CREDIT RATIONING OF FARM HOUSEHOLDS AND AGRICULTURAL PRODUCTION: EMPIRICAL EVIDENCE IN THE RURAL AREAS OF CENTRAL SULAWESI, INDONESIA

Nunung Nuryartono[*)]

[*)] Lecturer in Department of Economics, Faculty of Economics and Management;
Senior researcher in International Center for Applied Finance and Economics (InterCAFE), Bogor Agricultural Insitute

ABSTRAK

Makalah ini membahas pertanyaan mengenai apakah akses yang lebih besar dari layanan keuangan meningkatkan produksi pertanian. Pertanyaan penelitian spesifik yang dibahas adalah sebagai berikut: (1) Berapa banyak rumah tangga memiliki akses ke pasar kredit formal? (2) Berapa banyak rumah tangga dibatasi kredit? (3) Faktor-faktor apa yang mempengaruhi sehingga rumah tangga dibatas kredit? (4) Bagaimana pendistribusian kredit mempengaruhi produksi pertanian?

Sebagaimana banyak studi telah menunjukkan, banyak rumah tangga pedesaan kekurangan akses ke lembaga-lembaga kredit formal atau informal. Di daerah pedesaan di Propinsi Sulawesi Tengah, terutama di sekitar Taman Nasional Lore Lindu, hanya 21,5% dari rumah tangga memiliki akses ke kredit formal. Hasil-hasilnya juga memperlihatkan bahwa menurut kondisi-kondisi tertentu, hanya 18,1% dari rumah tangga tersebut tidak dibatasi kredit. Sebagian besar rumah tangga dibatas kredit karena kurangnya jaminan dan karena masalah seleksi diri.

Analisis ekonometrika terdiri dari dua bagian. Bagian pertama memeriksa faktor-faktor yang menentukan apakah rumah tangga dibatasi kredit, yang berpusat pada pasar kredit formal dengan menggunakan model Probit. Dalam bagian kedua dari analisis, diselidiki pengaruh dari dibatasinya kredit pada produksi padi dengan menerapkan model regresi switching. Hasil-hasil dari model Probit memperlihatkan peran modal manusia (yaitu pendidikan dan usia dari kepala rumah tangga) serta kekayaan dan indikator risk-bearing adalah signifikan dalam menentukan apakah rumah tangga dibatasi kredit.

Kata-kata kunci: rumah tangga pertanian, produksi pertanian, model regresi switching (SRM)

INTRODUCTION

Most developing countries continue to rely on their agriculture sectors for economic growth, poverty alleviation, food security, and environmental sustainability. In Indonesia, agriculture contributed 15.6 percent to the Gross Domestic Product (GDP) in 2001 (BPS, 2001). Although its contribution to economic development has a tendency to decline, agriculture remains important to the majority of the Indonesian population, particularly to those who live in rural areas. More than 50 percent of the households in Indonesia depend on agriculture activities as their main source of income. However, more than half (56,5 percent) of these farm household are categorized as smallholders with landholding of less than 0,5 ha.

The agricultural sector makes the largest contribution to the economic development in the Central Sulawesi Province. On the average, the share of agriculture in the Regional Gross Domestic Product (GDPR) is more than 40 percent. Since 1999, the contribution of agriculture has been increasing and this indicates the important role of agriculture in development process. In 1999, 2000, 2001, the contributions were 41.1 percent, 43.4 percent, and 44.3 percent respectively. This fact shows that agricultural sector in Central Sulawesi Province is a major driving force for economic growth.

A lot of important has been placed on the role of agricultural innovations in improving the welfare situations of the smallholders. Technology adoption significantly influences agricultural productivity and, in return, household income. In addition to its importance in income generation, the adoption of new technology is important as an alternative to extensive agricultural practices. However, to undertake productive investment in agricultural technology, smallholders require sufficient access to financial capital. Smallholders maybe perpetually trapped in poverty due to the lack of finances needed to undertake productive investment (Von Pischke *et al.*, 1990). Market imperfections in credit markets is hypothesized lead some potential borrowers to be rationed out of the credit markets. The credit rationing can cause a misallocation of resource in farm production. The misallocation of inputs in agricultural production lead that in the case of the credit rationed farmer to have lower profit than the non-credit constrained farmer (Carter,1989) and (Feder *et al.*, 1990).

