DETERMINANTS OF INCOME DIVERSIFICATION AND ITS EFFECT ON HOUSEHOLD INCOME IN RURAL VIETNAM

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Abstract

Exploiting data of Vietnam Household Living Standard Survey 2010, the study aims at finding determinants of income diversification at household level in rural Vietnam and evaluating effects of income diversification on household income. The data set covers 6,571 rural households of eight socio-economic regions. Herfindahl-Hirschman index (HHI) is applied to show income diversification at household level. Two-limit tobit model is applied to detect effects of household features and community characteristics on HHI then generalized method of moments (GMM) is employed to test effects of HHI on household income.

The results show that human capital in both quantity and quality terms plays a substantial role in encouraging rural households to diversify their income-generating activities. Rural households with higher education level and higher diversification ability tend to have more diverse income sources. Owning larger sources of physical capital, or better credit accessibility, and social capital also helps rural households improve income diversity.

The study results also confirm that income diversification is the dynamic of rural income improvement. Households can increase their income by diversifying their farm and non-farm activities.

Keywords: diversification index, Herfindahl-Hirschman index, generalized method of moments, household income

1. Introduction

Vietnam is on the way of industrialization. By increasing shares of manufacturing and service sectors in the GDP, labor surplus from agricultural sector is expected to be strongly absorbed. However, during 20 years of renovation, the speed of labor movement out of agriculture has been slow. Pressure of labor on land resource is still not reduced and hence the small-scale farms with low labor productivity are main features of rural Vietnam. Consequently, the rural households adapt the situation by reallocating their scare resources into diversified non-agricultural economic activities to search additional income.

From theories, world empirical experiences and policy makers' viewpoint, income diversification is considered a manner of escaping from poverty in rural areas. However, it is still unclear what are motives of income diversification in rural areas; how rural households diversify their income under a given specific internal resources and external conditions; and in land scarcity context of rural Vietnam, whether income diversification is an ideal solution to improve household income.

Therefore, this study aims to examine the determinants of income diversification, and the links between income diversification and household income in the rural Vietnam, especially over the economic depression period 2008-2010 caused by the global financial crisis. Specifically, two research questions are raised: i) what are the determinants of income diversification? and ii) how is the links between income diversification and household income in the rural Vietnam?

The study is structured as follows. Section 2 is devoted to review of diversification-related issues in previous studies. The basic regression specification is discussed in the next section. Section 4 provides an empirical analysis of the factors driving income diversification in the rural Vietnam as well as the empirical findings of the effect of income diversification on household income. The final section is for conclusion and policy implication.

2. Theoretical basis and analytic framework

2.1 Income diversification definition and its measurements

Firstly, income diversification is defined simply as a process in which multiple income sources are created by a rural household (Minot et al., 2006). Proxy indicator is the number of income sources of each household at given time. Although this indicator is closest to the original meaning of the word, it only reflects income-generating activities. Secondly, income diversification is defined as a process in which rural households increase their employment and income from the non-farm activities. Regarding this, either the share of time spent on or the share of earnings from non-farm activities is used to highlight the importance of non-farm income in a household's livelihood (Barrett & Reardon, 2001; Barrett et al., 2001; Davis & Bezemer, 2003; Ellis, 2000; Lanjouw & Feder, 2001). The Simpson index, the Herfindahl index, and the inverse Herfindahl index are proposed to capture a process in which households increase not just the number of sources but also get greater balance in term of share of income sources in their income portfolio (Ellis, 2000; Joshi et al., 2003; Minot et al., 2006).

