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PERCEPTIONS OF RISK AMONG COMMERCIAL FARMERS IN KWAZULU-NATAL IN A CHANGING ECONOMIC ENVIRONMENT

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This study analyses the importance and dimensions of risk sources and computer adoption among farmers in a changing economic policy and trade environment. A survey was conducted in 1996 among 112 commercial farmers in KwaZulu-Natal. The majority of respondents were in favour of a liberalized trade environment and deregulated domestic product and input markets. Respondents identified changes in the cost of farm inputs, government legislation (tax, labour, and land redistribution), the Rand exchange rate, and product prices as the most important sources of risk. Factor analysis of risk sources showed that various dimensions to risk exist, including changes in government policy, enterprise gross income, credit access and cost changes. Computers, a risk management tool, are more likely to be adopted by larger farm operators who have higher levels of education and who use more information sources, whilst operators of extensive production systems are less likely to adopt computers.

SAMEVATTING : PERSEPSIES VAN RISIKO ONDER KOMMERSIËLE BOERE IN KWAZULU- NATAL IN 'N VERANDERENDE EKONOMIESE OMGEWING

Hierdie ondersoek ontleed die belangrikheid en dimensies van risikobronne en rekenaaraanvaarding onder boere binne 'n veranderende ekonomiese beleid en handelsomgewing. 'n Opname is in 1996 onder 112 kommersiële boere in KwaZulu-Natal gedoen. Die meeste respondente was ten gunste van 'n geliberaliseerde handelsomgewing en gedereguleerde plaaslike produk- en insetmarkte. Respondente het veranderinge in die koste van landbou-insette, staatswetgewing (belasting, arbeid en grondherverdeling), die wisselkoers van die Rand en produkpryse as die belangrikste risikobronne beskou. Faktorontleding van risikobronne het getoon dat daar verskillende dimensies tot risiko bestaan, insluitend veranderinge in staatsbeleid, bruto ondernemingsinkomste, toegang tot krediet en kredietkoste. Rekenaars, 'n risikobestuursmiddel, sal meer waarskynlik aanvaar word deur groot landbouoperateurs wat hoër opvoedkundige vlakke het en wat meer inligtingsbronne gebruik, terwyl operateurs van ekstensiewe produksiestelsels minder waarskynlik is om rekenaars te aanvaar.

1. INTRODUCTION

Farming is characterised by uncertainty. Farm operators are faced with variable weather conditions, fluctuating input and product prices, rapidly advancing technology, changing environmental regulations and changing government policies, both domestically and internationally (Ortmann *et al*, 1992). Farmers

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may respond to risk by altering financial, marketing or production techniques (Barry *et al*, 1995; Eidman, 1990; Patrick *et al*, 1985). Withdrawal of government support, coupled with political changes and pressures for the agricultural sector to become more market orientated, has created additional uncertainty for commercial farmers in South Africa (Lyne and Ortmann, 1992).

Farmers' attitudes and responses to an agricultural environment characterised by increased uncertainty resulting from recent political changes, deregulated domestic markets and the GATT (General Agreement on Tariffs and Trade) provisions will be studied in this paper. In addition, the existence of risk dimensions and their relative importance to farmers in different regions of KwaZulu-Natal will be established. Improved access to internal and external sources of information aid in risk management (Barry *et al*, 1995). Consequently, the personal and business characteristics of farmers which explain computer adoption will also be examined.

2. DATA SOURCE AND CHARACTERISTICS OF RESPONDENTS

Data for this study were collected in 1996 through a postal survey. The target population of 4 436 commercial farmers in KwaZulu-Natal was stratified in a manner similar to that described by Lyne and Ortmann (1996) and randomly sampled. The first stratum, constituting bioclimatic groups 1 and 2 (Phillips, 1973), is termed the Coastal Belt. Bioclimatic groups 3, 4, 5, 6 and 8 represent the KwaZulu-Natal Midlands, whilst bioclimatic groups 7, 9, 10 and 11 comprise the Lowveld region. A questionnaire was mailed to 578 farmers, yielding 149 responses (25,8 percent) of which 112 (19,4 percent) were usable. The non-usable questionnaires were due to missing values, the sale of farming operations, or the retirement of some farmers. Twenty-six usable questionnaires were received from each of the Coastal and Lowveld regions, whilst 60 usable questionnaires were returned by Midlands farmers.