OBJECTIVES OF THE PAPER

In Central Sulawesi, the relative importance of crop income in the research area as reported by (Schawrze, 2004) is 44 percent of the total households income, with 56 percent generated from perennial and 44 percent from annual crops. This paper is intended to contribute to an improved understanding of the interlinkages between access to credit and agricultural productions, particularly for rice farming activities. Therefore the main research questions are:

1. What factors contribute to households being credit constrained in formal credit markets?
2. How does credit rationing influence agricultural profitability in rice production?

The data was collected in 2000 and 2001 using standardized formal questionnaires in 293 randomly selected households out of 12 villages in rural Central Sulawesi, particularly in the vicinity of the Lore Lindu National Park. This study was part of the Collaborative Research Centre 552 "Stability of Rain Forest Margins". For more details on sampling and data collection, see (Zeller , 2003).

METHODOLOGY

The Switching Regression model (SRM) is used to correct for possible sample selection bias, which may arise from other interventions that provide multiple services to farmers in addition to credit. Sample selection bias arises when factors unobserved by researcher but known by the farmer affect both the choice of technology as well as other decision variables (Fuglie and Bosch, 1995). The SRM Approaches is divided into two stages.

It has been hypothesized that access to credit markets and liquidity constraints have a significant effect on agricultural activities. A probit model in the first stage will be applied to determine the relationship between a farmer's credit constraint condition and a number of socioeconomic and credit variables, is employed as follow:

$$C^* = \gamma' Zi + \varepsilon i \qquad (1)$$

In equation (1), C* is dichotomous (1,0), indicating whether observation I is credit constrained or not; Zi represents a vector explaining variables such as human capital, income of household, assets of household, and tenure security; γ is a vector of parameters; and εI is a random error term.

Household are credit-constrained if the demand for credit exceeds the supply of credit, which means $C^* > 0$. These responses are used to define a criterion function which is an observable; dichotomous variable I where

$$I = 1 \text{ ; if } I^* = \delta' Zi + \varepsilon I = 0 \qquad (2)$$

$$I = 0 \text{ ; Otherwise}$$

A Probit maximum likelihood estimation is used to estimate the parameter δ in equation 2. It is assumed that var (εi) = 1 since δ is estimable only up to scale factor.

Agricultural profitability in rice production of the two groups of farmers is modeled by reduced form equations specified by

$$P_{cc} = \beta_{1i} X_{1i} + \varepsilon_{1i} \text{ ; if } I = 1$$

$$P_{ncc} = \beta_{2i} X_{2i} + \varepsilon_{2i} \text{ ; if } I = 0 \qquad (3)$$

Where variables Pcc and Pncc represent agricultural profitability for credit-constrained and non-credit-constrained household.

X_{1i} and X_{2i} are vectors of exogenous variables,

B_{1i} and β_{2i} are vectors of parameters, and

ε_{1i} and ε_{2i} are random disturbance terms.

Maximizing the bivariate likelihood function for this model is feasible but time consuming (Maddala, 1994). Therefore, following Lee (1978), a two-stage estimation method is used to estimate the system in equation (2) and (3).

The conditional expected values of the error terms ε1i and ε2i are:

$$E(\varepsilon_{1i} \mid \varepsilon_i = \delta' Z_i) = E(\sigma 1_\varepsilon \varepsilon_i \mid \varepsilon_i = \delta' Z_i) = \sigma 1_\varepsilon \frac{\emptyset(\delta' Zi)}{\Phi(\delta' Zi)}$$

$$E(\varepsilon_{2i} \mid \varepsilon_i = \delta' Z_i) = E(\sigma 2_\varepsilon \varepsilon_i \mid \varepsilon_i = \delta' Z_i) = \sigma 2_\varepsilon \frac{\emptyset(\delta' Zi)}{1-\Phi(\delta' Zi)}$$

Where $\emptyset$ and Φ are the probability density function and the cumulative distribution function of the standard normal distribution respectively. The ratio $\Phi / \emptyset$ evaluated at δ'Zi for each I is the Inverse Mills Ratio (IMR). For convenience,

