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To What Extent Are Credit Constraints Responsible for the Non-separable Behavior at Household Level? Evidence from Tobacco Growing Households in Rural Malawi

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Abstract: Microfinance institutions world-wide are continuously developing strategies for addressing credit market failure among liquidity constrained households. While an enormous amount of research has provided evidence for the positive welfare impact of access to credit at household level, very little is known regarding the extent to which credit can be used as a tool for enhancing separation in the making of consumption and production decisions at household level, which is an important precondition for specialization. The objective of this study is to examine the extent to which credit constraints can be used to explain non-separability among households from Malawi. The data used was collected by the International Food Policy Research Institute (IFPRI). The test for separation of consumption and production decisions is done using the on-farm labor demand model. Consistent with theory, results indicate that household demographic factors affect demand for labor among credit constrained households while they have no effect among unconstrained households. The implication from the study is that increased access to credit can be an important tool for arresting current market failures faced by poor rural households to the extent that once liquidity constraints are relaxed households can hire extra labor to enhance their productivity.

Key words: Credit constraints, separability, labor demand, Malawi

INTRODUCTION

Market failure for the poor has long been identified as a major constraint for them to move out of poverty. Through access to credit markets, households can do away with risk reducing but low return diversification strategies and concentrate on risky investments that give high returns (Simtowe *et al.*, 2006). Exploring causes of credit constraints among the poor, Kritikos and Vigenina (2005), note that the reasons for the continued exclusion of the poor from financial markets contain a risk and cost component. When markets fail as is the case in most developing countries, households become units of both production and consumption decision making and thus the two decisions are inseparable. Considering separability in production decision models is important because as rightly noted by Vakis *et al.* (2004) the comparative statics for households facing a market failure such as credit constraints are different from those without a market failure. Estimations, therefore, that do not take into account such differences will generate inconsistent parameter estimates. The supply of credit to liquidity constrained households is widely seen as a panacea for arresting credit market failure. However, empirical studies that examine the extent to which credit access enables households to make

production and consumption decisions separably are very uncommon. Knowledge of whether or not access to credit also enables a household to make its production and consumption decisions separably is crucial as it enables one to capture other potentially constraining factors and other market failures that might make credit ineffective to beneficiary households. Separation of production and consumption is an important step towards specialization and intensification and, therefore, good for development.

The objective of this research is to examine the extent to which credit constraints can be used to explain non-separation among tobacco growing households from Malawi. Through direct elicitation, an approach proposed by Diagne *et al.* (2000), households are classified into credit constrained and unconstrained regimes. The effect of access to credit on household behavior with regards to separability is done using the on-farm labor demand model. In this estimation the objective is to test whether or not the household demographic structure has an effect on labor supply and whether the magnitude of the effect of demographic factors varies between credit-constrained and unconstrained households.

The estimation is done using a switching regression which takes into account the selection bias associated with categorizing the sample into constrained and unconstrained regimes. The analysis starts with an

estimation of the probability of being credit constrained, followed by an estimation of the impact of household demographic structure on labour demand for the two regimes of households separately. A distinction is made between access to micro-credit, participation in the micro-credit market and being credit constrained. A household has access to micro-credit from a particular source if it is able to borrow from that source (Diagne and Zeller, 2001). A household participates if it actually borrows from that source of micro-credit. Thus, a household can have access but choose not to borrow, i.e., does not participate in the credit market. A household is credit constrained if its demand for credit exceeds the supply of credit.

Identification of credit constraints: a review of methods:

A number of approaches for identifying credit constraints have been cited in literature. Such approaches fall into two categories, namely the indirect methods and the direct methods. Indirect methods are based on tests of theoretical models involving credit constraints while direct methods are based on responses to qualitative questions about credit constraint status collected in surveys (Gilligan *et al.*, 2005). The indirect methods involve comparisons of parameter estimates for specific outcomes across constrained and unconstrained groups. The most widely used models for indirect test include consumption smoothing models and farm labour demand models. Vakis *et al.* (2005) propose a superior approach for identifying credit constrained households by using a mixture distribution approach to estimate the probability that a farm household behaves according to non-separability using a 1997 Peruvian data collected by the World Bank. They find that the approach is quite reliable in that it allows for the detection for non-separability on a number of markets at once and allows for heterogeneity in separability behavior across households.

