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CREDIT RATIONING IN RURAL FINANCIAL MARKETS: A PORTUGUESE STUDY CASE

by

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Abstract

This paper analyzes appropriate procedures for studying how the credit rationing process takes place in rural financial markets. The paper demonstrates that in order to analyze credit discrimination one should have a well-defined demand and supply model. This model should be estimated using data on both loans granted and loans rejected. The criteria by which credit applications were rejected or accepted should also be explicitly incorporated into the analysis.

Introduction

Non-price rationing in credit markets, as a substantive issue of theory and policy, is a subject of primary importance, and considerable controversy. Credit rationing was discussed in the earlier economic literature as a situation where the demand for loans exceeds their supply at the quoted loan rate of interest. Conventional economic theory has traditionally viewed market clearing and market equilibrium as one and the same. Consequently, a situation where supply does not equal demand has been perceived of as a disequilibrium state which could persist only if forced by the economy through external factors such as price regulation. However, it is widely known that lenders will not grant arbitrarily large loans even with high loan rates. Also it is known that borrowers with known differences in relevant characteristics get different loan contracts. This point has been recognized by more recent economic literature. This literature has attempted to explain the rationality of lender behavior of setting a price where loan demand exceeds supply by considering "legal" and "social" constraints, high screening costs, and most convincingly by assymetry of information in credit markets (for details, see Hodgman [1960], Jaffee and Modigliani [1969], Jaffee and Russell [1976], Azzi and Cox [1976], Baltensperger [1978], Keeton [1979], Stiglitz and Weiss [1981], Devinney [1986], and Bester [1987]).

This more recent literature, however, has not explained how the credit rationing process takes place, or has simply assumed that the discriminatory process

is carried out by random rejection. However, this is clearly unrealistic. The available empirical evidence suggests that most rural credit programs implemented in low income countries have invariably favored the largest and most influential producers, thus worsening the rural income distribution [Gonzalez-Vega, 1984b]. Recently, the rural financial markets literature has identified cheap-credit policies and high operational costs per unit of money loaned as some of the most important factors causing the disappointing results observed in rural credit programs.[1] It has been argued that cheap-credit policies tend to create excess demand thereby forcing agricultural lenders to ration credit through non-price mechanisms. Since operational lending costs and associated risks in servicing large rural producers are lower than those associated with small producers, the agricultural lender is motivated to favor the largest farmers in order to reduce per unit lending costs (Gonzalez-Vega, 1984a, Ladman, 1984).

The main objective of this study is two-fold. First, we discuss appropriate procedures for analyzing discriminatory credit rationing in rural credit markets. Second, we analyze if there was any discriminatory credit rationing in lending activities of a Portuguese agricultural lending program (the *Fundo de Melhoramento Agricola)* operating through the Ministry of Agriculture during the 1974-1979 period. This program reflects the classic supply-leading financial strategy of directing credit to agricultural producers with concessional rates of interest.

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1 For an extensive analysis of the impact of cheap-credit policies on rural credit markets cfr. Adams, Graham, and Von Pischke [1984].

Traditionally, empirical studies have established discrimination against some class(es) of borrowers (or regions, etc) by checking whether the dummy variable for a selected class of borrowers is statistically significant in a discriminant, probit, or logit function. However, these are not the appropriate procedures. Discriminant, probit, or logit models are of reduced (single equation) form variety. Hence, it is not possible to determine whether the dummy variable for some class of borrowers is statistically significant because of the demand or the supply function. This can be better explained through an example. Let's us assume that we attempt to determine if the class of borrowers denoted as IND has been discriminated against in a typical rural credit program by checking the sign and statistic significance of the dummy variable IND in a probit model. Let's assume that the coefficient obtained for this class of borrowers in the probit model is negative and statistically significant. Hence, the probit analysis concludes that IND borrowers have been discriminated against in the credit market. Now, let's assume that we also attempt to analyze if these class of borrowers (IND) has been discrimanted against by estimating the following simultaneous equation model:

$$\text{LOAN DEMAND:} \quad L^D = \alpha_0 + \alpha_1 IND + \alpha_2' X_1 + \alpha_3 r + \mu_1 \tag{1}$$

$$\text{LOAN SUPPLY:} \quad L^S = \beta_0 + \beta_1 IND + \beta_2' X_2 + \beta_3 r + \mu_2$$

where IND is the dummy variable corresponding to the class of borrowers under study; r is loan rate of interest; X_1 and X_2 are vectors of explanatory variables; αs and βs are parameters; and μ_1 and μ_2 are disturbance errors. Assume that, after solving the model specified above by appropriate methods, α_1 is negative and

statistically significant in the demand function, but β_1 is not statistically different from zero i.e., the class of borrowers IND demand less than other classes, but in terms of granted loans they are not different from other groups. In other words, the class of borrowers IND are not experiencing discrimination in the market. This result contradicts that obtained in the probit model. Consequently, in order to analyze discriminatory credit rationing in rural credit markets one has to have a well defined loan demand and loan supply model.

The Model

The model considered in this study draws on that of Nelson [1977] for labor markets, and Maddala and Trost [1982] for loan markets. The model can be represented as follows:

$$L_i^D=\beta_1'X_{1i}+\alpha_1 r+\mu_1 \tag{2}$$

$$L_i^S=\beta_2'X_{2i}+\alpha_2 r+\mu_2 \tag{3}$$

where i=1,....,n (applicants); L_i^D is the initial loan request from the ith applicant; L_i^S is the maximum amount that the lender is willing to offer to the ith applicant; X_i is a K-element vector of observable exogenous and regulatory variables; and μ_1 and μ_2 are random disturbances that follow a bivariate binormal distribution wit zero mean vector and unknown variances and covariances, σ_1, σ_2, and σ_{12}. Both disturbances are assumed to be independent of X_i.

Since the simultaneous equation model's objective is to study how the discriminatory credit rationing process takes place in rural credit markets, it is

necessary to consider the criterion by which the lender decides to grant or reject a loan. Following Nelson [1977] and Maddala [1984], let's assume the following accept-reject criterion:

$$L_i = \begin{cases} L_i^D, & \text{if } L_i^D \leq L_i^S \quad \text{(The loan is granted)} \\ 0, & \text{if } L_i^D > L_i^S \quad \text{(The loan is rejected)} \end{cases} \tag{4}$$

where L_i is the observed loan amount. This criterion function defines two sets of observations: n_0, the subset of rejected loans; and the subset n_1, the subset of granted loans. Since the system of equations (2) and (3) is a simultaneous equations model with censoring,[2] an identification problem arises. Given the fact that the model is similar to that of Nelson [1977], the necessary condition for identification of the model requires one restriction among the set β_2, σ_2, σ_{12}. For example, if some element of β_2 is restricted to be zero, the necessary condition is satisfied, even in the case that the corresponding element in β_1 is non-zero. Likewise, restricting σ_{12} to be zero is sufficient for identification.

The more appropriate estimation procedure of the model is the Maximum Likelihood technique. Following Nelson [1977] the model may be estimated as follows: Since, the data on the amount a loan applicant requests is usually available, and assuming that the necessary condition for identification are satisfied, then the demand function may be estimated by OLS. The supply function (3), in turn, may be estimated with a simple probit model with known threshold. From criterion function (4) we know that whenever $L^S \geq L^D$ the loan is granted. Hence, by replacing equation (3) for L_i^S we get $\beta_2' X_2 + \alpha_2 r + \mu_2 \geq L^D$. If $L^S < L^D$, the loan is

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2 Notice that in this case L_i^S is never observed.

denied. Thus, the likelihood function for the supply function may be written as

$$L(\beta_2,\sigma_2,X)=\prod^{n_0}\Phi\left(\frac{\beta_2'X+\alpha_2 r-L^D}{\sigma_2}\right)\prod^{n_1}\left[1-\Phi\left(\frac{\beta_2'X+\alpha_2 r-L^D}{\sigma_2}\right)\right] \quad (5)$$

where the first product is over all observations for denied loans, and the second is for all observations for granted loans; and Φ is the unit normal distribution function. The estimates of α_1 and α_2 will measure the effects of changing loan rate of interest on loan demand and supply, respectively. The estimated coefficient for β_2 will help to answer the question of whether or not the lender discriminates against certain sector(s) of the rural borrowing population, and/or the impact of differing regulatory measures on lender's acceptance rate.

