CAUSES OF MAIZE FARM BANKRUPTCY IN SOUTH AFRICA: 1970-1994

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The number of maize farms declared bankrupt in South Africa rose sharply from 16 farms in 1970 to 205 farms in 1986 and then fluctuated around the 150 farm level in the early 1990's. Ordinary least squares regression and principal component analysis confirmed *a priori* expectations that maize farm bankruptcy was negatively related to the lagged real maize producer price and annual rainfall (business risk factors), but positively related to the lagged aggregate farm debt/asset ratio and lagged real interest rates (financial risk factors).

OORSAKE VAN MIELIEPLAASBANKROTSKAP IN SUID-AFRIKA: 1970-1994
Die aantal mielieplase wat in Suid-Afrika bankrot verklaar is, het skerp gestyg vanaf 16 plase in 1970 tot 205 plase in 1986 en het toe gewissel rondom die 150-plaasvlak in die vroeë 1990's. Gewone kleinstekwadraatregressie en hoofkomponentontleding het *a priori* verwagtings bevestig dat mielieplaasbankrotskap negatief verband gehou het met die nalopende reële mielieprodusenteprys en jaarlikse reënval (besigheidsrisikofaktore), maar positief verband hou met die nalopende globale plaasskuld/bateverhouding en nalopende reële rentekoerse (finansiële risikofaktore).

1. INTRODUCTION

The number of maize farms declared bankrupt in South Africa rose sharply from 16 farms in 1970 to 205 farms in 1986 and then fluctuated around the 150 farm level in the early 1990's (Van Niekerk, 1995). As farm failure imposes major adjustment costs on the farmers involved and also gives rise to demands for Government assistance to alleviate financial distress, it is pertinent to ask why these farmers failed. Answers can help to identify appropriate future policy and management measures to avoid having to reorganise an insolvent business or liquidate the business and pay creditors (Barry *et al.*,1995).

Shepard and Collins (1982) studied aggregate United States (US) farm sector bankruptcy data over the period 1910-1978. Prior to World War II, the farm bankruptcy rate appeared to be linked with financial risk (leverage), while postwar bankruptcy was associated with business risk factors (variable real net farm income). Agricultural support payments since World War II did not induce, defer or reduce farm failures. Chan and Rotenberg (1988) identified financial leverage and energy-related expenses as key causes of farm bankruptcy in Canada during 1979-1986. In South Africa, Van Zyl *et al.* (1987) found that the initial farm solvency position, nominal interest rates and inflation together affected survival of "typical" Western Transvaal and North-Western Transvaal Bushveld farms. Leslie and Darroch (1993) reported that successful farms (positive long-run real return on equity) in Natal, the Eastern Orange Free State and Western Transvaal in 1993 had higher rates of return to assets and equity and lower costs of debt than unsuccessful farms. Rates of return to assets on successful farms also exceeded costs of debt, implying positive use of leverage. De Jager and Swanepoel (1994) used a logit model to show that insolvent farmers in the Northern Springbok Flats during 1990 had higher directly allocatable costs, relatively more carry-over debt, liquidity problems, less collateral in the form of land and lower gross farm incomes relative to long-term debt.

Given that no local study has yet analysed the above trends in aggregate maize farm bankruptcy levels in South Africa, this paper considers sources of business and financial risk which may have caused maize farm bankruptcies since 1970. A concluding section considers possible policy and management implications of the results.

2. TRENDS IN SOUTH AFRICAN MAIZE FARM BANKRUPTCIES: 1970-1994

Figure 1 compares aggregate farm sector and maize farm bankruptcies in South Africa during 1970-1994. Maize farm data are for the summer rainfall area as defined by the Directorate Agricultural Statistics (1996: 110). Aggregate farm bankruptcy increased from 50 farms in 1970 to 389 farms in 1994, with notable rises in 1978, 1984-1987 (four-fold from 80 to 320 farms) and 1990-1991. Maize farm bankruptcies were obviously lower over this period but showed similar trends (rose from 16 to 206 farms by 1986 and then fluctuated around the 150 farm level in the early 1990's), except for a decline in 1994. The fall in the annual aggregate and maize farm bankruptcies in 1993 could be attributed to a drought relief package (carry-over debt subsidy and loan guarantee scheme instalment) in 1992/93 totalling some R3,4 billion (Directorate Financial Assistance, 1996). The following section explains possible causes of the trend in maize farm bankruptcies.

3. POSSIBLE CAUSES OF MAIZE FARM BANKRUPTCIES IN SOUTH AFRICA

Commercial maize farmers in South Africa experience business and financial risk. Business risk refers to risk inherent in a business independent of the way it is financed and is reflected in variability of net operating income. It arises from factors such as price variability in both output and input markets. Financial risk reflects added variability of net cash flows due to fixed financial obligations associated with debt financing (Gabriel and Baker, 1980).

