Agricultural Organization, Rome.
- Fafchamps, M. and S. Lund (2003), “Risk sharing networks in rural Philippines”, *Journal of Development Economics*, Vol. 71(2), pp. 261-287.
- Fafchamps, M., C. Udry and K. Czukas (1998), “Drought and saving in West Africa: Are livestock a buffer stock?”, *Journal of Development Economics*, vol. 55(2), pp. 273-305.
- Fafchamps, M. and J. Pender (1997), “Precautionary saving, credit constraints, and irreversible investment: Theory and evidence from Semi-Arid India”, *J. Business and Economic Statistics*, 15(2): 180-194.
- Food and Agriculture Organization (2004), “Food insecurity and vulnerability in Viet Nam: Profiles of four vulnerable groups”, *ESA Working Paper*, No.04-11
- Foster, J., J. Greer and E. Thorbecke (1984), “A class of decomposable poverty measures”, *Econometrica*, 2 81: 761–766.
- Gertler and Gruber (2002), “Insuring consumption against illness”, *American Economic Review*, American Economic Association, vol. 92(1), pp. 51-70, March.
- Giles, J. (2006), “Is life more risky in the open? Household risk-coping and the opening of China's labor markets”, *Journal of Development Economics*, Elsevier, Vol. 81(1), pp. 25-60, October.
- Giles, J. and K. Yoo (2007), “Precautionary behavior, migrant networks, and household consumption decisions: An empirical analysis using household panel data from rural China”, *The Review of Economics and Statistics*, MIT Press, vol. 89(3), pp. 534-551, 05.

- Gine, X., R. Townsend and J. Vickery (2007), “Patterns of rainfall insurance participation in rural India”, *Policy Research Working Paper Series 4408*, The World Bank.
- Hulme, D. and A. Shepherd (2003), “Conceptualizing chronic poverty”, *World Development*, Vol. 31, No. 3, pp. 403–423, 2003.
- Harwood, J., R. Heifner, K. Coble, J. Perry and A. Somwaru (1999), “Managing Risk in Farming: Concepts Research and Analysis”, *Agricultural Economic Report No. 774*, Economic Research Service, USDA.
- Holzman and Jorgensen (2001), “Social Risk management: A New conceptual framework for social protection, and beyond,” *International Tax and public Finance*, N°8, 529-556.
- Islam, A. and P. Maitra (2012), “Health shocks and consumption smoothing in rural households: Does microcredit have a role to play?”, *Journal of Development Economics*.
- Jack, B.K. (2009), “Barriers to the adoption of agricultural technologies in developing countries”, Draft white paper for Agricultural Technology Adoption Initiative, Center of Evaluation for Global Action at University of California, Berkeley.
- Jacoby, H.G. and E. Skoufias (1997), “Risk, financial markets, and human capital in a developing country”, *Review of Economic Studies*, Wiley Blackwell, vol. 64(3), pp. 311-35, July.
- Jaffee S., P. Siegel and C. Andrews (2010), “Rapid agricultural supply chain risk assessment: A conceptual framework”, *Agriculture and Rural Development Discussion Paper 47*, The World Bank.
- Jalan, J., and M. Ravallion (1996), “Transient poverty in rural China”, *Policy Research Working Paper Series 1616*, The World Bank.
- Karlan, D. and J. Morduch (2010), “Access to finance”, Chapter 2 in D. Rodrik and M. Rosenzweig (eds.), *Handbook of Development Economics*, vol. 5, Amsterdam: North Holland.
- Karlan, D. et al. (2010), “Crop price indemnified loans for farmers: A pilot experiment in rural Ghana”, mimeo.
- Kimura, S. and C. Le Thi (2011), “Farm level analysis of risk and risk management strategies and policies: Technical note”, *OECD Food, Agriculture and Fisheries Working Papers*, No. 48, OECD Publishing, <http://dx.doi.org/10.1787/5kg6z83f0s34-en>.
- Kimura, S., J. Antón and C. Le Thi (2010), “Farm level analysis of risk and risk management strategies and policies: Cross country analysis”, *OECD Food, Agriculture and Fisheries Working Papers*, No. 26, OECD Publishing, <http://dx.doi.org/10.1787/5kmd6b5rl5kd-en>.
- Kochar, A. (1999), “Smoothing consumption by smoothing income: Hours of work responses to idiosyncratic agricultural shocks in rural India”, *Review of Economics and Statistics*, 81: 50-61.
- Kochar, A. (1995), “Explaining household vulnerability to idiosyncratic income shocks”, *American Economic Review*, American Economic Association, vol. 85(2), pp. 159-64, May.
- Ksoll, C., R. Macchiavello and A. Morjaria (2009), “Guns and roses: The impact of Kenyan post-election violence on flower-exporting firms”, *CSAE Working Paper 2009-06*, Centre for Study of African Economies, University of Oxford.
- Lanjouw, J.O. and P. Lanjouw (2001), “The rural non-farm sector: Issues and evidence from developing countries”, *Agricultural Economics*, Blackwell, vol. 26(1), pp. 1-23, October.
- Lanjouw, J.O. and P. Lanjouw (1995), “Rural nonfarm employment: A survey”, *Policy Research Working Paper Series 1463*, The World Bank.
- Lekprichakul, T. (2009), “Ex ante and ex post risk coping strategies: How do subsistence farmers in southern and eastern province of Zambia cope?”, Research Institute for Humanity and Nature, Kyoto, Japan.

