Modelling South African grain farmers' preferences to adopt derivative contracts using discrete choice models

EM Ueckermann, JN Blignaut, R Gupta and J Raubenheimer [1]

Abstract

This paper applies a discrete choice model to determine specific characteristics that influence South African grain farmers' preferences to hedge against uncertainties. This is the first empirical study on South African grain producers' preferences to adopt derivative contracting and is based on the survey data of Grain South Africa for 2006. With the application of separate binary logit models for each major grain commodity, this paper establishes that different grain farmers are significantly heterogeneous. The results also show that grain farmers' preferences to adopt derivative contracting are mostly influenced by the farmers' prediction of daily grain prices and trends, farm size and various geographic characteristics. From a policy perspective it has been indicated that food and income insecurity will be reduced if farmers can adopt derivative contracting at large scale since it will enable the producers to produce staple food on a continuous basis at a relatively profitable level.

Keywords: Discrete choice models; micro-analysis of farmers; agricultural markets and marketing

1.   Introduction

Prior to 1996, the South African grain industry was inwardly focused and heavily influenced by regulations and government control. With the deregulation of the grain industry, prices of grain products are, however, free to move according to national, as well as international, supply and demand considerations, leading to production, marketing and processing decisions based on market signals and not government interventions (Vink & Kirsten, 2000; Meyer 2005).

Following the deregulation of the grain industry, producers also lost their collective bargaining power since the former agricultural co-operatives changed in the business scope. This, together with decreasing producers' prices, increasing input costs and uncertainties in grain producer prices,

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[1] *Ms Ueckermann (E-mail: LizaU@compcom.co.za) is a postgraduate student, Department of Economics, University of Pretoria, while Prof Blignaut (E-mail: james.blignaut@up.ac.za) and Dr Gupata (E-mail: rangan.gupta@up.ac.za) are lecturers at the same institution. Dr Raubenheimer is a consultant for Genesis and compiled the questionnaire for the survey used in this paper.*

negatively affected the producers' ability to sustain profitability over the longer term (Department of Agriculture, 2004; Department of Agriculture, 2005; Bureau for Food and Agricultural Policy Research, 2005; Grain South Africa, 2005; Van Zyl, 2006). Therefore, risk management plays a vital role for the individual producer to reduce market uncertainties and consequently liquidity constraints.

To offer buyers and sellers a hedge against price uncertainty, risk management instruments (derivatives) were developed (Geyser, 2006). The South African Futures Exchange ("SAFEX"), which forms part of the JSE Securities Exchange, introduced the trading of derivatives (futures and options) for grain products in 1998. The trading of derivatives encourages increased productivity in the agricultural sector as farmers and users are able to concentrate their efforts on managing production risks. These are the risks associated with variables such as the weather, farm/production management and seasonal conditions. As a result, derivative contractual arrangements may be preferred to the spot or cash transactions.

To date, however, very little attention has been paid to the South African grain producers' risk perceptions and risk attitudes, as well as their empirical measurement, and this paper attempts to enhance the South African grain producers' decision-making behaviour towards risk reduction. In essence, this analysis tries to close this gap by using a logit model and micro-level data to analyse farmers' market behaviour in managing uncertainties in the market. These results are important for policy considerations to combat income insecurity and to improve producers' abilities to manage uncertainties within the so-called "free market" environment.

This analysis has three objectives. The first objective is to identify specific characteristics influencing grain farmers' preferences to adopt derivative contracts. Second, to highlight the differences between farmers' risk preferences in the production of white maize, yellow maize and wheat. Third, to enhance the understanding of independent grain producers' decision-making behaviour with the application of the research results of this paper. To obtain the set objectives, this paper has four components: First, a literature review on contract theory, in the agricultural context, with an application of discrete choice modelling. Second, the theoretical framework of the empirical model employed in this analysis is developed. The third components relates to the analysis of the data used, followed by the interpretation of the empirical results.

2.   Related studies

This section provides an overview of alternative empirical approaches used in previous international studies will be reviewed. This is done to seek guidance from the international studies for application within a South African environment since similar studies are rare.