As above discussion, inverse Herfindahl index (also called Herfindahl-Hirschman index) is the most appropriate measurement because (i) it takes into consideration both the number of income sources and the contribution of each source to total household income, and (ii) most main motives of diversification are income maximization or income stabilization.

$$HHI = 1 - HI = 1 - \sum_{i=1}^{n} P^2$$

2.2 Determinants of income diversification

2.2.1 Determinants of income diversity in push/pull factors

The theoretical discussion often categorizes the drivers of income diversification to push/pull factors (Barrett et al., 2001; Davis, 2003; Davis & Bezemer, 2003; Ellis, 2000; Haggblade et al., 2002; Start, 2001). The "push factors" terminology refers external factors which's changes causes the fluctuation of farm income (e.g. weather conditions, policy changes...); therefore, which leads to the increase of household's motivation in adopting income diversification strategy to mitigate the adverse effect of these factors. The "pull factors" refers growth opportunities in term of household income (Barrett et al., 2001; Barrett & Reardon, 2001). For instance, households have more likelihood to increase their income when favorable changes exist (e.g. education, infrastructure conditions, and gender) (Barrett et al., 2001; Lanjouw & Lanjouw, 2001). Household income diversification strategy is affected by push factors rather than pull factors. Moreover, pull factors may play complementary roles for push factors in facilitating income diversification (Barrett et al., 2001; Ellis, 2000). Reardon et al. (2007) point out the dynamic interactive process between pull and push factors.

2.2.2 Determinants of income diversity in income sources

Risk reduction: a household tends to reallocate its productive asset to several activities to avoid risk or loss correlated with its fundamental income (Dercon & Krishnan, 1996; Ellis, 2000; Barrett & Reardon, 2001; Start, 2001). Household often choose new activity such as

raising cattle and/or non-farm activities to cope with weather shocks (Reardon, Matlon & Delgado, 1988; Dercon, 1998). Income diversification typically occurs due to instability of income sources and risk-averse behavior of household. The empirical findings often show that poor rural households are more likely to have diverse income sources than richer households (Barrett, Bezuneh & Aboud, 2001; Block & Webb, 2001; Joshi et al., 2003).

Meeting consumption needs: in the context of resource and/or market constraints, the household is motivated to diversify with a view to getting earning to a level that would be able to meet their basic needs (Dunn, 1997; Ellis, 2000; Barrett & Reardon, 2001; Start, 2001). Moreover, if a household live in remote area where the cost of goods exchange will be very high, diversification also is a strategy to satisfy demands for goods of household as well as community (Singh, Squire & Strauss, 1986; Omamo, 1998).

Moreover, income diversification is considered as a household's strategy to cope with *diminishing marginal returns to labor problem*, especially in rural area whereas seasonal unemployment is common. Furthermore, income diversification could be employed to reduce risk or to fulfill the increasing basic needs of household, which depends on the research circumstances. For instance, Asian farmers diversify away from rice into higher-value crops and activities to boost their income, while African farmers' diversification motivation is risk reduction (Delgado and Siamwalla, 1997). Moreover, in Zimbabwe, Ersado (2003) finds the higher intention to diversify income is found for the rich households in rural areas rather than ones in urban areas.

2.2.3 Diversification as commercialization process

The welfare of diversified households is better than ones who have only one or a few fundamental income sources. But the diversified household is expected to have more assets, less risk-averse behavior to cope with the high variation in term of price of both commercial crop and foods. Therefore, the poor farmers face more constraints to participate in commercial production due to their liquidity constraints. Thus, farmers who live in more remote areas or sparsely populated areas rely more self-sufficient and less on commercial production (Omamo, 1998; Minot, 1999).

2.2.4 Diversification into non-farm activities

Many empirical evidences in Asia and Latin American show that the fundamental income source of poor household is from agricultural sector, while the non-poor household is more likely to participate in wage-earning and off-farm jobs (FAO, 1998; Lanjouw & Lanjouw, 2001). The development of rural infrastructure could increase the likelihood of poor household to engage in non-farm activities. The empirical evidences prove that the increase of non-farm share positively associates with development of electricity network (Reardon, 1997; Escobal, 2001; Lanjouw & Lanjouw, 2001). However, the development of road network in rural areas that has mixed effects. On one hand, local non-farm businesses are threatened because the imported goods are likely to be cheaper (Haggblade, Hazell & Reardon, 2002). On another hand, the cost of imported inputs from urban area that is also likely to be reduced, as well as the non-farm businesses have more market development opportunities. On net, the latter effect is greater in regions closer urban region (Reardon, 1997; Escobal, 2001; Lanjouw & Lanjouw, 2001). Similarly, the expansion of formal credit market could have mixed effects on household's income diversification strategy. The less-effective of formal credit market could constraints rural households to engage high-income non-farm activities but favors for low-income non-farm activities (FAO, 1998).