- Ligon, E., and L. Schechter (2002), “Measuring vulnerability: The director’s cut”, *Discussion Paper* No. 2002/86.
- Maccini, S. and D. Yang (2009), “Under the weather: Health, schooling, and economic consequences of early-life rainfall”, *American Economic Review*, American Economic Association, Vol. 99(3), pp. 1006-26, June.
- Macours, K. (2012), “Volatility, risk and household poverty: Micro-evidence from randomized control trials”, Plenary paper for the International Association of Agricultural Economists (IAAE), Triennial Conference, Foz do Iguaçu, Brazil.
- Macours, K., P. Premand and R. Vakis (2012), “Transfers, diversification and household risk strategies experimental evidence with lessons for climate change adaptation”, *Policy Research Working Paper* 6053, Latin America and the Caribbean Region. Poverty, Gender and Equity Unit, The World Bank.
- McCulloch, N. and M. Calandrino (2003), “Vulnerability and chronic poverty in rural Sichuan”, *World Development*, Vol. 31, Issue 3, pp. 611-628.
- McKay and Lawson (2003), “Assessing the extent and nature of chronic poverty in low income countries: Issues and evidence”, *World Development*, Vol. 31, pp. 425-439.
- Morduch, J. (1999), “Between the state and the market: Can informal insurance patch the safety net?”, *World Bank Research Observer*, 14(2): 187-207.
- Narayanan, S. and A. Gulati (2002), “Globalization and the smallholders: A review of issues, approaches and implications”, *MSSD Discussion Paper* No. 50, Washington, DC, IFPRI & World Bank.
- OECD (2011), *Managing Risk in Agriculture: Policy Assessment and Design*, OECD Publishing, Paris.
- OECD (2009), *Managing Risk in Agriculture: A Holistic Approach*, OECD Publishing, Paris.
- OECD (2008), *Role of Agriculture and Farm Household Diversification in the Rural Economy: Evidence and Initial Policy Implications*, OECD Publishing, Paris.
- OECD (2001), *Income Risk Management in Agriculture*, OECD Publishing, Paris.
- Park, A. (2006), “Risk and household grain management in developing countries”, *Economic Journal*, Royal Economic Society, vol. 116(514), pp. 1088-1115, October.
- Porter, C. (2012), “Shocks, consumption and income diversification in rural Ethiopia”, *Journal of Development Studies*, 48:9, 1209-1222.
- Pritchett, L., A. Suryahadi and S. Sumarto (2000), “Quantifying vulnerability to poverty - A proposed measure, applied to Indonesia”, *Policy Research Working Paper Series* 2437, The World Bank.
- Proctor, F.J. and V. Lucchesi (2012), “Small-scale farming and youth in an era of rapid rural change”, IIED/HIVOS, London/The Hague.
- Ravallion, M. (1988), “Expected poverty under risk-induced welfare variability”, *The Economic Journal*, 98 (393), 1171-1182.
- Reardon, T., C. Delgado and P. Matlon (1992), “Determinants and effects of income diversification amongst farm households in Burkina Faso”, *Journal of Development Studies*, January 1992.
- Romer Løvendal, C. and M. Knowles (2005), “Tomorrow’s hunger: A framework for analysing vulnerability to food insecurity”, *ESA Working Paper* No. 05-07, October 2005, FAO, Rome.
- Rose, E. (2001), “Ex ante and ex post labor supply response to risk in a low income area”, *J. Dev. Econ.*, 64, 371388.