Table 1 provides a list of some of the more important and relevant studies identifying characteristics that might be responsible for the choice of utilising a derivative contract in the agricultural industry. These studies are all based on survey data and maximum likelihood econometric estimation and revealed that farmers' preference is a function of their specific socio-economic circumstances.

Table 1: International studies based on maximum likelihood econometric estimation on farmer's behaviour to adopt derivative contracts

Discrete choice model	Study
Logit model	Asplund *et al.* (1989)
	Edelman *et al.* (1990)
	Schnitkey *et al.* (1992)
	McLeay & Zwart (1998)
	Mishra & Perry (1999)
Multinominial logit model	Sartwelle *et al.* (2000)
Tobit model	Shapiro & Brorsen (1988)
	Musser *et al.* (1996)
Probit & Tobit models	Goodwin & Schroeder (1994)
Tobit , Poisson & multinominial logit models	Katchova & Miranda (2004)

Source: Own compilation

Most of studies established that age, as a proxy for experience, has an insignificant, negative association towards the hedging adoption (Fletcher & Terza, 1986; Asplund *et al.*, 1989; Edelman *et al.*, 1990; Shapiro & Brorsen, 1988; Musser *et al.*, 1996; Katchova & Miranda, 2004). Shapiro and Brorsen (1988), along with Musser *et al.* (1996), suggested that one explanation of this result is that a more experienced farmer has the ability to effectively use the spot market. In contrast, Katchova and Miranda (2004) find that an older farmer is significantly more likely to adopt derivative contracting relative to spot market transactions.

Similarly, most of the studies established that education, including training in the derivatives market, has a significant, positive association towards hedging adoption (Fletcher & Terza, 1986; Goodwin & Schroeder, 1994; Musser *et al.*, 1996; Katchova & Miranda, 2004). However, Shapiro and Brorsen (1988) found the opposite. In this regard, the authors suggested that this result is consistent

with the human capital theory, where risk aversion decreases with increases in education and experience.

Mishra and Perry (1999), as well as Sartwelle *et al.* (2000), included regional dummies to account for factors such as climate variables, yield expectations and production patterns. These studies obtained a significant, positive association towards hedging adoption with respect to these variables. Similarly, Goodwin and Schroeder (1994), Musser *et al.* (1996), Mishra and Perry (1999), Sartwelle *et al.* (2000), as well as Katchova and Miranda (2004), established that larger farms are more likely to hedge against uncertainties.

Edelman *et al.* (1990), McLeay and Zwart (1998), as well as Sartwelle *et al.* (2000), suggested that farm diversification is measured by the percentage revenue from grain as a percentage of total revenue. These studies established that the greater the percentage of farm area devoted to a particular grain, the more likely it is for the farmer to participate in contracting, since their exposure to price fluctuations increase. Fletcher and Terza (1986), Asplund *et al.* (1989), Schnitkey *et al.* (1992), as well as Katchova and Miranda (2004), all reported that access to advisory services and information has a significant, positive association towards the adoption of derivative contracts to hedge against uncertainties. Within the South African market, a grain producer can either obtain information from associations, such as Grain South Africa and South African Grain Information Services (SAGIS), other market players or via the media. Furthermore, Asplund *et al.* (1989) and Mishra and Perry (1999) concluded that the adoption of new technology, such as computers and the internet, increases the likelihood to adopt derivative contracting.

Most of the studies reviewed treated producers as homogenous regarding the producers' use of derivative contracts[2]. In other words, these authors pooled the data across various agricultural products as if the data were collected from a single population. Pennings and Leuthold (2000) suggested that this assumption of homogeneity is unrealistic as farmers, producing different commodities, use different attributes when deciding to adopt derivative contracting. Therefore, this paper takes the heterogeneity of grain farmers into account by analysing the effects of South African grain farmers' characteristics on their preferences to hedge against uncertainties for each main grain crop, respectively.

In the subsequent sections a theoretical model is developed, followed by the data used as well as the empirical model and results.

