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Marie Godquin, Manohar Sharma. If only I could borrow more! Production and consumption credit constraints in the Philippines. 2005. halshs-00193374

HAL Id: halshs-00193374

<https://shs.hal.science/halshs-00193374v1>

Submitted on 3 Dec 2007

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**If only I could borrow more ! Production and
consumption credit constraints in the Philippines**

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2005.08



If only I could borrow more!
Production and consumption credit constraints in the Philippines.

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First draft: September 2004

This version: January 2005

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This paper provides a new approach to analyzing credit constraints by differentiating which of the household's production and consumption decisions are affected by credit constraints. It also provides a first attempt to estimate of the extent and determinants of credit constraints in the Philippines. Based on direct questions on households' experiences in credit markets, we estimate the percentage of credit-constrained households at 65%. The lack of credit constrained the level of agricultural production of 37% of the farming households; it also constrained the level of family business production of 31% of the households operating such businesses. Credit constraints also limited consumption choices of 21% of the sample households. We found that the presence of credit programs operating in the village and proximity to commercial banks and rural banks reduced the probability of credit constraints in production decisions. Further, some types of households are more likely to experience credit constraints. These are the households with little education, households that own little or no titled land, and sugar-producing households.

Keywords: Credit constraints, Philippines, Asia.

Ce papier propose une nouvelle approche des problèmes de contraintes de crédit en ce qu'il différencie quelles décisions de production ou de consommation du ménage sont affectées par les contraintes de crédit. Ce papier constitue également la première analyse de l'étendue et des déterminants des contraintes de crédit aux Philippines. A l'aide de questions sur l'expérience des ménages sur le marché du crédit, nous estimons le pourcentage de ménages contraints à 65%. Le manque de crédit contraignait ainsi les choix productifs agricoles de 37% des ménages agricoles de même qu'il contraignait 31% des choix productifs des ménages opérant une activité non agricole. Les contraintes de crédit affectaient également les choix de consommation de 21% des ménages enquêtés. Certains ménages sont plus exposés aux contraintes de crédit. Ce sont les ménages ayant un faible niveau de capital humain, les ménages possédant peu de terres avec titre de propriété et les ménages producteurs de canne à sucre. La présence de programmes de crédit opérant dans le village de même que la proximité de banques rurales ou commerciale permet de réduire les contraintes de crédit, tout du moins dans le domaine productif.

Mots clefs : Contraintes de crédit, Philippines, Asie.

JEL codes: O12, O16

1. Introduction

The Philippine rural financial sector has undergone dramatic changes in the past quarter century. It has evolved from a supply-led finance approach in the 1970s and 1980s characterized by loan targeting, credit subsidies and directed loans to certain sectors, to market-oriented financial and credit policy. Interest rate caps were lifted in the early 1980s, government banks and rural banks¹ were restructured in 1986-1987, bank entry and branching was liberalized in the early 1990s, the Central Bank was restructured in 1993, foreign banks were allowed to enter the market in 1994, and the country's largest bank, the Philippine National Bank, was privatized. However, the government was still heavily engaged in highly subsidized directed credit programs (DCPs) in the 1990s with 21 government agencies implementing 86 such programs (Llanto, Geron and Tang, 1999). As detailed in Llanto (2001), the Filipino rural financial sector in the 1990s was characterized by the huge fiscal cost of unsustainable DCPs and low financial discipline among borrowers, a weakened rural banking system dependent on subsidized funds, and inefficient targeting. This situation led the government to phase out all DCPs by 2002 for both the agriculture sector and the non-agricultural sector² and adopt a demand-driven approach to rural finance.³ Aside from providing financing opportunities, access to credit indeed stimulates productive investments and reduces the risk-vulnerability of rural households that might be therefore more willing to adopt new technologies (Eswaran and Kotwal, 1990). The Medium-Term Philippine Development Plan (MTPDP) for 2001-2004 recognizes the importance of an efficient, sustainable and demand-driven rural financial market and emphasizes the importance of increasing access to credit, including long term financing of small farmers and indigenous peoples and promoting a savings-led approach to agricultural and small off farm business financing.

¹ Between 1980 and 1987, the total volume of loans from formal institutions declined by 44% in real terms; three commercial banks, 147 rural banks and 32 thrift institutions failed (Cho and Khatkhate, 1990).

² The Agriculture and Fisheries Modernization Act (AFMA) passed in 1997 is the legal basis for the withdrawal of the government from agricultural DCPs. Its equivalent for the nonagricultural sector is Executive Order 138, passed in 1999.

³ The Agricultural Modernization Credit and Financing Program (AMCFP) of 1997 specifies that all lending decisions and credit delivery should be made through banks and strong or viable cooperatives and NGOs, excluding the government or non-government non-financial institutions from that field.

How credit constrained are rural households after financial liberalization? Previous studies on rural financial markets in the Philippines have described its policy environment (e.g. Esguerra, 1996 and Adams, Chen and Lamberte, 1993), the nature of interlinkages with the credit market (Floro and Yotopulos, 1991 and Nagarajan, David and Meyer, 1992), the demand for agricultural loans (Nagarajan, Meyer and Hushak, 1998) and the role of credit market in mitigating shocks (Fafchamps and Lund, 2003; Fafchamps and Gubert, 2002). Empirical studies on access to credit and credit constraints are still lacking for the Philippine rural sector.

Thus, this paper aims to provide information on the extent of credit rationing and its determinants in the rural Philippines. We develop a method of elicitation of credit constraints based on the approach of Feder, Lau, Lin and Luo (1990) that allows us to differentiate which of the household's decisions on consumption and agricultural and off-farm production are affected by credit constraints. We use this information to develop models of the joint probability of being constrained across multiple activities, including agricultural production, a non-farm family business and consumption.

The remainder of the paper is organized as follows: section 3 reviews approaches that have been used in the literature to measure households' access to credit and credit constraints. Section 3 develops our empirical model and section 4 describes the setting, sample and survey instruments. Section 5 presents the results of the empirical model while the final section concludes and discusses some policy implications.

2. Identification of credit constraints in the literature

Previous studies have found that the percentage of credit constrained households ranges from 19% to 72% as shown in Table 1. However, it is difficult to compare these estimates given the differences in the study samples and the methodologies used for eliciting credit-constrained status. The following of this section will thus review the different approaches to measure credit constraints.

Table 1 Prevalence of credit rationing

<i>Source</i>	<i>Details of the survey and sample</i>	<i>Definition of credit constraints</i>	<i>Extent of credit constraints</i>
Bali Swain (2002)	India, 1997, author's household survey, 761 farm households	Probability of access to formal sector loans of households with positive credit demand and for which the formal sector is predicted to be preferred to the informal sector	72%
Barham, Boucher and Carter (1996)	Guatemala, 1992, author's household survey, 201 producer households	Percentage of households credit constrained in the formal sector (credit unions and banks). Households are classified as fully constrained if they applied and were rejected or if they did not apply because insufficient collateral, high transaction cost of the loan or because they feared loss of wealth. Households that received a smaller loan than what they requested or wanted are classified as partially constrained.	34% of the households reported to be credit constrained by private banks. 28% of these bank-constrained households were also fully constrained by the credit unions and 27% were partially constrained by the credit unions.
Diagne, Zeller and Sharma (2000)	Bangladesh, 1993-1995, IFPRI, Rural Finance and Food Security Survey (1994), 350 households; Malawi, 1993-1995, IFPRI/Bunda, Rural Finance Survey (1995), 404 households	Households that had at least one of their members (members over 17 years old) facing a binding credit limit are classified as credit constrained. A household member has a binding credit limit if his perceived credit limit with a type of lender is null or equal to the amount borrowed from that type of lender.	55% and 61% of current members of credit programs experienced a binding informal or formal credit constraint in Bangladesh and Malawi respectively. 84% and 92% of households that have never been members of any credit program experienced a binding credit constraint in Bangladesh and Malawi respectively.
Feder, Lau, Lin and Luo (1990)	China, 1987, author's household survey, 187 agricultural households	The borrowers that indicated a desire for more credit at the going interest rates or that did not borrow because they could not obtain credit were classified as credit constrained.	37%
Jappelli (1990)	US, 1982, Survey of Consumer Finances (1983), 2971 households	Households are credit constrained if they report a positive answer to the following questions: have they been turned down by a lender or have not been able to get as much credit as they applied for in the past few years and were not able to get the corresponding credit through another application. Households that thought they would apply for credit in the past few years but did not do so because they thought they might be turned down are also considered credit constrained.	19%
Kochar (1997)	India, 1981-1982 All-India Debt and Investment Survey, 2415 farm households	Probability of access to formal sector loans of households with positive credit demand and for which the formal sector is predicted to be preferred to the informal sector.	26%

There are three main approaches to measuring credit constraints in the literature. The first type is an indirect method that infers the presence of credit constraints based on predictions from theory, such as the violation of the permanent income hypothesis, a difference between the shadow price of capital and the cost of credit, or changes in production activities in response to a change in eligibility status to formal credit. The second type of methodology is a semi-direct method as it uses access to the credit market to identify credit constraints. The third approach uses direct questioning of households or production units on their realized and latent credit experiences. We detail in the following these approaches and their most influential papers.

