DIVERSIFICATION IN LAND AND LABOR ALLOCATION IN RESPONSE TO SHOCKS AMONG SMALL-SCALE FARMERS IN CENTRAL VIETNAM

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Abstract

The paper analyzes the relationship between the allocation of labor and land of the households, the number of crops grown and the number of income sources of the households with different types of shocks and risks. It uses the data from the first phase of the household survey in three provinces of Central of Vietnam, conducted within the scope of the DFG research project "Impact of shocks on the vulnerability to poverty: consequences for development of emerging Southeast Asian economies". The results suggest that the households diversify their portfolio (labor and land) into different income generating activities in order to cope with shocks. Among the different types of shocks and risks, agriculture and economic shocks and risks are the main factors to explain the (ex-post) risk-coping strategies and the (ex-ante) risk management of the households. The number of crops grown and the number of income sources from the households experienced with shocks are higher than others. In addition, the high-risk expectation households diversify their labor and land more than the low risk expectation households. The access to credit and market, the number of household labor, the education of the household head, and the wealth of the household are also very important factors that impact on the diversification level of the households.

Keywords:

Diversification, risk management, risk coping strategies, Vietnam

1. Introduction

Poor households in developing countries generally face many uncertainties stemming from extreme weather conditions, market imperfection, and misguided policy regulations, in addition to the recent rapid liberalization and globalization process. Hence, income risk is generally high in developing countries making rural households particularly vulnerable to covariate and idiosyncratic shocks (DERCON; 1999). The complete absence or only partial existence of formal insurance and credit markets (BESLEY 1994) prompts households to adopt self insurance mechanism. In fact, as shown by DERCON; (1999) households living in the high risk environment have developed rather sophisticated (ex-ante) risk management and (ex-post) risk-coping strategies.

In Vietnam, MINOT *et al.* (2006) used the three Vietnam Living Standard Surveys (1993, 1998 and 2002) data to examine the trend of income diversification and poverty in Northern Upland of Vietnam. They found that income diversification including crop diversification, has increased in this region over time. Poorer households are more diversified in crop production than richer ones, and rural households are more diversified than urban. On the national level, crop diversification contributed about 12% of the growth of crop income with large variation among income groups. Non-farm income is becoming an important source of income of the household although it has grown only slowly during 1998-2002 period. Using the same data of Vietnam Living Standard Survey (1993 and 1998), VAN DE VALLE *et al.* (2004) examined the role of the participation in the rural non-farm market economy on the poverty and found that it will be the route out of poverty for some, but not all poor households. In addition, education, ethnic minority and commune characteristics are influencing on the consumption growth and level of diversification in the same way but some other factors have opposite

effects such as household size has positive for diversification but negative for welfare, land size has positive impact on the welfare but negative on diversification.

Most current papers have analyzed income diversification in the context of economic growth and poverty. However, these analyses did not always adequately capture the dynamic nature of poverty. For example, the role of past environmental and economic shocks can play in explaining diversification has often been ignored in the literature as this requires time series data of shock events. This paper explores this aspect for the case rural households in three provinces in Central Vietnam, namely Ha Tinh, Hue and Dak Lak. The data used for this analysis came from the first phase of a panel household survey carried out under the auspices of the DFG research project "Impact of shocks on the vulnerability to poverty: consequences for development of emerging Southeast Asian economies". A total of some 2200 households were interviewed on their socio- economic status, health, education, income, consumption, assets, borrowing and the shocks that they experienced during the past five years. A simple model is developed that uses different diversification parameters to investigate the effect of household characteristics as well as those of past shocks and anticipated risks on the diversification of labor and land resources of rural households.

The paper is organized as follows. In the next section a brief assessment of the type of risks that occurred in Vietnam in the recent past is presented. This can help to set the frame for specifying the role of shocks that were observed from the survey. Section 3 provides the methodology for measuring diversification. Section 4 presents the data and the model specification and section 5 presents the empirical results. The last section is summary and conclusion.

