MANFRED E. KUHN AND MARK A.G. DARROCH*

Factors Affecting Rural Medium-term Loan Repayment: Evidence from a South African Development Finance Institution

INTRODUCTION

Poor loan repayment performance experienced by many development finance institutions (DFIs) has placed an increasing financial burden on these agencies and governments, with default rates ranging from 27 to 60 per cent in African countries such as Ghana and Nigeria (Okorie, 1986). Lugemwa and Darroch (1995) reported a default rate of 40 per cent for small-scale seasonal credit borrowers at the Transkei Agricultural Bank. Without an adequate flow of funds, the capacity of the DFIs to provide more funds in the future is undermined, as financial success depends on a good loan recovery rate. Past African studies of loan repayment performance have focused on determinants of a binary loan outcome where loans were either current or in default. Loan repayment was positively related to factors such as timeliness of disbursement, enterprise profitability, additional sources of income, established previous loan history and lower client debt–asset ratios (Okorie, 1986; Vigano, 1993; Lugemwa and Darroch, 1995).

The above analyses ignore another dimension of the loan repayment problem, namely loans that are repaid in arrears. These can have considerable impacts on DFI liquidity management over time and hence should be considered when analysing loan repayment (Aguilera-Alfred and Gonzalez-Vega, 1993). To date, no research on loan performance in a DFI using multiple loan repayment categories has been done in South Africa. This study therefore aims to use a multiple category response model to estimate factors influencing medium-term loan repayment performance at a South African DFI (which for confidentiality purposes may not be named). This DFI is a parastatal organization financing small business, agricultural/rural development and housing predominantly in the former homeland areas of KwaZulu–Natal, South Africa. It obtains funds primarily from the Development Bank of Southern Africa at concessional interest rates, and has recently also begun actively to mobilize savings. Lenders often have limited information on borrowers and so may select clients who are more risky than they believe, leading to major repayment problems (the adverse selection problem) (Barry *et al.*, 1995). This study will

*University of Natal, Pietermaritzburg, South Africa. The financial assistance of the Centre for Science and Development (CSD) South Africa is gratefully acknowledged. Opinions expressed and conclusions reached are those of the authors and are not necessarily to be attributed to CSD.

therefore help the DFI to mitigate adverse selection by identifying characteristics of problem loans, and can also assist other DFIs in the region to improve selection procedures and reduce default rates. The lender–borrower relationship is first outlined, after which the model, results and policy implications are discussed.

THE PRINCIPAL–AGENT PROBLEM

Credit markets involve an exchange of money for a promise of repayment later. Consequently, there is a risk involved in such a transaction, with the risk being related to the level of information possessed by the two parties (Herath, 1994). An agency problem arises because the lender (principal) has insufficient information on borrower (agent) characteristics and the outcome of their investments. In addition, the principal is seldom able to monitor the actions of the agent perfectly and is therefore concerned with designing a contract which motivates the agent to act in the principal's interest. These contracts are seldom perfect since the principal has imperfect information on the agent's work effort and thus cannot ascertain whether poor performance on the part of the agent results from shirking or unfavourable external factors. Hence the agent is assumed to choose his action so as to maximize his expected utility given the structure of the reward function, while the principal selects a utility function that maximizes his own expected utility (Hayami and Otsuka, 1993).

The principal can limit divergencies from his objectives by establishing appropriate incentives (such as continued access to credit if the present loan is repaid) for the agent. The principal is also concerned with the ability of the agent to perform and successfully conclude the contract by timely repayment. To try to reduce adverse selection, the principal can devise a contract which will induce the desired self-selection by the agent (ibid.). Interest rates can be used to screen potential borrowers since they reflect the potential riskiness of the contract. Lenders may offer different loan contracts with different interest rates. Borrowers who are willing to pay higher interest rates may, on average, be worse risks because they perceive their probability of repayment to be low. However, increasing interest rates have a harmful effect on lenders' expected returns beyond some 'optimum' interest rate since the riskiness of the underlying pool of borrowers increases. Consequently, borrowers are rationed even if they are willing to pay higher interest rates to receive loans (Stiglitz and Weiss, 1981).

Development finance institutions face the additional problem of interest rate restrictions, whereby their interest rates are capped or subsidized below the optimum interest rate by governments wanting to make credit more accessible to the rural poor (Adams, 1984). This reduces the role of interest rates as a screening device and lenders have to resort to alternative means of screening borrowers. Loan contracts are thus adapted by many rural lenders to increase the indirect costs of lending by imposing more stringent collateral requirements and increasing the transaction costs through higher loan application fees and more frequent visits. Stricter collateral criteria have had limited success in development finance because many rural borrowers do not have sufficient collateral. Realization of the collateral in the event of default is also often very costly and politically not feasible, leading to the use of collateral substitutes such as third party guarantees and group lending (Nagarajan and Meyer, 1995). In addition to appropriate interest rates and collateral substitutes, lenders can limit adverse selection by improving client information using data on characteristics that they observe directly and independently of what applicants claim. The following section will discuss the empirical model used in the study to improve the information base for the local DFI.

