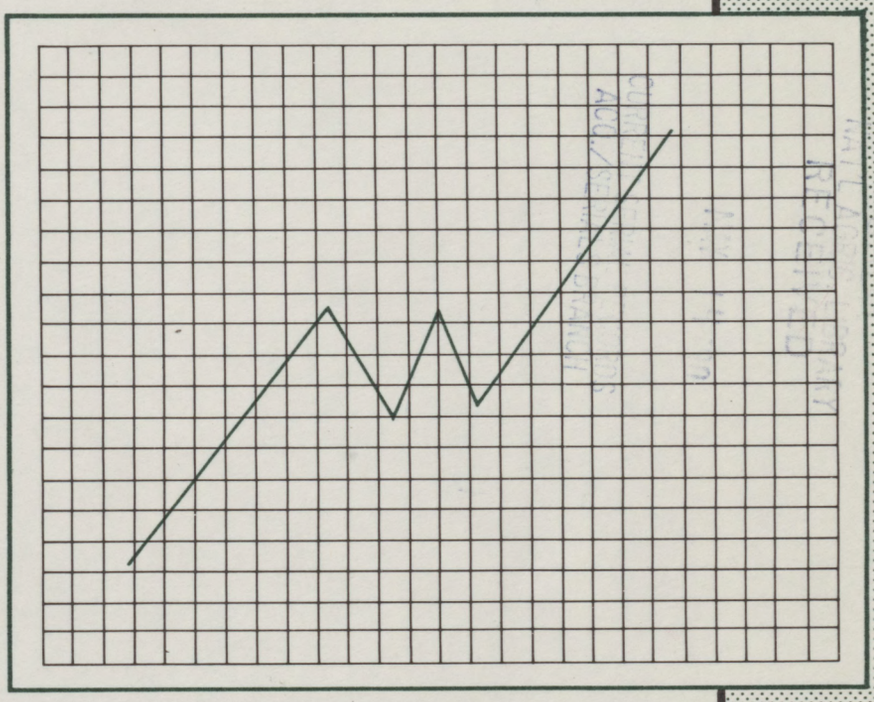

AGREKON

FOUR-MONTHLY JOURNAL
ON AGRICULTURAL ECONOMICS

Vol. 28 No. 2
JUNE 1989

Price R5,00
(plus GST)

INTER-RELATIONSHIPS BETWEEN FINANCIAL RATIOS FOR SUMMER CROP PRODUCERS: A NOTE

by K.G. FULLER and M.A.G. DARROCH*

ABSTRACT

A principal component analysis of financial ratios showing farm solvency, liquidity, profitability, efficiency and debt servicing ability is studied for 1 836 summer crop producers.

More highly leveraged farmers had high overdraft to net worth and low discretionary income to own capital ratios. They seemed to rely on short-term debt, in particular, to fund operations. Alternatives to short-term debt for managing liquidity - such as cost savings, diversification and asset and debt restructuring - could therefore be investigated by farmers and policy-makers. Lenders and co-operative advisers should emphasise to clients that fixed charges associated with higher leverage increase the potential for lower returns to own capital when events such as drought reduce cash inflow or rising interest rates increase cash outflow.

Farmers with high operating ratios also had high debt ratios. Improved operational efficiencies through cost savings may therefore reduce reliance on debt financing. Less solvent producers had asset structures with relatively higher proportions of medium-term assets. Accelerated depreciation allowances could have encouraged debt financing of medium-term assets or over-investment in medium-term assets, which reduces liquidity and increases debt use. The impact on asset investment decisions and farm liquidity of recently announced changes to these depreciation allowances needs investigation by policy-makers.

INTRODUCTION

The financial performance of farm businesses can be monitored using financial ratios. These ratios, based on financial statements, reflect farm solvency, liquidity, profitability, efficiency and debt servicing ability (Barry *et al.*, 1979, pp. 165-183). Research into how these ratios are inter-related can help to identify reasons for the financial results achieved by farm businesses.

