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**Min Chau Tran, Christopher Gan & Baiding
Hu**

Lincoln University, Canterbury, N.Z.

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Credit Constraints and Impact on Farm Household Welfare: Evidence from Vietnam's North Central Coast region

Minh Chau Tran¹, Christopher Gan² & Baiding Hu³

Abstract: *This study aims at identifying factors affecting formal credit constraint status of rural farm households in Vietnam's North Central Coast region (NCC). Using the Direct Elicitation method (DEM), we consider both internal and external credit rationing. Empirical evidences confirm the importance of household head's age, gender and education to household's likelihood of being credit constrained. In addition, households who have advantages in farm land size, labour resources and non-farm income are less likely to be credit constrained. Poor households are observed to remain restricted by formal credit institutions. Results from the Endogenous Switching Regression model suggest that credit constraints have negative impact on household's consumption per capita and informal credit can act as a substitute to mitigate the negative influence of formal credit constraints.*

Keywords: *Credit constraint, determinants, impact, welfare, rural households*

¹ Master Student, Faculty of Commerce, Lincoln University, Christchurch, New Zealand, Tel: 64-3-423-0287, Email: tranminhchau.na@gmail.com

² Corresponding Author, Professor, Faculty of Commerce, Lincoln University, Christchurch, New Zealand, Tel: 64-3-423-0337, Email: Christopher.Gan@lincoln.ac.nz.

³ Senior Lecturer, Faculty of Commerce, Lincoln University, Christchurch, New Zealand, Tel: 64-3-423-0231; Email: Baiding.Hu@Lincoln.ac.nz

1. INTRODUCTION

At the end of 2011, approximately 68% of Vietnam population lives in the rural area (GSO, 2012b), with 67.83% of the households lives on the farm. The poverty rate in the rural area is much higher than the urban area (14% compared to 3% (GSO, 2012b)). As savings in rural Vietnam is low (average 6.7 million Vietnam dong¹ (VND) per household annually (GSO, 2012a)), credit is considered to be an essential resource to improve farm household welfare and production. However, similar to many developing countries, Vietnam rural farm households are usually excluded by formal financial institutions due to high transaction cost and asymmetry information (Hoff & Stiglitz, 1990; Jaffee & Stiglitz, 1989). In addition, lack of collateral, weak credit contract enforcement and underdevelopment of insurance service discourage formal financiers to serve this market segment (Ghosh, Mookherjee, & Ray, 2000). In order to meet credit demand of rural households at affordable interest rate, the government subsidizes formal credit supply through three organizations namely the

¹ 6.7 million Vietnam dong is equal to 319 USD

Vietnam Bank for Agriculture and Rural Development (VBARD), Vietnam Bank for Social Policies (VBSP) and People's Credit Funds (PCF). In spite of the government's effort to expand subsidized credit institutions rapidly in recent years with the aim to combat poverty, many farm households remain constrained from formal credit and are forced to borrow from informal lenders (Barslund & Tarp, 2008; Dufhues & Buchenrieder, 2005; Nguyen, 2008; Pham & Izumida, 2002).

Despite the importance of formal credit to farm household outcomes in Vietnam, there are limited studies focusing on determinants of credit constraints and their impacts. To the best of our knowledge, there is no study evaluating the impact of credit constraints on rural farm household welfare particularly in Vietnam. In addition, the studies related to credit constraints only considered full quantity rationing (households applied for the loan and then were rejected), omitting the case of partly quantity rationing (loan obtained by the borrowers is less than their demand) and self-rationing.

This paper aims to identify the factors determining credit constraints in rural North Central Coast region of Vietnam (NCC). The study also examines the impact of credit constraints on farm household welfare in the studied region. The remaining of the paper is organized as followed: Section 2 reviews related literature. Section 3 describes the data obtained from the household survey conducted in NCC region. Econometric models and empirical results are presented in Section 4. Conclusion and policy implications are discussed in Section 5. The last Section highlights the limitations of the study.

2. LITERATURE REVIEW

2.1. Factors affecting credit constraints

Studies on determinants of credit constraints focus on three groups of factors namely characteristics of household head, household characteristics and geography related factors.

