

INSTITUTIONAL EFFECTS ON GRAIN PRODUCER PRICE-RISK MANAGEMENT
BEHAVIOR:
A COMPARATIVE STUDY ACROSS THE UNITED STATES AND SOUTH AFRICA

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By
ANDREA ELIZABETH WOOLVERTON

Dissertation Committee:
Dr. Michael Sykuta, Advisor and Chair
Dr. Douglas Miller
Dr. Joseph Parcell
Dr. Corinne Valdivia
Dr. Patrick Westhoff

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The undersigned, appointed by the dean of the Graduate School,
have examined the dissertation entitled

INSTITUTIONAL EFFECTS ON GRAIN PRODUCER PRICE-RISK MANAGEMENT
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A COMPARATIVE STUDY ACROSS THE UNITED STATES AND SOUTH AFRICA

presented by Andrea Woolverton,
a candidate for the degree of Doctor of Philosophy,
and hereby certify that, in their opinion, it is worthy of acceptance.

Dr. Michael Sykuta, Chair

Dr. Joseph Parcell

Dr. Douglas Miller

Dr. Corinne Valdivia

Dr. Patrick Westhoff

DEDICATION

This dissertation is dedicated to

My family, without whom I would never have inherited the heart, perseverance or practicality needed to get things done,

and

My excellent friends who helped me maintain perspective and laughed with me when I did not....and fried fish for me,

and

My wonderful teachers over the years, particularly Ms. Iris Yersak who told me at a very young age to “never peak.”

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ABSTRACT

This dissertation analyzes the impact of the surrounding agricultural marketing environment on grain producers' hedging decisions. This dissertation hypothesizes that supports such as producer income supports and grain price protections create general disincentives to consistently manage price-risk, particularly at low prices. A three-stage comparative method is used to test this hypothesis. Producer price-risk management interviews conducted in both the South African and U.S. grain belt regions are the primary data source. South African producer price-risk management decisions in a non-supported environment are compared to U.S. producer price-risk management decisions in a supported environment using a tobit regression. Producing in South Africa as compared to producing in the U.S. has a significantly positive impact on both pre-plant and pre-harvest hedging levels. Important market-based variables including debt, diversification and yield risk are also found to significantly impact the hedging decision across countries. This study is a novel addition to both price-risk management and institutional analysis literature informing potential shifts to market-based price-risk management in response to farm policy changes.

Chapter 1

Dissertation Introduction

1.0 Introduction

“Institutions are the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction. In consequence they structure incentives in human exchange, whether political, social or economic. Institutional change shapes the way societies evolve through time and hence is the key to understanding historical change...neither current economic theory nor cliometric history shows many signs of appreciating the role of institutions in economic performance because there as yet has been no analytical framework to integrate institutional analysis into economics and economic history.”

–Douglas North (1991)

This dissertation investigates agricultural producer price-risk management dynamics and how these decisions are impacted by the institutional environment in which they are made. Specifically, South African and United States corn producers’ price-risk management decisions are investigated and compared to isolate the surrounding agricultural marketing environment’s impact on price-risk management decisions. Supported agricultural marketing environments are hypothesized to alter market incentives to manage agricultural price risk by decreasing the producer’s perceived corn price risk. This study provides a comparative analysis to show how institutional environments interact with firm-level variables to shape endogenous producer price-risk management decisions and how non-supported environments facilitate market-based agricultural institution emergence.

1.1 Motivation

This study is motivated by two key observations. First, the United States Department of Agriculture (USDA) reports that relatively few United States corn producers currently utilize futures markets to manage price risk according to prescribed

theoretical levels. Second, in 2003, South Africa corn producers were reported to have a 30-40 percent futures market participation rate in the post-marketing board era. U.S. grain producers operate within a rather different agricultural marketing environment with producer income supports and price protections when grain prices fall below target levels. The U.S. supported environment is a stark contrast to the current non-supported South African agricultural marketing environment. Since 1933, agricultural risk management decisions have been made within U.S. farm program constructs.¹ Current U.S. grain producers have made all farm business decisions within some form of the U.S. farm program constructs. South African farm price and income support mechanisms ended with the 1996 elimination of commodity marketing boards.

Can the differences in grain producer price-risk management behavior be attributed to the surrounding agricultural marketing environment? How important is the farm program institution relative to producer and farm characteristics within grain producer price-risk management decision-making? From the price-risk management literature, it is unclear how farm programs impact producer price-risk management decision-making.