The data for this study, collected through the IFPRI survey, used the direct elicitation method in identifying credit constrained households. As such we briefly describe the methodology before carrying out the empirical tests. The direct method involves a direct elicitation in which respondents are asked questions on their perceptions of constraints. Using survey questions that are usually qualitative in nature, respondents are asked about the current credit demand in order to identify households facing credit constraints. The early application of the approach was done by Jappelli (1990), cited in Gilligan *et al.* (2005). Jappelli classified households in the US 1983 survey of Consumer Finances as credit-constrained if they had a loan application rejected or did not apply for a loan because they believed that they faced a probability of rejection. Feder *et al.* (1990), also cited in

Gilligan *et al.* (2005) classified households in China as credit-constrained if they stated the willingness to use more credit at prevailing interest rates if it were available. In a similar context, Diagne *et al.* (2000) classified a household as credit constrained if it had reached a perceived credit limit for any loan sources or if its members said that they could not obtain credit. In general, therefore, all elicitation approaches rely on survey questions that identify whether or not a household's demand for credit exceeds the supply available to the household.

The demand for credit may exceed supply for credit for a number of reasons. First, the demand could exceed supply due to quantity rationing. Quantity rationing occurs when a lender sets credit limits that are lower than the household credit demand, usually resulting from moral hazard concerns and enforcement problems. Second, high transaction costs may also restrict the supply of credit to the households. Third, the demand for credit may exceed the supply for credit due to risk rationing, also referred to as the discouraged borrower's scenario. Going by the definition of Boucher *et al.* (2005), risk rationing occurs when lenders, constrained by asymmetric information, shift so much contractual risk to the borrower that the borrower voluntarily withdraws from the credit market even when she or he has the collateral wealth needed to qualify for a loan contract. The private and social costs of risk rationing are similar to those of more conventional quantity rationing. Like quantity-rationed individuals, risk rationed individuals will retreat to lower expected return activities.

Some individuals will avoid getting enough credit or never get credit at all due to fears of low returns on the investment. This will happen among risk-averse households that will adopt a low risk and a low investment strategy in order to avoid defaulting on the loan.

Empirical model: The analysis starts with a categorization of households into credit constrained and unconstrained regimes. The elicitation approach described earlier allows us to capture whether or not a household is credit constrained by directly asking the household whether or not they needed more credit for crop production. Through a series of questions it is possible to know whether or not a household had excess demand for credit. The procedure allows for the treatment of excess demand for credit $ED = D - S$, as a latent variable for each household h , where D and S are the demand and supply of credit to the household, respectively. Following this procedure it is not possible to assess the magnitude of the constraint, but instead only an indicator of whether or not the household

is credit constrained is observed by Gilligan *et al.* (2005). The specification for the two categories of households can thus be written as follows:

$$\begin{aligned}
 k_h &= 1 \text{ if } ED^*_h = X'_h\alpha + u_h \geq 0 \\
 k_h &= 0 \text{ if } ED^*_h = X'_h\alpha + u_h \leq 0
 \end{aligned}
 \tag{1}$$

Where:

- X_h Represents household and farm characteristics that determine credit demand as well as characteristics of the household and the lending institution that determine the supply of credit
- u_h Is a random error term with zero mean capturing stochastic factors affecting both the demand and supply

In order to test the reliability of the self reported credit constraints as well as to understand the extent to which credit access contributes to separability in decision making we use the on-farm labor demand model. The on-farm labour demand model is constructed based on the intuition that if a household has access to as much labor as needed at market clearing wage rates and can obtain credit or has excess liquidity needed to hire the extra workers, the optimal demand for labor on the farm will not be affected by the number of potential workers in the household. The assumption of abundant labor is quite relevant for Malawi and many parts of the developing world where there is excess labor supply and where liquidity constraints limits the household capacity to hire labor when ever they need it. Following Benjamin (1992), the farm labor demand equation for household h in period t can be specified as follows:

$$L_{ht} = \delta_0 + \delta_1 w_{vt} + \delta_2 A_{ht} + \delta_3 n_{ht} + \delta_4 X_{ht} + \omega_{ht} \tag{2}$$

where:

- L_{ht} Is the total number of labor days on farm by household members and hired workers,
- w_{vt} The wage rate paid by households for the farming activities until harvest
- A_{ht} Is area of land cultivated, by household
- X_{ht} Variables controlling for managerial ability (such as age and education of household head), access to labor saving technologies and distance to markets
- n_{ht} Is a vector of variables representing the household structure including household size and composition (share of prime adult males and females)
- δ_3 Is a parameter representing the joint test for separability of production and consumption decisions. It should be equal to zero in order to accept separability.
- ω_{ht} Is a random error term

The model has power as a test for credit constraints as well as if farmers commonly hire workers for cash wages and use credit to finance the transactions, or if they would like to in the absence of credit constraints. In Malawi, farmers do not get credit to finance transactions for hiring labour, however if a farmer has no liquidity constraints they should be able to hire labour. The major limitation in this analysis is that because credit in Malawi is not given in cash, most households may still fail to hire labor even when they have access to credit. As such, using the labor demand model may not give reliable results because credit unconstrained households may be constrained on the labor market.

Nevertheless the use of an on-farm-labor demand model in testing for credit constraints has an advantage over other models such as the output supply model used by Feder *et al.* (1990) and Gilligan *et al.* (2005) because the effect of credit access on output supply operates through demand for factors such as labor and fertilizer. For this study, we find the test for separability using the farm labor demand model to be very appropriate because tobacco, being a labor and capital intensive crop, farmers have to hire extra labor to meet the labor demand. A switching regression model as mentioned by Maddala (1986), specified in Eq. (3) is used to test for separability. As noted in Gilligan *et al.* (2005), the model can be used to test both the accuracy of self-reported credit constraints and it has power in identifying constraints by allowing parameter estimates in each model to differ in credit constrained and credit unconstrained regimes. A joint test that $\delta_3 = 0$ in (2), is used to test for separation of production and consumption decisions. Based on the criterion function specified in Eq. (1) for whether or not a household is credit constrained, the endogenous switching regression is written as follows:

$$L_{ht} = W'_{1ht}\phi_1 + v_{1ht} \text{ if } k_{ht} = 1 \tag{3a}$$

$$L_{ht} = W'_{2ht}\phi_2 + v_{2ht} \text{ if } k_{ht} = 0 \tag{3b}$$

where:

$$\phi_1 = [\delta_0, \delta_1, \delta_2, \delta_3, \delta_4]$$

$$W'_{iht} = [w_{vt}, A_{ht}, n_{ht}, X_{ht},]$$

$v_{iht} = \omega_{iht}$ for $I = 1$ if the household is credit constrained and $I = 2$ if unconstrained.

The endogeneity in a switching regression comes from the fact that we allow for correlation between the error terms in the credit constraint criterion function (1)

and the equations of interest (3a) and (3b). Thus the error terms v_{1h} , v_{2h} and u_h are assumed to be jointly normally distributed with zero mean and the following covariance matrix.

$$\Sigma \begin{bmatrix} \sigma_{11} & \sigma_{12} & \sigma_{1u} \\ \sigma_{12} & \sigma_{22} & \sigma_{2u} \\ \sigma_{1u} & \sigma_{2u} & \sigma_{uu} \end{bmatrix}$$

The switching regression model accounts for the fact that each household has a non-zero probability of being credit constrained in each period, that this probability varies depending on household characteristics and that only one realization of these probabilities is observed in each period (Gilligan *et al.*, 2005). Consistent estimates of parameters ϕ_1 and ϕ_2 can be obtained by following a two step Heckman procedure of estimating the credit constraint Eq. in (1) as a Probit and estimating Eq. (3a) and (3b) separately, while correcting for the selection bias by including the inverse Mills ratio from Eq. 1 as a regressor in the two equations.