Respondents were on average 49,5 years of age, had 24,3 years of farming experience and 14,1 years of formal education. Sixty percent of respondents were individual owners of their farm business, 12 percent of the operations were close corporations, 10 percent companies and nine percent of respondents operated partnerships and nine percent trusts. Thirty-nine percent of respondents were employed to manage the farming operations. Computers were owned and used in the farm business by 64 percent of respondents, which is higher than the 48 percent reported by Woodburn *et al* (1994).

The average area operated in the Coastal Belt was 511 hectares (median was 313 hectares), 1 121 hectares in the Lowveld region (median was 253 hectares, due to

a predominance of irrigated sugar-cane farms and a few large extensive beef enterprises), and 866 hectares in the Midlands (median was 604 hectares). More than 70 percent of gross farm income was derived from sugar-cane production by 75 percent of farmers in the Coastal Belt. Sixty-two percent and 15 percent of farmers in the Lowveld region derived more than 70 percent of gross farm income from sugar-cane and beef production respectively. The Midlands region is characterised by a variety of farming activities. Among the farmers who received 70 percent or more of their gross income from a single enterprise, 27 percent were beef farmers, 12 percent dairy farmers, 10 percent sugar-cane farmers, eight percent timber farmers and six percent pig farmers.

Land is cash-rented by 21 percent of respondents, with the area rented ranging from 10 to 900 hectares (mean of 264 hectares). Two respondents were involved in share-lease agreements (50 and 100 hectares), while a single respondent rented out land (150 hectares).

About 86 percent of respondents were full-time farmers. Median household income from off-farm employment (including spouse's income) was R47 375 for the 35 percent of respondents who indicated off-farm employment (by themselves or their spouse). Market values of assets and debt/asset levels, and farm turnover (gross income) expected in a normal year in each region are presented in Table 1. Coastal Belt farms had the highest mean turnover and debt/asset ratio, followed by Lowveld and Midlands farms respectively. The debt/asset ratio should preferably be less than 0,5 (Barry *et al*, 1995). At a nominal interest rate of 15 percent, farmers will experience cash flow problems if borrowed capital exceeds one-third of the value of farmland, as the return to farmland is approximately five percent (Nieuwoudt and Vink, 1995). The ratios presented in Table 1 indicate that sample farmers are on average solvent.

3. RESPONSES TO GATT AND DEREGULATED DOMESTIC MARKETS

The General Agreement on Tariffs and Trade (GATT) focuses primarily on reducing tariff barriers to trade in industrial and agricultural products (Schuh, 1995). In compliance with the GATT agreement, signatories are required to reduce internal support (Giardini, 1995), all non-tariff barriers are to be converted to tariffs, individual tariff lines reduced and import opportunities must be allowed for to facilitate opening-up of markets (Josling, 1993). The volume of subsidised exports is to be reduced and sanitary and phytosanitary (SPS) measures revised and tightened (Giardini, 1995). A greater degree of price uncertainty faced by commercial farmers is therefore anticipated in the event of reduced government protection (Lyne and Ortmann, 1992).

Table 1: Farm asset values, debt/asset ratios and expected annual turnover on sample commercial farms in three regions of KwaZulu-Natal, 1996.