2.1.1. Characteristics household head

The most frequent household head related variables used to explain household's credit constraint status are age, gender and education. Empirically, previous studies show mixed results of the impact of age and gender on likelihood to be credit constrained. Freeman, Ehui, and Jabbar (1998) and Jia et al.(2010) find a negative relationship between age and probability of being credit constrained which is consistent with Barslund and Tarp (2008) in the case of Vietnam; Baiyegunhi et al. (2010) and Chaudhuri et al.(2011), show the inverse result. Similarly, the expected effect of gender on credit constraints is theoretically ambiguous. On one hand, male-headed households seem to have higher demand for credit (Mpuga, 2010) since they have better access to production resources, but they are disadvantaged to approach subsidized credit which is often in favour of women, therefore, they are more credit constrained. On the other hand, they are more self-financed than their female counterparts (Franklin, Diagne, & Zeller, 2008). Nevertheless, empirical studies show that male is more likely to be credit constrained (Barslund & Tarp, 2008; Chaudhuri & Cheral, 2011; Freeman et al., 1998; Zeller, 1994).

Education of household head is expected to improve the accessibility to formal credit since more educated farmers are believed to allocate credit more efficiently (Barslund & Tarp, 2008; Jia et al., 2010; Pham & Izumida, 2002). Surprisingly, households studied by Zeller (1994) are more credit constrained when they have more years of formal education. It may be due to the fact that the purpose of subsidized loan is for disadvantaged and illiterate households (Franklin et al., 2008)

2.1.2. Characteristics of households

Characteristics of households influencing household's constraint status can be categorized in four groups: physical capital related factors, human capital related factors, social capital related factors and economic related factors.

Physical capital can reduce the probability of being credit constrained since it can be used as collateral to minimize repayment default and evidence of household production capacity. Land title, land area, value of house, asset and livestock are popular indicators for physical capital. In general, households having land title are less likely to be credit constrained (Baiyegunhi et al., 2010; Boucher, Guirkinger, & Trivelli, 2009; Foltz, 2004), but the effect of land area is ambiguous. In some countries, farm land cannot be used as a collateral for example in China (Jia et al., 2010), thus, land area may have positive, negative, or no effect on credit constraints, depending on its effect on demand for credit. Foltz (2004) argues that land title can loosen credit restriction, but land area has insignificant effect. In China, Peru and Malawi, more farm land area means higher propensity to be credit rationed (Boucher et al., 2009; Jia et al., 2010) which is also reported in Petrick's (2004a) study on the effect of rented land. On the contrary, Reyes (2011) and Omonona et al. (2008) find the contributory effect of land area to ease credit rationing. Both land area and land use right (red book) in Vietnam have insignificant effects on the bank's decision to provide credit (Barslund & Tarp, 2008; Pham & Izumida, 2002).

Asset (including wealth) could be a proxy for household's physical capital. It is expected that households possessing more valuable asset are less dependent on credit and have more capacity to repay debt, therefore, are more likely to be credit unconstrained (Baiyegunhi et al., 2010; Boucher et al., 2009). Depending on the studied area, indicators for asset include availability of durable assets (Fenwick & Lyne, 1998), age of collateral assets (Petrick, 2004a), value of durable or total asset (Baiyegunhi et al., 2010; Boucher et al., 2009; Chaudhuri & Cheral, 2011) or weighted average durable asset (Winter-Nelson & Temu, 2005). Pham et al. (2002) and Barslund (2008) find insignificant effect of total asset value on lending decision of financial institutions in Vietnam. This independent relationship can be explained by the weak enforcement of credit contract in Vietnam that makes physical collateral become an ineffective screening device. Some physical capital related indicators represent production capacity rather than collateral value such as herd size or farm size also significantly affect credit restriction (Freeman et al., 1998; Kuwornu, Ohene-Ntow, & Asuming-Brempong, 2012).

Indicators for human capital include household size, dependency ratio, number of labours, number of males, and number of females. Families with higher number of persons are expected to have high consumption expenditures which decrease available capital to production and increase their dependence on credit; while the

effect of family size on supply side is vague. Therefore, households with larger family size are more inclined to be credit constrained (Chaudhuri & Cheral, 2011; Kuwornu et al., 2012). Other studies pay attention on dependency ratio on which the hypothesized sign is unanticipated. Empirically, this variable can have a negative (Pham & Izumida, 2002) or positive effect (Freeman et al., 1998) on the accessibility to formal credit. Instead of using dependency ratio, some studies separately examine the effect of the number of dependents and adults or labours on credit constraints (Barslund & Tarp, 2008), while some separate the effect of male and female labours (Boucher et al., 2009; Petrick, 2004a; Simtowe, Diagne, & Zeller, 2008). It is reported that families with more adults are more likely to be credit constrained as they have higher demand for credit, but the effect of male and female labours are mixed. While households with more female labours experience a difficulty in attracting credit in Petrick's (2004a), Simtowe et al.'s (2008) study concludes more male labours increase the likelihood of being credit constrained.

In the areas where training programs are available to support farmers to enhance their farm production, participation of farmers in these programs become an important factor. Participants in these programs have a higher probability to obtain credit since they are expected to be more productive (Reyes, 2011). Surprisingly, Freeman et al. (1998) demonstrates opposite finding, but the unexpected result was not explained by the authors.