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[2] *See Asplund* et al. *(1989); Edelman* et al. *(1990); Schnitkey (1992); Goodwin and Schroeder (1994); McLeay and Zwart (1998); Mishra and Perry (1999); Musser* et al. *(1996), as well as Sartwelle* et al. *(2000).*

3.   Theoretical framework

Here the authors assume that producers can state their preferences between derivative contracts and spot market transactions. Underlying this assumption is the fact that the producers are expected to rationally reveal their preference in line with the objective of improving their welfare. Therefore, to design a theoretical model, this paper considers a utility maximisation problem for a grain farmer's preference in the decision-making process to use derivative contracts.

Amemiya (1981), Greene (1993) and Verbeek (2000) stated that discrete models, which are strongly linked to utility theory, have been widely used in economics to investigate factors affecting an individual's choice from among two or more alternatives. In the context of agricultural production, some of the reviewed studies modelled the decision-making process as a utility maximisation problem for producers (see, for example, Goodwin & Schroeder, 1994; Mishra & Perry, 1999; Katchova & Miranda, 2004).

Based on economic theory, producers will always prefer to participate in the derivatives market if it maximises their profit, subject to their constraints (Bekele, 2004). Accordingly, Mishra and Perry (1999) represented producers' profit function as follows:

$$\pi_i = f\lambda q_i + r(1-\lambda)q_i - [\gamma_i + \alpha q_i + \rho\lambda q_i + \delta_i] \qquad (1)$$

where f represents the price received with a derivative (futures or options) contract; r is the spot price; q is the output of the grain crop; λ $(1-\lambda)$ $(0 \le \lambda \le 1)$ is the proportion of the grain crop sold in the derivatives market (with the balance sold in the spot market); γ is the total fixed production cost; αq is the variable cost component and; δ and ρq are the fixed cost and variable cost components associated with derivative contracts and spot transactions[3].

From equation 1, Brusset (2005) explained that another key difference between spot market usage and derivate contracts is that the spot market entails higher transaction costs to the producer due to information gathering, service quality and price discovery.

Mishra and Perry (1999) further stated that profits are stochastic, since output and prices are random variables. As such, a Taylor's series expansion of equation 1, under the assumption that the producers are risk averse (ϑ_i),

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[3] *These costs include information-gathering expenses, commissions or brokerage fees.*

implies an expected utility of profits function with observable variables in terms of its mean (μ) and variance (σ^2).

$$EU(\pi_i) = f_i(\mu, \sigma^2, \vartheta_i) \tag{2}$$

Willock *et al.* (1999) acknowledged that farmers' behaviour is not only driven by the maximisation of profit, rather it is the result of a complex process that is affected by several socio-economic and psychological variables.

In light of this, upon maximising the expected utility profits (equation 2), Mishra and Perry (1999) found an expression relating to the producers' preference to participate in the derivatives market. The expression can be related to a set of observable producer and socio-economic characteristics (*X*), the coefficient vector (β) and the residual error (ε).

$$\lambda_i = g(\beta_i X_i) + \varepsilon_i \tag{3}$$

Notably, McFadden (1973) acknowledges that the residual error term represents heterogeneity across a producer's preferences, once the observable variables have been taken into account. Since λ is unobservable, the authors applied discrete choice models with λ =1 if the farmer participates in hedging and λ =0, otherwise. In other words, the authors assumed a dichotomous nature of the dependent variable. In addition, Verbeek (2000) and Bekele (2004) maintained 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 logistical distribution of the error terms is assumed. The standard logistical distribution 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 logistic regression, where the farmers' decision is assumed to be of a dichotomous nature. This paper also incorporates the differences between farmers' hedging preferences for each major grain product. To this effect, this paper creates subsamples based on the major grain products; namely, white maize, yellow maize and wheat.

The discrete dependent variable is defined as the producer's preference to hedge against uncertainties (to participate in the derivative market), conditional on demographic and sociological factors.

$$\lambda_{ni} = \begin{cases} 1, \text{ hedge against uncertainties in grain product } n, \text{ if } \lambda n > 0 \\ \\ 0, \text{ prefer spot market for grain product } n, \text{ otherwise} \end{cases} \quad (4)$$

where n= {white maize, yellow maize, wheat}

In essence, each producer indicates a preference between two alternatives. The producer can either hedge against the uncertainties in the market (in other words adopt derivative contracting) or make use of the spot market transactions. A stochastic utility is associated with each alternative and the producers choose the one with which the utility is highest. The logistic distribution of the random variables, which describe the valuations of alternatives, expresses the distribution of the producers' preferences.