- Rosenzweig, M.R. and H.P. Binswanger (1993), “Wealth, weather risk and the composition and profitability of agricultural investments”, *Economic Journal, Royal Economic Society*, Vol. 103(416), pp. 56-78, January.
- Rosenzweig, M.R. and K.I. Wolpin (1993), “Credit market constraints, consumption smoothing and the accumulation of durable production assets in low-income countries: Investments in bullocks in India”, *J. Polit. Econ.*, 101(2): 223-244.
- Rothschild, M. and J. Stiglitz (1976), “Equilibrium in competitive insurance markets: An essay on the economics of imperfect information”, *Quarterly Journal of Economics*.
- Sadoulet, E. and A. de Janvry (1995), *Quantitative Development Policy Analysis*, The Johns Hopkins University Press, Baltimore and London.
- Shaban, R. (1987), “Testing between competing models of sharecropping”, *Journal of Political Economy*, 95(5):893-920.
- Singh, P. and Dercon (2012), “School meals as safety nets: An evaluation of the midday meals scheme in India”, *Young Lives Working Paper No. 75*, Young Lives, Oxford.
- Thorbecke, E. (2004), “Conceptual and measurement issues in poverty analysis”, *UNU-WIDER Discussion Paper No. 2004/04*.
- Townsend, R. (1994). “Risk and insurance in village India”, *Econometrica*, Vol. 62, No. 3 (May, 1994), 539-591.
- Udry, C. (1994), “Risk and insurance in a rural credit market: An empirical investigation in Northern Nigeria”, *Rev. Econ. Stud.*, 61(3): 495-526.
- Walker and Ryan (1990), “Village and household economies in India’s semi-arid tropics”, Johns Hopkins University Press, Baltimore.
- Webb, P. and T. Reardon (1992), “Drought impact and household response in East and West Africa”, *Quarterly Journal of International Agriculture*, 31 (3): 230-47.
- Wiedmaier-Pfister, M. and A. Chatterjee (2006), “An enabling regulatory environment for microinsurance”, Chapter 5.2 in Churchill (ed.), *Protecting the Poor: A Microinsurance Compendium*, ILO and Munich Re Foundation.
- Wood, G. (2003), “Staying secure, staying poor: The 'Faustian bargain'”, *World Development*, 31, 3: 455-71.
- World Bank (2001), *World Development Report: Attacking Poverty*, The World Bank, Washington, DC.
- Yang (2008), “Risk, migration, and rural financial markets: Evidence from earthquakes in El Salvador”, *Social Research*, Vol. 75, No. 3, Fall 2008.
- Yang and Choi (2007), “Are remittances insurance? Evidence from rainfall shocks in the Philippines”, *World Bank Economic Review*, Oxford University Press, vol. 21(2), pp. 219-248, May.

## Annex A.

### Technical Background of Risk Assessment Methodology Applied in Viet Nam

#### 1. Risk assessment using short panel data

The available household survey data for Viet Nam is three years of panel data. The method applied in previous OECD reports on risk management requires at least five years of longitudinal data (Kimura and Le Thi 2011). Representative panel data (data following the same households over time) is relatively rare in developing countries.

To overcome this shortcoming of the database, this study adapted an alternative methodology of risk assessment using cross-section data developed by Lanjouw et al. (2011), Pritchett et al. (2000), Chaudhuri et al. (2002), and McKay and Lawson (2003). Instead of measuring a risk exposure by an individual farm household, this methodology estimates the risk faced by a homogenous group of farm households. The shocks experienced by individual farm households in two periods (2004-06 and 2006-08) are normalised and pooled within the group, assuming that households in a homogenous group are exposed to same random shock. This annex describes the methodology of risk assessment applied in Viet Nam.