2.1. Indirect methods of eliciting credit constraint

One of the testable implications of the permanent income/ consumption-smoothing hypothesis is that in the absence of liquidity constraints, consumption changes are correlated with significant changes in lagged earnings or predicted changes in earning but not with transitory income shocks (Hall, 1978; Deaton, 1992). Various studies have thus used the rejection of the permanent income hypothesis as a test for the existence of liquidity constraints. Zeldes (1989) is one of the most influential of these studies, which used an a priori classification of liquidity constraint. Zeldes divides his sample based on whether the household holds at least two months of income as assets. His test relies on the fact that, if the ratio of wealth and financial assets to disposable income is a good indicator of liquidity constraints, the permanent income hypothesis is likely to be verified for households with high assets and rejected for low-wealth households. Indeed, Zeldes finds that lagged income is only significant for the low asset group.⁴ Several other papers have tested the permanent income hypothesis but no consensus has been reached on whether there is excess sensitivity of consumption to transitory income shocks that would be attributed to credit constraints (see Browning and Lusardi (1996) and Besley (1995) for a review). Moreover, Browning and Lusardi (p1832-1833) list several empirical and theoretical reasons that might lead to the rejection of the permanent income hypothesis

⁴ Jappelli (1990) however shows that the use of exogenous and fixed ratios is inappropriate to proxy liquidity constraints because it leads to the inclusion of unconstrained households in the low-wealth group and constrained households in the high-wealth group (see Jappelli, 1990, p. 232-233 for a numerical example).

even in the absence of liquidity constraints. Carroll (1992), for example, explains the rejection of the permanent income hypothesis due to precautionary savings behavior.

Sial and Carter (1996) used another type of indirect method to test for credit constraints. They estimate the shadow price of credit for small Pakistani farmers and find a large gap between the shadow price and the prevailing formal market loan rates. They attribute this large gap (around 190% for non borrowing farmers and around 60% at the mean loan size) to credit constraints faced by the farmers. However, this approach requires detailed information on revenues, cost and technology and is difficult to implement when there is heterogeneity of production activity and technologies both within and across households. Moreover, as explained earlier, other element of the credit contract such as collateral requirement or repayment schedules might generate a substantial difference between the nominal interest rate and the total credit cost.

Banerjee and Duflo (2002) provide a new approach to determine whether firms are credit rationed based on firms' reaction to a change in eligibility of directed lending programs. Both constrained and unconstrained firms are likely to be willing to borrow more from the formal sector if it is cheaper than other credit sources. If the increase in formal borrowing does not translate to production growth, the authors argue that firms are unconstrained and use the additional credit as a substitute for other borrowing. Credit constrained firms on the contrary will use it to expand their production. While this approach provides an interesting test of credit rationing it is applicable only in a context where a policy change in the supply of credit can be clearly identified. Furthermore, translating this approach to rural households might be problematic if credit is fungible and the increase in formal credit does not translate to an increase in agricultural or non-agricultural production but an increase in asset accumulation or consumption expenditures.

2.2. Approaches based on realized credit transactions

A second class of methods uses observable market outcomes to elicit credit rationing. Earlier studies have proxied credit rationing by the absence or non-use of formal loans. However, this is likely to be a crude approximation since, as previously shown, there is no simple relationship between credit rationing or credit constraints and

borrowing. Borrowing households could be willing to borrow more without having access to additional credit. Other households may also choose not to borrow because they are risk averse. In addition, these studies often assume that borrowing from the formal credit market is always preferable to borrowing from the informal credit market given the high value of local moneylenders' interest rates.

Kochar (1991, 1997) presents a model of access to credit that relaxes these assumptions. Using estimates of the informal and formal marginal interest rate for both borrowers and non-borrowers, she is able to determine whether the formal sector should be preferred to the informal sector.⁵ Unfortunately Kochar cannot distinguish between constrained and unconstrained non-borrowing households and assumes that non-applicant households have no demand for credit. This prevents us from classifying as credit constraints discouraged borrowers that did not apply because they thought they would be denied or because they were too far from a lender. While Kochar mentions that borrowers that borrow from both the formal and the informal sector are likely to be quantity constrained by the formal sector, this is not taken into account in the analysis that focuses on access and only indirectly on credit rationing. Bali Swain (2002) uses Kochar's model and adjusts its empirical specification using information on rejection of loan applications. As the author recognizes, the empirical specification still lacks information on quantity credit constraints and discouraged borrowers, which does not allow her to provide a complete picture of credit constrained borrowers.

2.3. Direct elicitation of credit constraints

Three types of direct questions have been used to elicit credit constraints based on household's experiences of rejection and need for credit. The first approach first applied by Jappelli (1990), and followed by Zeller (1994), classifies households as credit constrained if they report any rejected application of credit or report being granted less than the amount they initially asked for and were not able to get the corresponding amount through another credit application. Households that did not apply because they thought they would have been turned down are also classified as credit constrained.

⁵ The preference of the formal sector is also likely to depend on other elements of the loan contract such transaction cost, collateral requirements, repayment schedules.

Diagne, Zeller and Sharma (2000) asked all adult households members their perceived credit limit with different types of lenders and classify the households as credit constrained if at least one of its members has reached this credit limit. This approach still lacks information on excess demand and relies on the hypothesis that the household members that have reached their credit limit with a certain type of lender would have liked to borrow more from that lender and thus can be classified a credit constrained. It is also unclear why credit constraints of individual household members can easily translate to household level binding credit limit.

The strength of the type of questions used by Feder, Lau, Lin and Luo (1990) is that they rely on no assumptions and directly ask borrowing households whether they would have liked more institutional credit at the going rates of interest. Non-borrowing households were also asked the reason for not borrowing. Borrowing households, which would have liked more institutional credit and non-borrowing households, which reported that they did not borrow because they could not obtain credit, were classified as credit constrained. This approach has been subsequently used by Braham, Boucher and Carter (1996). It relies on the ability of the respondent to perceive credit constraints and report them, but the perception of the households on their credit experience is also more likely to have a more significant impact on their behavior than their ‘true’ credit constraint status. The type of classification by Feder, Lau, Lin and Luo is the one that we will follow in this paper as it relaxes all assumptions on credit constraints and is the one that fits best our definition of credit constraints in terms of unsatisfied positive marginal demand for credit.

2.4. Findings of the empirical literature on the determinants of credit constraints

From the above-mentioned literature, only the papers by Jappelli (1990) and by Feder, Lau, Lin and Luo (1990) and Zeller (1994) have proceeded to an estimation of the determinants of credit constraints. The three empirical models estimate a reduced form of credit constraints since both demand (how much the household would like to borrow) and supply (how much the financial intermediaries are willing to lend to that household) affect credit constraints. All three studies differ in terms of samples and estimation methods. Japelli’s (1990) study is on American households; Feder et al. (1990) is based

on a survey of Chinese farm households (see table 1), and Zeller (1994) on individual household members from Madagascar. Moreover, the determinants of credit constraints analyzed and their impact are not directly comparable. The study by Feder and al. and the study by Japelli show that savings, income and wealth have a negative impact on credit rationing whereas the number of adults in the households and the family size has a positive impact on credit rationing. In the study by Japelli, other demographic variables such as age, marital status and race reduce the probability of being credit constrained⁶. These studies identify savings and income as significant determinants of credit constraint status but these variables are also subject to endogeneity bias. Exogenous measures of income and wealth should thus be preferred.

