195- FACTORS AFFECTING THE HEDGING DECISION OF MAIZE FARMERS IN GAUTENG PROVINCE

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Abstract

The maize industry in South Africa has a long history of government intervention, fuelled by the two Marketing Acts (of 1937 and 1968). After the introduction of the Marketing of Agricultural Products Act (Act 47 of 1996), farmers were exposed to international maize prices, i.e. to the forces of global supply and demand. Through forward contracting (hedging), farmers can minimize the price risk that they are facing. Different factors affect the hedging decisions of farmers. The main objective of this study was to identify those factors for maize farmers in Gauteng, and hence to gain an understanding of their rate of adoption of hedging strategies. A Probit regression equation was estimated, and the results show that the factors that have the most influence are the gender, age, and agricultural qualification of the principal decision maker; whether the decision maker is a member of a grain association and the size of that grain association; the length of period that the decision maker has been producing grain; the size of the farm; whether the farmer rents in land; the proportion of off-farm income earned; and whether the farmer takes out insurance.

Keywords: Hedging; Price risk; Probit regression

1. Introduction

South African agriculture has a long history of government intervention with a series of laws, ordinances, statutes and regulations affecting all aspects of agriculture (Kirsten and Van Zyl, 1996). The new Marketing of Agricultural Products Act (No 47 of 1996) was promulgated at the end of 1996. Prior to this the grain industry was inwardly focused and heavily influenced by regulations and government control (Doyer *et al*., 2007).

The deregulation of agricultural marketing created the need for South African producers to give more individual attention to managing price risk. Price risk is perceived to be a major source of risk by farmers and processors, both locally (Woodburn, 1993) and internationally (Coble and Barnett, 1999). The management of price risk is important for farmers because price variability is a major component of the overall variability in profit, which is a barrier to sound planning.

The main objectives of this study are to determine which factors affect hedging decisions and to investigate the adoption rate of hedging against price risk by farmers in the maize industry in Gauteng. To this end a review of the relevant international and national literature that addresses the extent of hedging and the influences over hedging is presented in section 2. The research method is presented in section 3, followed by the results in section 4. Section 5 concludes.

2. Factors affecting farmers' hedging decisions: a review

The literature contains many examples of studies that have investigated the factors affecting decision making in agriculture in South Africa and elsewhere. In this section, this literature is reviewed with respect to the question why farmers decide to hedge, what are the farm and the

farmer characteristics that make a farmer more likely to hedge, and what instruments of risk management are adopted.

2.1 What makes farmers hedge?

A number of studies in South Africa and elsewhere have addressed this question:

- Bown (1999) investigated South African maize producers' use of forward pricing, showing that only 4.7 per cent of respondents used some form of forward pricing arrangements during 1998/99[1]. Ten years after deregulation Jordaan and Grove (2007) investigated the factors affecting Vaalharts maize producers' adoption of forward pricing and found this to be associated with lower levels of risk aversion and higher levels of human capital. Only 44 per cent of the respondents used some form of forward pricing and only 4 per cent used futures contracts.

- Simons (2002) asked "why do farmers have so little interest in futures markets?" and found that the cause was the ability of farmers to manage their exposure by adjusting leverage. With a fully efficient capital market, adjustment of leverage can fully supplant the use of hedging. However, Pannel, *et al.* (2007), argued that there are more reasons why farmers have so little interest in the futures market. Their results show that the impact of basis risk and transaction costs on hedging was moderate, while uncertainty about production only had a minor influence on hedging.

- Woolverton and Sykuta (2007) sought to understand the role of the U.S price support programs within the producer's actual price risk management strategy decision. Their study was designed as a comparative case study. The decision process being analysed was commercial maize producers' grain price risk management strategy and tool choices; the institutional environments were the agricultural marketing environments of South Africa and the U.S. Producer demographics were similar across South Africa and the U.S, although U.S producers were slightly older with more experience. South African producers considered price risk management more important than did U.S producers. South African producers were also found to consistently lock-in prices for a large percentage of expected maize yields. Production decisions in South Africa were affected by the maize price, while in the U.S it appeared as if producers planted almost regardless of price.

