FACTORS ASSOCIATED WITH FARM FINANCIAL FAILURE IN THE NORTHERN SPRINGBOK FLATS

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A logit model was used to distinguish between producers in the Northern Springbok Flats who had failed financially versus those who were financially successful, based on data from a survey which was conducted during 1990. Producers who had failed financially by April 1994 spent more on directly allocatable costs, had higher levels of carry-over debt and arrears instalments on long-term loans, had less collateral in the form of land, had lower farm gross incomes in relation to their long-term debt and bought land during the 1980's. Results reveal a need for improved financial and risk management, better consideration of implications of state intervention, and the use of solvency as well as pay-back measures when assessing credit worthiness.

'n Logit-model, gebaseer op data uit 'n opname wat gedurende 1990 uitgevoer is, is gebruik om tussen finansiële suksesvolle en onsuksesvolle produsente in die Noordelike Springbokvlakte te ondersoek. Produsente wat teen April 1994 finansieël misluk het, het hoër direk toedeelbare koste, meer oorlaatskuld en agterstallige paaiemente op langtermyn lenings gehad terwyl hulle ook minder kollateraal in grond en laer bruto boerdery inkomste in verhouding tot langtermyn skuld gehad het. Dié produsente het ook gedurende die 1980's grond aangekoop. Die resultate dui op 'n behoefte vir verbeterde finansiële- en risikobestuur, met groter inagneming van die gevolge van staatsinmenging en die gebruik van solvabiliteits- sowel as terugbetaal-maatstawwe om boerderye se finansiële posisie te evalueer.

1. Introduction

Since 1982 South African agriculture has been afflicted by a prolonged series of droughts during which production levels have declined. This followed the period from the mid-seventies to the early eighties which were considered as a time of apparent prosperity with record crops being the norm (Directorate of Agricultural Economic Trends, 1992). Groenewald (1982) showed that the parity position of South African agriculture started to decline from the early eighties. This declining parity trend persisted throughout the 1980's where prices of agricultural inputs increased more rapidly than prices of agricultural products and where the latter did not keep pace with the consumer price index (De Jager, 1990).

From the above it can therefore be deduced that the general profitability of South African commercial farming declined over this time. Furthermore, although the value of capital assets in the agricultural sector increased by 9,8 percent from 1975 to 1990, debt burden over the same period increased by 14,2 percent (Directorate of Agricultural Economic Trends, 1992). When one also considers that average monthly prime interest rate increased from 12 percent in 1975 to 21 percent in 1990, with a record high of 24 percent in 1984 (Reserve Bank, 1993), it is clear that financial risk faced by commercial farmers in South Africa also increased during this period.

During 1991, South African commercial agriculture owed approximately 22 percent of it's debt to the Land Bank, 32 percent to commercial banks and 24 percent to cooperatives, representing 78 percent of it's total debt of R17,2 billion (Directorate Agricultural-Economic Trends, 1992). It appears therefore that commercial banks, co-operatives and the Land Bank could incur considerable risk as a result of farm financial failure.

The aim of this study is firstly to compile a model of farm financial failure in the Northern Springbok Flats. Such a model can then be used in evaluating a farm's financial position with a view to the granting of new credit and when reviewing existing credit facilities. Secondly, policy implications for this area as well as for South African agriculture as a whole will be drawn.

2. Models distinguishing between financial failures and successes

During the sixties ratios were first used to predict financial failure. Beaver (1966) searched for a single ratio with which to make such a prediction. Other researchers who followed included Tamari (1966) as well as Daya (1977) and Zevenbergen (1978) in the South African context. Their research, however, was not based on any statistical technique and it also had the disadvantage that single ratio figures were used (De la Rey, 1981).

Altman (1968) made the first effort to use a statistical technique (discriminant analysis) in order to incorporate a combination of ratios in a prediction model. By combining a number of ratios in one discriminant function, Altman determined a cut-off point which represented a distinction between financially successful and unsuccessful businesses in the United States.

Various research followed (Sinkey, 1975; Altman *et. al.*, 1977; Hogan *et. al.*, 1987; Spahr, 1989) while De la Rey (1981) conducted the first such comprehensive study in South Africa. Other researchers (Meyer and Pifer, 1970; Olivier, 1992) attempted to include a time dimension where prediction models were compiled for different years prior to failure. Researchers began to apply statistical techniques other than discriminant analysis, including logistic regression, goal programming and recursive partitioning algorithms (Srinivasan and Kim, 1987; Gardner and Mills, 1989; Collins, 1989).