Social capital plays a crucial role in determining the success of households to attain credit, especially when physical collateral becomes ineffective loan screening device. Social capital can be divided into three types: the social status of household in community, the relationship of household with financial institutions and social group participation. Reputation, social status or entitlement in community (Jia et al., 2010; Pham & Izumida, 2002) is hypothesized to increase households' accessibility to formal credit. The good relationship with financial institutions measured by the length of relationship with banks (Reyes, 2011), connections with bank official (Barslund & Tarp, 2008) or savings account in banks (Gershon, Lau, Lin, & Luo, 1990) repayment history (Barslund & Tarp, 2008; Chaudhuri & Cheral, 2011). Participation in social groups reduces the probability of being rejected by the financial institutions since it decreases transaction cost to screen the household's creditworthiness (Reyes, 2011; Winter-Nelson & Temu, 2005). Dinh, Dufhues, and Buchenrieder (2012) use four indicators, such as strong and weak ties to persons of similar social standing (for example friends and family) and strong and weak ties to persons of higher social standing (for instance local authority) to measure household's social capital in Vietnam. However, none of these indicators is found to have any effect on the likelihood that farm households are credit constrained.

Economic indicators such as income and expenditure are found to have significant effects on credit constraints in previous studies (Foltz, 2004; Gershon et al., 1990; Kuwornu et al., 2012). Barslund and Tarp (2008) and Freeman et al. (1998) study the effect of production expenditure on credit constraints but only Barslund and Tarp's (2008) study shows significant positive relationship between expenditure on livestock feed and credit constraints. A major concern with these studies is the endogenous problem as credit constraints are proven to have impact on income and expenditure (Baiyegunhi et al., 2010; Li & Zhi, 2010). Other studies pay attention to the ratio of debt to income which is reported to curtail the probability that households

can obtain formal credit (Baiyegunhi et al., 2010; Zeller, 1994).

It is believed that the main sources of households' income are correlated with their credit constraint status. Economic activities which are prioritized by government, more familiar to financial institutions and less risky increase the opportunity for households to obtain loan. Jia et al. (2010) and Chaudhuri and Cheral (2011) illustrate that households who are more dependent on farming is less likely to fall in the credit constraint category since farming is prioritized by the government. On the contrary, Stampini and Davis's (2009) study shows that non-agricultural income reduces the dependence of farm households on credit, thus, relax credit constraints. The fluctuation of farm yields (Boucher et al., 2009), changes in agricultural product prices (Winter-Nelson & Temu, 2005), and engagement with atypical crops (Reyes, 2011) can aggravate credit constraints.

2.1.3. Geography related factors

According to Boucher et al. (2009) and Winter-Nelson and Temu (2005), distance to market or formal lenders increases transaction cost on households, therefore, exacerbates credit constraints. In addition, Barslund and Tarp's (2008) and Foltz's (2004) studies show that credit constraints are also determined by activeness of local credit institutions and local production development. Barslund and Tarp's (2008) study indicates that in Vietnam, in the areas where formal credit is more prevalent, households are less likely to be credit constrained. However, there is a concern that the result suffers from simultaneity as lower probability of being credit constrained attaches the households to formal credit.

2.2. Impact of credit constraints on household outcomes

Studies on the impact of credit constraints on household outcome predominantly focus on household productivity, investment and welfare. In term of household welfare, Dong, Lu, and Featherstone (2010), Li and Zhi (2010) and Kumar, Turvey, and Kropp (2013) indicate that credit constraints are detrimental to household income. Furthermore, credit constraints are attributed to decrease in household consumption. Credit constrained households suffer from a loss of 15.8% and 18.2% in consumption expenditure in Li and Zhi's (2010) and Li, Li, Huang, and Zhu's (2013) studies, respectively. The results are consistent with Zeldes (1989), Phimister (1995), Baiyegunhi et al. (2010) and Kumar et al. (2013) findings. Although the importance of credit especially microfinance to Vietnam rural households has been confirmed by many studies (see Nghiem, Coelli, & Rao (2012); Nguyen, Bigman, Van den Berg, & Vu (2007); and Phan (2012)), to the best of our knowledge, there is no study examining the impact of credit constraints on household outcomes.