EMPIRICAL ANALYSIS

Data sources

Two branches of the DFI, with major medium-term agricultural loan portfolios, were selected for the analysis as they could provide the most comprehensive information required for the study. Following Aguilera-Alfred and Gonzalez-Vega (1993), repayment performance over time was monitored to avoid distortions in delinquency measurement resulting from different loan maturities and portfolio growth rates. Primary information from 59 individual borrower dossiers was obtained for all medium-term agricultural loans disbursed in 1993 and 1994. The repayment status of these loans, at a selected cut-off date of 31 March 1996, was classified into three categories: (1) current or without repayment problems (all instalments paid within 30 days of the cut-off date); (2) paid with arrears (all instalments due paid within 30 to 90 days of the cut-off date); and (3) in default (with instalments still unpaid more than 90 days after the cut-off date). Of the 59 loans, 29 per cent were current, 17 per cent were in arrears and 54 per cent in default. A total of R1 408 000 was disbursed to the sample borrowers, with an average loan size at disbursal of R22 417, R38 116 and R20 179, respectively, for current, in arrears and default loans (1 Rand is currently equal to US$0.22). The main economic activities of the borrowers were chicken production, contract maize milling, contract timber and sugarcane harvesting and cartage, and contract ploughing and cartage. The nominal interest rates charged ranged from 14 per cent to 15 per cent, which is 4–5 per cent below the prime rate charged by commercial lending institutions.

Empirical model

The above empirical definition of loan repayment status implies that discrete regression models can be used to estimate determinants of the three loan categories. Both discriminant and logistic regression are well known techniques for analysing binary outcome data. Discriminant analysis can be extended to the multiple category case, but was not used because it requires that, within the groups, variables follow a multivariate normal distribution, with equal covariance matrices (Manly, 1986). Although the violation of this assumption will not necessarily lead to poor results, Press and Wilson (1978) recommended the logistic regression model because of its robustness in respect of the underlying distribution of the independent variables, which need not be multivariate normal. This is particularly useful if binary independent variables are used in the analysis. The maximum likelihood estimation of regression models with multiple category dependent variables is discussed by Madalla (1983). Given that P_j ($j = 1,\ldots,3$) are the probabilities of each one of the three repayment categories occurring, the multinomial logit model can be expressed as:

$$ln\left(\frac{P_j}{P_1}\right) = \beta_{0j} + \beta_{1j}X_{1i} + \ldots + \beta_{kj}X_{ki} + \mu_{ji} \qquad (1)$$

for $j = 2,3$; and $i = 1, \ldots, n$, where P_1 is the probability of loans being current, P_2 of loans paid with arrears and P_3 of loans in default. The X_{ki} are vectors of explanatory variables, β_{kj} are estimated parameters, n is the number of observations and k is the number of explanatory variables. Loan repayment status was estimated as a function of the following loan, business and personal variables.

- Loan characteristics
  LSIZE = loan principal amount (Rands);
  OWNLN = borrower's direct equity contribution relative to loan size.
- Business characteristics
  CONTRACT = 1 if the borrower funded a chicken production or contract ploughing and cartage business venture, and 0 is the borrower funded a maize milling or timber/sugar-cane contract harvesting and transport business;
  LIQUID = present annual income relative to annual debt obligations.
- Personal characteristics
  PREVLN = 1 if the borrower has had previous loans with the DFI, and 0 if a first-time borrower;
  GENDER = 1 for male borrowers, and 0 for female borrowers.

A proxy variable for asset collateral relative to loan size was not included in the analysis because file information on asset values was not reliable (DFI staff constraints meant that asset value data were often not validated by visits to clients). As information on the monitoring activities of the lender, number of years the borrower had been in the business, borrower education and family size was often missing from borrower case files, the possible impact of these variables on loan performance could not be evaluated.

Lenders can reduce the risk of client default by spending more resources on loan evaluation and supervision, obviously increasing administration costs. Wealthier rural loan applicants with larger asset bases can reduce lender information collection costs by being able readily to pledge (verifiable) collateral. This could result in the concentration of loan portfolios amongst wealthy clients with larger loan sizes (Gonzalez-Vega, 1984). Lender behaviour could also be influenced by the applicant's resource allocation, risk management and product choices (Barry *et al.*, 1995). Consequently, more funds are available to investments having a better risk–return combination possibly due to better markets or higher product prices. Sample borrowers with larger loans had larger asset bases, were diversified, had investments with higher net returns and dealt in well established markets for their products. Wealthier borrowers may also be better able to withstand negative income shocks by drawing on their own assets and diverting fewer loan funds to personal consumption (Barham *et al.*, 1996). Loan size (LSIZE) as a proxy for larger, wealthier clients is expected to be negatively related to loan repayment problems.