3. The empirical model

Our empirical model is based on an agricultural household model from which we derive the demand for funds of the household.⁷ Most of our sample households (72.5%) have some productive activity: 44% of them are engaged in farming only, 10% are engaged in non-agricultural activities only and another 18.5% are engaged in both farming and non-agricultural activities. We thus allow for two productive activities in our model. We assume that household members pool their resources and that decisions on expenditures on production and consumption are taken at the household level. In this model, credit constraints are thus defined at the household level and not at the individual level. Our estimations are based on reduced forms of credit rationing.

Every household maximizes a utility function subject to a budget and a time constraint. For simplicity of exposition, we will present a simple two period model where the household maximizes the utility that it derives from its consumption of undifferentiated goods C and of leisure L :

$$\underset{C_1, C_2, L_1, L_2}{Max} U(C_1, C_2, L_1, L_2) \quad (1)$$

⁶ Other variables used in the estimation but with no impact on credit rationing include for the study by Feder et al.: land, capital, number of dependents, education, farm experience, total initial liquid assets, outstanding debt in financial institutions, total outstanding debt and previous loan default and for the study by Japelli: debt, education, unemployment and sex.

⁷ See Iqbal (1986) for a presentation of a model of demand for funds of an agricultural household.

where the time subscript 1 refers to the recall period of the survey and the time subscript 2 refers to the “future” period and is meant to capture the duration of the relevant repayment period. The maximization of this function is subject to a budget and time constraint for each of the two periods:⁸

$$p_{a1}f_a(K_{a1}, H_{a1}, N_{a1}) + p_{b1}f_b(K_{b1}, H_{b1}, N_{b1}) + w_1M_1 + F = C_1 + I_a + I_b \quad (2a)$$

$$p_{a2}\lambda f_a(K_{a2}, H_{a2}, N_{a2}) + p_{b2}\mu f_b(K_{b2}, H_{b2}, N_{b2}) + w_2M_2 = C_2 + F(1+r) \quad (2b)$$

$$T = H_{a1} + H_{b1} + M_1 + L_1 \quad (2c)$$

$$T = H_{a2} + H_{b2} + M_2 + L_2 \quad (2d)$$

where the subscript *a* refers to agricultural activity and *b* to non agricultural businesses, and:

p_a, p_b : price of agricultural and non agricultural output

K_{a1}, K_{b1} : initial endowment of productive capital used for agriculture production and non-agricultural business, respectively

H_a, H_b : family labor used in the household farm and in the household’s non-agricultural business, respectively

N_a, N_b : on-farm hired labor, hired labor used for the family business.

M : net market labor supply

w : market wage rate

F : level of fund requirements

C : consumption

I_a, I_b : farm and off-farm business investment and input expenditures such that $K_2=K_1+\phi I$ and ϕ is the share of investment expenditures in investment and input expenditures.

λ, μ : technical improvement parameter of the farm and non farm sector

r : interest rate or cost of funds

T : total household available time

L : leisure or non-market time

⁸ The model of Iqbal (1986) included only the agriculture sector. We have separated hired labor used in household production from family labor.

p_a and p_b should be interpreted as price vectors and f_a, f_b , vectors of production functions when the household produces different crops or is engaged in different non-agricultural businesses.

The demand for funds (F) is defined in the previous system as the difference between investment and savings and can be rewritten as:

$$F = B - LE - FA \quad (3)$$

Where the demand for fund (F) is the sum of change in liabilities (B , borrowing – LE , lending) and change in internal borrowing (FA , net change in financial assets).

We define credit constraints as the situation where the household cannot avail the credit it desires at the prevailing relevant market conditions. The prevailing relevant market conditions, P^m , are in this case defined by the expected rates of interest (r) in the area associated to loan sizes (L), repayment schedules (RS) and level of guaranties (G); $P^m = \{r^m, L^m, RS^m, G^m\}$.

A household will thus be credit constrained if:

$$p_{a1}f_a(K_{a1}, H_{a1}, N_{a1}) + p_{b1}f_b(K_{b1}, H_{b1}, N_{b1}) + w_1M_1 + F < C_1^* + I_a^* + I_b^* \quad (4a)$$

$$p_{a1}f_a(K_{a1}, H_{a1}, N_{a1}) + p_{b1}f_b(K_{b1}, H_{b1}, N_{b1}) + w_1M_1 + B - L - FA < C_1^* + I_a^* + I_b^* \quad (4b)$$

or, using simplified notation:

$$B < B^*(P_m) = C_1^* + I_a^* + I_b^* - Y_1 + LE + FA \quad (4c)$$

where Y_1 , the total income in the first period, equals

$$p_{a1}f_a(K_{a1}, H_{a1}, N_{a1}) + p_{b1}f_b(K_{b1}, H_{b1}, N_{b1}) + w_1M_1$$

$B < B^*$ corresponds to $C_1 < C_1^*$ or $I_a < I_a^*$ or $I_b < I_b^*$ or any combination of these sub constraints and where B is the credit limit of the household and B^* its optimal level of borrowing at the prevailing relevant market conditions. C_1^* , I_a^* , I_b^* are respectively the optimal level of consumption expenditures and farm and off-farm level of investment and input expenditures that would be chosen in the absence of credit constraints.

Equation (4c) shows that two factors determine whether the credit constraint will be binding. The left hand side of the inequality represents the credit taken by the household or the household's credit limit when the constraint is binding, i. e. how much

⁹ We did not include the variation of the stock of consumer durables in this equation since rural Filipino households do not normally use such stocks to make liquidity adjustments.

financial intermediaries are willing to lend to the household. The right hand side determines the amount the household would like to borrow.

The life-cycle model does not deliver a closed-form solution for the optimal consumption level C^* in the presence of borrowing constraints. Moreover, production and consumption are no longer separable. We follow the assumptions made by Jappelli (1990) for his empirical model for the estimation of consumption credit constraints.¹⁰

Assumption 1: The reduced form of C^* , I_a^* , I_b^* can be expressed as $C^* = \alpha_c X + \varepsilon_c$, $I_a^* = \alpha_{I_a} X + \varepsilon_{I_a}$, $I_b^* = \alpha_{I_b} X + \varepsilon_{I_b}$, where X is a matrix of observable variables such as household demographic characteristics, age and education of the household head, wealth, production choices and accessibility of lenders.

Assumption 2: The debt ceiling, B , can also be expressed as a function of the same observable variables: $B = \beta X + \eta$.

We can thus provide the following reduced form of equation (4c):

$$0 < X(\alpha_c + \alpha_{I_a} + \alpha_{I_b} - \beta) - Y_1 + LE + FA + \varepsilon_c + \varepsilon_{I_a} + \varepsilon_{I_b} - \eta = Z \quad (5)$$

The optimal level of consumption and investment of the household as well as its credit limit is unobservable but we can identify the households that were credit constrained based on their answer to the question “During the past 12 months, would you have used more credit if it was available to you?”. Furthermore, since we have asked this question by use, for agricultural production, non-agricultural business and non-food expenditures, we can identify which decision is affected by the credit constraint. We can thus define the following three latent credit constraints equations:

$$Z_a^* = \lambda_a X + \mu_a$$

$$Z_b^* = \lambda_b X + \mu_b$$

$$Z_c^* = \lambda_c X + \mu_c$$

where λ_i are linear combinations of the parameters in (4c) and Z_a^* , Z_b^* , Z_c^* , the latent variables representing respectively the reduction in the level of agricultural ($I_a^* - I_a$) investment, reduction in the level of non-farm business investment ($I_b^* - I_b$) and reduction in the consumption level ($C_1^* - C_1$), attributed to credit constraints.

¹⁰ Production decisions aren't taken into account in Japelli (1990)'s model.

The corresponding index function for consumption is the following:

$$Z_c=1 \text{ if } \lambda_c X + \mu_c > 0$$

$$Z_c=0 \text{ if } \lambda_c X + \mu_c \leq 0$$

which reads: when $Z_c=1$, the household is credit constrained and its consumption decision is affected ($C_1^* > C_1$), otherwise, $C_1^* = C_1$

The two production index functions are defined similarly with the subscript a for agricultural production and b for non agricultural business.

Following the previous discussion, the set of regressors to be used in the estimation of credit constraint will be composed of variables that influence the demand for credit as well as variables that influence the credit limit the household faces. Since we estimate reduced forms, we will not be able to separately identify supply and demand influences on credit constraints. When supply and demand have opposite effects, some variables may not have a significant impact. Furthermore, some variables might have some impact on the demand for funds for production but not for consumption and vice versa. In the following, we discuss the variables we used in our analysis and their impact that we summarize in table 2.