3. DATA

The survey at household level was conducted in three provinces out of six provinces in the North Central Coast region. The sample households were selected using multi-staged stratified random sampling technique. In the first stage, three provinces namely Ha Tinh, Nghe An and Thua Thien Hue which are representatives of low, medium and high income per capita groups, respectively were chosen. In the next stage, two districts from Nghe An (Yen Thanh and Thanh Chuong) were selected

while only one district was selected from Thua Thien Hue (Huong Thuy) and Ha Tinh (Thach Ha) as we would like to compare the likelihood of being credit constrained among households in the same and different provinces. From the lists of communes² provided by the District People Committees, a commune from each district was also randomly selected. However, communes where there is no agriculture activity were excluded from the random lists. In the final stage, the sample households were randomly selected from the list of households provided by Commune People Committee and only farm households were included in the list. A total of 550 households were interviewed, yielding 479 usable questionnaires.

3.1. Credit constraints in the studied area

Table 1: Reasons for Household's formal credit constraint condition

Description	Credit application status		Total
	Households who applied for formal credit	Household who did not apply for formal credit	
Number of respondent households	310 (64.72%)	169 (35.38%)	479 (100%)
Number of credit constrained households	142 (29.65 %)	52 (10.86 %)	194 (40.5%)
Reason for formal credit constraints:			
• Constrained non-borrowers and reason		52 (10.86 %)	
- Administrative difficulties to process loan		40 (8.35%)	
- Fear of being rejected		12 (2.5%)	
• Rejected borrowers and reason	53 (11.06%)		
- Rejected due to lack of collateral	37 (7.72%)		
- Other reasons	16 (3.34%)		
• Non-rejected borrowers who received insufficient amount and reason	89 (18.58%)		
- Lack of collateral	17 (3.55%)		
- The amount requested exceeded limitation set by the bank	62 (12.94%)		
- Reason other than those sited above	10 (2.09%)		

Source: Author's calculations from the household survey

To identify credit constrained and unconstrained households, we applied Direct Elicitation method suggested by Boucher et al. (2009). According to the household's survey response, there are 310 households (64.72% of total surveyed households) applied for credit from formal source, in which 53 households were rejected by formal institutions. The main reason for rejection is lack of collateral (70%). Among

² Commune is the lowest administrative unit in Vietnam which is a subdivision of a district.

the 257 households who successfully obtained the loan, the survey result shows 89 households did not receive sufficient amount of loan mainly because of bank's limitation (62 households) and lack of collateral (17 households). Further 169 households who did not apply for formal credit, 52 households reported that they had demand for formal credit but they did not apply due to either administrative difficulties to process the loan (40 households) or fear of rejection (12 households) while the remaining households had no demand for formal credit. Based on the information provided by the households, 194 households are categorized to be credit constrained, accounting for 40.5% of total surveyed households, in which 40 households are considered to be transaction cost constrained, the remaining are quantity constrained. No household is identified to be risk constrained. This may be due to the fact that in rural Vietnam, when the households fail to pay their debts on due date, banks prefer to restructure their loans rather than to foreclose the household's property because their property has low liquidity.

3.2. Descriptive statistics of surveyed households

The characteristics of surveyed households are presented in Table 2 (Appendix). Majority of household heads are male accounting for 79%. It is common in rural Vietnam that males usually make important decisions since they are the main income earners and head of the household. Most of the respondents are married, belong to the age group of 35 to 55 years old and have middle school degree as the highest education attainment. The typical households consists of 5 members with 3 children. Although all respondents are engaged in at least one farming activity, only 60% of respondents consider it as the main occupation. The average size of household's farm land is 0.36 ha and their annual income reaches 58.68 million VND. Mean of household consumption per capita is 10.6 million VND. 20% of respondents are certified as the poor.

4. METHODOLOGY AND EMPIRICAL RESULTS

4.1. Model for identifying determinants of credit constraints

Since the dependent variable in the model for identifying determinants of credit constraints is binary, either logit or probit model is preferred to linear probability because the latter model cannot assure the probability value is in the range between 0 and 1 (Hill, Griffiths, & Lim, 2011). The difference between logit and probit model is the assumption of random term distribution. The error term in logit model is assumed to have cumulative distribution while normally distributed in probit model (Greene, 2003). In this study, we choose logit model because of its simplicity and the availability of odds ratios which is not the case with probit model. Since our survey covers both credit constrained borrowers and credit constrained non-borrowers, selectivity bias is not a major concern, thus we do not need to apply two stage procedure suggested by Heckman (1979). According to Wooldridge (2002), the use of two stage procedure in this case results in large standard errors.