2.2.5 Diversification into high-value activities

Income diversification also defined as a process of switching low-value activities to high-value ones. This process could be hindered by lacks of credit accessibility, market information, appropriate production technology, human capital, public infrastructure, social capital, and household's productive assets. In other words, the insufficiency of these meso-level factors could limit the likelihood to diversify into high-value non-farm activities (Barrett & Reardon, 2001; Davis, 2003; Ellis, 2000; Lanjouw & Feder, 2001; Reardon et al., 2007). Thus, proximity to towns, access to road, electricity and water are often used as proxies for these meso-level factors (Barrett et al., 2001; Ellis, 1998; Reardon et al., 2007).

2.2.6 Determinants of income diversification in household assets

The critical role of household productive assets is emphasized in the study of Reardon et al. (2007). Firstly, household's human capital (in term of quality as well as quantity) that is critical factor of its engagement in non-farm activities (Carney et al., 1999; Ellis, 2000, Reardon et al., 2007). More particular, the household with higher education level or with more workers has a greater likelihood in participating in (high-value) non-farm activities (Abdulai & Delgado, 1999, Ellis, 1998; Reardon, 1997). Secondly, although landholding positively associates with farm income and a greater likelihood of credit accessibility, but its effects on income diversification is mixed. Landholding could encourage rural households to increase their income capacity by adopt new non-farm activities (Abdulai & CroleRees, 2001) but also by intensifying farm activities (Minot et al., 2006). Thirdly, financial capital constraints often prevent the poor household to engage in high-value non-farm activities (Ellis, 2000). Because of the ineffectiveness of formal credit market in rural areas, the value of productive assets could be employed as proxies for financial capacity of household (Escobal, 2001). Lastly, social capital refers the relation networking of households, which is hardly to measure (Ellis, 2000). Some empirical studies assign some categorize variables as proxies, such as membership in organizations and "connections" to local authorities (Davis, 2003; Reardon et al., 2007).

2.2.7 Income Diversification in Vietnam

Pederson and Annou (1999), with the 1992–93 Vietnam Living Standards Survey, finds a typical household in rural areas willing to adopt income diversification that is small in farm size, and higher level of education. Henin (2002) find that the policy changes towards market-orientation which stimulates income diversification. Moreover, Castella & Quang (2002) argue that policy changes also have different effects on income diversification. More particular, the effect of policy changes on income diversification that is only found in uplands, whereas policy changes stimulate intensification in rice production in lowlands. These findings are supported by the work of Fatoux et al. (2002). Furthermore, Alther et al. (2002) highlights the market accessibility as important factor of income diversification.

2.3 Analytical framework

The study employed main ideas withdrawn from literature reviews on theories and empirical studies related to income diversification of household. There are several determinants affecting to the diversification and its extend which are classified in the following categories: i) household's human capital in terms of quantity, physical and educational quality; ii) household's natural represented by land holding; iii) household's physical assets; iv) household's financial capital such as of money, mainly savings and borrowings; and v) household's social capital which can be representative by ethnics and other social relationships. In addition, other determinants at meso-level that affect to income diversification of households as public infrastructure and availability of financial market also used in the empirical model.