The objective of this note is to identify inter-relationships between financial ratios of local summer crop farmers using principal component analysis (PCA). Farm management and policy research implications of these inter-relationships are discussed. Study ratios were derived from survey data collected by the South African Agricultural Union in 1983 (South African Agricultural Union, 1984). The two years prior to the survey period were characterised by drought and relatively high inflation and nominal interest rates (Davel, 1985, p. 11).

PREVIOUS RESEARCH

Empirical relationships between financial ratios have been studied using factor analysis (Pinches *et al.*, 1973; Lubbe, 1981) principal component analysis (Johnson, 1979) and cross-frequency analysis (Janse van Rensburg & Groenewald, 1987).

The factor and principal component studies all extracted meaningful classifications of financial ratios. Pinches *et al.* (1973) found the composition of ratio groups to be stable over time for industrial firms. Lubbe (1981) identified different ratio groupings for extensive beef and livestock farmers in the North Western Transvaal. The groupings were used to identify key financial ratio standards for these farmers. Johnson (1979) reported stable ratio group compositions across retail and primary manufacturing firms.

Janse van Rensburg & Groenewald (1987) found that Western Transvaal grain farmers with lower returns to own capital had higher total directly allocable costs per rand of gross farm income and invested more in machinery, equipment, land and fixed improvements per hectare. They concluded that poorer performers therefore incurred more cost relative to production and also made higher investments. This probably indicated less judicious purchase and investment behaviour (p.17).

The study presented in this note differs from previous research on financial ratios in that it is the first local application of PCA to identify inter-relationships between the financial ratios of summer crop producers derived from national survey data.

FINANCIAL SURVEY DATA

The South African Agricultural Union conducted a survey in 1983/84 to determine the financial position of South African farmers (South African Agricultural Union, 1984). A structured questionnaire was sent out to 43 122 members of provincial unions requesting information about farm type, assets, liabilities, farm income sources, off-farm

*Standard Bank of South Africa and the University of Natal respectively. Research was conducted while the senior author was a member of the Agricultural Research Unit, which is financially supported by the HSRC. Opinions expressed are those of the authors and do not necessarily reflect those of the Standard Bank, the HSRC or the University of Natal. The authors thank colleagues at the University of Natal and three anonymous reviewers for helpful comments

Article submitted: February 1988

Article received back from the authors: January 1989

income, production costs and fixed annual debt payments. Fixed assets, movable assets and livestock were recorded at realistic market values. A total of 11 080 usable questionnaires were returned.

The survey data provided by summer crop producers were extracted for this study. Farmers were classified as summer crop producers if summer crops contributed 60% or more of gross farm income. Most summer crop producers farmed in the Transvaal and the Orange Free State. After classification by farm type, the data were screened to exclude questionnaires with missing financial information. A listwise deletion of missing values gave a final sample of 1 836 summer crop producers.

ANALYSIS METHOD

The analysis involved, first, selecting a suitable set of financial ratios from the data and, secondly, using PCA to search for inter-relationships between the selected ratios. The SPSS-X FACTOR ANALYSIS subprogramme (SPSS, 1986) was used to obtain PCA results.

Financial ratios used

Ten financial ratios were selected for analysis, based on ratios used in past research (Hardy & Weed, 1980; Lubbe, 1981; Darroch, 1986; Fuller, 1988), and given in recognised texts (Lee *et al.*, 1980; Penson & Lins, 1980; Standard Bank, 1981). These ratios showed farm solvency, liquidity, profitability, efficiency and debt servicing ability.

Solvency

(i) Debt ratio (DR) = Total liabilities/Total assets

This ratio measures solvency, showing whether outstanding liabilities will be met if all assets are liquidated. The lower the DR, the relatively more solvent is the farmer.

(ii) Leverage ratio (LR) = Total liabilities/Net worth

As LR increases, debt commitments rise relative to equity, thus increasing the financial risk of repayment default.