The demand for consumption funds¹¹ is increasing with the size of the household but the demand for production funds¹² is decreasing with the size of the household as household labor substitutes for hired labor.

The productive experience of the household increase with the age of the household head and so does the demand for productive funds. We use a quadratic form of the age of the household head to allow for the diminishing impact of age.¹³ Credit limit should also increase with the productive experience of the household leading to an ambiguous sign of age of the household head.¹⁴

¹¹ In the following, we refer to non-food expenditure as consumption to ease the reading.

¹² When unspecified, production refers to both agricultural and non-agricultural production.

¹³ The diminishing impact of age could be explained by a reduction of marginal experience gain with age. The stock of productive assets also increases with age and could also lead to diminishing impact of age on the demand for fund.

¹⁴ A diminishing impact of age on credit ceiling could also be explained by reduced marginal experience gain with age. It could also be explained by higher probabilities of death as age increase if debt is difficult to transfer to children in case of death.

Better-educated households are expected to be better able to exploit investment opportunities when they arise and generate higher incomes in the future. Therefore, the demand for production funds is likely to increase with education of the household head. Education is also supposed to increase the demand for funds for consumption through expectations of a higher income in the future. The same arguments play in the same direction for the assessment of repayment capacity on the demand side, leading to an ambiguous sign. We use the percentage of household members over 14 years old with six or more years of education for the education of the household.

Size of cultivated land increases with the area of titled land and so do farm working capital. On the supply side, titled land can serve as collateral and increase the credit limit of the household. The area of titled land is also a proxy for wealth and is associated with better repayment capacity. Sugar producers have higher working capital requirements as each sugar cane sapling can be used for two to three planting seasons only, while expense in fertilizer and harvesting costs (use of harvesters and transportation costs) are higher. Sugar producers are thus more likely to use more credit for their agricultural production and thus have less external funds available to finance their other needs.

Households often cope with negative shocks by incurring loans or liquidating part of their financial assets. In the aftermath of such a shock, their stock of financial assets available for production and consumption is depleted which translate in a larger demand for external funds to keep the level of production and consumption expenditures constant. On the supply side, the increase in the level of household debt or the decrease in its financial assets (and capacity to cope with future shocks) affects negatively the amount the lenders are willing to lend to the household for production and consumption expenditures. Positive covariant shocks affecting the households increase their investment opportunities and thus their demand for credit.

The last group of variables that we will consider refers to the accessibility of financial intermediaries. The availability of credit services in a village is increasing with the number of government and NGO credit programs and decreasing with the distance to commercial banks. If lenders are constrained in the total amount they can lend or if there is little flexibility in their contractual arrangements, making their financial services de

facto unavailable for some of the households, then the availability of credit services in the village can increase the credit limit of some households.

To limit the extent of endogeneity bias, we did not include direct measures of savings, debt, income and non-food expenditures in our set of regressors as was done in previous studies, even if lenders use them to assess creditworthiness.

The following table summarizes the expected impact of our regressors on the external optimal demand for funds and credit limit. Variables that have a positive impact on the demand for funds increase the probability that the household is credit constrained whereas variables that have a positive impact on the household credit limit decrease its probability of being credit constrained.

Table 2 Predicted impact of the regressors on demand and supply side of credit constraints

	Net impact on credit constraints	Demand for funds			Supply credit limit
		Agricultural production (A)	Family business (B)	Non-food expenditures(C)	
<i>Household size</i>	(A) & (B): - (C):+	-	-	+	
<i>Age of the household head/ age squared</i>	ambiguous	+/-	+/-		+/-
<i>Education</i>	ambiguous	+	+	+	+
<i>Titled land</i>	(A): ambiguous (B)&(C):-	+			+
<i>Sugar producer</i>	+	+			- for family business and consumption (through indebtness)
<i>Individual negative shocks</i>	+	+ (through less internal funds)	+ (through less internal funds)	+ (through less internal funds)	- (through possible impact on debt/income ratio of the household)
<i>Collective positive shocks</i>	ambiguous	+ (through better investment opportunities)	+ (through better investment opportunities)	+ (through better investment opportunities)	+ (through better investment opportunities)
<i>Presence of credit programs</i>	-				+ (through availability of credit)
<i>Distance to commercial banks</i>	+				- (through availability of credit)

There are alternative candidate econometric strategies to estimate these three index functions. The first one is to estimate the three equations using three independent probits. However we observe the agricultural credit constraint outcome only on the subsample of agricultural producers (62.6%) and we observe the non agricultural credit outcome only on the subsample of households (28.3%) that operate a non agricultural business (table 3). It is possible that the agricultural households don't share the same characteristics as the non agricultural households resulting in biased coefficients of these two probit models. We thus tested for selection bias for these two equations.

Table 3 Repartition of the sample households based on their production status

		Household operates a non agricultural business?		
		Yes	No	Total
Household is engaged in agricultural production?	Yes	106	252	358
	(% total sample)	18.5	44	62.6
	(% row)	29.6	70.4	100
	(% column)	65.4	61.5	
	No	56	158	214
	(% total sample)	9.8	27.6	37.4
	(% row)	26.2	73.8	100
	(% column)	34.6	38.5	
Total		162	410	572
	(% row)	28.3	71.7	
	(% column)	100	100	

The probit model with sample selection assumes that we observe the binary outcome ($Z_j^{\text{probit}} = (Z_j^* > 0)$) of an underlying relationship ($Z_j = \lambda X_j + \mu_j$) and that this binary outcome is however only observed if:

$$S_j^{\text{select}} = (\gamma W_j + \phi_j > 0) = 1, \text{ where } \mu \sim N(0,1); \phi \sim N(0,1) \text{ and } \text{corr}(\mu, \phi) = \rho$$

When $\rho \neq 0$, standard probit will yield biased results. The test of the selection bias is based on the comparison of the likelihood of the full model with the sum of the log likelihoods for the probit and selection models, which are equal if $\rho = 0$ (see Van de Ven and Van Pragg (1981) and Greene (2003)).

Performing this test for the probit of agriculture specific credit constraint (Z_a) controlling for the probability of being an agricultural producer household did not reject the hypothesis that $\rho = 0$, suggesting that estimates from the simple probit do not suffer

from selection bias.¹⁵ Similarly, the same test for the non-agriculture business specific credit constraint (Z_b) did not lead us to reject the null hypothesis of the absence of sample bias.¹⁶

The coefficients of the three independent probit might still be biased as it is likely that some household level omitted variables jointly determine the error terms, μ_c , μ_a , μ_b , of these three index functions. Indeed, on the demand side, in the presence of credit constraints, production and consumption are jointly determined. On the supply side, we could argue that the household faces different credit limits based on the use of credit. This is justified when the lender can monitor loan uses or when the terms of the contracts like the repayment schedule do not allow the borrower to divert part of the loan from the use agreed with the lender. But at least part of the credit limit (if not all) is determined at the household level.¹⁷ The structure of the error terms therefore could be written as:

$$\mu_c = v_c \mu_{hh} + u_c \mu_{hhc}$$

$$\mu_a = v_a \mu_{hh} + u_a \mu_{hha}$$

$$\mu_b = v_b \mu_{hh} + u_b \mu_{hbb}$$

If $v_c = v_a = v_b = 0$, then estimating the three probit models separately will yield the same results as estimating them simultaneously, otherwise, estimating the three equations simultaneously will yield less biased coefficients. The trivariate probit (for further details, see Greene, 2003) assumes that we observe the binary outcomes ($Z_{aj}^{\text{probit}} = (Z_{aj}^* > 0)$),

¹⁵ The likelihood ratio test estimated the probability that $\rho=0$ was of 49%. The instruments used for the identification of the selection equation for being an agricultural producer are the size of the farm of the household in 1984 and the size of the farm in 1984 interacted with a dummy for being a split household (a split household is a new household in 2003 formed by one of the children of a household interviewed in 1984). These instruments have been tested with a Wald test that the coefficients of the instruments in the second equation are equal to zero.