- Dorfman and Kardi (2008) asked the question "do farmers hedge optimally or by habit?" The objective of their study was to investigate the role of a variety of factors in the hedging decisions of farmers on corn, soybeans and cotton. They examined the role of habit, demographics, farm characteristics and information sources on the hedging decisions by using panel data from a survey of Georgia farmers that recorded their hedging decisions for four years on three crops. They found that habit plays a significant role in hedging decisions for many farmers. The farmers' education level, attitude toward technology adoption, farm profitability and the ratio of acres owned to acres farmed also played an important role in hedging decisions.

- According to Barbieri and Mshenga (2008:169) if a firm has preferential access to inputs such as information it will have a competitive advantage in the market. Lee *et al.* (2001) support this by arguing that superior access to capital and human resources translates into a

[1] This was the first harvest after deregulation of the maize industry

cost advantage combined with the ability to produce high quality services and products to exploit niches more effectively. Groenewald *et al.* (2003: 71) found that the move towards more competitive agriculture in South Africa, unburdened by regulatory constraints, was characterized by an undersupply of relevant information in some cases and inadequate access in others. This negatively affected production, investment, financial and strategic decisions. This could impede the decision maker's ability to manage risk and uncertainty on different levels of the marketing process.

2.2 Farm characteristics

The size of the farm is an important characteristic that influences the decision of the farmer to hedge (see e.g. Goodwin and Shroeder, 1994; Musser *et al.*, 1994; Mishra and Perry, 1999; Sartwelle *et al.*, 2000; Katchova and Miranda, 2004 and Ueckermann *et al.*, 2008). These authors have all established that larger farms have a greater preference to adopt forward pricing contracts. Sartwelle *et al.* (2000) suggested that the large farms have economies of scale in terms of learning how to use marketing tools and collecting marketing information. Isengildina and Hudson (2001) further suggested that learning about alternative marketing tools is a lumpy cost and hence large farms are more likely to hedge.

Leverage is one of the important components of the financial characteristics of the farm (Turvey and Baker, 1989; Brorsen, 1995; Collins, 1997; Isengildina and Hudson, 2001). Earlier studies used the long term debt-to-asset ratio as a proxy for leverage (e.g. Isengildina and Hudson, 2001). Isengildina and Hudson (2001) also added that the debt-to-asset ratio is a more general measure of leverage, because it excludes the short-term component that varies from year to year depending on capital needs for operating expenses. They further state that the optimal hedge model suggests a positive impact of leverage on the use of forward pricing because it can provide an additional source of liquidity. However, Asplund *et al.* (1989) argue that leverage and forward pricing may be negatively correlated if a farm manager's use of debt and leverage indicate lack of risk aversion.

2.3 Farmer characteristics

Isengildina and Hudson (2001) argue that the level of education is an indication of the farmers' ability to process information. Olaniyan and Okemakine (2008) also argued that education is an economic good because it is not easily obtainable and thus needs to be apportioned. The level of education is important in reducing search, screening and information costs. Fletcher and Terza (1986); Goodwin and Schroeder (1994); Musser *et al.* (1996); Katchova and Miranda, (2004); and Ueckermann *et al.*, (2008) all established that education, including training in derivatives market operations, has a significant and positive association with the adoption of hedging.

Many studies (e.g. Fletcher and Terza, 1986; Asplund *et al.*, 1989; Shapiro and Brorsen, 1988; Edelman *et al.*, 1990; Musser *et al.*, 1996) have found that age is negatively associated with the adoption of hedging strategies. The argument is that more experienced farmers have a superior ability to use the spot market. However Katchova and Miranda (2004) found that an older farmer is significantly more likely to adopt derivative contracting relative to spot market transactions. This shows that the results of the study can have positive or negative outcomes.

According to Kant and Dow (2004), experience as a general concept comprises knowledge of or skill in or observation of something or even gained through involvement in or exposure to that thing. Therefore in this study experience is defined as the exposure of the farmer to maize farming. Davis *et al.* (2005) have found that farmers who have more years of farming experience are willing to forward price a larger proportion of their crop. They argued that the experienced farmer may be in a healthier financial position, and therefore more willing to hedge. However Davis *et al.* (2005)

also stated that a more experienced farmer may be more accustomed to the previous regime of market regulation, therefore he may forward price at a lower level. Therefore years of experience in grain farming can have a direct or an inverse relationship with the decision to hedge as well as the decision on how much to hedge.