The subsequent sections show the data used in this paper and the empirical results obtained.

4. Summary of data used

It was only as recent as in 2006 that Grain South Africa (Grain SA) conducted a survey across the grain growing regions that provides a sufficiently large set of individual observations, with a large degree of standardisation that allows for a study of this kind (Grain South Africa, 2006a). At the end of 2006, Grain SA granted the authors permission to use this dataset.

The dataset contains 517 observations and comprises data from a random sample across all the grain growing regions and is representative of the general grain producers' population. A 13-page questionnaire, compiled by the Genesis group, was used to collect information within each grain growing region with individual interviews. The questionnaire covers issues such as personal characteristics of the producer, farm characteristics, income dependency, biofuel possibilities, access to information sources, the market environment and producer's preference to hedge against uncertainties.

Though the initial objective of this survey was to assess the need for service delivery among the South African grain producers and the current degree of satisfaction with the service delivery of the association, Grain South Africa, to South African grain producers the survey also fits the objective of this paper.

The dependent variable for this paper was obtained from the response to a question in the questionnaire where grain producers were asked to state their need or preference towards SAFEX contracting. In other words, this variable reflects the grain producer's preference towards derivative contract adoption

to hedge against uncertainties. Of the 517 South African grain producers in the sample, 421 or 81% reflected a preference to hedge against uncertainties. Based on the current sample, the independent variables can be described as follows.

The average age of this sample was 43 years. This group of farmers indicated a high degree of willingness to attend training courses in SAFEX. Almost 75% of the grain farmers are willing to be trained in the derivatives market. On the other hand, only 24% of the South African grain farmers have a good relationship with the role players within the grain value chain.

The major grain producing provinces are the Free State, North West, and Mpumalanga, jointly accounting for 78% of the domestic annual production of grain. Furthermore, 60% of the total grain farmers are situated in these regions (Grain South Africa, 2006b). Given the relative importance of the three provinces mentioned, this paper will only focus on these. Based on the regional characteristics, this sample indicates that the location of the farm can provide insight into grain producers' behaviour towards participation in hedging.

This paper used the actual output as a proxy for the farm size. An annual crop production smaller than 500 tons is characterised as a small farm, while those producing greater than 500 tons are identified as a medium or large farms. Small farms are used as the base group. Looking at the producers' farm size, 27% of the producers interviewed, with a preference towards derivative contract adoption, were situated on small farms.

From this sample it is important to note that multiple observations come from single producers and each producer may produce more than one specialty crop. For example, from the sample it is evident that almost 80% of the producers interviewed, who prefer to hedge against uncertainties, are involved in the production of white maize, 60% in the production of yellow maize and 38% are involved in the production of wheat. Therefore, heteroscedasticity might be a problem within the empirical models.

The sample was relatively dependent on income obtained from grain production. This implies that the producers face a high degree of exposure to price fluctuations (Edelman *et al.*, 1990; McLeay & Zwart, 1998; Sartwelle *et al.*, 2000). Another factor that influences a farmer's preference to hedge against risk is the development of biofuel possibilities[4] and 96% of the producers indicated a need for the development of biofuel possibilities. From the

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[4] *The production of grain for biofuels includes both ethanol and biodiesel. On one hand, ethanol is alcohol and can be used in making animal feed or used as a petrol additive to improve engine performance, while biodiesel can be used in diesel engines (Who Owns Whom, 2006).*

producers interviewed, 87% of the producers, who prefer to adopt derivative contracting, obtain their information from associations to make their marketing decisions. Sixty-four percent of the producers, with a preference to hedge against uncertainties, obtain their information from other market players and only 27% of these producers obtain their information via the media. Most of these producers have access to the internet.