2. Agricultural Risks in Vietnam

To a large extent, rural households in Vietnam depend on agriculture as the main source of income. However, income from agriculture tends to be become less stable for two major reasons. First is the increasing environmental risks and second is economic risks incurred with Vietnam's rapid development. **N**atural disasters such as typhoons, storm surges, flash floods, drought, and saline water intrusion are increasing. In 2007, more than 400 people were killed by natural disasters, 6936 houses and 975 schools were destroyed. The total economic value of losses was estimated at USD 704 million (XHMT- GSO 2007). Natural disasters affect particularly the center coastal region where typhoons, storm surges, flash floods, drought, saline water intrusion often happened during the year. Drought is often recorded in Central Highland while floods, typhoons and storms are very popular in North Central Coast (CHAUDHRY and RUYSSCHAERT 2007). Vietnam in recent years is also increasingly being affected by livestock diseases such as Avian Flu and Foot and Mouse Disease. Rural households are mostly affected by these risks with strong implications for the economy considering that the agricultural sector accounts for almost half of total household income and absorbs 64% of the labor force in Vietnam (VHLSS 2006). The likelihood of disasters is also increasing as a result of global warming. A recent study by DASGUPTA *et al.* (2007) on the potential impacts of sea level rise in 84 coastal developing countries showed that a 1-metre rise in sea level would have an effect on approximately 5 percent of Viet Nam's land area, affect 11 percent of the population, impact on 7 percent of agricultural land, and reduce GDP by 10 percent.

The economic risks for agriculture and rural areas are a result of Vietnam's open economy policy. The process of liberalization and rapid integration into the world economy with reducing trade protection and subsidies makes the domestic markets become more exposed to fluctuations of the international markets. A good example is coffee in the Central Highlands, where, as a result of coffee price collapse, farm labor is moving to both wage and self employment despite low compensation. The rapidity of shifts in the sources of income for the

Central Highlands observed during 1998-2002 (World Bank 2002) demonstrated the impact of external market on the rural economy.

3. Methodology to measure diversification

In developing countries rural households often depend on a few sources of income (REARDON 1997; TOULMIN *et al.* 2000). ERSADO (2006) summaries key factors that can explain the income diversification strategy which a household can choose. These include: (a) self-insurance against risk in the context of missing insurance and credit markets, (b) an ex-post coping strategy, (c) an inability to specialize due to incomplete input markets, (d) a way of diversifying consumption in areas with incomplete output markets, (e) to exploit strategic complementarities and positive interactions between activities, and (f) simple aggregation effects where the returns to assets vary by individual or across time and space. In the absence of good formal insurance and credit markets, agricultural households in Vietnam have basically two options to reduce income variability. The first option refers to land allocation decisions and the second refers to the reallocation of labor.

On land, households may select an agricultural enterprise where the correlation between price and yield is low or by adjusting the crop portfolio to the specific characteristics of their land, i.e. growing different crops or different parcels on land in order to minimize the effect of biotic or abiotic stresses. The second option is that households reallocate their labor into non-farm activities as wage income is largely uncorrelated with agricultural income. In addition non farm income can help to accumulate assets in a good agricultural year which increases the household's capacity to smooth consumption in the years with shocks affecting agriculture.

The actual degree of diversification chosen by a household depends on several factors. First is the initial conditions, i.e. how strongly his income varies and what their capacity to smooth consumption is. Second is the household's preferences towards risk and third is the cost of diversification, i.e. the amount of income reduction for reducing risk. Risk averse household will tend to diversify more and will accept higher risk premiums. For example, MORDUCH (1990) found that credit-constrained households are more willing to sacrifice income in order to reduce risk. In order to better understand income diversification strategies actual portfolio diversification needs to be analyzed as the share of each income source in total income depends on the allocation of household resources for each income generating activity, including liquid capital, assets and labor allocation (e.g. BARRETT 2000; MINOT 2006).