Information used in this study was obtained from survey data gathered by the Directorate of Agricultural Economics during an investigation of the Northern Springbok Flats during 1990. The aim of the investigation was

to determine the structure of farms as well as the economic and financial position of producers in the area. A random representative sample of 66 respondents, out of a population of 221 producers, was obtained.

Results of the survey indicated that most farms were smaller than 600 hectares with mixed cropping (maize, sunflower and cotton) and beef production being typical. Capital investment as well as costs were relatively high while yields were very variable as this is a marginal cropping area. The majority of producers had also experienced solvability, liquidity and profitability problems (Directorate of Agricultural Economics, 1990).

The definition of a failed undertaking as set out by De la Rey (1981) was adjusted to make it applicable to agriculture. A failed farming enterprise was defined as one which was declared insolvent by the judicial system, leading to it's sequestration/liquidation. Furthermore, farmers who negotiated consolidation or settlement arrangements with the Department of Agriculture were also defined as having financially failed as such arrangements only take place when the farmer, due to his/her financial position, cannot obtain credit support elsewhere (Department of Agriculture, 1994).

During April 1994, local co-operatives and the Department of Agriculture extension office at Potgietersrus were consulted to identify which of the 66 respondents to the 1990 survey had failed. Only one respondent could not be traced and, in terms of the above definition, 17 of the 65 remaining respondents had failed.

4. Data analysis methods

Two methods were considered for the development of a model to distinguish between failed and successful farmers viz. discriminant analysis and logistic regression. Press and Wilson (1978) show that logistic regression is preferable to discriminant analysis in cases for which independent variables do not have multivariate normal distributions within groups. Certain independent variables, especially categorical dummies, used in this study violated this normality assumption. Discriminant analysis, however, is robust to departures from the normality assumption and if discriminant scores are univariately normally distributed for each group, then discriminant analysis is still statistically reliable (Truett *et. al.*, 1967:521).

Notwithstanding, when use was made of discriminant analysis, discriminant scores for the failed group were non-normally distributed (De Jager, 1994). Due to the importance financial institutions attach to correctly predicting financial failure, discriminant analysis was therefore dropped in favour of logistic regression. Logit modelling, a logistic regression technique, which ensures that the estimated probability of financial failure lies within a 0 to 1 range, was used. A logit model assumes that the odds of a farmer failing are a log-linear function of k independent variables of the following form:

$$\log\left(\frac{P_n}{1 - P_n}\right) = \alpha + \sum_{i=1}^{k} \beta_i X_{ni} \ldots\ldots X_{nk}$$

where:
$X_{ni} \ldots X_{nk}$ = k independent variables
P_n = probability of the n^{th} farmer failing
$1 - P_n$ = probability of the n^{th} farmer succeeding
a, β_i = parameter coefficients

Function (1) can be manipulated to give a logistic function which defines the probability of the n^{th} farmer failing as:

$$P_n = \frac{e^{a+\sum_{i=1}^{k} \beta_i X_{ni}}}{1 + e^{a+\sum_{i=1}^{k} \beta_i X_{ni}}}$$

(SAS, 1990:1072-6)

5. Variables used to distinguish between failed and successful farmers

Respondents to the 1990 survey were classified using a dummy variable BANK, which equalled 0 if the farmer was defined as having failed or 1 where the farmer was defined as being successful.

Although there are many ratios that can be used, it was only possible to consider ratios which could be calculated from survey data for the Northern Springbok Flats covering the 1989/90 production season. Independent variables which were used in models and studies of Altman (1968), De la Rey (1981), De Wet (1988) and Mostert (1990) were considered, while Van Zyl (1988) and the Directorate of Agricultural Economics (1989) were consulted. In total some thirty nine traditional financial ratios as well other independent variables were tested (De Jager, 1994). Certain variables which were used to distinguish between failed and successful farmers are discussed below.

5.1 Directly allocatable costs per hectare (DAC)

These are mainly costs associated with production inputs and are characterized by the fact that they can easily be allocated to different enterprises. The Northern Springbok Flats is considered to be a marginal cropping area with variable rainfall. Farms in this area with a high DAC are more exposed to production risks such as droughts which could result in them not being able to recover these costs. It is thus expected that a negative relationship exists between DAC and BANK.