The last set of variables identified are those variables needed to obtain predictions around daily grain prices and local, as well as international, industry trends. As demand and supply considerations play a major role within the said free market environment, this paper is of the view that a farmer's perception regarding daily prices and industry trends may influence the adoption of derivative contracting. In this regard, more than 90% of the farmers, who prefer to hedge against uncertainties, indicated the need for these predictions.

The following sections present the results obtained under the model specification.

5.   Results

Since farmers' risk preferences might differ between farmers producing white maize and other grain commodities, this section analyses binary logit models to elucidate the differences between these grain farmers' preferences to hedge against uncertainties.

A major problem normally encountered when working with the type of data used in this paper is heteroscedasticity; in other words, systematic relationships among the error terms, rendering inconsistent maximum likelihood estimators (Greene, 2000). To correct for the potential problem of heteroscedasticity, White's heteroscedasticity corrected standard error is specified, in all the models, to ensure consistency and efficiency of estimators.

In describing the differences between risk preferences for each grain commodity, separate models, as defined in equation 4, were estimated for white and yellow maize, and wheat producers.

A major benefit in logit modelling is that the model determines the relative importance of the independent variables to explain the dichotomous dependent variable, whether the independent variables are significant or not. It is this benefit that serves the basis to enhance the understanding of independent grain producers' decision-making behaviour. In this regard,

Table 2 only shows the log of odds of a farmer's risk preference for a particular grain commodity based on the strongest predictors identified.

The remaining part of this section provides a general discussion on the results obtained and examines the influence of each identified variable in more detail.

According to Hensher *et al.* (2005), Pseudo R² values between 0.2 and 0.4 are extremely good fits. The predictive power (Pseudo R²) of each model is, therefore, considered to be a good fit. This suggests that empirical performance is significant if each grain commodity is analysed separately.

Moreover, it is estimated that white maize farmers have a 69% probability to hedge against uncertainties; whereas yellow maize and wheat farmers have a probability of 47% and 19%, respectively. This indicates that white maize producers face the highest degree of price fluctuations. Importantly, this implies that different grain farmers are heterogeneous and not homogenous.

The value of taking heterogeneity into account, as reflected in the results obtained in Table 2 is examined, more carefully, below according to each variable.

5.1   Regional geographic characteristics

Regional geographic characteristics, such as climate variables, yield expectations, production patterns and unobserved regional characteristics significantly influence a grain farmer's preference to hedge against uncertainties. In particular, relative to the other locations, white maize producers located in Mpumalanga are the most likely to adopt derivative contracting; in other words, they are 22% more likely (see *Mpumalanga*, Column 1 of Table 2). On the other hand, yellow maize producers located in the Free State are most likely to hedge against uncertainties; in other words, they are 33% more likely (see *Free State*, Column 2 of Table 2).

This result is consistent as these regions are the main maize growing regions in South Africa. It can, therefore, be argued that the Mpumalanga region is the most liquid for white maize and the Free State region the most liquid for yellow maize. Conversely, this association is negative for wheat farmers in all regions under considerations. For example, North Western wheat farmers are almost 16% (significantly) less likely to adopt derivative contracting (see *North West*, Column 3 of Table 2). This result is expected, since wheat is mostly grown in the Cape area, which is omitted in our estimation.

5.2 Farm sizes

With reference to the influence of farm size (*FS_small*), the results reported in Table 2 further established that larger farms have a greater preference to adopt derivative contracting. This implies that the preference to hedge against uncertainties increases as the size of the farm increases. As suggested by Sartwelle *et al.* (2000), larger farms have economies of scale in terms of learning how to use marketing tools and collecting marketing information.

For example, a white maize farmer situated on a small farm is 18% (see *FS_small*, Column 1 of Table 2) less likely to hedge against uncertainties compared to 24% (see *FS_small*, Column 2 of Table 2) for yellow maize producers. This result suggests that these farmers entail higher per-unit cost than other grain-growing producers in terms of learning how to use marketing tools and collecting marketing information.