Data: The data used in this analysis draws from a survey of households conducted by the International Food Policy Research Institute (IFPRI) and the Department of Rural Development at Bunda College of Agriculture in 1996. The survey was designed to investigate the effects of access to credit on household welfare. The survey covered 404 households selected via stratified random sampling method, from the three regions and from 5 districts of Rumphi, Nkhotakota, Dowa and Dedza and Mangochi. The survey data is categorized

in seven modules, however only 3 modules were of relevance to this study and they included, household demographics, crop and livestock and credit and savings modules.

In the IFPRI survey households were directly asked about credit constraints. In order to categorize a household as credit constrained, several leading questions were asked and they included the following:

- Had any member in your household wanted to join a credit organization and applied for membership but his or her application was rejected?
- If yes what was the reason for rejection?
- If household member received any loan was he/she given the same amount as the amount he/she asked for?
- Did the household make any loan applications that were completely rejected?
- If no applications were made, why did you not ask for any loan in the past 4 months?

Using this approach it was possible to identify credit constrained households and the sources of credit constraints. In the sample data, about 55% of the households indicated that they faced credit constraints. As indicated in Fig. 1, the majority of households that were credit constrained were discouraged borrowers (48%). There are a number of reasons why households may be discouraged from borrowing most of which relate to the perception individuals have towards the lender. In this study most discouraged borrowers indicated that they did not make any attempts to apply for loans because they expected their applications to be rejected by the lender. About 20% of the credit constrained

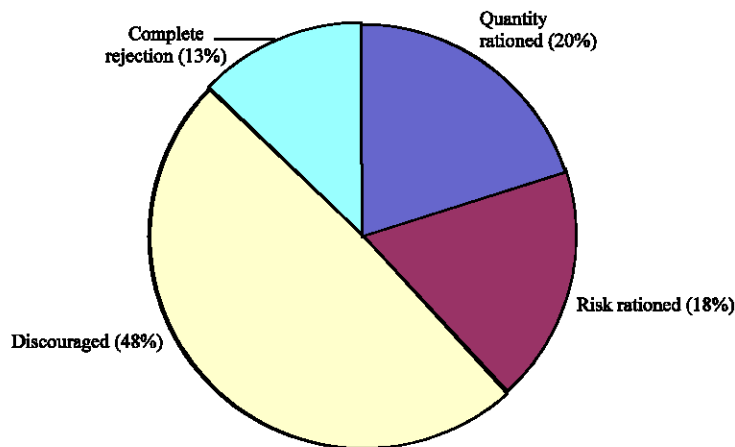


Fig. 1: Sources of credit constraints among credit constrained households

Table 1: Descriptive statistics by credit constraints

Data	Unconstrained (n = 67)		Constrained (n = 48)		Total (n = 115)	
	Mean	SD	Mean	SD	Mean	SD
Labor in man days per acre	216.00	145.00	148.00	65.00	197.00	130.00
Age of head (years)	45.68	12.60	44.69	14.35	45.13	13.58
Years of schooling of head	4.58	3.44	4.04	3.19	4.28	3.31
Male headed house holds (%)	0.80	0.40	0.66	0.48	0.72	0.45
Population males 15 to 64	1.38	0.95	1.10	0.82	1.22	0.89
Population females 15 to 64	1.57	0.83	1.39	0.80	1.47	0.81
Per capita land size (acres)	0.44	0.37	0.42	0.32	0.43	0.35
MK Value of assets	6509.00	24466.00	3699.00	5835.00	4958.00	16973.00
Distance to a commercial bank	33.35	19.19	35.81	19.75	34.71	19.52
1 = Mangochi district	0.22	0.41	0.27	0.44	0.25	0.43
1 = Nkhotakota district	0.18	0.39	0.17	0.38	0.18	0.38
1 = Rumphhi district	0.19	0.39	0.19	0.40	0.19	0.39

Source: Own calculations from IFPRI/RDD rural finance survey

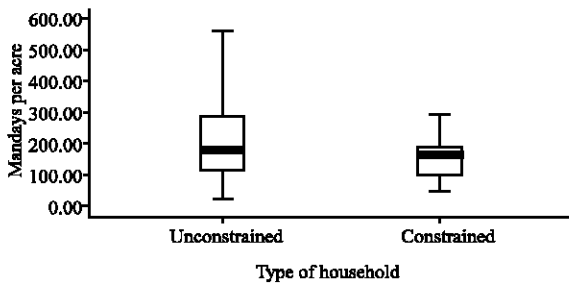


Fig. 2: Distribution of the intensity of labor use in man days per acre

household mentioned quantity rationing as their source of credit constraint. These are households that applied for credit but did not get the same amounts that they had requested. Risk rationing resulting from individuals not borrowing at all or not borrowing enough due to fear of failure of default was reported by 18% of the credit constrained households. Only 13% reported full rejections of loan applications.