Borrower's direct equity contribution relative to total loan (OWNLN) shows what the borrower has at stake in the proposed investment and reflects a risk-sharing agreement in which some of the risk of project outcome is borne by the borrower as an incentive to repay. This will not provide a first-best outcome since, as long as only part of the risk is borne by the borrower, he or she will equate his or her marginal cost of effort with his or her share and not the total marginal product of the investment (Hayami and Otsuka, 1993; Stiglitz and Weiss, 1981). If it partly motivates the borrower to try to ensure investment success, OWNLN could negatively affect loan repayment problems.

Data on the sector financed was included to account for the relative riskiness of different activities. Business ventures involving contract harvesting and carting of timber and sugar-cane had well established markets, while maize milling is a service in demand in the rural areas where maize is predominantly grown for consumption purposes. The more regular cash flows which result should improve the potential repayment ability of borrowers. Loans involving the purchase of tractors and implements, although offering attractive potential returns, were deemed more risky by loan staff because borrowers often failed to maintain equipment used for contracting services. Experience also shows that contractors involved in land preparation, such as ploughing, had liquidity problems because they seldom had enough work throughout the year (Ross, 1996). Chicken production enterprises, though they need relatively low capital outlay, faced intense competition, while increased feed costs and Newcastle disease have led to large losses and repayment difficulties. The CONTRACT variable should, therefore, be positively related to loan repayment problems.

Gross annual income relative to annual debt obligations (LIQUID) indicates borrowers' liquidity (ability to service the debt). The higher is LIQUID, the greater is the ability to repay loans on time. The previous use of DFI loans by the borrower (PREVLN) is used as a proxy for the extent of the lender–borrower relationship. The lender is likely to have more reliable information on established borrowers, while the borrower has a better knowledge of the lending procedures and late payment penalties imposed by the DFI (where the DFI does not refinance clients who default on previous loans). Clients having an established track record with the DFI are more likely to repay loans than new borrowers. The GENDER variable is also a potentially important discriminator. A general research finding about rural borrowers is that women have better repayment records (Christen *et al.*, 1994), so that GENDER (with a value of 1 for males) is likely to be positively related to loan repayment problems.

RESULTS

The multinominal logit parameter estimates are presented in Table 1. The residual deviance of 86.89 has a chi-squared distribution with 46 degrees of freedom, showing moderate lack of fit. However, the residual deviance is an unreliable indicator of goodness of fit where continuous variables are included in the logistic regression model (Collett, 1991). Logistic regression diagnostics, which included statistics to assess the influence of individual observations on the overall regression and individual parameter estimates (Hosmer and Lemeshow, 1989; Collett, 1991), showed no apparent lack of fit. An overall classification rate of 74 per cent was achieved, with 59 per cent of current loans, 50 per cent of arrears loans and 90 per cent of defaulters being predicted correctly.

The signs of the estimated coefficients mostly agree with *a priori* reasoning. For DFI lending policy purposes, larger loans and ploughing contractor businesses and broiler ventures are the key factors associated with payment in arrears ($ln(P_2/P_1)$). Although *a priori* expectations were that borrowers with larger loans would have fewer loan repayment problems, this result is mainly due to a few borrowers in the arrears category having bought expensive tractors and implements and not having enough contract work to fund loan repayment on time. The log odds of defaulting relative to being current ($ln(P_3/P_1)$) are greater for clients who are first-time borrowers, have modest loans, smaller own direct equity contributions, and manage contract ploughing or broiler ventures.

CONCLUSIONS

More stringent client monitoring and enforcement of loan contract provisions could reduce loan arrears and default at the institution studied. Business type is another factor for loan officers to consider, as ploughing contractors and broiler producers tended to repay in arrears and default. The contractors probably needed closer monitoring to ensure that equipment is properly maintained and sufficient income can be obtained to enable loan repayment, or they could be encouraged to diversify into contract transport (for example, sugar-cane, timber or inputs) to improve liquidity. Given increased competition and periodic disease outbreak, the lender should exercise caution when financing broiler production. Borrowers need to be made aware of the management requirements and should be encouraged to diversify to reduce price risk.