The credit constraint condition of the borrower i is defined by:

$$\begin{aligned} CC &= 1 \quad \text{if } CC = \alpha Z_i + \varepsilon_i > 0 \\ CC &= 0 \quad \text{otherwise} \end{aligned} \tag{1}$$

CC is credit constraint status of a household which is equal to 1 if household is credit constrained, zero otherwise; Z is a vector of household head, household and geography characteristics; ε is error term; α is parameter to be estimated. The probability a household is credit constrained or $CC = 1$ can be written as:

$$\text{Prob}(CC = 1) = \Lambda(\alpha Z_i) = \frac{1}{1 + e^{-(\alpha Z_i)}} = \frac{\exp(\alpha Z_i)}{1 + \exp(\alpha Z_i)} \quad (2)$$

And the probability that household is credit unconstrained or $CC = 0$ is:

$$1 - \text{Prob}(CC = 1) = \frac{1}{1 + \exp(\alpha Z_i)} \quad (3)$$

4.2. Model for measuring the impact of credit constraints on household welfare

With regards to the impact of credit constraints measurement on household welfare, endogenous switching regression model (ESRM) is applied to address the possible selection bias issue. The choice of ESRM is supported by Kiefer (1978), Poirier and Ruud (1981), Maddala (1983a) and Mare and Winship (1987). The model is also used in previous studies to evaluate the impact of credit constraints (Baiyegunhi et al., 2010; Dong et al., 2010; Foltz, 2004; Freeman et al., 1998).

According to Maddala (1983b), the usual exclusion restrictions or instrumental variables are not required in ESRM when there are enough observations in selection equation, but there should be at least one exogenous variable excluded from the outcome equations so that the parameters of outcome equations can be identified. However, Hamilton and Nickerson (2003) suggest the use of instrumental variables since in the absence of such instrumental variables the model still suffers from bias caused by unobserved factors. The problem is how we can evaluate the appropriateness of instrumental variable when there is lack of available tests for the validity of instrumental variables specified for ESRM. In García Pérez and Rebollo Sanz (2005) and Neal (1995) studies, the authors only can test the strength of instrumental variables by Likelihood ratio test. Further García Pérez and Rebollo Sanz (2005) admit the lack of over-identification test. To the best of our knowledge, there is no study conducting the test for the exogeneity of instrumental variables particularly for two step switching models.

The ESRM can be expressed as follow (Maddala, 1983a):

$$Y_{1i} = \delta_1 X_{1i} + \varepsilon_{1i} \quad \text{iff} \quad CC = 1 \quad (4-1)$$

$$Y_{0i} = \delta_0 X_{0i} + \varepsilon_{0i} \quad \text{iff} \quad CC = 0 \quad (4-2)$$

Where Y_{1i} and Y_{0i} represent welfare function of credit constrained and unconstrained households respectively; δ_1 and δ_0 are vectors of parameters; ε_{1i} and ε_{0i} are error terms. In the case of selection bias, the expected value of the error terms ε_{1i} and ε_{0i} are different from zero, leading to inconsistent estimates from the OLS estimation. As suggested by Lee (1978), a two stage methods is used where expected values of the error terms ε_{1i} and ε_{0i} are:

$$E(\varepsilon_{1i}|\varepsilon_i) = E(\sigma_{1\varepsilon}\varepsilon_i|\varepsilon_i \leq \alpha Z_i) = -\sigma_{1\varepsilon} \frac{\phi(\alpha Z_i)}{\Phi(\alpha Z_i)} \quad (5)$$

$$E(\varepsilon_{0i}|\varepsilon_i) = E(\sigma_{0\varepsilon}\varepsilon_i|\varepsilon_i \geq \alpha Z_i) = \sigma_{0\varepsilon} \frac{\phi(\alpha Z_i)}{1-\Phi(\alpha Z_i)} \quad (6)$$

Where ϕ , Φ are the probability density function and the cumulative distribution function of the standard normal, respectively. $\widehat{\alpha Z}_i$ is fitted value of CC calculated by estimating equation (1). The ratio ϕ/Φ in equation (5) and (6) is inverse Mills ratio terms, which can be written as:

$$\lambda_{1i} = \frac{\phi(\alpha Z_i)}{\Phi(\alpha Z_i)} \quad \lambda_{0i} = \frac{\phi(\alpha Z_i)}{1-\Phi(\alpha Z_i)} \quad (7)$$

Substituting equation (7) into equation (4-1) and (4-2) yields:

$$Y_{1i} = \delta_1 X_{1i} - \sigma_{1\varepsilon} \lambda_{1i} + v_{1i} \quad \text{iff } CC = 1 \quad (8-1)$$

$$Y_{0i} = \delta_0 X_{0i} + \sigma_{0\varepsilon} \lambda_{0i} + v_{0i} \quad \text{iff } CC = 0 \quad (8-2)$$

Where v_{1i} and v_{0i} are new error terms with zero expected value. Equation (8-1) and (8-2) are estimated by weighted least squares as v_{1i} and v_{0i} are heteroscedastic.