Region	Asset value (Rm)			Debt/asset ratio			Annual turnover (Rm)		
	n	Mean	Median	n	Mean	Median	n	Mea n	Median
Coastal (n=26)	25	5,612	3,691	18	0,149	0,141	22	2,086	1,471
Lowveld (n=26)	25	5,676	3,800	25	0,131	0,116	26	1,594	1,076
Midlands (n=60)	50	2,709	1,670	48	0,083	0,012	54	1,147	0,620

Only one respondent was not aware of GATT. Respondents had read about GATT in newspapers (70 percent) and other publications, such as *Effective Farming*, *Farmer's Weekly*, *Landbou Weekblad* and *Financial Mail*. Fifty-two percent of respondents anticipated a decrease in their crop prices in the event of the successful implementation of the GATT requirements, whilst 25 percent expected their crop prices to increase. A decrease in livestock prices was expected by 61 percent of respondents and 12 percent anticipated an increase in livestock prices. Approximately equal proportions of respondents expected input prices to decrease (43 percent) and increase (39 percent). A greater proportion of crop and livestock producers, ie those who realised more than 55 percent of their gross income from either crop or livestock production respectively, anticipated a decrease in input prices. Table 2 shows that about one-half of respondents foresaw a decline in farm profits and 38 percent a fall in land values if the GATT requirements are successfully implemented.

Table 2: Percentage of respondents anticipating changes to product and input prices, farm profits and land values following the GATT provisions, 1996.

Particulars	Decrease (percent)	Increase (percent)	No change (percent)	Uncertain (percent)
Crop prices (n=103)	52	25	14	9
Livestock prices (n=87)	61	12	10	17
Input prices (n=108)	43	39	11	7
Crop farmers* (n=54)	45	35	11	9
Livestock farmers* (n=37)	49	38	8	5
Farm profits (n=109)	49	19	16	16
Land values (n=110)	38	14	22	26

* Farmers who received more than 55 percent of their gross income from either crops or livestock.

A five-category scale, ranging from 'strongly disagree' with the statement given to 'strongly agree', was used to elicit farmers' attitudes towards a free trade environment (Table 3). For the various questions posed, between 59 and 92 percent of respondents were in favour of free trade. Ninety-two percent of respondents were in favour of the deregulation of domestic product and input markets, indicating that they perceive the recent deregulation of product marketing boards to be of benefit to their farm businesses. This conclusion may not apply generally as approximately 74 percent of the original 578 farmers in the sample did not return the questionnaire, while those who did may have definite views on liberalized trade.

Table 3: Responses of sample commercial farmers in KwaZulu-Natal to statements on a free trade environment, 1996.

Statement	Percentage of respondents in each category				
	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree
Free, unrestrained international trade (without the interference of governments both here and abroad) is beneficial for South African farmers (n=109).	5	16	20	50	9
A free, open market system of trade (ie. one without government intervention) should be pursued by all food exporting and importing countries by reducing all trade barriers (n=110).	2	18	13	51	16
Farmers in all countries exporting agricultural commodities should not receive any government support (n=111).	4	11	7	52	26
South African farmers should compete in a deregulated (free) domestic product market, if input markets are also deregulated (n=110).	0	3	5	71	21

Thirty-nine percent of sample farmers would respond to *further reduction in import tariffs* by adjusting their farming operations. In the event of *complete deregulation of domestic product and input markets*, 48 percent of respondents would alter their farming operations. Of the 45 percent of respondents who would

change the size and mix of enterprises currently operated, 46 percent would increase the size of current enterprises. Both enterprise diversification (adding a new enterprise) and changing the relative sizes of current enterprises were suggested by 23 percent of respondents. Reducing enterprise size (four percent of respondents) and changing farm enterprises totally (four percent) were also considered. Of the respondents who considered altering their cost structure, 29 percent would reduce labour employment, increase use of machinery, and maintain fertilizer use at current levels.

Of the 64 percent of respondents who would respond to reduced import tariffs and/or complete domestic market deregulation, 46 percent would seek additional marketing information to aid in management decisions and 44 percent would add value to their products. Forty percent of respondents considered purchasing additional technology to improve productivity, 35 percent considered exporting products, 32 percent employing machinery contractors and 24 percent would employ labour contractors. Employing the services of a private consultant or restructuring debt commitments were considered by 22 percent of respondents, 19 percent indicated engaging in forward contracts, 18 percent borrowing less capital or reducing family drawings, and 10 percent would trade on the futures market (SAFEX). The relatively small proportion of respondents considering trading on the futures market could possibly be due to the limited range of contracts currently available (eg there are no sugar contracts at present). Selling land was considered by 12 percent of respondents, 10 percent intended seeking off-farm employment, nine percent would introduce capital invested off the farm into the farm business, and six percent would sell assets or borrow more capital.