Grain producers' perception of forward pricing is an important factor in influencing the hedging decision. In philosophy, psychology and the cognitive sciences, a perception is defined as the process of attaining awareness or understanding (Flanagan and Lederman, 2001). Therefore grain producers with a positive perception about the free market are expected to forward price a large proportion of their crop (see e.g. Shapiro and Brorsen, 1988; Pennings and Leuthold, 2000; Ueckermann *et al.*, 2008). McNew and Musser (2000) argue that a farmer who is in favour of the free market system may perceive the forward pricing market as an opportunity to generate higher prices. Isengildina and Hudson (2001) added that producers who rank themselves high in marketing skills are more comfortable in using futures and options. Therefore grain producers skilled in marketing (knowledge about SAFEX) and those who have a good perception about the free market system are expected to forward price a larger proportion of their crop.

Jera and Ajayi (2008) reported that membership of a co-operative or commodity association increases access to productive resources such as seed, information and training. According to the literature (Fletcher and Terza, 1986; Asplund *et al.*, 1989; Schnitkey *et al.*, 1992; Katchova and Miranda, 2004; Ueckermann *et al.*, 2008) access to advisory services and information has a positive association with the adoption of forward pricing methods. Asplund *et al*. (1989) and Mishra and Perry (1999) also found that the adoption of new technology, such as computers and internet use, increases the likelihood of adopting forward pricing.

According to Randela *et al.* (2008) there is a growing body of social science research associated with the concept of social capital. They argue that the central thesis of the social capital literature is that features of social organisation, such as networks of interaction, empower individuals and groups, resulting in successful entrepreneurism and successful community action. According to Sharp and Smith (2003) it is through networks that information and other resources can be transmitted and the existence of trust facilitates cooperative behaviour based around these networks. Therefore social organization such as membership of a business association is expected to positively influence the adoption of forward pricing.

Velandia *et al.* (2009) conducted a study investigating factors that influence the adoption of risk management tools such as crop insurance, forward contracting and spreading sales, while taking into account the possibility of simultaneous use of multiple risk reducing instruments and the potential correlations among the adoption decisions. The results showed that risk management adoption decisions are indeed correlated. Furthermore, the decision to adopt one risk management tool positively influences the decision to adopt other risk management tools. The proportion of owned acres, off-farm income level, education, age and level of business risks were found to be important factors determining the adoption of risk management tools.

2.4 Alternative means of minimising price risk

Alternative means of reducing price risk influence the level at which farmers use forward pricing, since it influences the overall risk of investing in farming (Bown, *et al.*, 1999). In this study only three alternative risk management tools have been considered on the grounds of their prominence in the literature. Crop insurance, the level of diversification and the earning of off-farm income will be used as three alternative risk management tools.

According to Coble *et al.* (2000) there are two types of crop insurance that the farmer can use as a risk management tool, namely yield insurance, which exhibits a complementary relationship with hedging, and revenue insurance, which acts as a substitute for hedging at some level of coverage. Accordingly, farmers who use yield insurance are more likely to hedge, while the farmers who use revenue insurance are more likely not to hedge. Maize farmers who use yield insurance to protect their crop against natural events, for example, are more likely to hedge.

McLeay and Zwart (1998), Isengildina and Hudson (2001), as well as Sartwelle *et al.* (2000) suggest that farm diversification is measured by the revenue from one activity as a percentage of total revenue. They established that the greater the percentage of farm area devoted to a particular commodity the more likely it is for a farmer to participate in forward contracting.