Hedging via futures contracts and options is a theoretical answer to reduce risk associated with seasonal fluctuations in commodity prices (Carlton, 1984; Johnson, 1960; Working, 1953). In practice, however, few grain producers hedge consistently or correctly. According to the Commodity Futures and Trading Commission (CFTC), as little as 20% of U.S. producers hedge to any degree (CFTC, 2001).

¹ U.S. farm policy is revisited approximately every six years by Congress. Appendix A provides a brief synopsis of the major changes in the Farm Program since its inception.

There are many reasons cited in the literature that impact hedging levels such as leverage, basis risks, yield uncertainty, transaction costs, education and participation in government programs (Miller and Kahl, 1989; Turvey and Baker, 1989; Turvey, 1990). The farm program presence and participation is often discussed as a factor influencing producers' price-risk management decisions, but little has been conclusively written. Is it accepted that some producers choose not to hedge any proportion of their crop because of the substitutability of government programs? Do hedging decisions change when government support programs change?

The primary tenet of this research is that agricultural marketing environments (supported and non-supported) impact grain producers' price-risk management decisions. The farm program's presence and the continuing changes are hypothesized to alter market-based price-risk management incentives for the grain producer². The historical program goal of price stability has reduced the realized price risk faced by the producer. Tools such as marketing loans and counter-cyclical payments have *effectively* left-truncated the U.S. farmer's *perceived* spot price distribution; other program aspects including subsidized yield and revenue insurance and direct payments provide additional direct and indirect agricultural income.

While participation in government farm programs has been cited as a possible reason for the lack of grain producer hedging activity, it is difficult to estimate the effects of farm programs due to their embedded nature in producer decision making. Hauser et al. (2004) succinctly state the difficulties of modeling and measuring the effect of farm programs. Disaggregated data is difficult to obtain; farm programs change frequently and

² Currently, there are nine program crops with loan rates and direct payment and countercyclical payment eligibility. These crops are corn, grain sorghum, barley, oats, wheat, rice, cotton, peanuts and oilseeds.

it is difficult to avoid measurement problems associated with not knowing what prices, production and other market conditions would be in absence of the programs. Thus, the need exists for comparative methods to look at institutional impacts on a more general level.

Fortunately, there is a natural experiment occurring in South Africa that may provide insight regarding the interaction between producer income supports and price-risk management behavior. Following the 1994 political regime change, the South African government passed the Marketing of Agricultural Products Act of 1996. This legislation eliminated marketing boards³ for products ranging from maize (corn) to fruits, phased out certain import and export controls, eliminated price subsidies and introduced import tariffs.⁴ This change has created a market-oriented, non-supported commercial agricultural sector in South Africa.

In the years following deregulation, many wheat producers discontinued production and progressively maize producers began hedging via the newly formed South African Futures Exchange (SAFEX) grain contracts. This abrupt and distinct institutional change is a clear opportunity to examine and disentangle the reasons suggested for the inconsistent producer price-risk management levels in the United States.

In addition, the development of market-based agricultural financing and marketing in South Africa provides an instructive discussion of how economic

³ Marketing boards, in general, raise or maintain agricultural prices and incomes over time (Hoos, 1979). Established in 1937, the South African Marketing Boards were both the monopoly commodity buyers and the import/export regulators. These boards provided producers with a fixed price based on average cost of production plus some profit margin. Under this regime, it appears that there is no need for price-risk management.

⁴ Legislation details taken from SouthAfrica info.com “South African Agriculture”; accessed December 2005.

instruments can effectively ensure that the move from a regulated agricultural pricing environment to a deregulated environment need not result in chaos. The South Africa Futures Exchange (SAFEX) emerged in the early 1990s. Producers are reported to be actively participating in these markets directly or via a broker. Interesting, lenders have entered agricultural operations lending and are also involved in producer price-risk management.

This dissertation provides a new understanding of price-risk management choices across differing institutional environments through a comparative analysis across agricultural marketing environments. The research outcomes will provide a view into the aftermath of an institutional shock. Capturing the causal relationship between agricultural marketing environments and producers' price-risk management decisions will both add a unique empirical study to the institutional change literature and provide a useful perspective to futures exchange officials and agricultural policy makers regarding direct outcomes of farm policy elimination. In the tradition of agricultural economics, this research is expected to result in applied outcomes in addition to a theoretical contribution.