Sample farmers were also asked to rate their level of management skill relative to other farmers in their district on a five-point Likert-type scale (where 1 = low and 5 = high). The average rating for their managerial ability in farm production and overall farm management was 3,72, in farm finance 3,61, and 3,11 for product marketing. In the past, 21 control boards marketed about 90 percent of the total value of agricultural production (Lyne and Ortmann, 1992), thereby reducing the need for farmers to market their products. For farmers to survive in a deregulated policy and trade environment with increased price risk, product marketing skills will need to be improved and/or marketing experts employed.

Farmers' goals in a changing economic environment (where the top three goals were rated in order of preference) were also assessed. Maximising total farm profits was considered as the most important goal by 49 percent of respondents, while 70 percent ranked this objective in the top three places. Generating a stable income from the farm business and a steady accumulation of net worth were the

next two most important objectives. The top three goals are related, and their high rankings reflect the importance that respondents attach to profit generation. Being competitive on the world market was ranked in the top three places by about one-third of respondents, probably because international competitiveness is perceived to be important for survival in a changing trade environment.

Thomas (1987) indicates that farmers have the ability to assess their own risk attitudes. Sample farmers were requested to rate their willingness to take risks relative to other farmers in their district on a Likert-type scale ranging from one (much less willing) to five (much more willing). About 24 percent of respondents considered themselves more willing to take risks than other farmers (categories four and five). Spearman's rank correlation coefficient may be used to determine the linear association between variables of ordinal nature (SPSS, 1993). Consequently, Spearman's correlation coefficients for respondents who rated their willingness to take risks relative to other farmers and their objectives (ranked in order of preference, with one being the most important) were computed. Being competitive on the world market was the only objective to display a significant relationship with willingness to take risks (five percent level). The negative coefficient indicates that farmers who perceive themselves more willing to take risks relative to other farmers consider international competitiveness to be important, and it is these farmers who are likely to benefit the most from the GATT provisions. The next section deals with the relative importance of risk sources in farming in a changing economic environment.

4. RISK SOURCES

4.1 Importance of risk sources

The most important sources of risk reported in other studies have typically included variability in crop and livestock production and prices (Ortmann *et al*, 1992; Swanepoel and Ortmann, 1993) and changes in cost (Woodburn *et al*, 1995). Recent changes in South African agricultural policy and advances made by GATT may result in other factors being considered by farmers as important risk sources. Mean ratings of various sources of risk, measured on a five-point Likert-type scale (where five indicated 'very important'), are presented in Table 4, which also includes overall ratings of various risk sources derived in a 1993 study of commercial farmers in KwaZulu-Natal by Woodburn *et al* (1995).

Changes in costs of farm inputs achieved the highest rating (4,01) as was found by Woodburn *et al* (1995). This was followed by changes in tax legislation and variability in livestock prices (3,98), changes in labour legislation (3,96), changes in the Rand exchange rate (3,87) and further land redistribution by government

(3,86). Variability in crop prices (3,85) and crop yields (3,82) were other sources of risk to achieve mean ratings greater than 3,8.

Table 4: Relative importance of various sources of risk for sample commercial farmers in KwaZulu-Natal, 1996 and 1993.

Sources of risk	Mean ratings*	
	1996** (n=112)	1993*** (n=199)
Changes in costs of farm inputs	4,01(1)****	4,53(1)
Changes in tax legislation	3,98(2)	3,67
Variability in livestock prices (eg beef prices)	3,98(2)	4,20(4)
Changes in labour legislation	3,96(4)	3,59
Changes in the Rand exchange rate	3,87(5)	n/a
Further land redistribution/restitution	3,86(6)	n/a
Variability in crop prices	3,85(7)	4,20(3)
Variability in crop yields	3,82(8)	4,23(2)
Changes in costs of capital items	3,69	4,07(6)
Further reduction in trade tariffs on imported agricultural products	3,68	n/a
Variability in interest rates	3,63	3,99
Variability in livestock product prices (eg milk prices)	3,62	4,18(5)
Deregulation of domestic product markets	3,22	2,88
Variability in livestock production	3,19	3,88
Changes in environmental regulations	2,94	2,91
Changes in credit availability	2,89	3,47