3. Data and Methodology

3.1 Data source

The study uses the survey data set of Vietnam Household Living Standards Surveys 2010 conducted by GSO under support of World Bank and UNDP. The data set cover around 9,000 households of 8 socio-economic regions including income and expenditures. Only 6,581 rural households are selected for analyses. The surveyed indicators are divided in eight categories including i) Household structure and demographics; ii) Education; iii) Health and health care; iv) Employment and income; v) Expenditures; vi) Durable goods; vii) Housing, electricity, water, sanitation facilities; and viii) Participation in poverty reduction programs and credit. Overall, income source of a household that could categorizes into several sources. Firstly, off-farm self-employment refers income-generating activities as processing goods for sale or providing agricultural services. Secondly, on-farm self-employment refer income-generating activities relevant to crop, livestock, aquaculture production. Thirdly, wage employment refers work for wages relevant to agricultural production and industrial/service sectors. Lastly, two remaining income sources are transfer and other incomes.
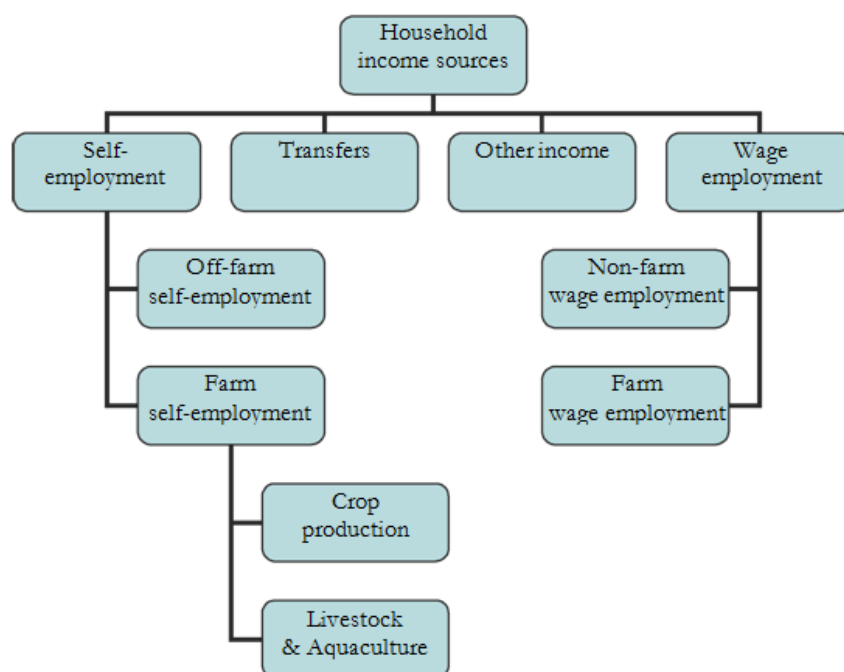

Figure 1: *Classification of household income sources in VHLSS 2010*

Source: Le (2010)

3.2 Data analysis methods

To answer first research question, we propose the data analysis procedure as below:

Step 1: we calculate income diversification Herfindahl-Hirschman index (HHI).

$$HHI = 1 - HI = 1 - \sum_{i=1}^{n} P^2$$

where p is proportion of each income source on total household income. Income diversification index is built basing on data are extracted from VHLSS 2010.

Step 2: we identify and select appropriate variables representatives for detecting determinants of income diversification of rural household. Because these variables are representatives for rural household's resources, they probably influence on household's income diversification. Other variables are used basing on experiences withdrawn from theories and empirical studies discussed in the section 2.2 above.

Step 3: we apply two-limit tobit model to analyze the determinants of income diversification. Since HHI cannot be below zero or above one, a double censored regression model, in particular a two-limit tobit model is used to analyze the determinants of income diversification. For simplicity, indices for the ith household and the jth HHI of each household in the sample are not included in the equation,

$$S^* = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n + u \quad (1)$$

$$S = \begin{cases} 0 & if \quad S^* \leq 0 \\ 1 & if \quad S^* \geq 1 \\ S^* & if \quad 0 < S < 1 \end{cases}$$

Here, X_1, X_2,…,X_n denote independent variables that have a bearing on time allocation. S^* is a latent variable indicating desired Herfindahl index while S is the observed Herfindahl index. The relationship between the observed and latent variable is provided above and u is an error term which is assumed to follow a standard normal distribution.

Since tobit model is used, a decomposition approach suggested by McDonald and Mofitt (1980) may be used to obtain the marginal effects of the independent variables on the outcome. That is, a change in an independent variable has two effects: i) it affects the conditional mean of S^* in the part of the distribution between 0 and 1; and ii) it affects the probability that the observation will fall in that part of the distribution.