$\lambda_{1i} = \emptyset(\delta' Z_i) / \Phi(\delta' Z_i)$ is defined for constrained

and

$\lambda_{1i} = \emptyset(\delta' Z_i) / [1 - \Phi(\delta' Z_i)]$ for non-constrained (4)

These terms are included in the specification of equation (3):

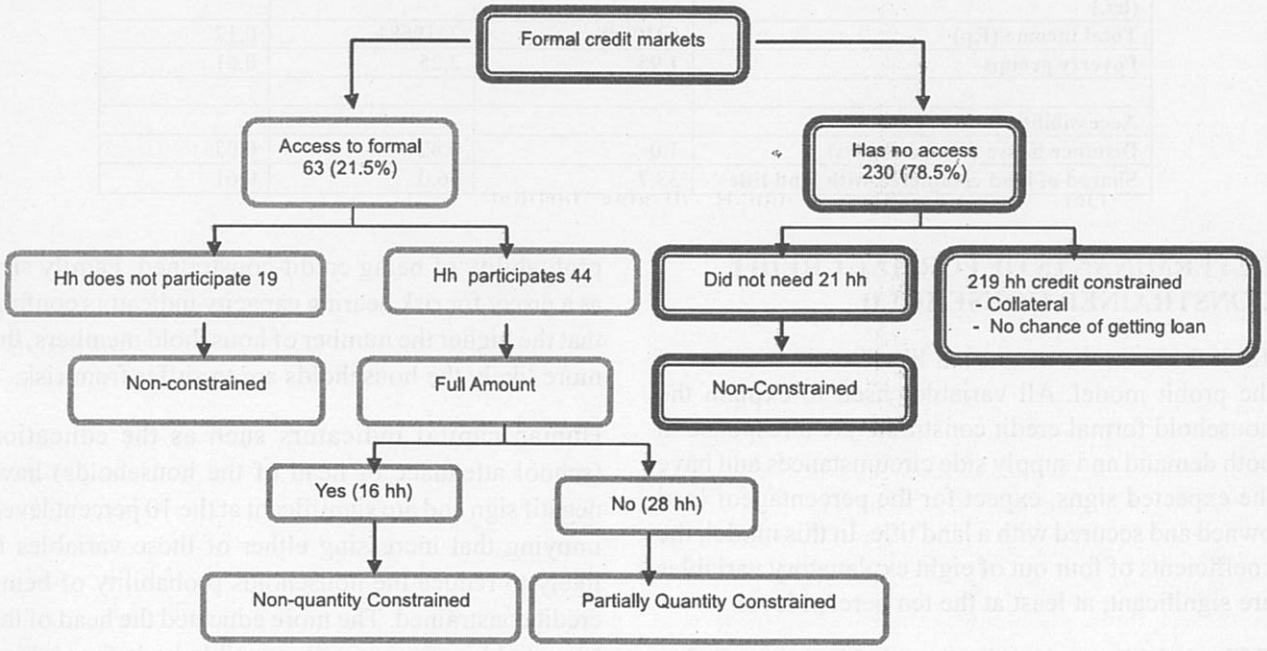
$$P_{cc} = \beta_1 X_{1i} + \sigma 1u \lambda_{1I} + 1_i; \text{ if } I = 1$$

$$P_{ncc} = \beta_2 X_{2i} + \sigma_{1u} \lambda_{2I} + 2_i; \text{ if } I = 0 \quad (5)$$

RESULTS AND DISCUSSION

Credit Constraints In Formal Credit Markets

The number of households with access to formal credit among the whole sample of households was 63 households or 21.5 percent. This means that those households gave a positive response when they were asked about the maximum amount of money they could borrow from any source of formal credit institutions. Of the 63 households, 44 participated in the formal credit markets or borrowed from those



Notes: hh = Household

Figure 1. Formal Credit Constraints in Rural Areas of Central Sulawesi Province

institutions (as pointed out earlier in sub-section 6.2.3). Approximately 63 percent of the households (28 households) out of the total number of borrowers were classified as partially quantity constrained because they did not receive the full amount that they proposed to the lender.