* Mean ratings are based on a five-point Likert-type scale (where 1 = low and 5 = high). Values include the ratings of those farmers who responded to the question, ie, only non-missing values were used to compute mean scores. Since the data are ordinal, the means should be roughly interpreted to give an overall view of the perceived importance of risk sources, and standard errors would not be meaningful, and hence are not given.

** This study

*** Woodburn *et al* (1995)

**** Figures in parentheses indicate ratings of risk sources.

The relatively high ratings for changes in tax and labour legislation, the Rand exchange rate and further land redistribution by government suggests that farmers currently perceive changes in government policies to be a greater source of risk to their farming operations than in the past. This is most probably due to recent policy changes implemented by the government. Deregulation of domestic product markets (3,22) ranked relatively low despite the recent

abolition of certain marketing boards. This may indicate that many respondents have welcomed the deregulation of the domestic market.

Variability in crop prices and yields were ranked relatively low compared to the study by Woodburn *et al* (1995). Changes in government policy and reduced import tariffs in 1995, which had a greater impact on livestock prices than on crop prices, may have given rise to changes in relative perceptions.

4.2 Factor analysis of risk sources

Barry *et al* (1995) contend that sources of risk faced by farmers may be business (inherent in the farming operation) and/or financial (financial claims on the firm). Economic research typically estimates the risk of a monetary outcome. However, five major dimensions of risk (namely technological, climatic, social, political and economic) may be viewed as sources of uncertainty particular to the external environment of the production unit (Eidman, 1990). Patrick *et al* (1993) suggest that farmers view uncertainty as having various dimensions but not as many as the original sources. Price and yield uncertainty are not viewed independently as farmers are concerned with gross income variability.

Factor analysis finds combinations of variables to produce indices that are uncorrelated. The indices obtained measure different dimensions in the data as they are uncorrelated (Manly, 1994). The 16 sources of risk given in Table 4 were included in a factor analysis to determine various dimensions to the sources of risk. Five factors, having Eigenvalues greater than one and accounting for 71 percent of the variation in the data, were included in the analysis. Eight of the 16 sources of risk had component loadings greater than 0,4 in two or more factors. Varimax rotation was therefore used to transform the provisional factors into new factors which are easier to interpret (Manly, 1994). Results of the analysis are presented in Table 5.

Communalities, except for the deregulation of domestic product markets, are greater than 0,5, indicating that most of the variation in the sources of risk is accounted for by the five common factors (Manly, 1994). In general, risk sources which had loadings greater than 0,5 in one factor did not exceed 0,3 in any other factor. Exceptions are changes in the Rand exchange rate, and further reduction in import tariffs.

Relatively high factor loadings for changes in tax, labour and environmental regulations, further land redistribution by government, further reduction in trade tariffs on imported agricultural products and changes in the Rand

exchange rate defined the first factor as "government policy". The second factor was labelled

Table 5: Rotated factor loadings of risk sources and regional and product factor scores for sample commercial farmers in KwaZulu-Natal, 1996