Farmers' on-farm decisions are often influenced by off-farm commitments and income (Fernandez-Cornejo *et al.*, 2007) therefore off-farm economic activity may affect the hedging decision of farmers differently depending on the relative importance of on-farm versus off-farm income. According to Velandia *et al.* (2009) producers with a low level off off-farm income are more likely to use forward contracting as a risk reducing instrument. Gabriel and Baker (1980) and Turvey and Barker (1989) suggested that if off-farm income is considered within a risk balancing framework, it is expected to substitute for hedging, suggesting an inverse relationship. However Asplund *et al.* (1989) suggested a positive relationship because off-farm work activity by farm family members may be complementary to hedging if it is used as a response to income or price variability.

According to Sartwelle *et al.* (2000) farmers who have their own storage are less likely to forward price their crops. Maize farmers who have their own storage will not hedge, because they are not exposed to the same intensity of price risk as those who do not have their own storage capacity.

3. Research methodology

Gauteng is usually the fourth or fifth largest maize producing province in South Africa, delivering between four and five per cent of the total harvest. It is surrounded by the major maize producing provinces, and is strategically placed as the heartland of the South African economy.

The empirical research for this study consisted of a structured questionnaire to commercial maize producers who have at least 400 hectares of land. In the initial round, 28 responses were received. After a number (five) of farmers were contacted individually, a further three responses were received. In total 31 maize farmers faxed and mailed back the completed questionnaires, sufficient for an analysis based on a standard normal distribution (Koutsoyiannis (1977: 83).

A Probit regression model is used to evaluate the impact of maize farm and farm owners' characteristics on the hedging decision of the maize farmers in Gauteng. A Probit regression model is used because the dependent variable (hedging decision) is a binary variable. In the theoretical framework the assumption was made that the maize farmer could hedge or not hedge. It must also be noted that hedging includes cash forward contracting, forward pricing and hedging with futures and options through SAFEX, and that no distinction was made between direct and indirect (cash forward, forward pricing, futures and options) means of hedging. The Probit regression equation was formulated as follows:

$$HD = \beta o + \beta_1 D_1 GENDER + \beta_2 D_2 RACE + \beta_3 D_3 RACE + \beta_4 D_4 RACE + \beta_5 D_5 RACE + \beta_6 D_6 AGE + \beta_7 D_7 AGE + \beta_8 D_8 AGE + \beta_9 D_9 AGE + \beta_{10} D_{10} AGE + \beta_{11} D_{11} PO + \beta_{12} D_{12}\ HE + \beta_{13} D_{13}\ HE + \beta_{14} D_{14}\ HE + \beta_{15} D_{15}\ HE + \beta_{16} D_{16}\ AGRICQU + \beta_{17} D_{17} PDM + \beta_{18} D_{18}\ MGA + \beta_{19} InNGA + \beta_{20} D_{20} RSOI + \beta_{21} D_{21}\ TVSOI + \beta_{22} D_{22} MSOI + \beta_{23} D_{23} SMSSOI + \beta_{24} D_{24} ISOI + \beta_{25} D_{25} OSOI + \beta_{26} D_{26} CR + \beta_{27} InPIGI + \beta_{28} InSOFF + \beta_{29} D_{29}\ RL + \beta_{30} D_{30} POTFR + \beta_{31} D_{31} POTFR +$$

$\beta_{32}D_{32}$POTFR + $\beta_{33}D_{33}$POTFR + $\beta_{34}D_{34}$POTFR + β_{35}InAPM 04 + β_{36}InAPM 05 + β_{37}InAPM 06 + β_{38}InAPM 07 + β_{39}InAPM 08 + β_{40}InAPM 09 + $\beta_{41}D_{41}$BEIFC + $\beta_{42}D_{42}$FDR + $\beta_{43}D_{43}$FDR + $\beta_{44}D_{44}$FDR + $\beta_{45}D_{45}$FDR + $\beta_{46}D_{46}$MS + $\beta_{47}D_{47}$MS + $\beta_{48}D_{48}$MS + $\beta_{49}D_{49}$MS + $\beta_{50}D_{50}$MS + $\beta_{51}D_{51}$SAFEXCA + $\beta_{52}D_{52}$DOSP + $\beta_{53}D_{53}$SAFEXE + $\beta_{54}D_{54}$FME + $\beta_{55}D_{55}$FMGFFD + $\beta_{56}D_{56}$ISAFEXE + $\beta_{57}D_{57}$OFI + $\beta_{58}D_{58}$POFI + $\beta_{59}D_{59}$POFI + $\beta_{60}D_{60}$POFI + $\beta_{61}D_{61}$POFI +$\beta_{62}D_{62}$INSUR + $\beta_{63}D_{63}$STR + $\beta_{64}D_{64}$ULCS + e_1