On the right side of the figure, one can see that 78.5 percent of the household sample (230 households) had no access to formal credit markets. Those households can be classified either as credit constrained or non-credit credit constrained by looking at the detailed responses from the households. 18 households had no access credit and were classified as non-credit constrained. They did not need to be engaged in the formal credit markets and mentioned that they had enough money. However, most of the household which had no access to formal credit were categorized as credit-constrained households (212 households). The various responses as to why the hpuseholds was not involved in formal credit markets included a lack of collateral.

Table 1. Socio-economic Characteristic of Households, Differentiated by Credit Status

	Credit Constrained (N=237)	Non-credit Constrained (N=56)	Sig. Level
Demographic Characteristic			
Age of head of household (years)	43,4	45,2	0,0
Family size	5,4	5,1	0,36
School attendance of head of household	3,8	4,2	0,10
Dependency ratio	0,71	0,67	0,67
Number of adults	3,72	3,68	0,87
Assets ownership and welfare			
Value of Total assets (Rp)	22122728	32158688	0,09
Value of livestock (Rp)	2280793	1656785	0,78
Size of land owned (ha.)	1,84	2,16	0,26
Area cultivated (ha.)	1,50	1,61	0,58
Wet land cultivated (ha.)	0,32	0,41	0,23
Upland cultivated with cocoa and coffee (ha.)	111	0,99	0,50
Total income (Rp)	6210648	7419684	0,17
Poverty groups	1,95	2,25	0,01
Accessibility and land tenure			
Distance house to road (hours)	1,0	0,42	0,03
Shared of land completed with land title	33,7	36,0	0,61

DETERMINANTS OF FORMAL CREDIT CONSTRAINED HOUSEHOLD

Table 2 shows the maximum likelihood estimates of the probit model. All variables used to explain the household formal credit constraint are a response to both demand and supply side circumstances and have the expected signs, expect for the percentageof land owned and secured with a land title. In this model, the coefficients of four out of eight explanatory variables are significant, at least at the ten percent level.

Of the variables representing households characteristics, family size is positif and significant, meaning that greater number of household member increases the profitability of being credit-constrained. Family size as a proxy for risk bearing capacity indicators confirm that the higher the number of household members, the more likely the households are to suffer from risk.

Human capital indicaturs such as the education (school attendace of head of the households) have negatif sign and are signifficant at the 10 percent level, impying that increasing either of those variables is likely to reduce the households probability of being credit constrained. The more educated the head of the household is, the more responsible he is for making decisions for the whole family and tends to be better at calculating the future.

Table 2. Probit Estimation of Determinants of Household Formal Credit Constraints

Variable	Coefficient	t value	Marginal effect
Constant	3,556	2,73***	
Family size	0,113	2,08***	0,02
Age of head of household (years)	-0,010	-1,41	-0,002
School attendance of head of households	-0,102	-1.90*	-0,22
Female head of household	0,001	0,07	-0,003
Size of land owned	-0,001	-1,07	-0,001
Ln total income	-0,151	-1,75*	-0,033
Shared of land completed with land title	0,001	0,35	0,0001
Distance to road (hours)	0,059	1,55	0,13
Chi squared		16,96**	
Pseudo R squared		0,06	
Log likelihood		-119,40	
Observations		293	

Notes: Marginal effects in percentage points, calculated at sample means *** and * are significant at 1 and 10 percent respectively

Total income, as proxy for welfare status, confirms that increasing the households total income reduces the probability of a household being credit constrained. This variable is significant at the 10 percent level. The implication is that a better household situation affects the decision of the lender to equity capital accumulated through past income earnings. The lender considers the welfare status of a client or potensial client before signing a contract to provide the loan.

It is expected that larger share of titled land will lead to a lower probability of credit rationing. The estimated coefficient of .001 is positive but fairlysmall in size and highly insignificant. Hence, a firm conclusion cannot be drawn regarding the role of land titling on credit rationing.

The distance from house to road as a proxy for market access, has positive sign. This means that alonger travelling time increases the probability of the household being credit consrained due to the higher transaction costs and the locations of formal credit institutions are mostly close to the centre of economic activities. However, the result is weak significantly.