Table 2: Results of South African grain farmers' risk preferences for major grain product

Variable	White Maize [Column 1]	Yellow Maize [Column 2]	Wheat [Column 3]
Mpumalanga	1.22***	0.846	-0.768
	(0.442)	(0.568)	(0.577)
	[0.222]	[0.208]	[-0.102]
Free State	1.07***	1.370***	-0.442
	(0.389)	(0.510)	(0.560)
	[0.211]	[0.330]	[-0.064]
North West	0.850**	1.200**	-1.295*
	(0.433)	(0.570)	(0.688)
	[0.162]	[0.288]	[-0.157]
FS_small	-0.922*	-1.917***	-0.861*
	(0.496)	(0.461)	(0.528)
	[-0.178]	[-0.236]	[-0.146]
Per_prices	3.102***	2.622***	1.815***
	(0.541)	(0.712)	(0.651)
	[0.292]	[0.280]	[0.183]
Trends	0.810	0.981	-0.567
	(0.587)	(0.754)	(0.677)
	[0.189]	[0.226]	[-0.098]
Pseudo R2	0.50	0.55	0.55
Chi-Square	123.66	118.95	126.72
Log Likelihood	-168.11	-159.57	-144.54
N	516	516	516
Pr (prefer hedging)	0.69	0.47	0.19

Standard errors are reflected in parenthesis
*(**)[***] significant at 10(5)[1]% level
Marginal effects reflected in [ ]
Other variables used in the regression and not reported in the table: age, gender, language, income dependence, own_use, labourers, IS_ass, IS_mp, IS_media, internet, biofuel, training, and relation
The estimated coefficients are presented with robust standard errors correcting for heteroscedasticity

5.3   Need for price predictions and industry trends

The need for predictions regarding daily grain prices and industry trends increases the likelihood to adopt derivative contracting. In particular, the results contained in Table 2 report that white maize producers with the need for daily price predictions are the most likely to adopt derivate contracting, compared to the other grain producers.

These white maize producers are 29% significantly more likely to hedge against uncertainties (see *Per_prices*, Column 1 of Table 2), followed by yellow maize producers being 28% (see *Per_prices*, Column 2 of Table 2) significantly more likely and wheat producers being 18% significantly more likely (see *Per_prices*, Column 3 of Table 2). As white maize producers face a higher degree of price fluctuation (Geyser, 2006), these results suggested that the need for daily prices depends on the underlying commodity's volatility. Therefore, hedging seems to be positively related to the extent that a particular grain farmer believes that using derivatives gives them greater freedom for business action. This implication is also consistent with the findings of Pennings and Leuthold (2000).

In terms of the need for local and international predictions regarding industry predictions (*Trends*), Table 2 shows the following: specifically, yellow maize producers' risk preference is influenced the most, followed by white maize farmers. The results, therefore, suggest that these farmers perceive hedging to increase, if their awareness and interest in making decisions and taking advantage of available information improves. On the other hand, the influence on a wheat farmer's risk preference is negative. This might indicate that the industry trends available in the wheat industry are ineffective to enhance derivative contracting adopting. These results also indicate that each grain commodity is constrained with different industry trends and developments.

The next section of this paper demonstrates the implications of the empirical results obtained.

6.   Implication of results

The purpose of this section is to show the importance of the results for policy considerations to combat income insecurity and to improve producers' ability to manage uncertainties within the said free market environment. In this regard, the implications of the results are as follows:

Differences in producers' risk perceptions about daily grain prices are found to be the most important factor. Thus, efforts to increase grain farmers'

derivative contract adoptions are more likely to be successful if policy considerations are directed towards improving the availability of efficient and reliable price predictions, as well as, creating a need for all grain farmers to use this information. This is expected to increase grain producers' awareness and interest in making decisions and taking advantage of the available information.

As a result, a producer's willingness to participate in the derivative market will increase with the effect of reducing their uncertainties. Considering that the transaction cost of derivative contracting is also lower than in spot market transactions (Brusset, 2005), enhanced participation in the derivative market is most likely to reduce a grain farmer's liquidity constraints.

The second strongest predictor is the need for local and international industry trends. This analysis also suggests that there is a lack of industry information, especially, for wheat farmers, and, hence, serving as an entry barrier. Predictions around industry trends are valuable within the free market environment as it makes producers aware of the market and market opportunities. This implies that policy considerations should target the supply of adequate market information to meet the needs of grain farmers. With adequate information regarding industry trends, it is likely to improve the ability of the grain producers to manage liquidity constraints.