According to Gujarati (2003:582) there are three approaches to develop a probability model for a binary response variable i.e. the Linear Probability Model (LPM), the logit model and the probit model. The LPM is plagued by several problems, such as non-normality of μ, heteroscedasticity of μ, possibility of the estimated dependent variable lying outside the 0 – 1 range and the generally lower R^2 values (Gujarati, 2003: 593). When it comes to probit and logit models the results are almost the same.

Gujarati (2003:608) argues that the Probit model can be presented based on utility, or a rational choice perspective on behaviour as developed by McFadden (1973). Amemiya (1981); Greene (1993) and Verbeek (2000) show that discrete models which are strongly linked to utility theory have been widely used in economics to investigate factors affecting an individual's choice between two or more alternatives. Goodwin and Schroeder (1994); Mishra and Perry (1999); and Katchova and Miranda (2004) have modelled the decision making process in agriculture as a utility maximization problem for producers.

Theoretically, a producer will always prefer to participate in hedging if it maximizes profit (Bekele, 2004). Mishra and Perry (1999) represented the producer profit function as follows:

$\pi_{i=f\lambda q_1+r(1-\lambda)q_1-}[\text{?}_i + \alpha q_i + \rho\lambda q_1 + \delta_i]$..... (1)

where f represents the price received with hedging, r is the spot price, q is the output of the grain crop, $\lambda(1-\lambda)(0 \leq \lambda \leq 1)$ is the proportion of the maize crop sold in the forward contract, ϒ is the total fixed production cost, αq_i is the variable cost component and δ and ρq are the fixed cost and variable costs associated with the forward contract and spot transaction. The key difference between spot market use and forward contracting is that the spot market entails higher transaction costs to the producer due to information gathering, service quality and price discovery (Brusset, 2005).

Mishra and Perry (1999) argue that profit is stochastic, since output as prices are random variables. As such, a Taylor's series expansion of equation 1, under the assumption that the producers are risk averse (∂_1), implied an expected utility of profit function with observable variables in terms of its mean (μ) and variance (σ^2)

EU (π_i) = $f_i(\mu, \sigma^2, \partial_1)$..... (2)

Farmers' behaviour is not only driven by the maximization of profit, rather it is the result of a complex process that is affected by farm and owner characteristics and alternative risk management tools (Willock *et al.*, 1999). In light of this, upon maximizing the expected utility profit (equation 2), Mishra and Perry (1999) found an expression relating to the producers' preference to hedge. The expression can be related to a set of observable producers and characteristics (X), the coefficient vector (β) and the residual error (ε).

λ = g($\beta_i X_i$) + ε_i.....(3)

Notably, McFadden (1973) acknowledges that the residual error term represents heterogeneity across a producer's preference, once the observable variables have been taken into account. Since λ is unobservable, the author applied a discrete choice model with λ = 1 otherwise, meaning the author assumed a dichotomous dependent variable.

Verbeek (2000) and Bekele (2004) mentioned that with appropriate distributional assumptions on the error terms, the approach leads to a manageable expression for probabilities implied by the model. Under this model specification, a standard distribution of the error terms is assumed and it has a mean of μ = 0 and a variance of $\sigma^2 = \pi^2/3$ and is symmetric around its zero mean. To overcome the concern of endogeneity bias, this application further assumes that there is no correlation between the error terms.

This particular model applies a probit regression model where the farmers' decision is assumed to be of a dichotomous nature. This discrete dependent variable is defined as the maize farmer's preference to hedge against uncertainties, conditional on owner and farm characteristics and alternative risk management tools.

$$\lambda_n = \{^{o,hedge\ against\ uncertainties\ in\ maize}_{1,prefer\ spot\ market\ for\ maize\ ,otherwise} \quad \text{.....(4)}$$

The equation above shows that each producer indicates a preference between two alternatives. A stochastic utility is associated with each alternative and the maize farmers choose the one with the utility is the highest. The distribution of the random variables, which describe the valuations of alternatives, expresses the distribution of the producer preferences.