5.2 Carry-over debt per hectare (CARR)

Carry-over debt is the portion of production debt received from co-operatives which when unable to be repaid is rolled over to the next production season. The carry-over debt scheme, which came to an end in December 1992, was supported by a government guarantee to the cooperative concerned that the state would act as security for carry-over debt. Cooperatives therefore had an incentive to provide production debt to producers where they would not normally have done so. Producers relying on this scheme thus became artificially exposed to financial risk and were less able to cope with the schemes termination. A negative relationship between CARR and BANK is thus expected.

5.3 Arrears instalments on long-term loans (LT-A)

LT-A refers to instalments on long-term loans which have gone into arrears due to liquidity problems as sufficient income is not generated to be able to comply with instalment obligations. This results in an accumulation of short-term debt and exposes farmers to

greater financial risk. It is therefore expected that LT-A will be negatively correlated with BANK.

5.4 Land owned over total farm size (OWN)

This variable was obtained by dividing number of hectares owned by total farm size in hectares. An undertaking with a higher OWN should show a higher asset value in its balance sheet. In addition, collateral flexibility will be greater and financial institutions will be less likely to pursue liquidation/sequestration of a farm business which has a relatively high OWN. It is thus expected that this variable will be positively correlated with BANK.

5.5 Gross farm income over long-term debt (GI-LT)

This variable was obtained by dividing gross farm income with total long-term debt. Farmers with a high GI_LT are expected to be in a better position to repay long-term loans and a positive correlation between GI-LT and BANK is expected.

5.6 Purchase of land during the past decade (LT)

This is a dummy variable which equals 1 if the farmer purchased land during the previous decade or 0 if not. Due to declining profitability, average nominal land price decreased from approximately R770.00 per hectare during 1989 to approximately R500.00 per hectare in 1994, severely affecting farmers solvency and collateral positions. Farmers who purchased land during the 1980's are therefore expected to be more exposed to financial failure (a negative relationship between LT and BANK). Correlations between these six independent variables and the financial failure dummy BANK are given in Table 1. Coefficient signs agree with *a priori* reasoning on relationships between BANK and independent variables.

6. Results

The SAS LOGISTIC procedure was used to fit a logit regression model to the data. The stepwise method was used to add explanatory variables to the regression. At each step, variables were examined for entry or removal according to whether or not adjusted Chi-squared statistics computed for each variable were significant or not at the 10 percent probability level (SAS, 1990, p.1072).

Altogether 6 variables fulfilled this selection criterion with signs on coefficient estimates satisfying *a priori* reasoning and t values indicating statistical significance (see Table 2). Gamma and Somer's D are statistics where a 0 in the range -1 to +1 indicates that no distinction between the two groups has been modelled. Results show that both statistics exceed 0.8, suggesting that the model has successfully differentiated between failed and successful farmers. These results imply that selected independent variables, individually and jointly, influence the probability of failure (SAS, 1990,:866-7).

High classification accuracy depends on whether failed farmers receive a predicted probability of failure of 0.50 or above and whether successful farmers receive a predicted probability of failure of 0.49 or below. Approximately 71 and 96 percent, respectively of failures and successes were correctly predicted. The overall classification accuracy was approximately 89 percent, suggesting that the model has adequately distinguished between financial failures and successes.

Results indicate that DAC is the first variable to distinguish between failed and solvent farmers. Failed farmers had an average directly allocatable cost of R280.01 per hectare during the 1989/90 production season which is almost double that of successful farmers (R143.41/ha). This could imply that failed farmers did not take long-term yields into account when applying production inputs, thus making themselves more vulnerable to production risks.

Farmers with a higher CARR had a greater probability of failure. Results indicate that farmers who have failed had an average carry-over debt of approximately R172.00 per hectare during the 1989/90 production season as opposed to approximately R69.00 per hectare for successful producers. The Northern Springbok Flats is a marginal cropping area where consecutive high yields are not common, implying that producers have a limited ability to pay back accumulated debt. The build-up of carry-over debt implies that production credit which was given to farmers was not based upon long-term expected yields. It also implies that the State supported carry-over debt scheme did not prevent producers from failing financially.

Farmers with a relatively high LT-A have a greater chance of facing failure than farmers with relatively less arrears instalments on long-term debt. During the 1989/90 production season, failed farmers had an average of R156427.60 in arrears instalments on long-term debt, nearly twice as much as successful farmers who had an average of R54049.73. These results suggest that a conservative debt policy is associated with financial survival in this area.