¹⁶ The likelihood ratio test estimated the probability that $\rho=0$ was of 82%. For the non-agricultural business producers, the instruments used are the net revenue from non-agricultural business in 1984 and its interaction with the dummy for split households. These instruments have been tested with a Wald test that the coefficients of the instruments in the second equation are equal to zero.

¹⁷ In this case, $B = B_{hh} + B_c + B_a + B_b$. The credit limit of the household is the sum of a household level credit limit and additional credit limits specific to consumption, agriculture and off-farm business respectively. We provide some examples that can illustrate such cases: a household could avail of a loan from a relative to finance education expenditures but that relative might not be willing to provide the same loan to finance production expenditures; a farmer credit cooperative might be willing to provide the household with a loan for financing its agricultural production but no other needs.

$Z_{bj}^{\text{probit}} = (Z_{bj}^* > 0)$ and $Z_{cj}^{\text{probit}} = (Z_{cj}^* > 0)$) of three underlying relationships ($Z_{aj} = \lambda_a X_{aj} + \mu_{aj}$, $Z_{bj} = \lambda_b X_{bj} + \mu_{bj}$ and $Z_{cj} = \lambda_c X_{cj} + \mu_{cj}$) that might be interrelated.

In this case, a general specification is to assume that the errors terms in the three latent equations jointly follow a trivariate normal distribution so that $(\mu_{aj}, \mu_{bj}, \mu_{cj})' \sim N(\underline{0}, \Sigma)$, where the variance-covariance matrix Σ is given by:

$$\Sigma = \begin{pmatrix} 1 & \rho_{ab} & \rho_{ac} \\ \rho_{ba} & 1 & \rho_{bc} \\ \rho_{ca} & \rho_{cb} & 1 \end{pmatrix},$$

where ρ_{ij} denotes the correlation coefficient of μ_i and μ_j ($i, j = a, b, c$; $i \neq j$).

Separate probit models are “nested” in the trivariate probit model and occur when $\rho_{ab} = \rho_{ac} = \rho_{cb} = 0$, which means that we can test whether the trivariate probit model fits the data better than separate models. A likelihood ratio test rejected the joint absence of correlation in the error terms (each correlation coefficient being also significant and positive) and supported the use of the trivariate probit models to better estimate the impact of the different variables.¹⁸ The trivariate probit model will thus provide the best technique to estimate the different dimensions of credit constraints that the sample households are facing. As previously mentioned, we don’t observe the three index functions for all households as only producing households were asked the production credit constrained questions. Our model can therefore be estimated maximising the following log-likelihood function:

$$\begin{aligned} \text{Log}L &= \sum_{j=1}^{572} \sum_{m=0}^1 \sum_{n=0}^1 \sum_{l=0}^1 I_j^{abc} \log(p(Z_a = m, Z_b = n, Z_c = l / X_j)) \\ &+ \sum_{j=1}^{572} \sum_{m=0}^1 \sum_{l=0}^1 I_j^{ac} \log(p(Z_a = m, Z_c = l / X_j)) \\ &+ \sum_{j=1}^{572} \sum_{n=0}^1 \sum_{l=0}^1 I_j^{bc} \log(p(Z_b = n, Z_c = l / X_j)) \\ &+ \sum_{j=1}^{572} \sum_{l=0}^1 I_j^c \log(p(Z_c = l / X_j)) \end{aligned}$$

¹⁸ The likelihood ratio test rejected the hypothesis that the covariance of the error terms of the three models is equal to zero with a probability of error of less than 0.1%.

Where the subscript j refers to the household and I_j^{abc} is a dummy variable that takes the value of one if we can observe Z_a , Z_b , and Z_c , i.e. if the household j is engaged in both agricultural and non agricultural productive activities. I_j^{ac} , I_j^{bc} , and I_j^c are similarly constructed with I_j^{ac} taking the value of one if the household is engaged in agriculture production only; I_j^{bc} taking the value of one if the household is engaged in non agriculture production only and I_j^c taking the value of one if the household doesn't operate any productive activity for itself.

$p(Z_a = m, Z_b = n, Z_c = l / X_j)$ is derived from the cumulative distribution of the standard trivariate normal distribution that we simulated with the Geweke-Hajivassiliou-Keane (GHK) simulator.

$p(Z_a = m, Z_c = l / X_j)$ and $p(Z_b = n, Z_c = l / X_j)$ are derived from the cumulative distribution function of the standard bivariate normal distribution and $p(Z_c = l / X_j)$ form the standard normal distribution.

Results of the three independent probit models as well as results of the production probit with sample selection are reproduced in annex 1.

4. Setting, sample and survey instruments

4.1. Description of the survey setting and sample

This study uses an original household survey conducted by IFPRI during the months of September 2003 to January 2004 in Southern Bukidnon, province of Mindanao in the Philippines. In 1995, Bukidnon represented 1.4% of the population of the Philippines (PPDO, 2003). According to the 2003 National Statistical Coordination Board estimates on poverty, 39.6% of the population of Bukidnon falls under the national poverty line. Bukidnon is a landlocked province that derives most of its income from agriculture with corn (42.9% of the total cultivated crop area), rice (21.19%) and sugar (13.75%) being the major crops cultivated (PPDO, 2003). The setting of this study thus differs from previous studies on credit markets in the Philippines that were focused on rice growing areas (Floro and Yotopopulos, 1991; Nagarajan, David and Meyer, 1992; Nagarajan, Meyer and Hushak, 1998; Fafchamps and Lund, 2001 and Fafchamps and

Gubert, 2002). Our sample is composed of 572 rural households, 311 of whom were previously surveyed in 1984. The remaining 261 households are splits of these original households (new households established by son/daughters and their spouses) who settled in the same survey barangays.¹⁹ The sampling design in 1984 reflects the primary objective of the previous study, to examine the impact of agricultural commercialization. At that time, agricultural commercialization occurred through a switch from the cultivation of corn, a subsistence crop, to the cultivation of sugar, a cash crop. Consequently, the sample was designed to include adequate representation of both corn and sugarcane-farming households. This was done by choosing households from barangays (villages) in the vicinity of the (then) only sugar mill, as well barangays outside this vicinity. Within the chosen barangays, household samples were drawn to provide adequate representation of different categories of cultivator groups as determined by a village census conducted prior to that survey.²⁰

4.2. Participation in the credit market.

Rural households in Bukidnon are frequent users of credit. Three quarters (75.35%) of the sample households were engaged in at least one credit transaction within the past year.²¹ The sources of credit prevalent in the area can be classified into three groups, namely formal, semi-formal, and informal institutions. Formal institutions include banks and pawnshops. Among banks, rural banks traditionally lend to small farmers and microenterprises, while commercial banks finance large-scale agriculture. Some private thrift banks cater to small and medium enterprises located in the countryside and government financial institutions such as the Land Bank of the Philippines lend to private rural financial institutions such as rural banks and cooperatives on a wholesale basis. The latter in turn provide retail loans to small farmers and other small-scale economic agents. Semi-formal institutions comprise cooperatives, non-government organizations, credit association, commercial store that provide appliance or

¹⁹ The barangay is the smallest political unit in Philippine government.

²⁰ Further details on the 2003 sample and on the evolution of financial transactions between 1984 and 2003 are provided in Godquin and Sharma (2004). An overview of financial institutions in Bukidnon is also provided in Morales (2004).

²¹ If we exclude the loans that were outstanding prior to the beginning of the one-year recall period, 71% of the sample households had incurred at least a loan in the past year.

consumer durable loans and “lending investors”. Lending investors are companies that are engaged in lending with minimum regulatory requirement and supervision but are not allowed to collect saving deposits of any kind. The informal lenders are composed of relatives, friends, farmers, traders or local moneylenders. Twelve percent (12.24%) of our sample households had incurred at least one loan from a formal institution, 28.15% from a semi-formal intermediary and 54.72% from an informal intermediary.²²

4.3. Survey instruments for eliciting credit constraint status.

In this paper, we use the type of questions used by Feder, Lau, Lin and Luo (1990) to classify the households as credit constrained. In order to have a more detailed approach to credit rationing, we differentiated these questions by credit use so that we could construct production and consumption specific credit rationing variables. The rationale for this differentiation was that in our survey area as well as in other parts of the world, many cooperatives, banks and targeted programs have developed many types of production loans, but fewer options are available to finance consumption related expenditures such as health or education expenditures. The above-mentioned specialization of the type of loans financed by the different lenders gives some support to this statement.