There are different methods that can be applied to measure diversification as discussed by CULAS *et al.* (2005) and MINOT *et al.* (2006). Culas *et al.* used four indices to measure diversification. The first index is called *Index of maximum proportion (M1)* and it is defined as the ratio (proportion) of the farm's primary activity to its total activities. It is measured as the maximum proportion of the crop acreage in activity *i* in total farm acreage cropped so the diversification increases when *M1* decreases. This index has the limitations as it does not take into account the balance in planting area among the other crops as well as the total number of crops grown. With the same value of *M1,* the households having more crops grown or more balancing in term of the share of planting area among the rest of crops (excluding the biggest proportion of planting area crop) could have more diversification than other households. The second index is the number of activities *(M2)* that the farm operates and as pointed out by the author, the weakness of this index is that it gives no weight to the distribution of the farm's employment over the activities. The third index is *Herfindahl index (M3)* that is measured by taking the square of the shares of a farm's activities, gives a particular weight to the farm's principal activities. As it gives limited weight to minor activities, this index is insensitive to minor activities. The fourth index is *Entropy index (M4)*, this index gives less weight to the larger activities by multiplying the share of activity *i* by a log term of the inverse of the respective shares. However, both *M3* and *M4* could not apply for the cases that the household

has negative income from the income generating activities. Therefore, these indices could not be used for estimating income diversification. MINOT *et al.* used *M2*, *Share of income from non-farm in total income* and the SID index to measure income diversification. The *Share of the income from non-farm* also has limitations as it could not reflect the balancing in income proportion among non-farm activities.

In this study we use the Simpson index of diversity to measure the portfolio diversification of the household:

$$SID = 1 - \sum_i P_i^2$$

where **Error! Bookmark not defined.**P_i is the proportion of household portfolio that is allocated to income generating activity *i*. The index takes into account the number of income generating activities, the share of household resources allocated to each activity and gives more weight to the activity with a higher share of household portfolio allocation. The index ranges from 0 to 1 with 0 if a household devotes all resources to one income generating activity and approaching 1 if the number of income generating activities is very high.

In this paper the SID index is applied to measure the household's diversification in land and labor taking into account resource capacity. The SID index for labor allocation was based on the main occupation of the household member aged from 10 to 60. Household labor was classified into three types, namely agriculture, wage employment and non-farm self-employment. The SID index for land area was based on the area that households allocated to each crop during the crop year 2006/07.

4. Data and Model Specification

4.1. Data

We use the data from the first phase of the survey in three provinces in Central of Vietnam of the project "Impact of shocks on the vulnerability to poverty: consequences for development emerging Southeast Asian economies". This survey was conducted in Dak Lak, Hue and Ha Tinh provinces from June to August 2007. There were 2200 households that were randomly selected for interview from 220 villages in 110 communes in all districts of these provinces. The sample was distributed proportionately to the population size of each district with some adjustments to over-sampling in the remote areas where the population is small and thus the number of households would have been insufficient for the estimation[1]. Hence a weighting procedure was used to adjust for over-sampling in remote areas. Two questionnaires were used in this survey, one for the household and the other for the village. The household questionnaire collects information about various aspects of socio-economic conditions of the household. It includes demographic, migration, education, health, agriculture economics, off-farm and non-farm employment, financial institutions and economic geography, remittance, insurance, consumption and assets. In addition, there is a special section that collects information about the different types of shocks that the household has experienced since 2002 and the different types of future risks that the household perceived. It includes the common (flood, drought, storm, avian flu,) and the idiosyncratic (sick, death, accident, lost of job, bankruptcy) shocks and risks. For each type of shock and risk, the respondent was asked to evaluate the impacts on the household as well as the coping strategies that household used to cope with the shock. The village questionnaire is used to interview village leader with the purpose to collect information about infrastructure and basic public goods such as access to the market, road, irrigation system that could affect the livelihood of the households[2].

[1] Detail information about sample design of this survey is discussed in HARDEWEG *et al.* (2007).

[2] Questionnaires are posted in http://www.vulnerability-asia.uni-hannover.de/downloadspublic.html.

4.2. Model Specification

A simple linear regression model was used to measure the effect of shock and risk on the portfolio and income diversification of the household.

(1) $$Y_{ij} = \beta_0 + \beta_k X_{ijk} + \gamma_n S_n + \varphi_m R_m + \varepsilon_{ij}$$

Where: Y_{ij} are the SID indexes of labor, land of the household *i* in village *j,* the number of income sources, the number of crops grown of the household *i* in village *j*.