To answer second research question, we try to examine the effect of diversification on household income is examined by using GMM estimators. The model specification is presented table 2 below:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_7 X_7 + \beta_8 Herfindahl-index + u \quad (2)$$

Thanks to the large number of observation, the model could avoid the multicollinearity issue. Moreover, to cope with potential endogeneity issue of Herfindahl index, choosing the plausible instrumental variables is critical. Because the presence of endogenous explanatory variables (e.g. Herfindahl index), all of estimates may be biased and inconsistent. The instrumental variable used in this step should meet two conditions: (i) instrumental variable are correlated (positively or negatively) with endogenous explanatory variable, (ii) instrumental variable are uncorrelated with the disturbance term. In this study, instrumental variable is used as number member working in non-farm activities.

The estimator applied is the generalize method of moments (GMM) because almost variables in this study is jointly endogenous. In other words, there are the two-way relationships between explanatory variables and dependent variable. Moreover, endogeneity issue could lead to inconsistent estimates.

Table 1. Model specification for determinants of household's income diversification

	Relevant variables	Variables' measurement	Expected sign
Dependent variable	Household's income diversification	Herfindahl-Hirschman index	
Independent variables			
Household features	Household education level	Average schooling year	(+)
	Number of sick person	People in sickness	
	Number of health treatment	Number per year	(+/-)
	Total cost for treatment	1000 VND per year	(+/-)
	Number of household member working non-farm	People per household	(+)
	Number of household member working for others	People per household	(+)
	Number of household member working on-farm	People per household	(-)
Land resource	Total agricultural cultivated area	1000 m^2	(+/_)
Physical asset	Housing area	m^2	(+/-)
	Mobile phone	1: if yes; 0: if none	
	Motorbike	1: if yes; 0: if none	(+)
Additional income	Having credit	1: if yes; 0: if none	(+)
	Total debt	Debt amount (1000 VND)	
Social network	Ethnicity	1: if Kinh and Hoa; 0: otherwise	(+/_)
	Relationships to public officers	1: if yes; 0: none	(+)
Regional factors	Presence of transport road	1: if yes; 0: none	(+/_)
	Presence of private factory	1: if yes; 0: none	(+)
	Presence of roadway to centers	1: if yes; 0: none	(+)
	Number of natural disaster, disease occurrence within year	number	(+)

Table 2. Model specification for detecting effect of income diversification on household income

	Relevant variables	Variables' measurement	Expected sign
Dependent variable	Log(Household's per capita average income)		
Independent variables			
Income Diversification	Household's income diversification	Herfindahl-Hirschman index	(+/-)
Household features	Household education level	Average schooling year	(+)
	Number of sick person	People in sickness	
	Number of health treatment	Number per year	(+/-)
	Total cost for treatment	1000 VND per year	(+/-)
	Number of household member working non-farm	People per household	(+)
	Number of household member working for others	People per household	(+)
	Number of household member working on-farm	People per household	(-)
Land resource	Log(Total agricultural cultivated area)	1000 m^2	(+/-)
Physical asset	Housing area	m^2	(+/-)
	Mobile phone	1: if yes; 0: if none	
	Motorbike	1: if yes; 0: if none	(+)
Additional income	Having credit	1: if yes; 0: if none	(+)
	Total debt	Debt amount (1000 VND)	
Social Network	Ethnicity	1: if Kinh or Hoa; 0: otherwise	(+/-)
	Relationships to public officers	1: if yes; 0: none	(+)

Regional factors	Presence of transport road	1: if yes; 0: none	(+/-)
	Presence of private factory	1: if yes; 0: none	(+)
	Presence of roadway to centers	1: if yes; 0: none	(+)
	Presence of waterways	1: if yes; 0: none	
	Number of natural disaster, disease occurrence within year	number	(+)

4. Empirical Findings

4.1 Determinants of income diversification

This section explores the determinants of income diversification using data of VHLSS 2010. Empirical estimates of unrestricted and restricted tobit models are presented in table 3 and 4 below.