#### *Grouping homogenous group of households*

The farm households are grouped to a homogenous group that are most likely to be exposed to same random risks. Several grouping criteria are applied such as household's regional location, main economic activity, age of household head and farm type. Table A.1 presents the criteria applied to group homogenous households in Viet Nam.

**Table A.1. Criteria of household grouping in Viet Nam**

	Regional location	Main economic activity	Farm type	Age of household head
<b>Number of groups</b>	<b>7</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>Criteria</b>	<b>Eight regions</b> (Red river, Mekong, North East, North West, North Central Coast, South Central Coast, South High land and South East)	<b>Mainly farming</b> (more than 50% of household income from farming). <b>Mainly non-farming</b> (less than 50% of household income from farming) and <b>Non-farm</b> (No agricultural production)	<b>Commercial rice farms</b> (more than 25% of rice marketed), <b>Non-commercial rice farms</b> (less than 25% of rice marketed) and <b>Non rice farms</b> (no rice production)	Less than 40 years old, Between 40 and 55 years old, and More than 55 years old.

### Normalisation of risks

The shocks experienced by individual households are measured in terms of rate of change relative to the average of two years so that the choice of base year and the difference in the levels do not affect the measurement of shocks<sup>13</sup>. For example, given that the available panel data of income is only for three years ( $t$ ,  $t+1$  and  $t+2$ ), the rate of change in income for household  $i$  in a group  $j$ ,  $\Delta_{i,j}$ , is evaluated at mean of income across two years.

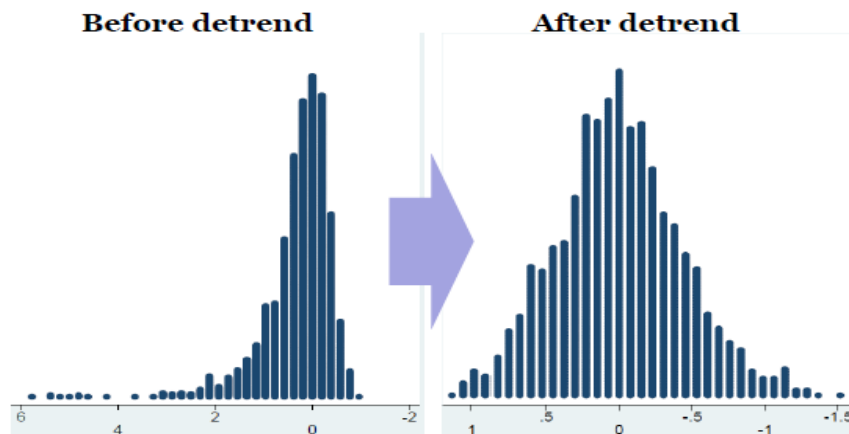
$$\Delta_{i,j} = \frac{y_{it+1} - y_{it}}{\bar{y}_{i,t,t+1}}$$

Viet Nam experienced very rapid economic growth. The database shows that real per capita household income grew on average at more than 7% annually between 2004 and 2008. Thus, household income variables have a strong positive time trend so that simple measurement of risk over time would overestimate the risks experienced by households. To get rid of time trend from real income variables, the average time trend observed in a homogenous group of farm  $\bar{\Delta}_j$  is subtracted from an individual shock  $\Delta_{i,j}$  to obtain detrended shock  $\Delta_{i,j}^d$ .

$$\Delta_{i,j}^d = \Delta_{i,j} - \bar{\Delta}_j, \text{ where } \bar{\Delta}_j = \frac{\sum_{k=1}^{n_j} \Delta_{k,j}}{n_j}$$

The normalisation of risks transforms the distribution of shocks so that the households in a group face mean zero shocks. As a result, the distribution of shock becomes more similar to normal distribution, which allows various statistical test (see Figure A.1).