4.3. Empirical results

4.3.1. Determinants of credit constraints

Table 2 describes the explanatory variables used in the logit model. The VIF test (mean VIF=1.48) confirms the absence of multicollinearity from the model. High p value (p=0.81) obtained from Hosmer-Lemeshow's goodness of fit test indicates the model is well-fitted with the data (Janosz, LeBlanc, Boulerice, & Tremblay, 1997). The percentage of observations that are correctly predicted by the model is 77.36% (PCP =76.36). The likelihood ratio test (LR test) with $\chi^2(12)=215.45$ indicates that the model as a whole is significant at 1% level. Marginal effects were estimated only for continuous variables since they may not be meaningful for discrete variables (Greene, 2003).

Table 3 shows the significant effect of gender, age, education, demanded size of loan, size of farm land, labour ratio, off-farm labour, poor certificate and one geography dummy variable on the household's likelihood of being credit constrained.

All three characteristics of household head have significant effect on household credit constraint condition. The significantly negative effect of age on household's credit constraint status indicates that household heads who are older than 55 have lower propensity of being credit constrained. It may be due to the fact that older farmers often accumulate enough capital and they are less likely to invest. The result is supported by findings of Barslund and Tarp (2008). Our result also indicates that female household head are more likely to be credit constrained than their male counterparts. The odds ratio of 0.46 implies that the odds that female-headed households are credit constrained is 2.17 times (1/0.46) higher than their male

counterparts. Similarly, the odds that household heads who obtained high school degree or higher are credit constrained is 1.82 times lower than those who only obtain secondary or primary school.

The influence of human capital on the likelihood of being credit constrained is confirmed by the significant effect of labour ratio and number of off-farm labours on household's credit constraint condition. The result is consistent with Petrick's (2004b) study, which indicates that households having income earner advantages are more likely to receive sufficient loans.

Table 3: Logit model for credit constraint determinants

Variable	Coefficient	T-ratio	Odd Ratios	Marginal effect
GENDER	-0.775	2.56*	0.46	
AGE_55PLUS	-1.160	3.04**	0.31	
HIGH_EDU	-0.590	1.99*	0.55	
DEMANDDUM	2.316	8.47**	10.13	
LANDSIZE	-0.072	2.27*	0.93	-0.016
INRATIO	-0.207	2.18*	0.81	-0.046
LARATIO	-1.886	2.59**	0.15	-0.426
OFFFARM	-0.627	3.03**	0.53	-0.141
POOR	0.753	2.30*	2.12	
VANTHANH	0.444	1.29	1.55	
THACHTIEN	0.231	0.60	1.26	
THUYTHANH	0.888	2.17*	2.43	
Constant	1.599	2.54*	4.95	
Number of observation	477			
Likelihood ratio	215.45**			
Pseudo R ²	0.3347			
PCP	77.36			
EPCP	70.60			

*Note: ** and* denotes significance at 1% and 5% level respectively; PCP is an abbreviation for percentage correctly predicted; EPCP is an abbreviation for expected percent correctly predicted.*

The effect of farm land area is found to be negative and significant at 5% level, indicating that households possessing larger farm land size have more advantages to approach formal credit. It is important to emphasize that in the case of Vietnam, farm land is an indicator for production capacity rather than being treated as collateral.

The negative relationship between ratio of non-farm income to farm income and the propensity to be credit constrained implies that the more the family depends on farm income, the more likely they are credit constrained. This finding supports Stampini and Davis's (2009) results uncovering that non-agricultural income reduces the dependence of households on credit, thus, relax credit constraints in rural Vietnam.

In term of geography variables, our survey covers four areas THANHCHUONG and YENTHANH (belongs to Nghe An), THACHHA (Ha Tinh) and HUONGTHUY (Thua Thien Hue). As THANHCHUONG has a higher poverty rate than HUONGTHUY, but lower poverty rate than THACHHA, and the same provincial location with YENTHANH, it is used as the reference geography dummy variable in

the logit model. The results in Table 3 show that only HUONGTHUY is significantly different from the reference location. This means the households living in low poverty rate communes find it more difficult to access to formal credit since disadvantaged areas are often prioritized by subsidized institutions.

Although the poor is considered the target group of subsidized credit, they are more likely to be credit constrained than non-poor households. The odds ratio of 2.12 indicates that the odds that poor households are rationed is 2.12 times higher than their non-poor counterparts. This supports the findings of Nguyen (2008) who postulates that poor households are more likely to be excluded by formal financial institutions.