The research objectives are timely and needed given the changing U.S. farm program landscape. Understanding impacts prompted by farm policy changes will be valuable to theory and decision makers in the future, especially those engaged in trade negotiations and farm policy. The U.S. government, in theory, is moving toward a more self-sufficient (less supported) agricultural sector given World Trade Organization (WTO) agreements and recent U.S. Farm Program changes. The Federal Agriculture Improvement and Reform Act of 1996 deleted deficiency payments that had been

providing income and price support to producers since 1973. As mentioned, other program components have been available since 1933. While some payments have been reinstated, price support components of the U.S. farm program are expected to decline and, possibly, be eliminated in the coming years if the U.S. acts according to WTO rulings⁵. Predicting institutional change is difficult because decision makers have always existed within the institution. Today's U.S. *grain* producers have never existed in an environment without some level of revenue support and/or price protection expectations. The producer price-risk management outcomes are unclear if government support is substantially decreased.

1.2 Dissertation Structure and Results

The dissertation proceeds with a review of relevant literature identifying the theoretical gap being addressed and continues with three papers exploring and analyzing agricultural marketing environment impacts on U.S. and South African grain producers' price-risk management decisions. The dissertation concludes with a discussion of the overall conclusions and further research prompted by these findings.

Chapter two surveys both price-risk management literature and institutional theory and analysis. This survey establishes the theoretical gap within price-risk management literature and the consequent need for an institutional perspective. The price-risk management literature focuses on theoretical optimal hedging models and producer price-risk management surveys and compares and contrasts alternative price-risk management tools. Both theoretical and empirical price-risk management literature have difficulty explaining observed grain producer price-risk management behavior.

⁵ It should be noted, however, that the 2007 U.S. House committee bill would increase price-based subsidies relative to the 2002 farm bill. The 2002 farm bill reinstated a modified version of the price-based subsidies dropped in 1996.

This dissertation hypothesizes the explanation problem lies in the fact that theoretical hedging models do not incorporate the surrounding agricultural marketing environment (grain price protections) into the optimal hedging ratio derivation and producer surveys identifying variables impacting producer price-risk management behavior cannot separate the agricultural marketing environment from the producers' responses. However, an important conclusion made within the theoretical price-risk management literature is that producers will choose not to hedge if the minimum output price that could occur is greater than the amount necessary to meet the financial obligations of the firm.

The institutional literature survey reviews theoretical institutional literature and institutional analysis studies. Theoretical institutional literature establishes that institutions and environments create incentives and influence decision-makers operating within the institution. By definition, it is difficult to study these incentives and influences within the institution. Comparative studies allow researchers to separate the institutions from the decisions when attempting to identify the institutional effects.

Literature incorporating institutional analysis of U.S. farm program elements (e.g. LDPs and subsidized crop insurance schemes) into the producer's price-risk management decisions has done so in a hypothetical manner. These studies show empirically that loan rates decrease the utility producers receive from market-based hedging when loan rates approach or exceed the market price. These results are based on simulated price-risk management portfolios and discrete farm program policies. These studies infer to potential U.S. farm program effects, but do not gauge the real effects from the producer's perspective.

Chapter two establishes the need for some conclusive institutional analysis of farm program effects on grain producer price-risk management. To capture institutional incentives created by the agricultural marketing environment, general farm program effects, particularly commodity price protections and income supports must be tested rather than discrete changes in policies. This analysis requires an understanding of how producers perceive farm program surrounding environment. This dissertation addresses the gap in the price-risk management literature using institutional analysis in chapters three through five.

Chapter three begins the institutional analysis with an exploratory analysis of U.S. producers' perceived farm program effects within their business operations and the subsequent impact on price-risk management behavior. Missouri producers stated the U.S. farm program effectively creates a price safety net through a floor price establishment, facilitates cash flow and guides their grain marketing strategy within their farm operations. The loan deficiency payment program and direct payments are found to be the most important farm program aspects pertaining to the identified effects. Missouri grain producers generally did not mention subsidized crop insurance as an important aspect of the farm program. Perceptions of farm program effects are found to impact Missouri producer hedging levels. The identified farm program effect of safety net and floor price establishment was found to have a significant, negative impact on producers' *actual* pre-harvest expected price lock-in level.