Descriptive statistics for selected variables in the data are presented in Table 1. They include the household demographic structure and socio-economic characteristics such as age, sex and education level of a household head. Also included are variables that indicate the wealth status such as land size and the value of assets. Market access factors such as distance to markets and the ongoing wage rate are also captured. The a priori expectation is that the household demographic structure will have a positive effect on labor supply among credit constrained households, while it will have no effect among the unconstrained. We expect that a higher wage rate will reduce demand for labor in both categories of households but it will have a greater effect among constrained households. Descriptive statistics show that households with no binding credit constraints have older heads of households than those with binding constraints. Unconstrained households have a much smaller

proportion of female headed households (20%) compared to households that have some credit binding constraint (34%).

Figure 2 shows that the distribution of labor intensity use for credit unconstrained households has a larger mean (216 man days) than the distribution of labor intensity use for credit constrained households (148 man days). The next section investigates whether the differences in labor intensity use between the two categories of households can be attributed to the differences in the household demographic structure.

RESULTS AND DISCUSSION

Determinants of on-farm labor demand: Table 2 presents OLS estimates of the farm labor demand model in which the dependent variable is the total man days worked on the farm. The estimates are meant as a test for separation of consumption and production decisions as well as a test for credit constraints. The a priori expectation is that labor demand should be independent of household demographics if production and consumption are separable. Columns 1 and 2 show pooled sample estimates. The results reveal that the number of adult males aged between 15 and 64 has a significant and positive effect on labor demand. These results suggest that in general households in the study area make production and consumption decisions simultaneously. The number of males and females aged more than 60 has a negative impact on labor demand although neither of them is significant. As expected in developing countries where child labor is sometimes used for farm production, the number of boys and girls aged between 7 and 14 years has a positive effect, although it is not significant. In line with a priori expectations the size of land operated returned a positive and significant effect. The wealth of a household proxied by the value of assets also had a positive and significant impact on labor demand. Richer households are more likely than poor households to hire

Table 2: Factors affecting farm labor demand

Dependent variable:	Full sample		Credit constrained		Credit unconstrained	
Total labor days on farm	-----		-----		-----	
Independent variables	Coefficient	Std. errors	Coefficient	Std. errors	Coefficient	Std. errors
Wage	0.916	3.240	2.009	1.442	-2.655	6.216
Average years of schooling	-1.477	12.596	-11.442**	5.519	1.031	22.561
Population males older than 64	-104.737	85.742	-0.552	28.012	-83.259	154.520
Population females older than 64	-94.766	88.862	-50.161*	28.909	-182.069	147.221
Population boys 7 to 14	14.699	23.666	9.283	9.205	1.492	39.777
Population girls 7 to 14	17.560	20.124	-1.323	8.975	35.492	30.893
Population males 15 to 64	58.904**	26.329	34.203**	14.522	59.214	41.236
Population females 15 to 64	12.883	24.771	-2.176	5.240	74.200	55.575
Sex of head	15.032	54.241	-1.887	16.015	70.894	115.628
Area sown/planted in acres	76.551***	19.632	12.441	8.533	99.447**	33.563
Age of head	2.776	1.842	0.843	0.625	3.214	3.247
asset value	0.018***	0.005	0.003	0.003	0.022**	0.008
Distance to ADMARC	-3.067	4.631	-13.648	8.652	-3.313	6.392
1=Nkhotakota district	107.415	67.258	33.638	205.316	95.582	111.513
Dedza	10.463	85.104	72.428	213.665	73.322	147.133
1=Dowa district	-98.9418	89.41512	8.237		-63.326	152.582
LAMBDATEOB	-44.4652	47.91321	12.488	110.893	-61.498	54.782
Lambda			11.958	13.152	-40.938	66.459
(Constant)	-91.077	126.49	142.453	61.436	-185.830	239.725
No observations	115.00		48.00		67.00	
R-squared (pooled)	0.51					
Joint F-test for demographic variables	0.05		0.05		0.207	