Owing to the heterogeneity of loan sources and of credit needs, it is thus possible that the households face use-specific credit limits. Households that have no access to credit due to the absence of lenders or because their credit limit is equal to zero are more likely to be credit constraints across different credit uses, conditional on having a positive demand for credit across all credit uses. If credit is not perfectly fungible because of repayment schedules, monitoring of the lender, or timing issues in the allocation of funds, then it is possible that household that could avail of more credit for production if they wanted to could be credit constrained for consumption loans.

We therefore constructed three credit constraint dummy variables reflecting credit constraints affecting agricultural production, non-agricultural business and non-food

²² Further details on the loan contracts, on the use of the loans, on the segmentation of the credit market and on the role of credit in financing health and education expenses, agricultural cost and setting up of non-agricultural business are provided in Godquin and Sharma (2004).

consumption (clothing, health expenditures, education are some of the items covered)²³. These variables take the value of one if the household answered positively to the following questions respectively:

- If more production credit had been available to you in the past 12 months, would you have used it?²⁴
- If more credit had been available to you for your business in the past 12 months, would you have used it?²⁵
- If more credit had been available to you in the past 12 months to finance any of those items, would you have used it?²⁶

The households that answered yes to any of these questions should thus borrow more if more credit is made available to them. No specific restrictions were mentioned on the contractual arrangements and it was understood that the respondent had their relevant expected market conditions in mind responding to these questions. The first question was asked to households that reporting farming activity only (358 of the 572 survey households, 63%) and the second was asked to only those households that were operating a non-agricultural business (162 households, 28% of the sample).

The last question was asked uniformly to all the households. The same type of question has also been asked for major consumption durables and non-land assets. However the potential credit uses covered by that question are overlapping with the needs covered by the above-mentioned questions and we used the response to the question on the intended use of this additional credit to update the responses to the three selected credit constraint variables.²⁷

²³ No question related to credit constraints affecting food consumption was asked in the food consumption module even though credit use was collected in this module.

²⁴ This question was asked at the end of the block collecting information on agricultural production activities and input use.

²⁵ This question was asked at the end of the block collecting information on non-agricultural business.

²⁶ This question was asked at the end of the non-food expenditure block.

²⁷ If a household responded to that question that it would have liked more credit to purchase farm inputs, it was classified as agricultural production credit constrained (2 households reclassified). This question had no impact on the classification of households regarding the non-agricultural business and consumption credit constraint variables. However, 9 households that had no family businesses expressed the need for credit to invest in such a business. We did not use this information since we will need to control for selection of the households and need to keep only the households that operated a family business for estimations of family business specific credit constraints.

We also asked all households whether, during the past year, they “needed any credit for which they didn’t apply”. For the households that responded positively to this question, we further asked what they would have done with the corresponding credit. The three credit constraint variables were further checked with the response to this question.²⁸ This led us to the following credit constraint classifications of the households:

Table 4 Production and consumption credit constraint variables

	Agricultural production	Family business	Consumption
Unconstrained	224 (63%)	111 (69%)	450 (79%)
Constrained	134 (37%)	51 (31%)	122 (21%)
Number of households	358	162	572

There are 414 households engaged in either agriculture or off farm businesses or both, 39% of which are credit constrained in their production decisions.²⁹

We also asked the households that reported they did not want more credit why they were not interested in more credit, allowing the households to give up to three responses. The analysis of these responses (table 5) indicates that the level of credit rationing might actually be higher. Only 18% of the responses for agricultural production could be associated with a real absence of credit need (have enough money, landowner pays expenditures, too much debt already, not used to borrowing, credit not necessary). Thirty households reported that they did not own the required collateral and 64 reported that the interest and other costs were too high, indicating some extent of price rationing.

If we consider that the households that report that interest rates and other costs were too high or that they didn’t own the required collateral are credit constrained, we

²⁸ This has lead to 14 reclassifications of households as agriculture production credit constrained, 1 as non-agricultural business credit constrained and 19 as consumption credit constrained. Among households that were not agricultural producers, 4 expressed agriculture related credit need and 2 households that were not operating any family business reported business related credit need.

²⁹ This figure doesn’t derive directly from table 4 as some households that are engaged in both agricultural and non agricultural activities can be constrained on one of their production activity only but be counted as constrained in their production decisions.

observe a sharp increase in the level of credit rationing:³⁰ 59% of the agricultural producers³¹ and 43% of the non agricultural producer would be constrained.

Table 5 Reasons why the households didn't want more credit to finance their production

Reasons for no interest in additional credit	Agricultural production		Family business	
	Freq.	Percent	Freq.	Percent
Interest rate and other costs too high	64	20.71	15	13.39
Do not own required collateral	30	9.71	5	4.46
Afraid cannot pay back	150	48.54	65	58.04
Afraid of losing collateral	9	2.91	3	2.68
Have enough money	41	13.27	20	17.86
Too much debt already	6	1.94		
Landowner pays expenditures	4	1.29		
Not used to borrowing	2	0.65		
Area is too small/credit not necessary	3	0.97		
Do not like borrowing			4	3.57
Total	309	100	112	100

This reclassification of production-constrained status would lead to an increase in the overall level of credit rationing from 39% up to 52%. If the credit market is competitive, interest rates should reflect the risk faced by the lender and only changes in the level of risk of the demand side can reduce price rationing. The high proportion of households that report that they would not have used more credit because interest rates were too high suggest a need for interventions such as implementation of risk reducing agricultural technologies or credit bureaus aimed at reducing risk. In the remainder of the paper, we will use the direct answers of the households regarding their marginal credit needs and use the variables as defined in table 4.

Households can have unsatisfied credit needs other than production or non-food consumption credit needs as revealed by the response to the question on the use of the

³⁰ Households that reported that they did not want more credit for consumption were not asked why they were not interested in more credit for consumption.

³¹ Two households reported that the interest rates and other costs were too high but also that either it had enough money or that it already had too much deb. These two households were not reclassified as credit constrained.

credit that the household needed in the past year but didn't ask for (see above).³² Around 20% of the households (104 households) reported that they needed credit that they didn't ask for food consumption.

Table 6 Purpose of the 'discouraged' loan needs

Purpose of the discouraged loans		Freq.	Percent
Food expenditures	Food consumption	104	28.73
	Education	29	8.01
	Health	25	6.91
Non-food expenditures	Clothing	1	0.28
	Traveling expenses	4	1.1
	Marriage/family events	4	1.1
	Improving dwelling unit	16	4.42
Assets and consumer durables	Means of transport	4	1.1
	Consumer durables	29	8.01
Agricultural production	Farm inputs	66	18.23
	Farm equipments	2	0.55
	Purchase animals	18	4.97
	Purchase/lease of agricultural lands	6	1.66
Non-agricultural business	Purchase of goods for trade	24	6.63
	Purchase of inputs and working capital	19	5.25
	Purchase of equipment	3	0.83
	Additional capital for business	1	0.28
Refinancing	Debt repayment/refinancing	7	1.94
	Total	362	100

The analysis of the reasons why the households did not apply for these loans indicate that most of these are discouraged credit transactions:

Table 7 Reason why the households didn't apply for some loan need

Reasons for not applying		Freq.	Percent
Credit too costly	Interest rates and other costs too high	60	9.6
Not enough collateral	Not enough land collateral	7	1.12
	Not enough other collateral	40	6.4
Unsatisfied with other terms of	Had to work/sell produce to the lender	1	0.16
	Usual repayment period too short	7	1.12

³² 303 (53%) of the households reported that they needed credit in the past year that they didn't ask for and were given the possibility to provide up to two purposes of these credit needs.

the contract	Usual frequency of installment inadequate	2	0.32
	Too much time before the credit is given	4	0.64
	Did not like to mortgage	3	0.48
	Too many requirements	6	0.96
	Didn't like the terms & conditions of the loan	2	0.32
	Loan need too small	6	0.96
	Loan need too large	1	0.16
No available lender	Lender too far	7	1.12
	Did not know anybody who could lend me	8	1.28
Afraid of the consequences of credit	Afraid to lose collateral	16	2.56
	Afraid to incur extra fees for late repayment	179	28.64
	Afraid of having bad repayment reputation	50	8
Self-selection, other	Think lender would not approve loan	18	2.88
	Not able to meet with lender/ ashamed to borrow	2	0.32
	Did not understand the agreement	1	0.16
No interest in additional loan	Too much debt already	63	10.08
	No stable job/income to pay loan	10	1.6
	Found work/receive remittance from children	9	1.44
	Spouse did not give consent	1	0.16
	Disliked borrowing	67	10.72
	No longer need any loan	55	8.8
Total		625	100

We also asked the households whether any loan they applied for in the past year had been rejected. Thirty one percent of the households (180) were rejected for at least one loan and only 38% of these were able to get one of these rejected loans from another lender.