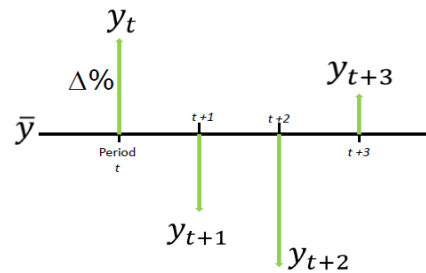
Figure A.1. Detrend data



13. All nominal monetary value is converted to the real price in 2004 using GDP deflator at the data processing step.

### Measurement of shocks

The first step of the methodology measures individual incidence of risk a deviation from the expected shock. Then, the individual incidence of risk is pooled among the homogenous group, assuming a representative household in a group is exposed to a pooled shock. In other words, the methodology assumes that a representative household in a group could experience the shocks overtime occurring across farms in the group.



Finally, the variability for a representative household in a group is measured as standard deviation of the detrended shocks  $\Delta_{i,j}^d$ . Due to the mean zero property of the detrended shock, the standard deviation of the detrended shocks are identical to a coefficient of variation, which can be comparable indicators of risk with those used in other countries.

$$CV_j \text{ of } y_t = \frac{\sqrt{\frac{\sum_{i=1}^{n_j} \{(1 + \Delta_{i,j}^d) \bar{y}_{t,j} - \bar{y}_{t,j}\}^2}{n_j - 1}}{\bar{y}_{t,j}}}}{\bar{y}_{t,j}} = \sqrt{\frac{\sum_{i=1}^{n_j} \Delta_{i,j}^{d^2}}{n_j - 1}}{\bar{y}_{t,j}}} = SD_j \text{ of } \Delta_{i,j}^d$$

## 2. Assessment of poverty risk

### Measurement of poverty incidence

The ideal measure of food security is consumption of foods and other requisites. However, since availability to complete consumption data is limited and consumption customs differ from region to region, one traditional and prevailing way to identify poverty is to see monetary-valued expenditure per capita.<sup>14</sup> It requires whether household's expenditure per capita is below national poverty line or food poverty line. Poverty line is defined as a minimum cost to support daily life requirement such as food and housing, while food poverty line focuses on a minimum food requirement to sustain human body healthy. A household whose expenditure per capita is below poverty line is considered as a poor household.

Since the size of income and expenditure is different from each other household, the value of income and expenditure is converted into per capita<sup>15</sup>. The assessment of poverty incidence in this report used expenditure based official poverty line and measurement

14. See Deaton and Zaidi (2002) for more discussion.

15. The report applied OECD-modified adult equivalent scales to calculate per-equivalent-adult income.

methods which are set by General Statistics Office of Viet Nam.<sup>16</sup> The measurement of poverty needs to include household's implicit expenditure and income. In Viet Nam, a large proportion of rice farms produce rice for their own consumption. The value of self supply is evaluated by average consumer price and included as a part of household expenditure and income.

### ***Measurement of vulnerability to poverty***

Pritchett et al. (2000) define vulnerability as the risk that a household experiences poverty within a certain defined future time period. The vulnerability to poverty in this report is measured by a representative household in each homogenous group of households. A representative household is assumed to have an average level of income within the group. The representative household  $i$  of the household group  $j$  experience poverty incidence if a negative income shock  $\Delta_{i,j}$  exceeds the certain threshold  $\Delta_{PL,t,j}$  where household per capita income falls below the poverty line.<sup>17</sup>

The vulnerability to poverty of the representative household is then measured as a proportion of income shocks that exceed the threshold which lead the representative household  $i$  of the household group  $j$  to poverty. This proportion can be interpreted as a probability of falling into poverty at time  $t+1$  for the representative household, which can be calculated separately for 2004-06 and 2006-08 periods.

$$P_j = \frac{\sum_{i=1}^{n_j} I(\Delta_{i,j}, \Delta_{PL,t,j})}{n_j}$$

$$\text{where } I(\Delta_{i,j}, \Delta_{PL,t,j}) = \begin{cases} 1 & \text{if } |\Delta_{i,j}| \geq |\Delta_{PL,t,j}| \text{ with } \Delta_{i,j} < 0 \\ 0 & \text{otherwise} \end{cases}$$

16. Official poverty lines in 2004, 2006 and 2008 are 2 077, 2 560 and 3 360 TVD/person/year, respectively.

17. Income-based relative poverty line is set at the lowest 20 percentile per capita income in the total sample in database in each year.