Results specific to this study sample suggest that clients with larger loans are less likely to default. Such loans tended to be associated with more (verifiable) collateral, lower administration costs per unit of credit and probably better quality information on potential investment returns. Increasing the owner's equity stake in the business increases the share of the risk borne by the client and provides a stronger incentive for loan repayment. Although this measure is a second-best option, it can be an alternative when collateral is an ineffective means of enforcing loan contracts. Borrowers having an established record with the bank tended to repay their loans, highlighting the importance

TABLE 1 *Parameter estimates of the multinomial logit model*

Variable	CONSTANT	LSIZE	OWNLN	CONTRACT	LIQUID	PREVLN	GENDER
$ln(P_2/P_1)$	34.93474	0.00009*	–1.15182	4.33428*	0.091111	–1.93530	–1.64722
	(0.74)	(1.78)	(–0.88)	(1.77)	(1.48)	(–1.33)	(–1.10)
$ln(P_3/P_1)$	67.04195	–0.00005*	–9.29282**	1.84108*	–0.02078	–2.08309**	–1.58103
	(1.53)	(–1.58)	(–2.09)	(1.74)	(–0.41)	(–1.95)	(–1.21)

Notes: *t*-statistics in parentheses; * and ** indicate significance at 10% and 5% levels, respectively; Madalla's pseudo $R^2 = 0.4307$; McFadden's pseudo $R^2 = 0.2805$

of reputation in a borrower–lender relationship. Local DFIs need to be flexible in designing suitable contracts and criteria for client selection to promote viability and continued outreach into rural areas. Finally, the study identifies key extra information such as asset value and education level which must be captured, and verified, in borrower case files to assess how these factors affect loan repayment performance.

REFERENCES

Adams, D.W. (1984), 'Are the arguments for cheap agricultural credit sound?', in D.W. Adams, D.H. Graham and J.D. von Pischke (eds), *Undermining Rural Development with Cheap Credit*, Colorado: Westview Press.

Aguilera-Alfred, N. and Gonzalez-Vega, C. (1993), 'A multinominal logit analysis of loan targeting and repayment at the Agricultural Development Bank of the Dominican Republic', *Agricultural Finance Review*, **53**, 55–64.

Barham, B.L., Boucher, S. and Carter, M.R. (1996), 'Credit constraints, credit unions and small scale producers in Guatemala', *World Development*, **24**, 793–806.

Barry, P.J., Ellinger, P.N., Hopkin, J.A. and Baker, C.B. (1995), *Financial Management in Agriculture*, Chicago, Illinois: Interstate Publishers.

Christen, R.P., Rhyne, E. and Vogel, R.C. (1994), 'Maximising the outreach of microenterprise finance: The emerging lessons of successful programmes', IMCC Paper No. 6860.

Collett, D. (1991), *Modelling Binary Data*, London: Chapman and Hall.

Gonzalez-Vega, C. (1984), 'Credit rationing behaviour of agricultural lenders', in D.W. Adams, D.H. Graham and J.D. von Pischke (eds), *Undermining Rural Development with Cheap Credit*, Colorado: Westview Press.

Hayami, Y. and Otsuka, K. (1993), *The Economics of Contract Choice: An Agrarian Perspective*, New York: Oxford University Press.

Herath, G. (1994), 'Rural credit markets and institutional reform in developing countries: Potential and problems', *Savings and Development*, **18**, 169–91.

Hosmer, D.W. and Lemeshow, S. (1989), *Applied Logistic Regression*, New York: John Wiley & Sons.

Lugemwa, W.H. and Darroch, M.A.G. (1995), 'Discriminant analysis of seasonal agricultural loan repayment by small-scale farmers in Transkei', *Agrekon*, **34**, 231–4.

Madalla, G.S. (1983), *Limited-dependent and Qualitative Variables*, New York: Cambridge University Press.

Manly, B.J.F. (1986), *Multivariate Statistical Methods: A Primer*, Bristol: J.W. Arrowsmith.

Nagarajan, G. and Meyer, R.L. (1995), *Collateral for loans: When does it matter?*, Economics and Sociology Paper No. 2207, Department of Agricultural Economics and Rural Sociology, Ohio State University.

Okorie, A. (1986), 'Major determinants of agricultural smallholder loan repayment in a developing economy: Empirical evidence from Ondo State, Nigeria', *Savings and Development*, **10**, 89–99.

Press, S.J. and Wilson, S. (1978), 'Choosing between logistic regression and discriminant analysis', *Journal of the American Statistical Association*, **73**, 699–705.

Ross, K. (1996), 'Personal communication', head of rural development for branch of study, Development Finance Institution.

Stiglitz, J.E. and Weiss, A., (1981), 'Credit rationing in markets with imperfect information', *American Economic Review*, **71**, 393–410.

Vigano, L. (1993), 'A credit scoring model for development banks: An African case study', *Savings and Development*, **17**, 441–79.