AN OVERVIEW OF THE AGRICULTURAL ACTIVITIES

We can distinguish three common types of agricultural technology that are used for land preparation: (1) the use of a hand tractor (2) manual labor accomplished with some tools, and (3) the use of animals. For larger areas of paddy, farmers tend to apply modern

Table 3. Land Preparation Technology, Differentiated by Farm Size

Technology	Farm Size (ha.)			
	< 0,50 (N=34)	0,50-1,00 (N=72)	>1,00 (N=10)	Sig. Level
Hand tractor (ha.)	0,067	0,28	1,11	0
Manual (ha.)	0,04	0,04	0	0,69
Animal (ha.)	0,13	0,32	0.7	0,01
	% of households			
Hand tractor	29	43	40	0,17
Manual	18	1	0	0,12
Animal	53	46	40	0,75

technology. The average area of land owned by farmers who owned more than 1,0 ha and used a hand tractor is 1,11 ha and this group represents 40 percent of the >1,0 ha group.

116 households out of the total household sample were counted related to their agriculture activity in the wet-land area. Only 29 percent of the farmers who control a cultivated area of less than 0,5 ha use hand tractors. In this activity, farmers who do not own a hand tractor have the possibility of renting one, either through farmer's organizations or from individuals. A common agricultural practice and technology beside the hand tractor is the use of animals. More than 50 percent of the farmers who cultivated an area of less than 0.5 ha used an animal in land preparation.

IMPROVED VARIETIES, CHEMICAL FERTILIZER, AND PESTICIDE

The different types of technology applied in agricultural practices in paddy fields differentiated by poverty groups. The type of seed determines the potential yield. Farmers are aware of this situation and most of them use an improved variety. Therefore, from the analysis of variance, there is no significant difference among the poverty groups. More than 90 percent of the poorest households use this type of seed as well as 76 and 89 percent of the poor and less poor groups respectively.

More wealthy households are more likely to apply more advanced technology. 68 percent of the less poor group used area on their fields, while only 38 percent of households belonging to the poorest group applied urea. 51 percent of all of the farmer applied urea. A proxy for pesticide use is the amount of money spent to buy these pesticides. The same pattern is found regarding pesticide use: the better the household situation, the more pesticides they use. Interestingly, the percentage of households across all poverty groups which applied pesticides was higher than the percentage that used urea. 61 percent of all of the rice farmers utilized pesticides.

IMPACT OF FARM HOUSEHOLDS' CREDIT CONSTRAINTS ON THE AGRICULTURAL PROFITABILITY

Table 4 shows estimated coefficient for a profit function of the agricultural rice activities which are distinguished between households' credit constraints and non-credit constraints.

The coefficient for family size has positive sign but is insignificant for non-credit constrained household. Meanwhile, this coefficient for credit-constrained households is positive and significant at the 5 percent level. This result suggest that the credit-constrained households tend has an advantage along with

Table 4. Pseudo-Profit Function Coefficient for Credit Constrained and Non-credit Constrained Households

Variable	Credit Constrained	Non-credit Constrained
Constant	-5167 (612700)	1368822 (1910947)
Family Size	168829,5 (77588) **	162144 (251080)
School attendance of head of households	81334 (106313)	241288 (202157)
Size of land owned	-310,8 (1304)	-5098(2465) *
Walking distance house-road (rupiah)	-195703 (569780)	-2087445 (3047460)
Value of assets (rupiah)	-0,002 (0.004)	0,054(0,029) *
Loan from formal credit markets	0,217 (0.079) ***	-0,756 (0,507)
Lamda	1458146 (1494485) **	1458146 (5663253)
Adjusted R-Square	0,19	0,31
F	3,78 ***	2,28*
Observations	85	21

Note: ***, ** and * are significant at 1, 5, and 10 percent level respectively
Standard errors in parentheses

increasing family members. Family labour contributes to the agricultural activities and increase profit in rice farming production.

Similarly, the coefficient of loan size from the formal credit markets exhibits a different effect on each group. The loans' coefficient has a positive sign and is significant at the 1 percent level for the credit constrained households. This finding confirms the fact that the additional loans from the formal credit markets are used to finance their activities in the paddy production, particularly for adopting new technologies which increase productivity. (Nuryantono, 2005) found in the research area that in the case of adoption technology such as fertilizer, pesticides the roles of financial markets in financing agricultural technology adoption is important. However, in the case of non-credit constrained households the loans' coefficient has a negative effect is insignificant.

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