We add the demand dummy variable which is equal to 1 if households need to borrow more than 30 million VND and 0 otherwise with the aim to test whether the limitation of loan size at 30 million VND set by the Vietnam Bank for Social Policies can meet the farm household's demand for credit. The significantly negative relationship between this variable and credit constraint status (at 1% level) reveals that subsidized credit only satisfy partially farm household's demand for credit. In addition, if the household's demand exceeds 30 million VND their odds of being credit constrained is 10.13 times higher than those whose demand is lower than 30 million VND (see Table 3).

The marginal effects presented in Table 3 uncover that among the factors affecting household's credit constraint condition, human resources may be the most important determinants since labour ratio and number of off-farm labours have strongest marginal effects on probability of being credit constrained while the marginal effects of farm land size and income ratio are modest.

4.3.2. The impact of credit constraints on household welfare

Table 4 shows the results obtained from the endogenous switching regression model (Equation 8-1 and 8-2). Consumption per capita is chosen to be the indicator for household's welfare. The choice of this proxy follows the recommendation of Ravallion (1992) and Coudouel, Hentschel, and Wodon (2002). Consumption per capita is measured in logarithm which fits the data better in the consumption function (Campbell & Deaton, 1989). Wald test confirms the significance of all regressors except the constant. The likelihood ratio test (LR test) with $\chi^2(2) = 5.04$ which is significant at 10% level indicates that the endogenous switching model is better than the exogenous model. Furthermore, the significance of ρ_1 implies that the sample may suffer from selection bias and OLS estimation would results in biased estimates. Since ρ_1 is negative and significant at 1% level, we can conclude that credit constrained households have lower consumption per capita than a random household. The positive sign of ρ_0 suggests that credit unconstrained household have higher consumption per capita than a random household, however the coefficient is insignificant and thus inconclusive.

The predictors of consumption per capita are generally the same in the case of credit unconstrained and constrained households in terms of significance and sign except for the variable INFORMAL appearing only in the consumption equation (8-1) of credit constrained households. The negative significant effect of this variable on consumption per capita implies that credit constrained households who received sufficient amount of credit from informal sources can improve their consumption per capita by 8.4% (Table 4).

Table 4: Impact of credit constraints on household's consumption per capita

Variable name	Credit unconstrained		Credit constrained	
	Coefficient	t-statistic	Coefficient	t-statistic
POOR	-0.134	3.84***	-0.174	6.16***
LANDSIZE	0.016	4.20***	0.019	2.60***
HH_SIZE	-0.104	10.21***	-0.133	10.99***
LARATIO	0.289	4.59***	0.271	3.03***
INRATIO	0.011	2.38 **	0.020	1.32
GENDER	-0.025	0.76	0.043	1.59
AGE_55PLUS	-0.011	0.47	-0.030	0.70
HIGH_EDU	0.031	1.38	0.018	0.60
CHILDSTU	0.132	6.12***	0.245	8.96***
OFFFARM	0.088	5.48***	0.125	5.28***
YENTHANH	0.079	2.52 **	-0.015	0.42
THACHHA	0.063	2.18**	0.070	1.65
HUONGTHUY	0.066	2.43**	-0.024	0.60
INFORMAL			-0.084	3.63***
Constant	2.415	28.47***	2.508	27.01***
$\sigma_{0\varepsilon}$	0.150	(23.44)***		
$\sigma_{1\varepsilon}$	0.158	(12.85)***		
ρ_0	0.0892	(0.315)		
ρ_1	-0.617	(3.53)***		
Log likelihood	24.58			
Wald test	441.84***			
LR test	$\chi^2(2) = 5.04^*$			

Note:; ***, ** and * denote significance at 1%, 5% and 10% level respectively; figures in parenthesis are t-ratios; $\sigma_{0\varepsilon}$ and $\sigma_{1\varepsilon}$ are the square root of the variances of the residuals of consumption per capita models; ρ_0 and ρ_1 are correlation between error terms of credit constraint condition equation and equations of consumption per capita of credit unconstrained households and constrained households, respectively.

Table 4 also shows the difference in the significance of income ratio variable and geography variables between the consumption equations of credit constrained and unconstrained households. The insignificant effect of income ratio variable on consumption per capita of credit constrained households implies that for constrained families, the role of non-farm income in improving household welfare is negligible. This could be due to the lack of credit and income generated from non-farm activities become instable, thus, leading to the minor change in consumption. Regarding geography variables, the significance of three dummy variables in credit unconstrained household's consumption model reflects the deviation in living standard between THANHCHUONG and the three remaining locations. However, there is no difference among consumption per capita of credit constrained households of THANHCHUONG and other locations. The lack of credit may be the reason that prevents households from utilising location advantages.

Noticeably, an addition member in credit constrained households reduces consumption per capita by 13.3% while in the case of credit unconstrained households is only 10.4%. Children's tertiary expenditure is also a bigger burden for credit constrained households than credit non-constrained households. The presence of children studying at tertiary level increases the consumption per capita of credit constrained households by 24.5%, but only 13.2% in the case of credit unconstrained households (see Table 4).