Results indicate that farmers who own a higher percentage of land farmed (OWN) have less chance of failure. This implies that these producers have a collateral buffer which they can use to obtain credit, highlighting the importance financial institutions attach to physical collateral.

Farmers with a higher GI_LT had a greater chance of success than those with lower values for this variable. Farmers who are thus over-leveraged with long-term debt are therefore less able to repay this debt at current farm income levels. Producers who purchased land during the 1980's (LT) also had a greater chance of failing financially.

7. Conclusion

This study highlights the need for improved financial and risk management practices in the Northern Springbok Flats. Financial institutions should base production credit on long-term expected yields and take pay-back potential as well as solvency into account when extending credit. Furthermore, agronometric research which is aimed at lowering production risks in this area should also be undertaken.

To limit production and financial risks, policies which encourage cropping of marginal land and provide artificial credit security should be carefully evaluated.

Table 1: Pearson correlation coefficients of independent variables for 65 commercial farmers, Northern Springbok Flats, 1989/90 production season

VARIABLE	BANK	DAC	CARR	LT-A	OWN	GI_LT	LT
BANK	1.00 (0.00)						
DAC	-0.416 (0.00)	1.00 (0.00)					
CARR	-0.300 (0.02)	0.015 (0.90)	1.00 (0.00)				
LT-A	-0.207 (0.10)	-0.113 (0.37)	-0.000 (1.00)	1.00 (0.00)			
OWN	0.190 (0.13)	0.067 (0.60)	-0.009 (0.94)	-0.010 (0.94)	1.00 (0.00)		
GI_LT	0.228 (0.07)	0.093 (0.46)	-0.218 (0.08)	-0.061 (0.63)	-0.188 (0.13)	1.00 (0.00)	
LT	-0.252 (0.04)	0.113 (0.37)	0.102 (0.42)	-0.009 (0.94)	-0.014 (0.91)	-0.206 (0.10)	1.00 (0.00)

Note: figures in brackets show significance levels

Table 2: Logit modelling results showing variables associated with financial failure of commercial farmers in the Northern Springbok Flats, 1989/90 production season

Summary of the stepwise procedure			
Step	Variable entered	Chi-Square	Pr > Chi-Square
1	DAC	10.736	0.0011
2	CARR	6.464	0.0110
3	LT-A	6.816	0.0090
4	OWN	4.950	0.0261
5	GI_LT	8.401	0.0037
6	LT	2.995	0.0835
Linear probability function coefficient estimates			
Variable		Coefficient estimate	t value
INTERCEPT		0.6980	0.368
DAC		0.0202	2.886***
CARR		0.00896	2.500**
LT-A		5.506E-6	1.907*
OWN		-9.1922	2.592**
GI_LT		-0.2096	2.395**
LT		1.7686	1.653*
*** denotes significance at the 1% level, ** the 5% level, * the 15% level			
Somer's D		0.880	
Gamma		0.882	
Classification accuracy:			
Failures		70.6%	
Successes		95.8%	
All responses		89.2%	
Group means of independent variables			
Variable	Unit	Failure	Success
DAC	Rand/ha	280.01	143.41***
CARR	Rand/ha	171.66	68.68**
LT-A	Rand	156427.60	54049.73*
OWN	%	0.78	0.87*
GI_LT	%	3.34	10.54*
LT	1=yes; 0=no	0.76	0.48**
*** denotes significantly different group means, assuming equal variances, at the 1% level, ** the 5% level, * the 15% level			

In addition, careful consideration should be given to policies and quotas which could result in increases in land prices to ensure that new entrants and existing producers do not become over-leveraged.

It was seen that land owned is associated with financial success, showing the importance of land as a form of security. This has important implications for the financing of upcoming agriculture. Where possible, private ownership of land should be encouraged and alternative means of securing debt for upcoming producers should be researched.

In summary, the model which has been developed is a simple tool which can be used by financial institutions in the Northern Springbok Flats to assist with credit extension. It is hoped that similar research can be done to identify factors associated with financial failure in other areas.

Notes

1. The authors gratefully acknowledge ms. J. Kritzinger of the Directorate of Agricultural Economics for her statistical programming input. Constructive comments on methodology by Dr B.E. Eiesenberg and mr R.L.J. Coetzer, Assistant Director and Biometrician, respectively of the Agrimetrics Institute, Agricultural Research Council, are also gratefully acknowledged.

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