4. Results and analysis

The purpose of this study is to identify factors affecting the hedging decision of farmers in Gauteng significantly. Only 35 per cent of the maize farm owners forward contracted their maize against price risk. The probit regression model was run using the SPSS 20 statistical software. The statistical analysis also included a number of tests for collinearities and heteroscedasticity for the empirical model. The existence of heteroscedasticity is a major concern in regression analysis because it can invalidate statistical tests of significance that assume that the modelling errors are uncorrelated and normally distributed and that their variances do not vary with the effects being modelled. In order to correct this, the Weighted Least Squares (WLS) was used (Gujarati 2003). The presence of multicollinearity among the independent variables was treated by dropping some of the collinear variables (Gujarati, 2003). In doing so, some specification error might occur. However this is a risk that has to be taken, as their inclusion could render the model over-specified, and there is also a need to conserve degrees of freedom, given a sample size of 31 observations.

Overall the estimated model is highly significant in explaining the hedging decisions of the farmers, with a chi-squared value of 4168.109. Also the model correctly predicted 100 per cent of the observations, which implies that the model is a good fit. It is evident from Table 1 that the model reveals a statistically significant impact of various maize farm and maize farm owner characteristics, as well as alternative means of reducing price risk on hedging decisions. The z test was used to test the statistical significance of individual regressors. According to Koutsoyiannis, 1977:83) the z test is based on the standard normal distribution and is applicable only if the population variance is unknown, and provided that the sample is sufficiently large (n>30). The level of significance chosen is a 95 per cent confidence interval.

In binary regression models, goodness of fit is important, but the expected sign of the regression coefficients and their statistical significance are even more important. It is evident from Table 1 that the significant characteristics include gender, age, agricultural qualification, principal decision

maker, member of grain industry association, number of grain industry associations the farmer belongs to, period in grain industry, size of the farm, whether the farmer rents in land, proportion of off-farm income and insurance.

Table 1: Results of the heteroscedasticity corrected probit regression model

Independent variables	**Dependent variable: hedging decision**				
Parameters	**Estimates (Coefficient)**	**Std. Error**	**z-value**	**Sig (P)**	**Expected signs**
Gender	-0.580***	0.107	-5.439	0.000	
Race	0.2000	0.040	0.511	0.609	
Age (years)	-0.111***	0.023	-4.887	0.000	+/-
Principal occupation	-0.034	0.064	-0.531	0.595	+
Highest education	-0.051**	0.029	-1.747	0.081	+
Agricultural qualification	0.137***	0.040	3.388	0.001	+
Principal decision maker	0.296***	0.082	3.626	0.000	
Member of grain association	-0.651***	0.111	-5.866	0.000	+
Number of grain associations	-0.042***	0.016	-2.635	0.008	+
Radio	-0.042	0.050	-0.842	0.400	+
Period in grain industry	-0.029***	0.004	-6.619	0.000	+/-
Size of the farm	0.000***	0.000	26.493	0.000	+/-
Rent land	0.196***	0.041	4.774	0.000	
Proportion of off-farm income	-0.059***	0.019	-3.149	0.002	-
Insurance	-0.172***	0.059	-2.886	0.004	+
Silo/storage	0.064	0.063	1.020	0.308	-
Use local cooperative silo	-0.051	0.039	-1.293	0.196	-

Chi-Square = 4168.109; df = 199; p-value = 0.00; *** Estimate is significant at the 0.05 level; ** Estimate is significant at the 0.10 level; Number of valid cases = 217; Probit (P) = $\beta_0 + \beta_i X_i$

The age of the maize farmers is negatively related to hedging decisions, and is statistically significant at the 5 per cent significant level - older maize farmers are more likely to hedge than younger maize farmers. As was seen earlier, most studies argue that more experienced farmers have a greater ability to use the spot market. Barbieri and Mshenga (2008) suggested that it may be that younger farmers are more willing to introduce new products and services and those younger farmers may be more entrepreneurial and willing to tolerate the risk associated with innovation.