Consumption per capita of poor households is lower than their non-poor counterparts in the credit constrained group by 17.4% while the difference in consumption per capita between poor and non-poor households in credit unconstrained group is only 13.4% (see Table 4). In other words, sufficient credit contributes to narrow the welfare gaps between the poor and non-poor households.

5. CONCLUSION

Using the Direct Elicitation method, our survey uncovers more than 40% of rural farm households in the Vietnam's North Central Coast region are credit constrained by formal credit institutions. Quantity constraint accounts for the highest proportion of the cases, followed by transaction cost constraint. No case of risk constraint was reported. The empirical evidences reveal that young and less educated households with female head are less likely to receive sufficient loan from formal financial institutions. Similarly, farm land size, labour resources and non-farm income play an important role to relax household's credit constraint status. The findings also raise the concern that subsidized credit allocation favours better off households but farm households in wealthier areas have disadvantages to obtain subsidized credit. The maximum loan size offered by the formal financial institutions is still lower than the household's actual demand. Moreover, our results clearly showed that credit constraints have negative impact on the household welfare in the North Central Coast region and this impact can be alleviated by informal credit.

Our results recommend that apart from enhancing credit allocation regime, the government should focus on improving the households' education and developing non-farm economic activities in rural areas which not only ease formal credit restriction but also promote household welfare. It is also important that policy makers and formal financial institutions pay more attention on finding relevant credit policy for the poor and disadvantaged households in lower poverty rate communities to assure that they can receive sufficient loan for production and consumption. The limitation of loan size set by Vietnam Bank for Social Policies need to match with the actual households' demand because if the households cannot access to sufficient credit, loan efficiency would be reduced. Relaxing credit constraints is essential not only to enhance the household welfare but also narrow the welfare gap between the poor and non-poor households. The substitute effect of informal credit on the household welfare supports the idea about the integration of two credit sectors into one well-functioning market as documented in Phan, Gan, Nartea, and Cohen (2013) study. Since our study covers only small sample size, some implications are only applicable for NCC region.

6. LIMITATIONS OF THE STUDY

One limitation arises from the usage of the Direct Elicitation method to identify credit constrained households. The method cannot detect effective and ineffective constraints. Another limitation is the inability of cross section data to capture long term impacts of credit constraints on household welfare. Finally, causes of credit constraints from the lender's view cannot be observed.

APPENDIX

Table 2: Definition of variables and descriptive statistics

Variables	Description	Mean	S.D.
CONSTRAINED	1 if household's credit constrained, 0 = unconstrained	0.40	0.49
GENDER	1 if household head is male, 0 = female	0.79	0.40
AGE_35	Household head is less than 35	0.09	0.29
AGE_45	Household head's age is between 35-45	0.34	0.48
AGE_55	Household head's age is between 45-55	0.37	0.48
AGE_55PLUS	1 if household head is older than 55; 0 = otherwise	0.19	0.39
MARRIED	1 married households, 0 = otherwise	0.91	0.28
PRI_EDU	Primary school as highest level of education	0.08	0.28
MID_EDU	Middle school as highest level of education	0.68	0.47
HIGH_EDU	High school degree or higher	0.24	0.42
OCCUPATION	1 if household's main occupation is farm, 0 = otherwise	0.60	0.49
DEMANDDUM	1 if the amount of loan households needed to borrow is larger than 30 million VND, 0 = otherwise	0.41	0.49
LANDSIZE	Size of household farm land (1000m ²)	3.63	2.69
INCOME	Household's annual income (Million VND)	58.64	30.19
INRATIO	Ratio of non-farm income to farm income	1.99	2.34
EARNERS	Number of income earners	2.33	0.82
CON_PER	Household's consumption per capita (Million VND)	10.60	3.07
LARATIO	Ratio of labour to total family members	0.55	0.19
OFFFARM	Number of off-farm labours	1.27	0.83
POOR	1 if household have poor certificate, 0 = otherwise	0.20	0.40
HH_SIZE	Household size	4.41	1.31
CHILD_NUM	Number of children	3.02	1.15
CHILDSTU	1 if household have child being tertiary student	0.28	0.45

INFORMAL	1 if household get sufficient credit from informal source	0.22	0.41
YENTHANH	Geography dummy variable	0.25	0.43
THACHHA	Geography dummy variable	0.25	0.43
HUONGTHUY	Geography dummy variable	0.24	0.43

Source: The author's survey data

Note: A total of 477 observations was used, 2 observations were excluded for the concern of outliers

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