Business risk factors which could cause maize farm bankruptcy include drought and variable product and/or input prices. Drought is expected to increase bankruptcies by reducing net cash flows. Particularly severe drought conditions occurred in the summer rainfall area in 1982, 1991 and 1994 (CCWR, 1996). Variable product and input prices can impact on farm failure rates by producing wide fluctuations in farm income (liquidity effects). Lower real net farm income would likely increase bankruptcy rates (Shepard and Collins, 1982). In South Africa, an added risk dimension affecting maize farm incomes would be the fall in real maize producer prices since the 1987/1988 marketing year when Maize Board pricing policy changed and losses on export sales were reflected in lower net maize

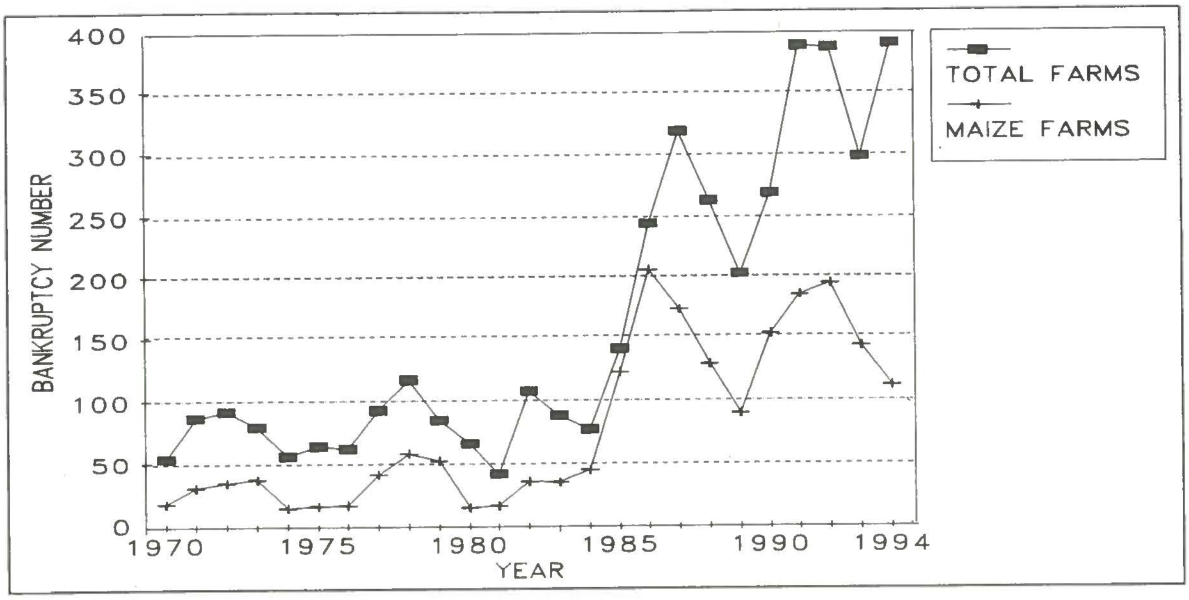

Figure 1: Aggregate and maize farm bankruptcy trends in South Africa: 1970-1994.

Source: Directorate Agricultural Economic Trends (1995); Central Statistical Service (1994 and 1995); Van Niekerk (1995).

producer prices (Faminow and Laubscher, 1991). A negative relationship between real maize producer price and maize farm bankruptcy is expected.

Financial risk factors include real interest rates and the aggregate farm debt/asset (leverage) ratio. When real interest rates are relatively high, farmers (especially those with high leverage) are less able to afford more credit and the cost of debt increases. Potential bankrupts thus have difficulty in accessing credit to keep operating and prevent or delay failure. A positive relationship between real interest rates and maize farm bankruptcy is hence anticipated. Commercial bank overdraft interest rates were used as a proxy for market interest rates (South African Reserve Bank, various years) and adjusted to real terms using the change in Consumer Price Index, CPI (1990=100) (Directorate Agricultural Statistics, 1996). Annual real overdraft interest rates fell from 2 percent to around -1,5 percent over 1970-1975, rose to 1 percent for 1976-1978 and fell to -4,5 percent by 1980. De Kock Commission recommendations for more market-orientated commercial and Land Bank interest rates led to historically high real overdraft interest rates of 5-7 percent during 1983-1985, while positive real rates of 2,5-6,5 percent have continued since 1988. More market-related rates imply greater expected future interest rate volatility and higher financial risk.