X_{ijk} are control variables for factors, which are believed to influence the diversification decision of a household. These include household and village characteristics. The total asset lost due to the shock could reduce the chance for household to recover production so it could have negative impact on the diversification of the household. Access to credit, however, could help the household to expand its production and allow the household to change the crop pattern as well as to move labor working in agriculture into other sectors. Therefore, it could have positive impacts on the diversification of the household. We expect the same sign impact of the total asset for production on the diversification of the household as the household with more assets for production could have a higher chance to diversify its labor and land. Labor is an important input of the production so the household with more labor (measured as the number of people aged from 10 to 60) could have more chance to diversify in agriculture production as well as in non- farm activities thus this variable could have positive impacts on the dependent variable. In Vietnam, there is a big different between Kinh & Chinese ethnic group with the ethnic minority group in both economic and culture. Therefore, we also add the ethnic minority variable in the model in order to measure the difference in diversification of these groups. The age of the household head is the proxy of the indicator reflecting the working experience that is also added on the model to control the impact of this variable on the diversification. Education could have positive impacts on the diversification of both labor and land of the household as higher education could give more opportunity to work in the non-farm employment that requires skilled labor. In addition, household heads with higher education could manage and allocate its resources better than the lower education household head. The sex of household head might also impact on diversification so it is also added to the model. In order to grow more crops, the household needs more land so the total owned land area could have positive impact on the land diversification and the number of crops grown by household but it could have an opposite impact on labor diversification as it absorbs more labor to work in agriculture sector. The Land Use Certificate (LUC) reflects the ownership status of the household on the land so the household could invest more on the LUC plots. In addition, the irrigated land could allow the household to specialize on the high yield value crop. Therefore, these variables could have negative impacts on the diversification of the household. People living in the mountainous area or far away from the urban area could have a lower chance to work on the non-farm activities due to lack of information and high transaction costs, such as transportation, so we expect that they could have negative impacts on labor diversification. However, they could have positive impacts on the land and crop diversification due to high transaction costs for buying and selling the products. The dummy variables to control the difference in diversification among three provinces are added on the model. The descriptive statistics of the dependent and independent variables are shown in the table 3 in section 5

The effect of shocks on diversification was measured in different ways. First, we define S_n as a dummy variable in order to investigate the difference between households who, during the past five years, suffered from one or more shocks and those who did not. In the second step, shocks were defined as a continuous variable , i.e. taking the number of shocks that household has been experienced from 2002 to 2006. In the third step, different types of shocks were

defined as dependent variables[3]. Hereby, shocks were divided into four groups. These groups are demographic and health shocks, including the illness and death of a household member, social shocks such as conflicts with the neighbor in the village, agricultural shocks such as natural disasters (flood, drought, or pests), and diseases and economic shocks, such as job loss or the collapse of a business. The variable S_n that represents for each group of shocks is measured as the number of shocks that household experienced in the past 5 years for each group.

R_m is defined as a risk variable. In the household survey, respondents were asked to assess the likelihood of different types of events that they expected would take place in the next 5 years and the impacts of these events on the household. The definition of events on this subsection is the same as in the shock section. Therefore, the R_m variable has the same variable labels as the S_n variable except that R_m reflects the risk management strategy of the household while S_n refers to the risk coping strategy.

There is a reason to believe that village characteristics might simultaneously correlate with both diversification and shock. Households living in the same village are often affected by common shocks such as natural disasters, crop and livestock diseases and they also have the same production pattern, especially in agriculture production. Therefore, they could affect the identification of the estimation of (1). To control these factors and the unobserved external variables, a village- fixed model was developed, and these factors and unobserved external variables are captured by fixed- effects V_j.