Liquidity

(i) Immediate liquidity ratio (CCL) = Cash/Current liabilities

Also called the quick ratio, this ratio indicates the potential for working liabilities to be redeemed by cash. Ratio values of 1,5 to 2 indicate relatively liquid financial positions (Standard Bank, 1981, p. 32).

(ii) Debt structure ratio (DSR) = Current liabilities/Total liabilities

In general, the lower the DSR, the more liquid is the farm business (Penson & Lins, 1980, p. 41).

Profitability

(i) Discretionary income returns to own capital (DIR) = Discretionary income/Own capital

Discretionary income is derived by subtracting annual fixed charges (mortgage, hire purchase and interest payments) from net farm income and is a surplus available for reinvestment or personal expenditure. The ratio gives the rate of discretionary income return per rand of own capital invested in the farm.

(ii) Farm business profitability ratio (FBPR) = Net farm income/Total assets

This ratio indicates the rate of return to the assets of the farm business. The higher the FBPR, the more profitable is the use of farm assets. This return can be compared with rates of return on alternative investment or farm types.

Efficiency

(i) Operating ratio (OPR) = Total operating expense/Gross farm income

The proportion of gross returns absorbed by operating expenses is shown by OPR. A comparison of this ratio with those of other farmers would indicate relative efficiency of input use.

(ii) Asset structure ratio (ASR) = Medium-term assets/Total assets

This ratio indicates the proportion of total assets represented by machinery, vehicles and equipment. The higher the ASR, the lower is the relative investment in operating capital. This may reduce farm operating efficiency owing to over-capitalisation in medium-term assets.

Debt servicing ability

(i) Debt servicing ratio (DSER) = Annual fixed charges/Gross farm income

This ratio measures the ability of gross farm income to meet finance charges as they fall due. The higher the ratio, the greater is the proportion of income used to meet these charges rather than to fund operations. This would tend to reduce farm enterprise viability.

(ii) Overdraft to net worth (ONWR) = Overdraft/Net worth

A commercial banker will usually request security when granting overdrafts, so that funds are recoverable should borrowers default. As ONWR rises, security cover (represented by owner net worth) declines relative to the overdraft, indicating potential repayment problems.

As this application of PCA examines how financial ratios are inter-related, no distributional assumptions about the ratios are required (Tabachnick & Fidell, 1983, p. 380).

Principal component analysis

Principal component analysis examines inter-relationships between the 10 financial ratios by linearly transforming them into composite variables, or principal components, which are uncorrelated to each other (Kim, 1975, p. 470). Each principal component (Z_j) is extracted as:

$$Z_j = a_{j1}x_1 + a_{j2}x_2 + \ldots\ldots\ldots + a_{j10}x_{10} \quad (1)$$

where $x_1, x_2, \ldots\ldots, x_{10}$ are the 10 financial ratios un-

der study and j = 1, 2, ..., 10. The coefficients a_{j1}, a_{j2}, ..., a_{j10} are chosen such that successive Z_js account for as much of the variation (information) in the original ratios as possible in descending order (Nieuwoudt, 1977, p. 77).

Inter-relationships between ratios are identified by the relative size of the coefficients. Ratios with the highest coefficients in any Z_j are most highly correlated with that Z_j. By interpreting the relationship between these ratios, the researcher can attach meaning to that Z_j.

The components derived from the financial ratios depend upon the data matrix used for analysis. According to Morrison (1978, p. 268), if the variables are measured in widely differing units linear transformations would have little meaning and hence standardised variates and the correlation matrix should be employed. Conversely, if the variables are reasonably commensurable the variance-covariance matrix should be used. The ratios given above are not reasonably commensurable as they monitor different financial concepts. For example, LR indicates 'units' of solvency, whereas CCL shows 'units' of liquidity. The correlation matrix and standardised variables were therefore used to derive the Z_j.