The aggregate farm debt/asset (leverage) ratio measures total farm debt as a percent of total farm assets and, hence, the solvency and risk-bearing ability of farmers. Higher debt burdens imply higher fixed debt service charges and greater financial risk, as debts must be repaid in high and low income years. This increases the probability that highly leveraged farmers will face difficulties in servicing debt (Chan and Rotenberg, 1988). Leverage and maize farm bankruptcy are expected to be positively related. Farm sector leverage in South Africa rose from 0,06 in 1970 to a peak of 0,17 in 1985 and remained around 0,15 to 1994. Favourable accelerated depreciation allowances on machinery investment, negative real interest rates in the early 1980's and drought in the early 1980's and 1990's probably encouraged more use of debt.

There is likely to be a time lag between the incidence of business and financial risk factors and ultimate farm bankruptcy. For example, drought and higher interest rates in one year will affect borrowers' future ability to meet debt repayments, as they reduce present income (and possibly savings) and raise the commitments against future income (Rucker and Alston, 1987). Proxy variables for business and financial risk in the maize farm bankruptcy model estimated below are lagged to indicate that the bankruptcy process is dynamic.

4. RESEARCH METHODOLOGY

Factors affecting maize farm bankruptcies during 1970-1994 were estimated from time series data using ordinary least squares (OLS) regression and principal component analysis. Regional sequestration data were obtained for the summer rainfall area over this period for all farms exceeding 50 hectares, and exclude farm companies and close corporations (Van Niekerk, 1995). The number of farm sequestrations was taken as a proxy for the number of farm bankruptcies. The preliminary OLS model is given by equation (1):

$$BANKR = b_0 + b_1\,RMP1 + b_2\,WEA1 + b_3\,LEV1 + b_4\,RINT2 + e_t \quad (1)$$

where BANKR = annual maize farm bankruptcies; RMP1 = real maize producer price (which reflects the level of real maize subsidies) in previous year; WEA1 = rainfall in the previous year in the designated area (CCWR, 1996); LEV1 = farm sector leverage ratio in the previous year; RINT2 =

real commercial bank overdraft interest rate two years prior, and e_t = disturbance term.

5. RESULTS

5.1 Correlation coefficients

All correlation coefficient signs agreed with *a priori* expectations. Annual bankruptcy, BANKR, was significantly negatively correlated with RMP1 (-0,453 at the 5 percent level) and WEA1 (-0,401 at the 10 percent level), but significantly positively correlated with both LEV1 (0,842) and RINT2 (0,666) at the 1 percent level. Aggregate leverage, LEV1, was significantly correlated with both RINT2 (0,500) and WEA1 (-0,439) at the 5 percent level, and with RMP1 (-0,369) at the 10 percent level. These results, together with a significant correlation between RINT2 and WEA1 (-0,470) at the 5 percent level, indicated potential multicollinearity.

5.2 Regression model

The initial estimated OLS maize farm bankruptcy model (GENSTAT, 1995) was:

$$\begin{aligned} BANKR = 25{,}202 &- \underset{(-1{,}850)^{*}}{1{,}180\ RMP1} + \underset{(0{,}242)}{0{,}018\ WEA1} \\ &+ \underset{(4{,}296)^{***}}{1003{,}521\ LEV1} + \underset{(3{,}053)^{***}}{6{,}377\ RINT2} \end{aligned} \qquad (2)$$

where adjusted R^2 = 78,17 percent, d=1,10881, t-values are in parentheses, and *** and * indicate significance at the 1 percent and 10 percent levels respectively.

Expected multicollinearity occurs in equation (2) as the WEA1 coefficient is not statistically significant and has the wrong sign. Principal components extracted from the standardised explanatory variables (ZRMP1 etc.) to cope with this problem are shown in Table 1. The Durbin-Watson d statistic for detecting autocorrelation falls in the indecisive range, but the Geary test gave 11 runs which lie in the 95 percent confidence interval [7,898, 16,600], so the hypothesis of randomness is accepted (Gujarati, 1988: 372).

The principal components (PC's) are used to restate equation (2) in terms of the original variables purged of multicollinearity (Chatterjee and Price, 1977). Standardised annual maize farm bankruptcy, ZBANKR, is first regressed on PC_1 and PC_2 which explain most (77,81 percent) of the variation in the explanatory variables (principal components PC_3 and PC_4 were omitted as they showed the linear relationships between the explanatory variables which were the source of the multicollinearity).

$$ZBANKR = \underset{(8{,}070)^{***}}{0{,}594\ PC_1} + \underset{(2{,}020)^{*}}{0{,}206\ PC_2} \qquad (3)$$

where adjusted R^2 = 75,60 percent, t-values are in parentheses, and *** and * indicate significance at the 1 percent and 10 percent levels respectively.