(2) $$Y_{ij} = \beta_0 + \beta_k X_{ijk} + \gamma_n S_n + \varphi_m R_m + V_j + \varepsilon_{ij}$$

5. Results

Illness of the household, drought, floods, livestock diseases and unusual heavy rainfall are the major shocks that were experienced by farmers in the three provinces. However, drought is most popular in Dak Lak while floods usually occur in Ha Tinh and Hue. Hue has a much higher percentage of household affected by unusual heavy rainfall while Ha Tinh has a higher percentage of households affected by livestock diseases. Table 1 gives the information of some key indicators of the three provinces. Ha Tinh is the poorest province measuring by the percentage of poor households and the income per capita while Dak Lak is the richest provinces. In addition, households living in Dak Lak have about 43% of income from crops while households in Hue and Ha Tinh are less dependent on the income from crops.

Table 1. Summary statistics of key indicators of the three provinces

	Ha Tinh	Hue	Dak Lak
Poor households (%)	48.0	30.7	28.9
Income from crop production (thousand VND)	3155.7	3361.4	14077.1
Total income of the household (thousand VND)	19136.5	23862.2	32990.3
Income per capita per month (thousand VND)	443.9	488.5	678.8
Share of income from crop (%)	16.5	14.1	42.7

Table 2 shows the summary statistics of all variables. Over three-fourth of the households reported at least one shock in the past five years. The main types of shocks are agriculture and demographics shocks. In terms of shocks expected in the future an even higher proportion of the respondents (94%) expected at least one event to take place in the next 5 years.

Table 2 also shows the variables for diversification. On average, each household has about 4 income sources and 2 crops grown. It reflects the specialization in agriculture production in

[3] We use the same shock classification as in the household questionnaire of the survey

these provinces, especially in Dak Lak where coffee production is dominant. The results of SID land and labor indices (0.22 and 0.23, respectively) also show the low level of diversification of the rural households in these provinces.

Table 2. Summary statistics of variables

Variables	Mean	Std. Err.	Min	Max
Dependent variables				
Number of income sources	3.91	0.04	1.00	8.00
Number of crops grown	1.87	0.07	0.00	8.00
SID land index	0.22	0.01	0.00	1.00
SID labor index	0.33	0.01	0.00	0.72
Independent variables				
Household (HH) characteristics				
HH experienced at least one shock in the past 5 yrs. (1=yes)	0.78	0.01	0.00	1.00
Number of shocks experienced from 2002 to 2006	1.35	0.03	0.00	4.00
Number of Demographic shocks from 2002 to 2006	0.44	0.02	0.00	4.00
Number of Social shocks from 2002 to 2006	0.03	0.00	0.00	2.00
Number of Agriculture shocks from 2002 to 2006	0.73	0.03	0.00	4.00
Number of Economics shocks from 2002 to 2006	0.08	0.01	0.00	3.00
HH expected at least one risk in the next 5 years (1=yes)	0.94	0.01	0.00	1.00
Number of risk that HH expected in the next 5 years	4.47	0.09	0.00	9.00
Number of Demographic risks	1.56	0.06	0.00	5.00
Number of Social risks	0.57	0.03	0.00	4.00
Number of Agriculture risks	2.52	0.08	0.00	8.00
Number of Economics risks	1.64	0.08	0.00	7.00
Total asset loss due to shocks in the past 5 years (10^6 VND)	4.10	0.33	0.00	220.00
Household is currently borrowing (1=yes, 0=no)	0.74	0.01	0.00	1.00
Total asset value for production of the HH (10^6 VND)	7.84	0.56	0.00	518.41
Total asset value for crop production of the HH (10^6 VND)	7.25	0.50	0.00	518.41
Total household member aged from 10 to 60	3.66	0.05	0.00	11.00
Ethnicity of the household (1= Kinh & Hoa, 0=other)	0.84	0.02	0.00	1.00
Age of the household head	48.27	0.38	17.00	99.00
Square age of the household head	2519	39.99	289.0	9801
Number of years in school of the household head	6.78	0.15	0.00	20.00
Sex of the household head (1=male, 0=female	0.84	0.01	0.00	1.00
Total land area owned by household (ha)	0.73	0.05	0.00	40.76
Share of HH's land area having Land Use Certificate (LUC)	0.66	0.02	0.00	1.00
Share of the irrigated land of the household	0.39	0.40	0.00	1.00
Village characteristics				
Distance from village to District town (km)	13.75	1.05	0.20	75.00
Village is located in the mountain (1=yes, 0=no)	0.42	0.04	0.00	1.00
Ha Tinh province (1=yes, 0=no)	0.38	0.00	0.00	1.00
Hue province (1=yes, 0=no)	0.22	0.00	0.00	1.00
Dak Lak province (1=yes, 0=no)	0.39	0.01	0.00	1.00