The results further indicate that producers located on smaller farms are significantly less likely to hedge against uncertainties. This result, as suggested by Sartwelle *et al.* (2000), is due to economies of scale associated with larger farms. Therefore, to enhance small farmers' preferences towards derivative contract adoption, policies targeting to decrease smaller farmers' per-unit cost, in terms of learning how to use derivative tools and collecting marketing information, is likely to be successful.

Geographic characteristics, accounting for climate variables, yield expectations and production patterns, are also found to be some of the other the strongest predictors affecting a grain farmer's preference to hedge against uncertainties. This suggests that research considering hedging strategies for producers, which does not consider geographic characteristics, is inappropriate and, consequently, triple the financial burden on grain producers.

Taking heterogeneity into account shows that different groups of farmers have different decision structures. This information is valuable, as it improves the understanding of different grain producers' preferences towards derivative contract adoption and can assist them in modifying their hedging strategies to effectively use derivatives.

With the implementation of the suggested policies, it is highly likely that the problems of food and income insecurity can be addressed, as the grain producers will have the ability to produce South Africa's staple food on a continuous basis, and at a relatively profitable level.

7.   Conclusion

This paper provides insights into the grain producer's preferences to hedge against risk at a time when most grain producers face significant liquidity constraints. This paper is unique in the sense that this is the first maximum likelihood econometric estimation based on South African survey data, analysing the producer's preferences to adopt derivative contracting.

In addition, the uniqueness of this empirical analysis lies in its separate evaluations of the most important grain commodities, in order to account for the diversity of preferences. In essence, the analysis is based on contract theory, with an application of discrete choice modelling. The paper employs binary logit models, based on farm-level data, obtained from the Grain South Africa Survey conducted in 2006. The models are also consistent with a theoretical framework of a utility maximisation problem for a farmer's decision-making process.

The research results reveal that the strongest predictors influencing the likelihood of adopting derivative contracts relative to spot market usage are the grain farmers' need for prediction on daily prices and trends, the underlying commodity, farm size and the geographic characteristics. Taking heterogeneity into account, the results further show that the strongest predictors have different influences on the different grain producers' likelihood to adopt derivative contracting:

(i)   White maize producers, who are located in Mpumalanga, with the need for daily price predictions, are found to be the most likely to adopt derivate contracting. Conversely, white maize farmers situated on a small farm and those with good value chain relationships were less likely to adopt derivative contracting.

(ii)   Yellow maize farmers, the Free State region is the most liquid for yellow maize producers and these producers' preferences are also influenced by predictions on industry trends and farm size, relative to the other grain commodities.

(iii) Wheat producers are overall less likely to hedge against uncertainties relative to the other grain producers. This low probability can be

attributed to a low need for daily price predictions relative to the other commodities, farm size and the negative influence of industry trends.

In light of these results, the following are recommended:

- Policy considerations should be directed at improving the availability of price- and commodity-related information to improve farmers' efficient and reliable price predictions, as well as at creating a need for all grain farmers to use this information. Without such data farmers will be unable, or unwilling, to use the derivatives market implying the non-development of this tool;
- Policy considerations should target the supply of adequate market information to meet the needs of grain farmers. Policymakers should aim to develop a decentralised system of providing information, which should be transparent and easy to decipher, and ensure that it reaches a large number of farmers. Policymakers should also ensure that the information is kept updated;
- Policymakers should aim at decreasing devise a strategy to decrease smaller farmers' per-unit cost in terms of learning how to use derivative tools and collect marketing information by building capacity by providing training tools, manuals, and organising workshops. Policymakers could also consider developing an easy to use and easy access central database with price and commodity information for use by the farmer.
- Research, considering hedging strategies for producers, should prioritise geographic characteristics.
- Heterogeneity should be accounted for in econometric analyses.

To conclude, with the implementation of the recommendations, there is a high possibility that the problems concerning food and income insecurity will be reduced, since the grain producers will have the ability to produce South Africa's staple food on a continuous basis, and at a relatively profitable level.

Acknowledgements

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