All independent variables presented in model specification (table 1) are included in the unrestricted model (table 3), regardless multicollinearity issue among independent variables. The "general to specific" estimation strategy is employed to treat the estimates of the unrestricted model. Insignificant independent variables are excluded one by one to get the restricted model in table 4. The insignificant variables are total agricultural land area, number of disaster, number of labors working for others, and number of sick person. In Vietnam, rural households consist of both farm and non-farm ones and they often engage in a variety of non-farm activities; and the limit of agricultural land holding of farming households force households' members to look for other activities for additional earnings. Therefore, the variable total agricultural land area has statistically insignificant effect on income diversification index. The fact that variable number of disaster has no any effect on income diversification could be due to its measurement in VHLSS data set. As calculated by number of disaster occurrence within year, that variable probably does not really reflect the seriousness of disaster that forces households to diversify their income source. Meanwhile, collinearity between variable number of sick person and others as total cost of treatments might leads to its insignificant influence on income diversification index. Finally, the number of non-farm labors could be a better proxy of non-farm activities than the number of labors working for others. Hence the latter is not statistically significant.

Related to the restricted empirical model, effects on income diversification index of the estimates are statistically significant (table 4). Five variables representative for human capital of rural households positively affecting to income diversification are average schooling year, number of non-farm labors, number of on-farm labors, number of health treatments within years, and the total cost of treatment within years. These results indicate that human resource quality and quantity of households play a substantial role in directing households to diversified activities. Household's income diversification is stronger as educational level and quantity of labor increase. The positive influence of on-farm labor quantity suggests that in rural areas, households try to make best use of on-farm labor for non-farm additional activities.

In particular, the increase in number of health treatment and cost of health treatment leads to increase in income diversification. When members of households have health problems, they might have a higher likelihood to look for more diverse activities such as on-farm wage earnings for finding more financial source to cover health treatment costs, or to ease their time allocation for health treatment.

Table 3. Unrestricted model for determinants of income diversification

Dependent Variable: HHI
Method: ML - Censored Normal (TOBIT) (Quadratic hill climbing)
Sample: 1 6581
Included observations: 6571
Left censoring (value) at zero
Convergence achieved after 5 iterations
Covariance matrix computed using second derivatives

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Total agricultural cultivated area	-3.17E-08	5.23E-08	-0.607129	0.5438
Total cost of health treatment	1.45E-06	3.59E-07	4.046168	0.0001
Having credit	0.044569	0.010113	4.407144	0.0000
Housing area	-0.000223	7.06E-05	-3.162844	0.0016
Kinh or Hoa ethnics	-0.016243	0.007489	-2.168954	0.0301
Having mobile phone	-0.022293	0.006183	-3.605315	0.0003
Having motorbike	-0.026139	0.014547	-1.796838	0.0724
Number of non-farm labors	0.024775	0.003312	7.480846	0.0000
Number of disaster	0.001758	0.001316	1.335664	0.1817
Number of on-farm labors	0.061014	0.001997	30.54567	0.0000
Number of health treatment	0.000437	0.000343	1.276799	0.2017
Presence of transport road	-0.030100	0.005104	-5.897699	0.0000
Number of labors working for others	-0.001467	0.002510	-0.584486	0.5589
Presence of private factory	-0.017488	0.006171	-2.833824	0.0046
Having relationships to public officers	0.033510	0.013027	2.572315	0.0101
Presence of roadway to centers	0.048474	0.017017	2.848490	0.0044
Household educational level	0.003906	0.000992	3.939103	0.0001
Number of sick persons	0.000726	0.001013	0.717371	0.4731
Total debt	-3.18E-07	5.52E-07	-0.575914	0.5647
Constant	0.319522	0.022703	14.07387	0.0000

Error Distribution				
SCALE:C(21)	0.198960	0.001754	113.4409	0.0000

Mean dependent var	0.445801	S.D. dependent var		0.218932
S.E. of regression	0.197223	Akaike info criterion		-0.344607
Sum squared resid	254.7745	Schwarz criterion		-0.322906
Log likelihood	1153.206	Hannan-Quinn criter.		-0.337105
Avg. log likelihood	0.175499			

Left censored obs	89	Right censored obs		0
Uncensored obs	6482	Total obs		6571

Note: calculated by authors basing data extracted from VHLSS 2010

Table 4. Restricted model for determinants of income diversification

Dependent Variable: HHI
Method: ML - Censored Normal (TOBIT) (Quadratic hill climbing)
Sample: 1 6581
Included observations: 6571
Left censoring (value) at zero
Convergence achieved after 4 iterations
Covariance matrix computed using second derivatives