Given the chapter three results that perceived farm program do affect producers' actual price-risk management behavior, it is reasonable to question what grain producer price-risk management practices look like in a non-supported agricultural marketing

environment. Chapter four investigates and analyzes South African emergent producer price-risk management strategies. South African producers perceive post-marketing board maize price risk significantly larger than maize price risk during marketing boards. South African producers have generally moved toward a consistent [annual] price-risk management strategy. Producers using more independent strategies, futures contract hedging and options, tend to be younger and/or more educated than those using some combination of forward contracts.

Approximately 85 percent of South African producers interviewed use their price-risk management strategy to lock-in at least break even revenues; approximately 79 percent of producers are locking-in revenues beyond those dedicated to input costs. These producers' objectives and price-risk management actions are consistent with the theoretical intentions of price-risk management to secure prices [revenues]. Those producers locking-in more than 33 percent pre-harvest are significantly younger and more leveraged than those producers choosing to not.

Chapter five culminates the dissertation with a comparative analysis of South African and U.S. corn producer's price-risk management decisions and strategies isolating the impact attributed to the differing agricultural marketing environments. Chapter five isolates this impact by comparing expected price lock-in levels across U.S. and South African producers. South African producers without *perceived* price floors lock-in a significantly larger percentage of the expected maize prices pre-planting than producers with *perceived* price floors. Differing agricultural marketing environments are not found to significantly impact the probability of producers using futures hedges or

options to lock-in expected prices. However, education in a non-supported environment has larger, positive impacts on futures usage than education in a supported environment.

Chapter six concludes the dissertation and offers further research potential. If the U.S. farm program is eliminated, competitive U.S. producers are expected to substitute market-based tools for current farm programs to create price floors. More educated producers are expected to adapt at a faster rate than less educated producers. Lenders are expected to maintain lending volumes and become more involved in producer price-risk management practices, particularly higher risk producers.

Chapter 2

Literature Survey

2.0 Introduction

Chapter two surveys the relevant academic literature and discusses how this dissertation addresses unanswered research questions that further understanding of institutional impacts on agricultural price-risk management. This chapter first examines traditional theoretical optimal hedging models and empirical producer price-risk management literature consisting of producer surveys. This literature is largely based on U.S. agriculture. A discussion of alternative price-risk management methods and tools is included to provide background regarding substitution between tools and methods.

The literature survey proceeds with a review of the institutional theory which provides motivation for institutional analysis and effective research methods. Empirical studies incorporating institutional analysis into the producer price-risk management decision follow. These empirical institutional analysis studies represent the most current producer price-risk management addressing farm program effects.

Cumulatively, the literature survey frames how this dissertation furthers academic understanding of producer price-risk management through institutional analysis.

2.1.1 Theoretical Price-risk Management Literature

Early optimal hedging literature traditionally evaluates risk management portfolios when utility is maximized or risk is minimized (Johnson, 1960; McKinnon, 1967, Telser, 1955). The producers' portfolio strategies are dependent upon market bias, risk aversion, expected income and price variability. The resulting optimal hedge is part of the overall risk management portfolio. The model results have prescribed theoretical

hedging ratios close to one given the independent variables mentioned. This result means that producers are prescribed to lock-in close to 100 percent of expected grain production given the model constraints.

Kahl (1983) compares and contrasts a 1972 theoretical optimal hedging model developed by Heifner with earlier models of Johnson (1960) and Telser (1955). Heifner's model serves as a representative utility maximizing optimal hedging model where cash price variance is an independent variable. The model assumes the producer will maximize utility (as proxied by profit) in the next time period adjusted for risk. The objective function Ω is

$$\Omega = E(\pi) - \lambda Var(\pi) \quad (2.1)$$

where π = profit on total portfolio of assets
 λ = positive risk parameter (assuming risk aversion)

Expected profit is expressed as

$$E(\pi) = \chi_F \mu_F + \chi_C \mu_c \quad (2.2)$$

where $\chi_{F,C}$ = level of futures and cash position, respectively
 $\mu_{F,C}$ = expected profit from holding a long futures and cash position, respectively

Profit variance is expressed as

$$Var(\pi) = \chi_F^2 \sigma_F^2 + \chi_C^2 \sigma_C^2 + 2\chi_F \chi_C \sigma_{cF} \quad (2.3)$$

where σ_F^2 = variance of profits from holding a futures position
 σ_C^2 = variance of profits from holding a cash position
 σ_{FC} = covariance between profits of holding futures and cash positions