5.1. Diversification of labor allocation

To investigate the effects of shocks, six different variants of the model were tested, i.e. with three different ways of including shocks and with and without fixed effects. The shock variables were included as dummy variables (model 1 and 2), as count variables for all shocks (model 3 and 4) and by type of shocks (model 4 and 6). Results of all models are shown in table 4. Model 1 & 2 illustrate that households who experienced shocks during the past five years were significantly more diversified in labor allocation for both cases with and without the fixed village effects. When counting the number of shocks (model 3 & 4) only the fixed effects model is significant. Specifying shock variables by type shows that only in the fixed effects model, agricultural shocks are significant. This is an evidence that households used labor diversification as one of the (ex-post) risk-coping strategies.

The risks which households expect seem to also have significant influence on diversification (model 3 & 5). This is reasonable as current portfolio decisions are made to increase and stabilize future incomes. The result also shows that the high risk averse household diversifies its labor more than the low risk averse household. Among the different types of risks, agriculture and economic risks are the main factors to explain the (ex-ante) risk management of the household, measured by labor diversification.

In order to move labor into other production sectors, especially into non-farm self-employment, a household needs money to invest on the labor skill, initial investment to set up a business. One of the capital channels is to take loans from a bank or other lenders. Access to credit is a strong positive, significant impact on the level of labor diversification of the household and the coefficient is consistent among the models. The level of labor diversification is obviously dependent on the number of labors in the household. The household with more labors will allocate some of them into non- agricultural sectors to maximize the production efficiency. The age of the household head has a negative impact of the labor diversification of the household but education measured by number of years in school of the household head has significant positive impact. The household owning more land and having a higher share of land with Land Use Certificate (LUC), could invest more on agriculture production and require more labors. As a result, the land area owned by the household and the share of land with LUC have a negative impact on labor diversification; however, these factors are not statistically significant. The distance from the household location to the urban area could be a constraint for the movement of the labor from agriculture sector in to other sector due to the lack of information, and high costs of movement and transaction. We found that the households living far from the district town and the households living in the mountainous areas are significantly less diversified than other households. In addition, the households living in Hue province where the urbanization is higher and is the highly concentrated in tourism are much more diversified than the households living in Dak Lak or Ha Tinh. The omission of village variables in the fixed effects model reduced the overall fit of the model suggesting that location factors are an important determinant of labor diversification.