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Having credit	0.040448	0.007081	5.712018	0.0000
Household educational level	0.003846	0.000988	3.894150	0.0001
Housing area	-0.000225	7.04E-05	-3.201845	0.0014
Kinh or Hoa ethnics	-0.016472	0.007461	-2.207686	0.0273
Having mobile phone	-0.022275	0.006165	-3.613084	0.0003
Having motorbike	-0.026370	0.014508	-1.817537	0.0691
Number of non-farm labor	0.025099	0.003241	7.743680	0.0000
Number of on-farm labor	0.061149	0.001983	30.84047	0.0000
Number of health treatment	0.000547	0.000281	1.944315	0.0519
Total cost of health treatment	1.48E-06	3.56E-07	4.146668	0.0000
Presence of transport road	-0.030194	0.005103	-5.917103	0.0000
Presence of private factory	-0.017511	0.006155	-2.845219	0.0044
Having relationships to public officers	0.032105	0.012879	2.492892	0.0127
Presence of roadway to centers	0.046785	0.016948	2.760441	0.0058
Constant	0.324135	0.022355	14.49957	0.0000
		Error Distribution		
SCALE:C(16)	0.199010	0.001754	113.4407	0.0000
Mean dependent var	0.445801	S.D. dependent var		0.218932
S.E. of regression	0.197194	Akaike info criterion		-0.345615
Sum squared resid	254.8939	Schwarz criterion		-0.329081
Log likelihood	1151.519	Hannan-Quinn criter.		-0.339900
Avg. log likelihood	0.175243			
Left censored obs	89	Right censored obs		0
Uncensored obs	6482	Total obs		6571

Note: calculated by authors basing data extracted from VHLSS 2010

Having credit is the proxy of household financial capital. That variable positively affects to income diversification index, which suggests that credit accessibility helps to enhance household income diversification. Credit can be used for both investments in traditional income-creating activities and in new and diverse activities.

In terms of physical assets, housing area negatively affect to income diversification index. It could be due to housing area reflects types of households' main activities. Normally, farming households often have higher housing area for agricultural product drying and storage while non-farm households do not need to have big housing area for such purposes. In this sense, therefore, larger housing area probably implies farming households often have less income diversification.

The households having relationships to public officers are in advantage when such relationships can bring them better chances of income diversification. It is obviously because better social capital can help people obtain more information and social aid.

The households living in regions with better roadway to centers can obtain higher likelihood of income diversification. Improved infrastructure, especially roads to provincial and/or district centers probably open the chance of increasing non-farm activities for people.

However, the empirical estimates also show unexpected effects of some variables on income diversification index, such as having mobile phone and motorbike; household's ethnicity; presence of transport road; and the presence of private factory in the location. The situation remains unsurely explanations and raises difficult concerns. Having mobile phone and motorbike are expected to positively affect on income diversification because it means better communication and information as well as improvement of individual mobility. Similarly, the empirical estimates show that Kinh or Hoa ethnics are likely to be less diversified while in reality ethnic minorities are more subsistence-oriented and resistant to new ways of earning living because of their personalities and/or cultural values. In the same sense, when the community has transport road and private factory, the probability of income diversification reduces. It seems that impact of community infrastructure on income diversification is mixed as found in some previous studies (Haggblade, Hazell & Reardon, 2002; Reardon, 1997; Escobal, 2001; Lanjouw & Lanjouw, 2001). The contrast of these findings to the expectations is hard to interpret and hence, is considered as a limitation of this study.

4.2 The effect of income diversification on household income

This section explores the effect of income diversification on rural household income. The empirical estimates are presented in table 5 below. The used instrumental variable is number of non-farm labors. The estimator applied is GMM to cope with the potentially joint endogeneity of most variables involved. The average household income and the total area of agricultural land are taken in logarithm to measure the change impact in percentage.

As presented in the table 5, the R-squared of the empirical model is negative, therefore we lacks its conventional interpretation[1]. Nevertheless, the estimates allow to concluding that income diversification index has very strong effect on household income in rural Vietnam. This finding is consistent to both theories and previous studies like in Delgado and Siamwalla (1997). The results also show a clear positive association between average schooling year and average household income. It means households with higher educational levels enjoy higher income in general or improvement of rural education probably a good way to increase household income.