Only components with eigenvalues exceeding 1,0 are interpreted. The rationale is that 1,0 represents the variance of the original variables, so a component with an eigenvalue of less than 1,0 accounts for less of the total variance than did any one of the original variables (Johnston, 1980, p. 140).

PRINCIPAL COMPONENT ANALYSIS RESULTS

Correlation matrix

Intercorrelations between the 10 financial ratios are reported in Table 1.

Producers with high debt (DR) ratios had low farm enterprise profitability (FBPR) ratios and high asset structure (ASR) ratios. High leverage (LR) ratios were associated with low discretionary income returns to own capital (DIR) ratios and high overdraft to net worth (ONWR) ratios. Farmers having high immediate liquidity (CCL) ratios also recorded low debt structure (DSR) ratios. High discretionary income returns to own capital (DIR) ratios were linked with high farm enterprise profitability (FBPR) ratios and low ONWR ratios. Finally, producers reporting high operating (OPR) ratios also had high debt servicing (DSER) ratios.

Principal components

Five components with eigenvalues exceeding 1,0 were extracted from the correlation matrix (Table 1). These components accounted for 73,7% of total variance in the 10 financial ratios and are presented in Table 2.

The first component, Z_1, is a linear combination of all the financial ratios:

$Z_1 = 0{,}900$ LR - 0,794 DIR + 0,697 ONWR + 0,003 OPR + 0,006 DSER + 0,054 ASR - 0,007 DR + 0,045 DSR + 0,017 CCL - 0,010 FBPR

This component indicates a 'profitability - leverage - debt servicing ability' dimension in the ratios. Summer crop producers with low discretionary income returns to own capital (DIR) ratios had high leverage (LR) and overdraft to net worth (ONWR) ratios. As LR and ONWR rise, fixed charges (mortgage, hire purchase and interest payments) absorb proportionally more income, thereby reducing discretionary income and hence DIR.

Component Z_2 describes an 'efficiency - debt servicing ability' bond between operating (OPR) ratios and debt servicing (DSER) ratios. Producers with high operating expenses (variable costs) relative to gross farm income tended to have high annual fixed charges relative to gross farm income. Less efficient farmers may therefore have relatively higher debt commitments.

Component Z_3 shows a 'solvency - efficiency' link by the positive association between asset structure (ASR) and debt (DR) ratios. Producers with higher proportions of medium-term assets in their asset structures had high total liabilities relative to total assets. Less solvent farmers appear to have financed relatively large vehicle, machinery and equipment purchases with borrowed funds.

Component Z_4 identifies a 'liquidity' dimension by associating low immediate liquidity (CCL) ratios with high debt structure (DSR) ratios. Less liquid summer crop producers seemed to rely on operating credit reserves, in particular, to fund liquidity shortfalls.

Component Z_5 is a 'profitability' dimension, linking high farm business profitability (FBPR) ratios to some extent with high discretionary income returns to own capital (DIR) ratios. Relatively higher net income returns on assets employed translate into relatively higher returns on own capital invested in the farm enterprise.

TABLE 1. Matrix of correlation coefficients between financial ratios of 1 836 summer crop producers

	DR	LR	CCL	DSR	DIR	FBPR	OPR	ASR	DSER	ONWR
DR	1,00									
LR	0,03	1,00								
CCL	-0,06	-0,01	1,00							
DSR	0,03	0,01	-0,17**	1,00						
DIR	0,02	-0,65**	0,01	-0,01	1,00					
FBPR	-0,13**	0,02	0,04	-0,03	0,20**	1,00				
OPR	0,01	0,01	-0,01	0,01	-0,01	-0,03	1,00			
ASR	-0,14**	0,04	-0,07	-0,06	-0,06	0,02	-0,01	1,00		
DSER	0,06	0,01	-0,01	0,01	-0,01	-0,09	0,83**	-0,01	1,00	
ONWR	0,04	0,46**	-0,01	0,07	0,05	0,01	0,01	-0,01	0,01	1,00