In an attempt to provide a global picture of credit constraints we considered the following types of households as credit constrained:³³ (1) households that experienced at least one rejection for a loan they had asked for, and were not able to get any of these loans elsewhere; and (2) households that reported they needed credit for which they did not apply.³⁴ Adding to these constrained households (52%) the households that reported they would have liked more credit for agricultural production, for their family business or for

³³ In the regressions however, we use the variables of credit constraints differentiated by use as defined in table 4.

³⁴ Fifty households expressed a latent credit need for which they did not apply, but would not have been interested in obtaining a loan if credit had been available to them. These households were not considered as credit constrained. Their answer to the question on why they did not apply was one of the following: they disliked borrowing, they had too much debt already, they found work or received remittances from their children, the spouse did not consent, or they no longer needed any loan.

their non-food expenditures, we reach a total number of 372 credit-constrained households, corresponding to 65% of our sample.

We will concentrate our subsequent analysis on credit constraints for production or for non-food expenditures.

4.3. Selected descriptive statistics of the survey households

Table 8 presents the definitions, means, standard deviations, minimum and maximum of the variables used for our estimations of credit constraints and table 9 presents the means of these variables for the total sample, for agricultural producers, for family business owners and for households engaged in both farm and non farm production. Households engaged in agricultural or non-agricultural production tend to be larger and have an older household head. Smaller households typically young households³⁵ who typically start working for somebody else before being able to accumulate assets and start a business on their own. Although the Philippine constitution provides for universal primary education, only 50% of the households in which all members aged 14 and above have at least six years of schooling. In 29% of the households, only half or less of the members above 14 years old have at least six years of education. 27% of the household heads had 4 years of education or less in our sample. There is substantial variation in the area of titled land owned by the farming households with 25% of the farming households owning more than 75% of the total titled land area of farming households. The Gini coefficient of 0.96 indicates that landownership concentration is very high. There are on average more households operating family business in barangays where governmental or NGO credit programs operate. These credit programs usually support livelihood activities and seem to have been successful in expanding off-farm businesses.³⁶ Agricultural producers are on average closer to a commercial or rural bank than non-farm households.

³⁵ A test of difference of means for the age of the household head reveals that non-producers households have significantly younger heads.

³⁶ These programs could also target areas where there are more off-farm businesses.

Table 8 Description and descriptive statistics, the whole sample

Variables	Description	Mean	Std.Dev.	Min	Max
hhsiz	Size of the household	5.58	2.236	1	20
ageh	Age of the household head in years	44.21	13.629	17	78
education	Proportion of household members over 14 years old with at least six years of education	0.75	0.311	0	1
tland	Area of titled land owned by the household, in hectares	1.24	3.428	0	42.65
sugarprod	Dummy=1 if the area planted to sugar by the household is at least 0.25 hectares	0.3	0.457	0	1
shock	Number of negative shocks experienced by the household between 2001 and 2003	0.43	0.698	0	4
pshock	Number of shocks that have made 10% or more of the barangay households worse off during the years 2001 to 2003	0.78	1.005	0	3
creditpg	Number of NGO or governmental programs that provide credit services in the barangay	2.2	1.801	0	8
dbank	Distance to the nearest commercial or rural bank, in kilometers	21.26	32.228	0	100

Table 9 Comparison of means based on productive activity

	Total sample	Agricultural producer households	Households operating a family business	Households engaged in farming and family business
hhsiz	5.58	5.78**	5.91**	6.1**
ageh	44.21	46.74***	46.57**	47.76**
education	0.75	0.75	0.83***	0.75**
tland	1.24	1.98***	1.23	1.87**
sugarprod	0.3	0.47 ³⁷	0.37**	0.57***
shock	0.43	0.44	0.38	0.4
pshock	0.78	0.77	0.81	0.77
creditpg	2.2	2.22	2.55**	2.65**
dbank	21.26	18.05**	23.74	23.53

***Difference of means significant³⁸ at the 1% level; **significant at the 5% level; * significant at the 10% level.

³⁷ Test of difference of means not performed since non-agricultural households cannot be sugar producers.

³⁸ Difference in the means of farm households compared to non-farm households for example.

Table 10 compares the means of variables relevant to the comparison of credit constrained and unconstrained households.

Table 10 Comparison of means based on credit constraint status

	Total sample	Agricultural production credit constrained households ³⁹	Family business credit constrained households	Non-food consumption credit constrained households
hhsiz	5.58	6.02*	6.6**	5.9**
ageh	44.21	47.35	48.6*	44.44
education	0.75	0.71**	0.77*	0.72
tland	1.24	2**	0.78	0.86*
sugarprod	0.3	0.56**	0.44	0.34
shock	0.43	0.58**	0.38	0.58**
pshock	0.78	0.58**	0.66	0.56**
creditpg	2.2	1.89**	2.22*	2.01
dbank	21.26	21.48*	33.27**	25.75**
sample size/number of constrained households	572	358/118	162/50	572/112

***Difference of means significant at the 1% level; **significant at the 5% level; * significant at the 10% level.

Households constrained in non-farm production and non-food consumption tend to have less titled land. Sugar producers are on average more likely to be credit constrained than farm households that do not produce sugar. Positive and negative as well as idiosyncratic and covariant shocks are associated with the credit constraint status of households. We investigate this further in our regressions, as a significant impact of idiosyncratic and covariant shocks would indicate a need for better risk mitigating strategies. Producer households are on average less credit constrained when some NGO and government credit programs operate in their barangays, but these programs do not make a difference for consumption credit constraints. Finally, credit constrained households are on average farther from commercial and rural banks than unconstrained households.

5. Results of the estimation of production and consumption credit constraints.

³⁹ The test compares the mean of the variables for credit constrained farm household to these of unconstrained farm households.

The comparisons of means for credit constrained and unconstrained households provide interesting information regarding the characteristics of credit constrained households, but these descriptive results obviously do not take into account the effect of other variables household level unobservables. We address this issue in the regression analysis below.

The results of the two bivariate probits of the probability of being credit constrained for agricultural production and consumption and for being credit constrained for non-farm business and consumption are presented in table 11.

A striking result from trivariate probit is the consistent and significant negative impact of education (EDUCATION) on the production credit constraints. We expected less- educated households to have a lower demand for external funds but to be more subject to credit rationing by the lenders. The results of our estimation indicate that the supply side effect is stronger.

The distance from commercial and rural banks (DBANK) also significantly increases the probability of being credit constrained but for agricultural production activities only. Similarly, the presence of NGO and governmental credit programs (CREDITPG) seems to be successful in reducing credit constraints for agricultural production. These two results indicate that some barangays still have poor access to formal financial institutions and that access to such institutions would likely increase agricultural production and in turn generate growth. The fact that the distance to banks and the presence of credit program has no impact on non agricultural production and consumption credit constraints might be explained by the minimal provision of credit for those purposes by such institutions. Being a sugar producer (SUGARPROD) has a strong positive impact on credit constraint status for agricultural production, which indicates that sugar planters may be willing to invest more in their plantation but that credit constraints impede them from doing so. Producing sugar also significantly increase the probability of being credit constrained for off-farm businesses which might indicate that sugar producers prioritize the allocation of credit obtained, first to their farming activity, and then to their off-farm business. But since they don't have enough access to credit to reach their optimal level of production for their farming activity, they have only little funds remaining for their off-farm activity and therefore lack available external funds to reach

their optimal level of off-farm production. Another interpretation would be that lenders are less willing to lend to sugar producers because of the long repayment cycle. Sugar is an annual crop and if households cannot rely on their family business income to repay the loans they incur to finance off-farm business, then the repayment cycle of the loan has to be one year. Sugar producers also have a higher probability of being constrained on their consumption choices.

As mentioned earlier, supply and demand influence the effect of the area of titled land (TLAND) on credit constraints for agriculture production in opposite ways whereas only supply should have an effect for off-farm businesses and consumption credit constraints. Our results support the theory. The area of titled land significantly reduces the probability of being credit constrained for off-farm businesses and consumption whereas it has no impact on farm production credit constraint.