Factor		1	2	3	4	5
Eigenvalue		5,124	2,150	1,783	1,215	1,098
Percentage variance explained		32,0	13,4	11,1	7,6	6,9
Sources of risk	Communalities*	Government policy	Crop gross income	Livestock gross income	Credit access	Cost changes
Changes in tax legislation	0,778	0,861	0,039	0,008	0,081	0,168
Changes in labour legislation	0,756	0,824	0,132	-0,009	-0,055	0,237
Further land redistribution/restitution	0,705	0,790	0,073	0,143	0,235	-0,024
Changes in environmental regulations	0,546	0,664	-0,041	-0,170	0,267	0,051
Changes in the Rand exchange rate	0,573	0,542	0,499	0,167	-0,018	-0,036
Deregulation of domestic product markets	0,428	0,465	0,222	-0,048	0,247	0,314
Further reduction in trade tariffs on imported agricultural products	0,528	0,472	0,250	0,416	0,207	0,166
Variability in crop prices	0,879	0,097	0,907	-0,041	0,138	0,161
Variability in crop yields	0,849	0,096	0,871	-0,073	0,193	0,199
Variability in livestock prices	0,896	-0,073	-0,125	0,935	0,011	0,036
Variability in livestock production	0,829	0,078	0,007	0,896	0,138	0,033
Changes in credit availability	0,768	0,289	0,085	0,095	0,816	0,051
Variability in interest rates	0,663	0,196	0,097	-0,012	0,765	0,175
Variability in livestock product prices	0,540	-0,062	0,251	0,381	0,572	0,031
Changes of costs of capital items	0,838	0,212	0,056	-0,030	0,067	0,886
Changes in costs of farm inputs	0,794	0,111	0,306	0,192	0,163	0,790
Factor scores:						
Coastal Belt		0,090	0,518	-0,579	0,073	-0,281
Lowveld		0,444	-0,373	-0,313	-0,044	0,126
Midlands		-0,231	-0,063	0,387	-0,013	0,067
Livestock		-0,213	-0,354	0,747	0,188	-0,289
Crop		0,323	0,271	-0,480	-0,062	0,036

* Communalities are that portion of the variance in the sources of risk accounted for by the common factors.

"crop gross income" due to loadings in excess of 0,85 for variability in crop prices and yields. Variability in livestock prices and production had high factor loadings in the third factor classifying it as "livestock gross income". The fourth factor was termed "credit access" owing to high factor loadings for changes in credit availability and variability in interest rates. High factor loadings for changes in costs of capital items and farm inputs identified the fifth factor as "cost changes". Similar risk dimensions were derived by Woodburn *et al* (1995).

For the first factor, positive factor scores for the Lowveld and Coastal Belt indicate that respondents in these regions, particularly in the Lowveld, are more concerned about changes in government policy than Midlands farmers. The predominance of sugar-cane farmers in these regions indicates that deregulation of the sugar industry may be of concern. This is also reflected in the high factor score for crop farmers. The higher score for the Lowveld relative to the Coastal Belt indicates a greater concern for changes in government policy in the Lowveld region. Respondents in the lower-rainfall region of the Lowveld, where irrigated sugar-cane is important, could be more concerned with potential changes in water rights because changes in environmental regulations as a source of risk has a higher mean score for Lowveld (3,29) than Coastal (2,71) respondents.

The scores for the second and third factors indicate that variability in crop gross income is of greater concern to respondents in the Coastal Belt, which produces mainly sugar-cane, whilst variability in livestock gross income concerns respondents from the Midlands, which is an important beef and dairy producing region. The relatively low scores for the fourth factor (credit access) indicate that changes in credit availability and variability in interest rates are of similar importance to respondents in the three regions. There is a slight bias towards Coastal Belt farmers who have the highest mean debt/asset ratio (Table 1). The fifth factor, cost changes, appears to be more important to Lowveld and Midlands farmers.

Mean factor scores are also given for producers who receive more than 55 percent of their gross income from crop or livestock production. A large and positive mean score for crop farmers in the first factor indicates that the risk associated with changing government policies is of greater importance to crop farmers than to livestock producers. This may be due to the risk associated with changes in labour and environmental regulations as crop farmers on average employ more labour and use more chemicals and fertilizer that may be of environmental concern. Credit access appears to be more important to livestock farmers (variability in livestock product prices has a weighting of 0,572 in the factor), and the factor cost changes has a small but positive coefficient for crop farmers.

These results suggest that farmers view risk as having certain dimensions, as indicated by Patrick *et al* (1993) and Woodburn *et al* (1995). In addition to income variability and changes in credit access and costs, farmers also consider changes in government policy to be an important source of risk to their farming operations.