Table 3. Determinant of SID labor index

	Dependent variable: SID labor index of the household (model)					
Independent variables	**1**	**2**	**3**	**4**	**5**	**6**
HH experienced at least one shock in the past 5 years	0.043***	0.055***				
HH expects at least one risk in the next 5 years	0.007	-0.000				
No. of shocks experienced from 2002 to 2006			0.007	0.012**		
No. of risks expected in the next 5 years			0.006***	0.003		
No. of demographic shocks from 2002 to 2006					0.008	0.010
No. of social shocks from 2002 to 2006					-0.016	-0.010
No. of agricultural shocks from 2002 to 2006					0.004	0.015*
No. of economics shocks from 2002 to 2006					-0.015	0.005
No. of demographic risks					-0.004	0.000
No. of social risks					-0.005	-0.010
No. of agricultural risks					0.009***	0.005
No. of economic risks					0.009**	0.006
Total asset loss due to shocks in the past 5 years (10^6 VND)	-0.001	-0.000	-0.001	-0.000	-0.000	-0.000
HH is currently borrowing	0.025*	0.017	0.023*	0.017	0.022*	0.017
Total asset value for production of the HH (10^6 VND)	-0.000	0.000	-0.000	0.000	-0.000	-0.000
Total HH member aged from 10 to 60	0.028***	0.027***	0.027***	0.026***	0.028***	0.026***
Ethnicity of the HH (1= Kinh & Hoa, 0=other)	0.027	0.005	0.028	0.006	0.030	0.003
Age of the HH head	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***
Number of years in school of the HH head	0.004***	0.005***	0.004***	0.005***	0.004***	0.005***
Sex of the HH head (1=male, 0=female)	0.003	-0.006	0.003	-0.007	0.004	-0.007
Total land area owned by HH (ha)	-0.005	-0.003	-0.004	-0.003	-0.005	-0.003
Share of HH's land area having Land Use Cert. (LUC)	-0.013	-0.019	-0.013	-0.019	-0.015	-0.020
Share of irrigated land of the HH	-0.000	-0.000	-0.000	-0.000	0.000	-0.000
Distance from village to District town (km)	-0.001**	(dropped)	-0.001*	(dropped)	-0.001**	(dropped)
Village is located in the mountains (1=yes)	-0.044***	(dropped)	-0.042***	(dropped)	-0.036**	(dropped)
Hue province (1=yes, 0=no)	0.055***	(dropped)	0.061***	(dropped)	0.063***	(dropped)
Dak Lak province (1=yes, 0=no)	0.010	(dropped)	0.017	(dropped)	0.013	(dropped)
_cons	0.228***	0.246***	0.229***	0.260***	0.221***	0.260***
Number of observations	2,137	2,137	2,137	2,137	2,137	2,137
Adjusted R^2	0.111	0.082	0.112	0.085	0.116	0.086
Village fixed-effect	No	Yes	No	Yes	No	Yes

note: *** p<0.01, ** p<0.05, * p<0.1

5.2. Diversification of land

Land diversification is mainly related to agriculture and economic shocks. There is a reason to believe that the correlation in terms of income variability among the crops is imperfect positive. Different types of shocks could impact on the different types of crops. Therefore, the household might allocate the agriculture land to different crops and balancing of land allocation for each crop to manage the risk in agriculture production. Table 4 shows that shocks have a strong positive significant impact on the land allocation among the crops of the household. Like the impact of the diversification of labor, the more shocks that households experienced in the past 5 years, the more balance we found in terms of land allocation among the crops and higher number of crops grown by the household.

Table 4. Determinant of SID land index

	Dependent variable: SID land index of the household					
Independent variables	**1**	**2**	**3**	**4**	**5**	**6**
HH has experienced at least one shock in the past 5 years	0.022	0.027**				
HH expects at least one risk in the next 5 years	0.008	-0.020				
No. of shocks experienced from 2002 to 2006			0.019***	0.014***		
No. of risk expected in the next 5 years			0.006**	0.003		
No. of demographic shocks from 2002 to 2006					0.006	0.002
No. of social shocks from 2002 to 2006					-0.023	0.000
No. of agricultural shocks from 2002 to 2006					0.044***	0.030***
No. of economic shocks from 2002 to 2006					-0.058***	-0.005
No. of demographic risks					-0.004	0.002
No. of social risks					0.001	-0.003
No. of agriculture risks					0.014***	0.007**
No. of economic risks					-0.002	-0.001
Total asset loss due to shocks in the past 5 years (10^6 VND)	-0.000	-0.001	-0.000	-0.001*	-0.000	-0.001
Household is currently borrowing	0.020	0.016	0.012	0.012	0.009	0.013
Total asset value for crop production of the household (10^6 VND)	-0.001***	-0.000*	-0.001**	-0.000	-0.000**	-0.000
Total HH member aged from 10 to 60	0.010**	0.010***	0.009**	0.009***	0.008*	0.008***
Ethnicity of the HH (1= Kinh & Hoa, 0=other)	-0.049	-0.047	-0.048	-0.044	-0.038	-0.044
Age of the HH head	0.008**	0.006**	0.008**	0.006**	0.008**	0.006**
Age square of the HH head	-0.000**	-0.000**	-0.000**	-0.000**	-0.000**	-0.000**
Number of years in school of the HH head	0.000	0.001	0.000	0.001	0.001	0.001
Sex of the HH head (1=male, 0=female	0.001	0.003	0.001	0.003	0.001	0.002
Total land area owned by HH (ha)	0.006	-0.001	0.006	-0.001	0.005	-0.001
Share of the HH land area having Land Use Certificate (LUC)	-0.005	-0.004	-0.005	-0.005	-0.004	-0.005
Share of the irrigated land of the HH	-0.001***	-0.001	-0.002***	-0.001	-0.002***	-0.001*
Distance from village to District town (km)	-0.002*	(dropped)	-0.001	(dropped)	-0.001	(dropped)
Village is located in the mountains (1=yes)	0.110***	(dropped)	0.110***	(dropped)	0.105***	(dropped)
Average travel time to go to market (minutes)	0.002***	(dropped)	0.002***	(dropped)	0.002***	(dropped)
Hue province (1=yes, 0=no)	-0.093***	(dropped)	-0.088***	(dropped)	-0.093***	(dropped)
Dak Lak province (1=yes, 0=no)	-0.018	(dropped)	-0.026	(dropped)	-0.023	(dropped)
_cons	-0.050	0.073	-0.056	0.051	-0.071	0.036
Number of observations	2,117	2,117	2,117	2,117	2,117	2,117
Adjusted R^2	0.148	0.054	0.157	0.075	0.182	0.098
Village fixed- effect	No	Yes	No	Yes	No	Yes