**Significant at the 1 % level

TABLE 2. Principal components of correlation matrix of financial ratios

Variable	Component coefficients Components				
	Z_1	Z_2	Z_3	Z_4	Z_5
LR	0,900	-0,001	0,008	-0,021	0,002
DIR	-0,794	0,006	0,087	0,029	0,354
ONWR	0,697	0,015	0,122	0,084	0,223
OPR	0,003	0,957	-0,009	0,002	0,007
DSER	0,006	0,954	0,036	0,002	-0,058
ASR	0,054	-0,007	0,812	0,077	0,043
DR	-0,007	0,030	0,812	-0,008	-0,129
DSR	0,045	0,003	0,055	0,767	0,054
CCL	0,017	0,001	-0,010	-0,754	0,087
FBPR	-0,010	-0,045	-0,094	-0,043	0,935
Eigenvalue	1,975	1,837	1,414	1,113	1,030
% variation per component	19,8	18,4	14,1	11,1	10,3

CONCLUSION

More highly leveraged summer crop farmers had high overdraft to net worth and low discretionary income to own capital ratios. These farmers were relying on short-term debt, in particular, to fund operations. The association of low immediate liquidity (cash to current liabilities) ratios with high debt structure (current liabilities to total liabilities) ratios supports this conclusion. Farmers and policy-makers could therefore investigate alternatives to short-term debt - such as cost savings, diversification and asset or debt restructuring - for managing liquidity.

Costs may be cut by, for example, reducing tillage operations or fertiliser use. Farmers who have already made costs savings could improve cash flow through enterprise diversification or using off-farm income. Diversification raises two policy issues for future research: first, to what extent can summer crop farmers with large existing short-term debt commitments afford to convert to new enterprises? Secondly, what impact will diversification have on production levels of summer crops and potential alternative products, for instance wheat and livestock?

Asset restructuring would involve selling off surplus assets (machinery, vehicles, equipment or land) to raise cash inflow. However, if assets are sold at substantial discount (which may well occur in more financially stressed summer crop areas), the proceeds may not cover cash deficits (Boehlje & Eidman, 1983, p. 942). Debt restructuring by rescheduling short and medium-term liabilities to a long-term basis can reduce annual debt service obligations and improve cash flow.

The negative relationship between leverage and discretionary income returns shows that fixed charges associated with higher leverage increase the potential for poor returns when unfavourable events such as drought reduce cash inflow, or rising interest rates increase cash outflow. Lenders and co-operative advisers should stress this relationship when planning financing strategies with farm clients. While many farmers would increase short-term borrowings during drought, policy-makers must examine why producers entered the drought period with relatively high fixed charge commitments. Past access to subsidised credit at low negative real interest rates is a possible reason (Davel, 1985, p. 11).

Farmers with high operating ratios (total operating expenses to gross farm income) also had high debt servicing ratios (annual fixed charges to gross farm income). Although drought would reduce gross farm incomes of many farmers (increasing operating and debt servicing ratios), this relationship implies that improved operating efficiencies - through cost savings - could reduce reliance on debt. Pack (1984, p. 7) recommends that operating costs should not exceed 70 % of gross farm income (operating ratio of 0,7) for a normal farm business to survive.

High debt ratios (total liabilities to total assets) were associated with high asset structure ratios (medium-term assets to total assets). This indicates either debt financing for medium-term assets or possible over-investment in medium-term assets, which reduces liquidity and increases debt use. Accelerated depreciation allowances, which previously enabled farmers to write off 100 % of the value of equipment and vehicles used solely for farming against farm income in the year of purchase, may have encouraged asset acquisition. Policy-makers therefore need to examine whether the new three year (50 %, 30 %, 20 %) depreciation regime for such assets (*The Farmer*, p. 14) will significantly reduce the potential for over-investment.