Finally, the experience of idiosyncratic negative shocks (SHOCK) significantly increases the probability of being credit constrained for farm activities and consumption whereas the experience of collective positive shocks (PSHOCK) significantly reduces the probability of being constrained in the three dimensions. This result highlights the need for risk mitigating strategies since households cannot completely rely on credit to cope with negative shocks, which limit their ability to reach their optimal production level.

The age of the household head appeared to be a significant factor influencing the probability of being constrained for off farm activities with the probability first increasing and then decreasing. It isn't surprising that older households have lower credit needs as they already have had the time to accumulate assets. It is more surprising that young households are less credit constrained than middle age households. The household size (HHSIZE) did not have any impact on any credit constraint status.⁴⁰

⁴⁰ Alternative proxy of household labor such as the number of household members 14 years old and above didn't prove to have a significant impact on credit constraints either.

Table 11 Estimation of credit constraints using a trivariate probit model

	Credit constraints		
	Ag production	Non-Ag production	Non-food expenditures
hhsiz	0.016 (0.033)	0.050 (0.053)	0.030 (0.029)
ageh	-0.037 (0.038)	0.155 (0.069)**	0.028 (0.032)
agehsq	0.000 (0.000)	-0.002 (0.001)**	0.000 (0.000)
education	-0.691 (0.242)**	-0.801 (0.455)*	-0.291 (0.200)
tland	0.004 (0.018)	-0.197 (0.085)**	-0.080 (0.037)**
sugarprod	0.506 (0.149)**	0.646 (0.255)**	0.297 (0.147)**
shock	0.314 (0.098)**	0.110 (0.184)	0.251 (0.083)**
pshock	-0.153 (0.072)**	-0.186 (0.102)*	-0.107 (0.062)*
creditpg	-0.070 (0.038)*	0.011 (0.054)	0.010 (0.034)
dbank	0.006 (0.002)**	0.005 (0.003)	0.003 (0.002)
cons	0.781 (0.807)	-3.808 (1.649)**	-1.467 (0.677)**
Nb of obs.	572		
Rho12	0.471	(0.145)**	
Rho13	0.490	(0.080)***	
Rho23	0.468	(0.132)***	
Log likelihood	-566.221		
Independance of equations: chi ²			
(rho12=rho13=rho23=0)	44.163		
Prob>chi ²	0.000		

t statistics are given in parentheses.

** 10% level of significance, ** 5% level of significance, *** 1% level of significance*

6. Concluding remarks

Based on direct questions on households' experiences with credit market we were able to estimate the percentage of credit-constrained households at 65%. This estimate could even be higher if we consider the households that report they would not use more

credit if available to them because interest rates were too high or because they lack the appropriate collateral. Credit constraints have differential effects on the household's production and consumption decisions, depending on its credit needs and the availability of loan products from financial intermediaries. We found that credit constraints affect the scale of production, production technology or input use of 37% of the farming households of our sample and of 31% of the households operating a non-agricultural business activity. Since some farm households are also operating a family business, the total percentage of households for whom production choices were affected by credit constraints is of 39%. This result suggests that better provision of credit to rural household might translate in a higher growth level of the rural economy where poverty is still pervasive. Credit constraints also affected consumption choices of 21% of our sample households. The most frequent reasons for not borrowing more funds are that interest rates are too high or that the household is afraid it will not be able to pay back. This indicates that access to credit would benefit from a reduction of risk and that the development of risk reducing agricultural technologies or credit bureaus would also be appropriate in this setting. Our empirical model allows us to identify credit-constrained households and which of their production or consumption decisions were affected by credit constraints. We found that the presence of credit programs operating in the barangay and proximity from commercial banks and rural banks were successful in reducing the probability that credit-constraints would affect production decisions. Some households are more likely to experience credit-constraints; these are low educated households, households that own little or no titled land and the sugar producers. The fact that sugar producers are more credit constrained for their production and consumption decisions is particularly striking as sugar producing is viewed as a way to escape poverty in this area. Further research is needed on the size of the constraints and the impact of relaxing credit constraints on production and consumption. As discussed in this paper, it would also be helpful to develop studies that would allow to identify households similar in their credit needs and compare how credit constraints affect their decisions. This would enable us to get more precise information on supply side rationing behavior and on the ways to reduce credit constraints.

Annex 1

This annex reproduces the results of the three independent probit models (table 12) as well as results of the two production probit with sample selection for being respectively an agricultural producer and operating a non agricultural business (table 13).

Table 12 Estimation of credit constraints using three independent probit models

	Credit constraints		
	Ag production	Non-Ag production	Non-food expenditures
hysize	0.014 (0.032)	0.073 (0.054)	0.029 (0.029)
ageh	-0.035 (0.039)	0.143 (0.070)*	0.027 (0.032)
agehsq	0.000 (0.000)	-0.001 (0.001)**	0.000 (0.000)
education	-0.698 (0.247)**	-0.668 (0.482)	-0.295 (0.201)
tland	0.002 (0.018)	-0.177 (0.084)**	-0.074 (0.037)**
sugarprod	0.505 (0.152)**	0.589 (0.268)**	0.277 (0.149)*
shock	0.292 (0.100)**	0.006 (0.191)	0.255 (0.083)**
pshock	-0.150 (0.074)**	-0.178 (0.112)	-0.113 (0.063)*
creditpg	-0.066 (0.037)*	-0.006 (0.055)	0.005 (0.034)
dbank	0.005 (0.002)**	0.006 (0.003)**	0.003 (0.002)
cons	0.777 (0.827)	-3.801 (1.665)**	-1.425 (0.677)**
Nb of obs.	358	162	572
Log Likelihood	-218.31	-86.73	-283.26
Pseudo R2	0.078	0.141	0.045

t statistics are given in parentheses.

** 10% level of significance, ** 5% level of significance, *** 1% level of significance*

Table 13 Estimation of credit constraints using three independent probit models

	Ag production		Non-Ag production	
	Credit constraint	Selection equation	Credit constraint	Selection equation
hhsz	0.013 (0.032)	-0.054 (0.049)	0.075 (0.055)	0.026 (0.028)
ageh	-0.035 (0.039)	0.016 (0.049)	0.145 (0.070)**	0.060 (0.032)*
agehsq	0.000 (0.000)	0.000 (0.001)	-0.001 (0.001)**	0.000 (0.000)
education	-0.704 (0.248)**	-0.187 (0.323)	-0.598 (0.579)	0.817 (0.222)***
tland	0.001 (0.018)	17.697 (2.168)***	-0.176 (0.084)**	-0.072 (0.030)**
sugarprod	0.500 (0.152)**		0.601 (0.271)**	0.150 (0.143)
shock	0.290 (0.100)**	0.030 (0.155)	-0.008 (0.199)	-0.089 (0.089)
pshock	-0.150 (0.074)**	0.015 (0.098)	-0.178 (0.112)	0.061 (0.059)
creditpg	-0.066 (0.037)*	-0.040 (0.062)	0.004 (0.068)	0.023 (0.036)
dbank	0.005 (0.002)**	0.002 (0.003)	0.007 (0.003)**	0.002 (0.002)
farmsize84		0.249 (0.067)***		
farmsize84s		-0.120 (0.071)*		
nonagrev84				0.000 (0.000)***
nonagrev84s				0.000 (0.000)*
cons	0.807 (0.828)	-1.996 (1.083)*	-4.092 (2.043)**	-3.136 (0.691)***
Nb of obs		572		572
Log Likelihood of separated models		324.57		390.190
Log Likelihood full model		324.32		390.160
Independance of equations:				
chi ² (rho=0)		0.31		0.05
Prob>chi ²		0.478		0.817

t statistics are given in parentheses.

* 10% level of significance, ** 5% level of significance, *** 1% level of significance

As discussed in section 3, they correspond to less preferred empirical strategies either because they do not take the correlation in the errors terms into account. However it is of interest to notice that our results are robust to other specifications. There is indeed little change either in the significance of the impact of the different variables or in the sign of the significant variables for these two specifications. The only changes we can notice is in the estimation of the non agricultural production credit constraints where in both specification, education and collective positive shocks lose their significance whereas the distance to the bank significantly increase the probability of being credit constrained.

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