note: *** p<0.01, ** p<0.05, * p<0.1

As expected, agriculture shocks are the robust factor that impacts on the land diversification of the household (model 5 & 6). The economic shock has a negative impact on land diversification but it is not significant when we use the village fixed- effect model. The possible reason is that the economic shocks could reduce the price of output (crop products) and increase the price of input of crop products. Therefore, the households could change to producing the high yield value crops. As a result, the land diversification measured by SID index is reduced. Agriculture risks also have significant, positive impacts on the land diversification of the household but smaller than the agriculture shocks. The household with

more expectation about agriculture risks has the higher level of land balancing among the crops and higher number of crops grown than the other household (model 5 and 6). It is clear that the balancing of the agriculture land among different crops and the increase of the number of crops grown is risk management and strategies that household used to cope with the agriculture shocks.

The household with more assets for crop production could concentrate on producing the tradable crop products that yield higher value and, therefore, reducing the number of crops grown as well as the diversification of the land. We found the significant negative impact of asset for crop production on the level of land diversification. The number of labors has a strong positive significant impact on the land diversification, and the age of the household head has non-linear correlation with land diversification. The irrigated land allows the household to specialize their crop production and then reduce the balancing of land allocation. The household living in a place that is far from the market might have to grow more crops and balance their land more because of high transaction costs such as transportation costs for inputs and outputs so they have to produce self consumption goods instead of tradable goods. We found that the households living in the mountainous area and far from the market have stronger positive significant land diversification than other households and the households living in more urbanization place (Hue province) have diversified their land less than other households. This finding is consistent with the finding of Nicholas Minot *et al.* (2006) for the households in Northern Upland of Vietnam.

6. Summary and Conclusion

Vietnam is among the countries which could be severely affected by climate change and natural disasters. Using data from the first phase of the household survey in three provinces in Central of Vietnam, conducted within the scope of the DFG research project "Impact of shocks on the vulnerability to poverty: consequences for development of emerging Southeast Asian economies", we found that the household used a self-insurance mechanism to cope with the shock, mainly with agriculture shocks. There are the evidence from our paper that the households diversify their portfolio into different income generating activities in order to cope with shocks. Among the different types of risks, agriculture and economic shocks and risks are the main factors to explain the (ex-post) risk-coping strategies and the (ex-ante) risk management of the households. Households diversify their labor to work in different sectors and their land into different crops and balance the share of labor in each sector and land for each crop in order to cope with shocks. As result, we found that the number of crops grown and the number of income sources from the households experienced with shock are higher than others. In addition, the high risk expectation households also diversify their labor and land allocation more than the low risk expectation households. Access to credit and the market, the number of the household labors, education of the household head, and the wealth of the household are also the important factors that drive the level diversification chosen by a households.

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