To find the optimal futures and cash position (hedging ratio), the objective function is differentiated with respect to χ_F and χ_C . The first-order conditions are set

to zero and solved for optimal quantities of χ_F and χ_C . The optimal hedging ratio is expressed as

$$\text{Optimal Hedging Ratio} = \frac{\chi_F}{\chi_C} = \frac{\mu_F(\sigma_C^2 - \sigma_{FC})}{\mu_C(\sigma_F^2 - \sigma_{FC})} \quad (2.4)$$

Kahl essentially finds that Heifner's utility maximizing model and Johnson's and Telser's risk minimizing optimal hedging models arrive at essentially the same calculation for optimal hedging. The variables within the optimal hedging ratio include the expected profits from the futures and cash positions, the futures and cash price variances and the covariance between futures and cash prices; normally distributed prices and profits are assumed. Risk aversion affects the size of χ_F and χ_C , but does not affect their ratio. To reach a zero numerator, cash price variance must equal to the covariance between cash and futures price or a zero profit must be expected from the futures holding. Cash price variance is not likely to be equal to cash and futures prices covariance due to local supply and demand conditions impacting the observed cash price.

According to futures theory, cash and futures prices move together by definition indicating a positive futures and cash price covariance. The optimal hedge ratio increases as either the expected profit from futures (μ_F) increases or the cash price variance (σ_C^2) increases. The optimal hedge ratio decreases as the either expected profit from the cash position (μ_C) increases or the futures price variance (σ_F^2) increases. To reach a zero optimal hedging ratio, the numerator must reach zero as division by zero is impossible.

Brorsen (1995) presents an alternative hedging theory to Johnson (1960) incorporating risk neutrality, forward pricing costs and nonlinear borrowing costs. While Brorsen does not estimate concrete optimal hedging levels, he suggests that more

leveraged producers may hedge more than less leveraged producers given nonlinear borrowing costs. He does, however, argue that optimal hedge ratios do increase as cash price variability increases. An important contribution of this research is risk aversion not being required for hedging strategy presence in the presence of nonlinear borrowing costs. Brorsen argues that firm's finances and hedging costs rather than risk preferences should be the focuses when discussing why some firms use futures and others do not.

Collins (1997) argues that pre-1997 optimal hedging models (utility-maximizing and risk-minimizing) cannot explain actual producer behavior primarily because most of the models cannot arrive at a zero (corner) hedging solution, a commonly observed producer hedging decision, without stringent assumptions. Collins develops a positive model of hedging based on avoiding financial failure rather than price risk minimization. This model maximizes expected return subject to a safety constraint limiting the probability of disaster.

According to his model results, Collins puts forth an interesting hedging conclusion: "The firm will choose not to hedge if the minimum output price that could occur is greater than the amount necessary to meet the financial obligations of the firm."

Arias et al (2000) use Collins' model to empirically derive optimal hedging ratios for wheat and steer producers based on progressive tax rates, nonlinear borrowing costs, and bankruptcy in addition to the previously studied parameters including yield risk, price variability, basis risk and financial risk. While Collins' model is theoretically capable of producing a zero optimal hedging solution, the wheat optimal hedging ratio remained positive, ranging from 0.45 to 0.62, depending on leverage levels.

Each of the discussed optimal hedging models arrives at some positive hedging level using empirical data and model assumptions. However, it is commonly observed that United States grain producers do not manage grain price risk as prescribed. Some U.S. grain producers are not managing price risk to any degree. Optimal hedging models to this point do not account for a corner solution (zero producer hedging) which creates a need for further consideration of the producer price-risk management decision.

2.1.2 Empirical Price-risk Management Literature

A sizable literature has been devoted to explaining producers' deviations from prescribed optimal hedging ratios in light of seemingly effective markets and price-risk management tools.⁶ Peck (1975) finds that hedging effectiveness is related to the producer's accuracy in *predicting price variances*. Turvey (1989) finds the degree of the individual producer's *leverage* is an important factor in the decision to hedge. The debt to asset ratio impacts the whole farm optimal hedge ratio. Shapiro and Brorsen (1988) also find that hedging activities depend on debt levels. In a minimum-variance model, Castelino (1992) finds that there is less incentive for wheat and corn producers to hedge as *basis variance increases ceteris paribus*. *Production risk* substantially reduces optimal hedge ratios and their effectiveness under risk minimization (Grant, 1989; Lapan and Moschini, 1994). As would be expected, optimal hedging ratios increase with an increase in *cash price variance* (Kahl, 1983; Peck, 1975; Robinson and Barry, 1987).