BIBLIOGRAPHY

BARRY, P.J., HOPKIN, J.A. & BAKER, C.B. (1979). *Financial Management in Agriculture* 2nd Ed. Danville, Illinois: Interstate Printers and Publishers, Inc.

BOEHLJE, M.D., & EIDMAN, V.D. (1983). Financial Stress in Agriculture: Implications for Producers. *Amer. J. Agr. Econ.* 65: 937-944

DARROCH, M.A.G. (1986). *Factors Affecting the Availability of Overdraft Financing to Natal Sugar-Cane Farmers* Proceedings of the 24th Annual Conference of the Agricultural Economic Association of South Africa, Durban, May 1986: 75-85

DAVEL, H. (1985). *An Assessment of the Present Situation of*

RSA Farmers: Implications for the Future Proceedings of the 23rd Annual Conference of the Agricultural Economic Association of Southern Africa, Bloemfontein, May 1985: 1-13

FULLER, K.G. (1988). *An Economic Analysis of Farm Financial Ratios in South Africa* Unpublished M. Agric. Mgt thesis, University of Natal

HARDY, W.E. & WEED, J.B. (1980). Objective Evaluation for Agricultural Lending. *S.J. Agr. Econ* 12: 159-164

JANSE VAN RENSBURG, B.D.T., & GROENEWALD, J.A. (1987). The Distribution of Financial Results Between Farmers During a Period of Agricultural Setbacks: Grain Farmers in the Western Transvaal, 1981/82. *Agrekon* 26(1): 13-19

JOHNSON, W.B. (1979). The Cross-Sectional Stability of Financial Ratio Patterns. *J. Fin. Quant. Anal* 14: 1035-1048

JOHNSTON, R.J. (1980). *Multivariate Statistical Analysis in Geography: A Primer on the General Linear Model* 2nd Ed. New York: Longman Group Ltd

KIM, J. (1975). Factor Analysis. Chapter 24. *Statistical Package for the Social Sciences SPSS* New York: McGraw-Hill Co.

LEE, W.F., BOEHJE, M.D., NELSON, A.G., & MURRAY, W.G. (1980). *Agricultural Finance* Ames: Iowa State University Press

LUBBE, W.F. (1981). *Norme vir Sakebestuur en Finansiering van Boerdery in Ekstensiewe Gebiede, met Besondere Verwysing na die Noordwes-Transvaalse Bosvelddele* Unpublished M.Sc. Agric. thesis, University of Pretoria

MORRISON, D.F. (1978). *Multivariate Statistical Methods* 2nd Ed. McGraw-Hill. Book Company: Tokyo

NIEUWOUDT, W.L. (1977). Interrelationships Amongst Efficiency Measures: A Note. *J. Agric. Econ.* 28: 77-81

PACK, B. (1984). Money Matters. *Farm Business*: 7-8

PENSON, J.B., & LINS, D.A. (1980). *Agricultural Finance: An Introduction to Micro and Macro Concepts* Englewood Cliffs: Prentice-Hall, Inc.

PINCHES, G.E., MINGO, K.A., & CARUTHERS, J.K. (1973). The Stability of Financial Patterns in Industrial Organisations. *J. Fin* 28: 389-396

SPSS (1986). Factor. Chapter 37, *Statistical Package for the Social Sciences Release X* Chicago: SPSS Inc.

STANDARD BANK. (1981). *Finance and Farmers: A Financial Management Guide for Farmers* Johannesburg: Standard Bank of South Africa Ltd

SUID-AFRIKAANSE LANDBOU-UNIE (1983). Die Finansiële Posisie van Boere in die Republiek van Suid-Afrika, 1983 Pretoria: Suid-Afrikaanse Landbou-unie

TABACHNICK, B.G., & FIDELL, L.S. (1983). *Using Multivariate Statistics* New York: Harper and Row

THE FARMER (1987). The SAAU's Comment on the Margo Report 12-15