5. COMPUTER ADOPTION IN A CHANGING RISK ENVIRONMENT

With a decline in government support, farmers will need to assume greater risk-bearing in their management (Lyne and Ortmann, 1992; Ortmann *et al*, 1992). Internal (financial accounting systems) and external (agribusiness) sources of information aid in risk management (Barry *et al*, 1995). This will increase the demand for new production, marketing and financial information that update and improve farmers' expectations regarding future events (Barry and Fraser, 1976). Following agricultural liberalization in New Zealand, demand for information relating to assessing market opportunities increased substantially (Robinson, 1995). In a study by Woodburn *et al* (1994), computers were considered to be helpful in most management activities, enabling farmers to process data quickly and efficiently thereby empowering managers to make more relevant, informed and timeous decisions.

The objective of this analysis is to determine the effect of personal and business characteristics on the adoption of a personal computer in the farm business. The dependent variable (Y_i) is dichotomous, scoring one if a personal computer is owned and used by the farm business, and zero otherwise. According to Gujarati (1995), linear probability, logit and probit models are suitable for regression on dummy dependent variables. Linear probability models are, however, unattractive as they express Y_i as a linear function of the explanatory variable(s) (X_i) and there is no guarantee that the conditional probability of the event Y occurring, given X , will lie within the zero to one range. Logit and probit models, however, overcome this disadvantage. The logit model is mathematically less complex than the probit model (Gujarati, 1995) and is therefore applied in this study.

Based on the results of other studies (eg Ortmann *et al*, 1994; Woodburn *et al*, 1994), personal characteristics considered in this analysis include farmer's age, educational level, number of information sources used, willingness to take risks, and the rating of own management skills relative to other farmers in the district. Business characteristics constitute farm turnover in a normal year, proportion of land rented, the business' debt/asset ratio, off-farm income and dummy variables accounting for beef, dairy and sugar-cane.

Only variables with coefficients significant at the 10 percent (or higher) level were retained in the analysis. The following general logit model shows the explanatory variables included:

$$\ln pi / (1-pi) = b_0 + b_1EDU_i + b_2INFO_i + b_3SIZE_i + b_4BEEF_i$$

where pi is the probability of adopting a computer on farm i . The dependent variable $\ln pi / (1-pi)$ is the natural log of the odds ratio in favour of adopting a computer (ie, the ratio of the probability that a farmer will adopt a computer to the probability that a computer will not be adopted (Gujarati, 1995)). EDU measures the number of years of formal education, whilst INFO shows the number of information sources used by the farmer. SIZE represents the annual turnover of the farm business (in millions of rands) and BEEF is a dummy variable (equal to one if turnover from beef production exceeds 55 percent of gross farm income, and zero otherwise). Results of the logit model, estimated using the maximum likelihood technique, are presented in Table 6.

Table 6: Logit model of computer adoption by sample commercial farmers in KwaZulu-Natal, 1996 (n=102).

Variable	Parameter estimate	Standard error	Asymptotic <i>t</i> -statistic	Standardised parameter estimate
Intercept	-4,2619	1,9499	-2,19**	-1,2651
EDU	0,2218	0,1311	1,69*	0,5201
INFO	0,4405	0,2164	2,04**	0,6617
SIZE	0,9158	0,4068	2,25**	1,7522
BEEF	-1,2866	0,7393	-1,74*	-0,4637
Model Chi-square	37,108***			
Correct prediction (percent)				
Total:	79,41			
Adopters:	86,76			
Non-adopters:	64,71			

Note: *, ** and *** indicate significance at the 10 percent, 5 percent and 1 percent levels of probability, respectively.

The model Chi-square statistic, which tests the joint significance of the explanatory variables included in the model, is highly significant. The estimated model correctly classifies 86,76 percent (59 of 68) of adopters and 64,71 percent (22 of 34) of non-adopters, yielding an overall correct classification rate of 79,41 percent (81 of 102). Upward bias may exist in the classification rate as the entire sample was used to estimate the logit model and to classify cases. Cross-

validation involves splitting the sample in half into a prediction sample and a validation sample, but the entire sample is used to derive final parameter estimates. The cross-validation proportion reduction in error for this study (0,204) indicates that prediction errors are reduced by 20,4 percent when using the prediction model (Demaris, 1992). Reduction in prediction error is probably underestimated as sample size limitations resulted in a reduction of statistical significance of coefficients in the prediction model due to information loss.