U.S. producer survey literature has also identified producer price-risk management decision drivers. Table 2-1 summarizes four studies which survey producers to understand the forces behind risk management decisions. Generally,

⁶ Ederington (1979) finds that hedging ratios close to one for a sample of wheat and corn producers effectively reduces price variance by up to 89 percent.

authors have found education, leverage and size to positively impact forward pricing usage. The experience impact is unclear.

Table 2-1. U.S. producer surveys assessing price-risk management decisions.

	Shapiro and Brorsen (1988, n=41)	Makus et al (1990, n=595)	Goodwin and Schroeder (1994, n=509)	Sartwelle et al (1998, n=386)	Davis et al (2005, n=1270)
Focus	Factors influencing producers' hedging level	Factors influencing producers' use of futures and options contracts	Factors affecting producers' adoption of forward pricing methods	Factors affecting use of cash marketings, forward contracts and futures/options	Impact variables on the choice and level of forward pricing
Target Population	Indiana corn/soybean producers	Marketing pilot program producer participants	Kansas corn/wheat/soybean/cattle/pork producers	Kansas, Texas and Iowa grain producers	Indiana, Mississippi and Nebraska corn/soybean producers
Method	Tobit regression	Probit regression	Tobit regression	Binomial/Multinomial Logit	Heckman's two step maximum likelihood
Significant Variables and Impact Direction	Perceived ability to increase income stability (+), Debt level (+)	Previous use of forward contracting (+), Marketing club membership (+), Education (+), Farm size by sales (+)	Experience (-), Percentage of land in row crops (+), Debt/asset ratio (+), Input intensity (+), Marketing seminar attendance (+)	Experienced, risk averse producers with on-farm storage were more likely to use cash and forward contracts vs. futures and options	Choice to forward price: Age (-), Use mktg consultant (+), Price expectations (-), Risk fear (+), Comfort (+) Level: Farm size (+) Use mktg consultant (+), Price expectations (-), Debt (+), Diversification (-), Crop Insurance (+)

Shapiro and Brorsen also discuss the potential role of participation in commodity programs and the use of crop insurance in the grain producer's hedging decision, but do not include these variables due to simultaneity and the reduced form model used. Goodwin and Schroeder included government payments per acre as an explanatory variable. They found a negative, but statistically insignificant, relationship between forward pricing adoption and government payments per acre.

Davis et al (2005) adds a U.S. producer survey study using a large, stratified random producer sample from Indiana, Mississippi and Nebraska to assess the impacts of socioeconomic variables on forward pricing adoption and soybean and corn forward price pre-harvest hedging levels for the 1999 crop year. Neither age nor education are found to have significant effects on forward contract use or level, but leverage and size are found to have positive impacts as consistent with prior surveys. Diversification via

livestock is found to negatively impact grain forward contracting levels. Other variables found to significantly impact forward contract usage include perceived price risk, comfort level with forward contracting and lender encouragement. The negative impact found of comfort with futures on forward marketing usage indicates substitution within price-risk management tools. These results generally support previous U.S. producer survey results with smaller samples.

Producer price-risk management strategies found within an agricultural marketing environment void of both commodity price protections and farm income supports have been studied by Brown, Ortmann and Darroch (2000). Using data from a 1996 mail survey, the authors identified factors affecting price-risk management tool adoption by commercial South African maize producers in the immediate response to the maize marketing board elimination. The authors use ordinary least squares (OLS) to examine the relationship between these factors and an aggregate risk management score index. Variables found to significantly impact price-risk management tool adoption as measured by an index include: use of on-farm or commercial maize storage (+), off-farm employment (+), crop insurance coverage (+), education (+), proportion of income derived from maize (+) and self-rated marketing ability (-).

The resultant factors in the BOD study are compared to parallel United States studies; the authors directly based their variable expectations on prior U.S. results. This U.S.-South Africa direct comparison ignores the differing institutional environments regarding maize price and farm income supports within both countries. The U.S. exhibits a supported agricultural marketing environment with maize price protections and producer income payments whereas South Africa is a non-supported agricultural

marketing environment. The variable impact directions are similar, but the magnitudes are difficult to compare given the differing agricultural marketing environments within the U.S. and South Africa.