The Data

The data for this study consist of 6516 loan applications during 1974-1979 from the Fundo de Melhoramento Agricola statistics. The period 1974-1979 was chosen to investigate the impact on the loan portfolio of the economic and political changes that occurred in Portugal after the April 1974 Revolution. The data terminates in 1979 the last year that the program operated. Table 1 presents the definition of the variables used in this study.

Table 1: DEFINITION OF VARIABLES USED IN THIS STUDY

VARIABLE	DESCRIPTION
INT	Interest rate on loan
RINV	Loan request size in contos (basis 1976).
TYPE OF BORROWERS.....	
IND	Dummy = 1 if individual
COP	Dummy = 1 if cooperative
COLLATERAL	
MORT	Mortgage
TYPE OF INVESTMENT.....	
TERR	Dummy = 1 if soil preparation
FRU	Dummy = 1 if fruits
LIVEST	Dummy = 1 if livestock
WATER	Dummy = 1 if irrigation and drainage.
CUL	Dummy = 1 if horticulture and forest.
REGION	
NORTH	Dummy = 1 if north
SOUTH	Dummy = 1 if south
CEN	Dummy = 1 if center.
TIME DELAY IN LOAN ACTIVITY.....	
DELOK	Number of months to approve a loan.
DELAUT	Number of months to disburse a loan.

The Results

The estimated demand and supply model is the following:

$$\text{Demand: } RINV=\beta_0+\alpha_1 INT+\beta_1 IND+\beta_2 COP+\beta_3 NORTH+\beta_4 SOUTH+\beta_5 CEN$$
$$+\beta_6 DELOK+\beta_7 DELAUT+\mu_1 \quad (6)$$

$$\text{Supply: } L^*=\beta_0+\alpha_2 INT+\beta_1 RINV+\beta_2 IND+\beta_3 COP+\beta_4 MORT+\beta_5 TERR+\beta_6 FRU$$
$$+\beta_8 WATER+\beta_9 CUL\beta_{10} NORTH+\beta_{11} SOUTH+\beta_{12} CEN+\mu_2 \quad (7)$$

where L^* is the dummy variable defined as follows

$$L^{*} \begin{cases} = 1, \text{ if the loan is granted} \\ = 0 \quad \text{otherwise} \end{cases}$$

The variables are defined in Table 1. The results of the demand and supply model with exogenous interest rates are set forth in Table 2. The supply equation was estimated by probit model. The demand equation, in turn, was estimated by ordinary least squares.

The Supply Results. The interest rate coefficient (INT) shows a highly significant sign (t-ratio 18.57) as expected, i.e., the probability that the lender grants a loan increases with higher nominal interest rates. The negative and significant sign of RINV (t-ratio 2.12) indicates that the size of the loan demanded negatively influences the lender's willingness to grant a loan. This result can be interpreted as loan-size rationing. Mortgage collateral is apparently not considered by the lender as an incentive mechanism to sort borrowers of different risk, as proposed by Bester [1987]; the sign is positive, but insignificant (t-ratio 0.49). Individual (IND) and cooperative (COP) borrowers were not discriminated against in the credit allocation process by the lender. The signs of both estimators are positive and significant at a one percent level (t-ratio are 5.42 and 6.89, respectively). The results obtained for type of investment show that the fruit sector was discriminated against during this period; in fact, the sign of FRUIT is negative and significant at the 5 percent level. (t-ratio -3.24). Other activities were favored by the program. The sign of TERR, LIVEST, WATER ,and CUL are positive and significant, especially the sign of CUL (t-ratio 7.77).