The insignificant effect of agricultural land area on household income again confirms that in rural Vietnam the legal limit of landholding does not allow rural household to increasing their income in general. Meanwhile diversifying income source though non-farm activities strongly helps to improve household income. The Kinh and Hoa households are more likely to get higher earnings than other minorities. The households living in remote areas are likely to have less income.

The estimates of community characteristics as waterway and roadway show mixed effects on household income. It might be due to the deeply differences in geographical characteristics and development level of infrastructure in rural regions of Vietnam. Nevertheless, the presence of private manufacturing sector in community tends to help increasing household income in that community.

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[1] As Wooldridge (2012) mentioned in his textbook, "Unlike in the case of OLS, the R-squared from IV estimation can be negative because SSR for IV can actually be larger than SST. Although it does not really hurt to report the R-squared for IV estimation, it is not very useful, either".

Table 5. The effect of income diversification on household income

Dependent Variable: Logarithm of Average Household Income
Method: Generalized Method of Moments
Sample: 1 6581
Included observations: 5412
Estimation weighting matrix: Two-Stage Least Squares
Standard errors & covariance computed using estimation weighting matrix
Instrument specification: NUMBER_NON_FARM WATER_WAY
    SCHOOLING_YEAR/HHSIZE C LOG(AGRICULTURAL_LAND_AR
    EA) KINH_HOA SICK_PERSON ROADWAY REMOTE_AREA
    ROADWAY_CENTER PRIVATE_SECTOR

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	6.754041	0.246434	27.40714	0.0000
HHI (instrumental variable)	3.409584	0.611386	5.576814	0.0000
Household educational level	0.067701	0.005387	12.56678	0.0000
Logarithm of total agricultural land area	-0.001722	0.015489	-0.111164	0.9115
Kinh or Hoa ethnics	0.532778	0.052723	10.10517	0.0000
Number of sick persons	0.005617	0.004337	1.295117	0.1953
Presence of transport roadway	0.084188	0.045494	1.850523	0.0643
Remote area	-0.095708	0.033213	-2.881642	0.0040
Presence of roadway to centers	-0.228518	0.105709	-2.161772	0.0307
Presence of private factory	0.240413	0.034724	6.923537	0.0000
Presence of waterway	0.176212	0.045560	3.867666	0.0001

R-squared	-1.067429	Mean dependent var	9.240667
Adjusted R-squared	-1.071257	S.D. dependent var	0.673004
S.E. of regression	0.968578	Sum squared resid	5066.908
Durbin-Watson stat	1.519973	J-statistic	17.21897
Instrument rank	12	Prob(J-statistic)	0.000033

Note: calculated by authors basing data extracted from VHLSS 2010

5. Conclusion and Recommendation

The results show some important findings about determinants of income diversification, and the effect of income diversification on rural household income. Human capital in both quantity and quality dimensions plays a substantial role in encouraging rural households to diversify their income-created activities. Rural households with higher education level, more diversification ability tend to be more diversified in income source. Owning better financial capital or credit accessibility and social capital helps rural households improve income diversity.

The study result also confirms that income diversification is the dynamics of rural income. Households can increase their income through diversify their activities in both farm and non-farm.

The study has faced difficulty in interpreting unexpected effects of some factors. In particular, infrastructure seems to have mixed effects on both income diversification and household income in rural Vietnam. It is likely that regional features have potentially influences on differences in infrastructure investment and development level in rural Vietnam. Therefore, variables indicating regional characteristics should be considerately employed to improve validity of empirical estimates.

The findings lead to policy implications that better providing fair educational and healthcare services in rural is significant solution to support income diversification and increase household income via human capital improvement. Policy that helps diversifying sources and increasing volume of rural credit and easing accessibility to credit is promising to increase diversification and income of rural household. Although effect of better infrastructure in rural areas on income is not well confirmed but we believe that they are basic physical facilities to serve for better educational and healthcare services and support generation of non-agricultural activities as well.

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