The results of the estimated model are consistent with those of Ortmann *et al* (1994) and Woodburn *et al* (1994). The positive EDU coefficient implies that the probability of computer adoption increases with higher levels of education. This is expected as time spent on mastering computer systems is reduced, the capacity to use computer-provided information and exposure to computer systems is greater with higher levels of education. Understanding of complexities in production and financial relationships is expected to improve with increasing levels of education (Batte *et al*, 1990).

The number of information sources (INFO) used is positively related to computer adoption. It is anticipated that farmers who seek more information believe the benefits of additional information outweigh the costs. These farmers will thus have a higher probability of adopting a computer in order to gain additional information to aid with decision making. As expected, a positive and significant zero-order correlation coefficient of 0,261 exists between EDU and INFO, but this did not lead to multicollinearity in the logit model. The coefficients estimated for these variables are both significant at least at the 10 percent level of probability.

Gross farm turnover (SIZE) has a large effect relative to the other independent variables (highest standardised coefficient) and is positively related to the adoption of a personal computer. Decision making on larger farms is expected to be more complex thereby increasing the benefit of computers as a decision aid. The cost of computer adoption is largely scale independent whilst the return to improved information is scale dependent, thereby increasing profit per unit of output as farm size increases (Woodburn *et al*, 1994).

The predominance of a beef enterprise (BEEF) in the farming operation reduces the probability of owning and using a computer. Mean farm size for farmers who scored a one for the BEEF variable was 1480 hectares indicating extensive beef production systems. Benefits of computerised information systems are expected to be lower for less intensive production systems. These operations require less complex recording systems and have lower information requirements.

6. CONCLUSIONS

Most respondents in this study support trade liberalization *but* foresee lower product prices, farm profits and land values if the GATT provisions are successfully implemented. A possible reason for this apparent anomaly is the additional source of risk associated with potential changes in government agricultural policy. Following agricultural liberalization in New Zealand, farmers were faced with changes in prices and the economic environment but considered these more modest and predictable than government's reactions to political demands (Robinson, 1995). Respondents also seem to be aware of the importance of becoming more competitive on domestic and international markets.

Seeking additional marketing information to aid in management decisions and adding value to their products were cited as responses to reduced agricultural support. Production responses included increasing the size of current enterprises (to take advantage of economies of size), adding a new enterprise (diversification) and changing the size and mix of current enterprises. Opportunities exist for private consultants, who are considered by 22 percent of respondents as a potential source of information (but currently used by only 10 percent of them), to advise farmers, particularly on product marketing (respondents considered their marketing skills as poor relative to other farming skills). Restructuring debt commitments, borrowing less capital and reducing drawings were financial responses considered, but were not considered as important.

Changes in tax, labour and land legislation were considered more of a threat to the farm business than variability in crop prices, crop yields and livestock production. This is contrary to results presented by Woodburn *et al* (1995). The uncertainty surrounding present government policies may have contributed to this changing perception. Results of a factor analysis of 16 sources of risk confirmed that farmers view risk in various dimensions and not necessarily as individual sources. This supports the results of Patrick *et al* (1993) and Woodburn *et al* (1995).

The adoption of a personal computer will enhance risk bearing as it will improve farmers' access to relevant and timeous information. Level of education and importance placed on attainment of information are personal characteristics that are positively related to the adoption of a computer. Farmers operating less intensive production systems (eg extensive beef) are less likely to adopt a computer. Farm size had the largest effect on computer adoption and larger farm operators are more likely to use a personal computer in their farm business.

NOTES:

1. The authors thank their colleagues in the Department of Agricultural Economics, University of Natal, Pietermaritzburg, for constructive comments on an earlier draft of the paper.
2. Financial assistance from the University of Natal Research Fund (UNRF) and the Centre for Science Development (CSD) is gratefully acknowledged. The views of the authors do not necessarily reflect those of the UNRF or the CSD.

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