The results obtained for the dummy variables for regions indicates that the program has rationed credit away from applicants in Southern Portugal. In fact, the SOUTH shows a negative and significant sign, at the 5 percent level (t-ratio -2.50). Applicants from the North, on the other hand, appear to have been favored with lending activities from the Fundo de Melhoramento Agricola. The NORTH presents a mildly significant sign (logit t-ratio 1.90); significant at a 10 percent level. Applicants from the center appear to be neither favored nor rationed by the lender. CEN estimator shows a positive but insignificant sign (t-ratio 0.18).

The Demand Results. The demand equation estimators show interesting results. The interest rate coefficient is negative as expected but insignificant (t-ratio -0.19). This may be explained by the low rates of interest charged by this agricultural lending program. The cheap-credit policies and the lender's inability to establish an interest rate that would clear the market imposes implicit costs on borrowers. It is interesting to note that when we consider a proxy variable for borrower transaction costs, such as time delay (DELAUT) in the credit disbursement process, we have a negative and significant sign (t-ratio -2.28). This implies that the longer the delay in the credit disbursement, the lower is loan demand. Another interesting aspect that we can observe in loan demand is that the loan size demanded by cooperatives is significantly larger than the loans demanded by individuals. COP presents a positive and significant sign (t-ratio 9.58, significant at 1 percent). IND, in turn, shows a negative and insignificant sign (t-ratio -0.18). Finally, it is interesting to note that the average loan amount demanded by individuals from the South was smaller than the average size of loans demanded by borrowers from the North of

the country. SOUTH presents a significant negative sign (t-ratio -7.64, significant at 1 percent level). NORTH shows a positive sign, significant at 5 percent level.

Table 2: ESTIMATES OF LOAN SUPPLY AND DEMAND MODEL

VARIABLE	SUPPLY(PROBIT)	DEMAND (OLS)
INT	0.029 (18.57)	-0.01 (-0.19)
RINV	-0.016 (- 2.12)	
IND	0.445 (5.42)	-0.02 (-0.18)
COP	0.551 (6.89)	1.03 (9.58)
MORT	0.022 (0.49)	
TERR	0.367 (4.14)	
FRU	-0.380 (- 3.24)	
LIVEST	0.299 (3.35)	
WATER	0.297 (3.62)	
CUL	0.765 (7.77)	
NORTH	0.116 (1.90)	0.350 (3.81)
SOUTH	-0.092 (- 2.50)	-0.530 (-7.64)
CEN	0.011 (0.18)	-0.042 (-0.40)
DELOK		0.001 (0.29)
DELAUT		-0.002 (-2.28)
CONSTANT	-1.601 (- 2.63)	0.022 (1.79)
		RSQ = .239
		D-W = 1.466

Total number of observations = 6516
Number of Loan Applicants Rejected = 2413.
Number of Loan Applicants Accepted = 4103.
RSQ = R-square between observed and predicted.
D-W = Durbin-Watson
Figures in parentheses are asymptotic t-ratios for the supply function and exact t-ratios for the demand function.

Conclusions

The present paper argued that in order to analyze the credit rationing process in rural financial markets, one should have a well-defined demand and supply model estimated by using data on both loans granted and loans rejected. The role of existing constraints, like interest rate ceilings, and the criteria by which loan applications were accepted or rejected should also be explicitly incorporated into the analysis.

The paper illustrates the loan demand and loan supply model with non-negotiable loan contracts using loan information provided by a Portuguese agricultural development program, the Fundo de Melhoramento Agricola during the period 1974-1979. The results show a clear discrimination against applicants from the South of the country. Orchard enterprises (fruits) appears to be the agricultural activity experiencing the most discrimination against during this period. The coefficient obtained for the loan size variable (RINV) shows that the lender has oriented its lending activity mainly to activities requiring small loan size. The coefficients obtained for the loan demand show that those demanding small loans, in turn, has been subject to higher transaction costs, as represented by the time delay in credit approval.

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