Source: Own calculation from RDD/IFPRI 1999 rural finance survey, Note: * p<0.10; ** p<0.05; *** p<0.01

labor. A joint F-test of significance of the six household demographic factors on labor demand rejected the null hypothesis of no effect at 5% an indication that households in the sample generally face some sort of market failure. At this stage of the analysis we can not state with certainty whether or not the lack of separability is a result of liquidity or credit constraints.

Testing the extent to which credit constraints cause non-separability: Although there could be other causes of this failure of separation such as labour market imperfections, our interest is to test the extent to which credit constraints contribute to such a failure. We do that by estimating a switching regression model of credit constrained and credit unconstrained regimes whose results are presented in column 3-4 and 5-6, respectively. The switching regression on which results are based is specified in Eq. (3). The sample is split based on reported credit constraints. The hypothesis under test here is that the amount of labor supplied for farm production activities will vary with the demographic structure of the household if a household has liquidity constraints and that the demographic structure will have no effect on labor supply among unconstrained households. Results in columns 3 and 4 indicate that the number of adult males aged between 15 and 64 years has a positive and significant effect on labour demand in the constrained regime while its effect is insignificant in the unconstrained regime (column 5 and 6).

Further, a joint F-test of significance of the six demographic variables on labour demand rejected the null hypothesis of no effect in the constrained regime at 5% and could not reject the null hypothesis in the unconstrained regime. This suggests that the lack of access to credit in the constrained regime prevents households from hiring extra labor and hence they rely on family labor. It must be pointed out, however, that although credit constrained households show non-separability, as noted in Gillgan *et al.* (2005), it is difficult to separate the contribution of credit market imperfections from labor market imperfections in such a test for separation. This is because even when households are not credit constrained they may be unable to hire labor if the labor markets in the area are under developed.

The presence of separation among the unconstrained group is in concurrence with a priori expectations. Tobacco is by nature a labour and capital intensive crop such that households wanting to grow the crop will ensure that they have enough liquidity before they can do so. Further, the difference in the effect of household demographic variables on labour demand between constrained and unconstrained regimes suggests that credit constraints are partly responsible for the failure of separation in the constrained group.

Results further indicate that factors that affect labour supply in credit constrained households are not important in unconstrained household. For example, the size of land and the value of asset increases labour supply in unconstrained regimes but it has no effect on constrained households.

CONCLUSIONS AND POLICY RECOMMENDATIONS

This study investigated the extent to which access to credit relaxes liquidity constraints and leads to separation in household decision making. As a test of the reliability of self reported credit constraints we estimated the probability that a household will face credit constraints and tested for separation in the constrained and unconstrained regimes using a on-farm labor demand model. Results indicated that, consistent with theory, household demographic characteristics have a significant effect on labor demand among households facing credit constraints while they have no effect on labor demand in the unconstrained regime. Although the lack of separation in credit-constrained households could be a result of other market failures, such as imperfect labor markets, results in the current study appear to suggest that credit constraints are responsible for the lack of separability in the constrained regime. The implication of such findings is that credit can be used as a tool for arresting market failure to the extent that households would be able to higher enough labor for their farm production activities.

Nevertheless, considering that most credit in Malawi is given in-kind (eg agricultural inputs such as seed and fertilizer) this leaves households with very limited room to convert the credit into cash that can be used to pay for hired labor. Therefore, it is possible that even when credit is provided households may still fail to hire the extra labor needed to expand their production activities making them constrained on the labor market. Failure of separation in such cases could be a result of rigid credit policies. It is, therefore, important for microfinance institutions to consider diversifying their products by introducing other forms of credit such as consumption credit and labor hiring credit so that households may pay for extra hired labor when ever it is needed.

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