Standardised annual maize farm bankruptcy could also be estimated by OLS regression of ZBANKR on the standardised explanatory variables as per equation (4):

$$\begin{aligned} ZBANKR = b_1\ ZRMP1 + b_2\ ZWEA1 + b_3\ ZLEV1 \\ + b_4\ ZRINT2 \end{aligned} \qquad (4)$$

Following Chatterjee and Price (1977: 176), it can be shown that the b coefficients of equation (4) can therefore be estimated from equation (3) coefficients and the PC_1 and PC_2 loadings in Table 1 as:

$$\begin{aligned} b_1 &= (-0{,}27971 \times 0{,}594) + (-0{,}84848 \times 0{,}206) \\ b_2 &= (-0{,}51694 \times 0{,}594) + (0{,}41157 \times 0{,}206) \\ b_3 &= (0{,}60042 \times 0{,}594) + (0{,}19553 \times 0{,}206) \\ b_4 &= (0{,}54225 \times 0{,}594) + (-0{,}26624 \times 0{,}206). \end{aligned} \qquad (5)$$

Substituting these expressions into equation (4) gives the estimated standardised maize farm bankruptcy regression model as:

$$\begin{aligned} ZBANKR = -0{,}341\ ZRMP1 - 0{,}222\ ZWEA1 \\ + 0{,}397\ ZLEV1 + 0{,}267\ ZRINT2 \end{aligned} \qquad (6)$$

The standardised variables are independent of the original units of measurement, and their coefficients show the relative importance of the variables. The leverage ratio, ZLEV1, is the most important explanatory variable, followed by the lagged real maize producer price, ZRMP1, lagged real interest rates, ZRINT2, and lagged annual rainfall, ZWEA1. Standard errors and t-values of the b coefficients were estimated following Gujarati (1988: 60). The t-values are equivalent to those in original scale since scaling does not affect the correlation of the variables. Finally, the regression coefficients in equation (6) were multiplied by S_{BANKR}/S_{Xi} (standard deviation of BANKR divided by standard deviation of the relevant explanatory variable) to express the amended OLS annual maize farm bankruptcy model in original scale (Chatterjee and Price, 1977) as per equation (7):

$$\begin{aligned} BANKR = 112{,}600 &- \underset{(-3{,}831)^{***}}{0{,}274\ RMP1} - \underset{(-3{,}920)^{***}}{0{,}134\ WEA1} \\ &+ \underset{(8{,}154)^{***}}{661{,}984\ LEV1} + \underset{(2{,}802)^{**}}{4{,}531\ RINT2} \end{aligned} \qquad (7)$$

where adjusted R^2= 75,60 percent, t-values are shown in parentheses, and *** and ** indicate significance at the 1 percent and 5 percent levels respectively.

Table 1: Principal components extracted for the maize farm bankruptcy model.

	Principal Component			
Variable	PC_1	PC_2	PC_3	PC_4
ZRMP1	-0,27971	-0,84848	-0,05519	0,44588
ZWEA1	-0,51694	0,41157	-0,64805	0,37870
ZLEV1	0,60042	0,19953	0,09676	0,76832
ZRINT2	0,54225	-0,26624	-0,75341	-0,25973
Eigenvalue	2,049	1,064	0,525	0,363
% variation	51,21	26,60	13,11	9,07

Comparing equations (7) and (2), the adjusted R^2 falls slightly but the t-values increase markedly, except for the RINT2 coefficient which is still significant at the 5 percent level. All other coefficients are now highly significant and the WEA1 coefficient sign is correct. The regression coefficient estimates in equation (7) are biased as some information was lost by dropping PC_3 and PC_4, but they have more precision than the OLS estimators in equation (2) (Chatterjee and Price, 1977: 175).

6. CONCLUSIONS

Maize farm bankruptcy over the period 1970-1994 was negatively related to the lagged real maize producer price and annual rainfall (business risk factors), but positively related to the lagged aggregate farm debt/asset ratio and lagged real interest rates (financial risk factors). This implies that bankruptcy is a dynamic process, as there is a time lag between the incidence of these factors and ultimate farm failure.

Policy implications are that changes in maize producer price policy created an additional source of risk for maize farmers to manage. Recent further deregulation of domestic maize pricing means that maize farmers must give more attention to managing price risk, possibly by using forward contracts or maize futures contracts on the South African Futures Exchange. Macroeconomic policy changes (more market-related real interest rates) also directly affect maize farmers. Stable monetary policy can thus contribute to stability in the maize sector. Policy measures which encourage debt use may contribute to farm bankruptcy. Maize farmers will need to closely monitor farm policy and macroeconomic trends to form accurate expectations of potential bankruptcy causes. This can lead to improved management of debt and business and financial risk at farm level. Specialist extension personnel, consultants and lenders need to advise clients on the relationship between net farm income, interest costs and leverage levels for successful debt management.

While causes of aggregate maize farm bankruptcies have been estimated, more research is needed on the individual characteristics of bankrupt farmers. For example, "are farmers operating relatively larger farms going bankrupt ?" and "are younger, more leveraged farmers, or those less able to manage business and financial risk, going bankrupt ?".

NOTES:

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