The highest level of education of the farmer has a negative relationship with hedging, where highest education refers to a diploma, degree or postgraduate degree. Those more highly educated are therefore less likely to hedge. However this is not supported by previous studies such as Heierli and Gass (2001); Isengildina and Hudson (2001) and Olaniyan and Okemakine (2008), who found that a higher level of education is an indication of the farmer's ability to process information and causes these farmers to have a better understanding and interpretation of information.

Whether the farmer has an agricultural qualification is positively related to hedging and significant at the 5 per cent level. This is supported by Isengildina and Hudson (2001) who confirmed that the relevant (agriculture) education is an indication of the farmers' ability to process information and cause some farmers to have better understanding and interpretation of information than others.

The regression results show that whether the farmer is the principal decision maker on the farm is positively related to hedging. This is also statistically significant at the 5 per cent level. This indicates that if the owner spends all of his/her working time in the farm, it is more likely that he/she will have more chances of forward contracting.

Whether the farmer is a member of a grain or business related association is negatively related to hedging and the relationship is statistically significant. This might be because most of the maize farmers do not hedge against price risk. *A priori* one would expect the opposite result because

associations provide opportunities to network with different role players in the industry and share information. Bruderl and Preisendorfer (1998) found that information received from professional networking is often assumed to be more useful, reliable and exclusive and less redundant than information received from formal sources. Furthermore, the number of grain or business related associations that a farmer belongs to is also negatively related with hedging behaviour, and is also statistically significant.

The period over which the farm owner has been in the grain industry has a negative relationship with hedging and is statistically significant at the 5 per cent level. This implies that farmers who have been in the grain industry for a long time are not hedging. These results are contrary to expectation, as it was expected that the relationship would be positive as other studies (e.g. Davis *et al*., 2005) have found that farmers who have more years of farming experience are willing to hedge a larger share of their crops. However Davis *et al.* (2005) confirmed that a more experienced farmer may be more accustomed to the previous regime of market regulation, and may therefore forward price at a lower level.

Whether the farm owner rents land is also positively related to hedging and is statistically significant at the 5 per cent level. These results were as expected – it is believed that in order to secure income or reduce risk she or he must hedge. Hedging can assist farmers to secure funds as it can be used as guaranteed income.

The proportion of the owners' income that is earned off-farm is also negatively related to hedging, and is statistically significant. This indicates that as the proportion of off-farm income increases the maize farmer becomes less likely to hedge. This confirms the finding of Velandia *et al.* (2009) who found that farm owners with a low level of off-farm income tend to hedge.

In the same vein, whether the farmer insures his/her crops against natural events that can be identified and quantified is also negatively related to hedging and statistically significant at the 5 per cent level. This shows that maize farmers are using insurance as an alternative risk management tool. This confirms Coble *et al.* (2000) who found that farmers who use insurance are more likely not to hedge.

5. Conclusion

The main objective of the study was to determine the factors that affect the hedging decisions of the maize farmers in Gauteng. The second objective was to determine the adoption rate of the risk management tool by farmers. This objective is also important to indicate whether farmers are using the instrument to protect themselves against price risk. The third objective was to identify alternative means of reducing price risk that farmers can use to protect themselves.

Only 35 per cent of the maize farmers in Gauteng hedged against price risk. This is in line with other South African research which has shown that even after 15 years of deregulation of agricultural markets farmers are still not protecting themselves against price risk. This may be due to the learning curve of the farmers who entered the maize industry after deregulation.

This study identified certain farm and producer characteristics that increase the probability that the farmer will hedge the crop. The results are in many instances counter-intuitive, for example that older and better educated farmers are more inclined to hedge. However, when it comes to more agriculture-specific education, the relationship is positive. Furthermore, the results confirm that farmers who take other steps to mitigate risk, such as earning off-farm income and taking out insurance will be less inclined to hedge, while farmers who rent in land to increase the size of their farming operation are more inclined to hedge.

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