2.1.3 Alternative Price-risk Management Methods

Generally, price-risk management literature refers to price-risk management “hedging” via “futures contracts”. Producers may also use other strategies to manage price risk aside from locking in expected prices with a market-based tool. In addition, producers use other market-based “hedging” tools in addition to futures contracts, particularly forward contracts, to secure grain prices. It is important to understand the entire portfolio of price-risk management strategies available to producers prior to investigating impacts on price-risk management decisions.

The United States Department of Agriculture (USDA) identifies three primary grain price-risk management methods as options in a producer’s price-risk management portfolio (Harwood et al., 1999). These methods include: enterprise and/or financial structure *diversification*, crop [revenue] *insurance*, *marketing* (forward) contracts, futures hedging and options usage. Some substitution is expected among these methods. Interestingly, *keeping cash on hand* and *good buys* are reported by producers in the 1996 ARMS survey to be the number one risk management strategy across every farm size, commodity and region (Harwood et al., 1999).

The growing presence of marketing contracts as a price-risk management strategy merits a discussion contrasting futures hedging and forward contracting. Marketing contracts in 2003 covered 14.3 percent and 14.0 percent U.S. corn and soybeans produced, respectively (MacDonald and Korb, 2006). Various authors have compared

the attributes of these two strategies. Telser and Higinbotham (1977) point out that organized futures markets substitute the trust-worthiness of the exchange for that of the individual trader while facilitating the exchange of a standardized contract. Carlton (1984) adds that futures exchanges provide contract transferability (liquidity) and reduce monitoring costs (buyer/seller performance). Williams (1986) calls these differences the “liquidity theory of futures markets.” To understand the difference between the two contracts, one must understand and agree that there is some value in retaining flexibility to undo or change a commitment. This value can be compared to “real options”⁷ in the financial markets.

Executing a hedge via futures contracts versus marketing contracts is also an important contrasting factor. It has been argued that producers do not hedge due to lack of futures markets understanding (CFTC, 2001; Goodwin and Schroeder, 1994). Futures markets are complicated and require the producer to either study the markets him/herself or hire a broker to advise and execute the hedging activities. In most marketing contract situations, the producer can read and understand the contract terms and a representative is available to discuss the contract.

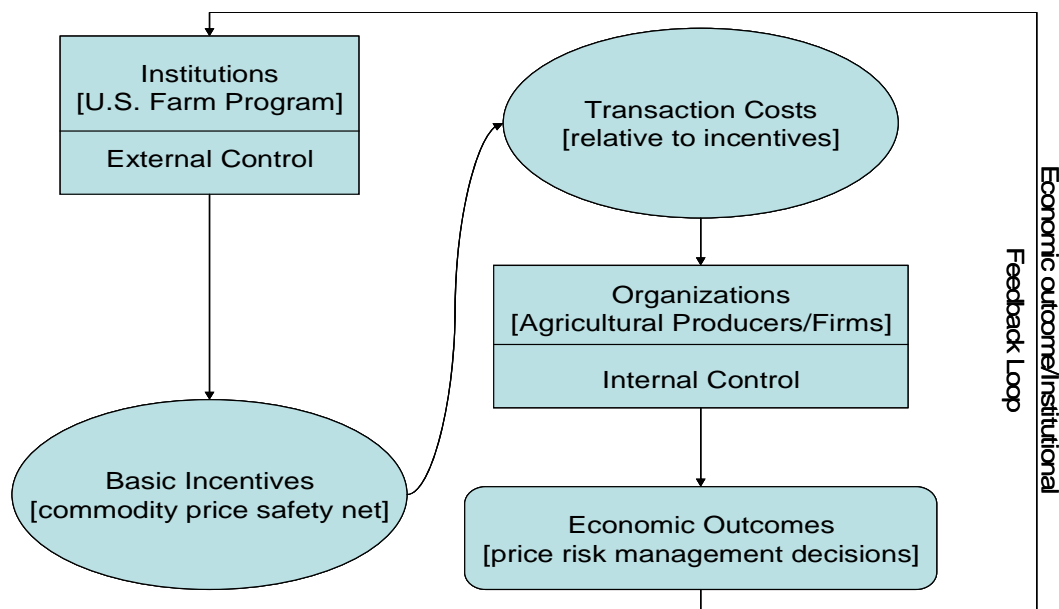
Collectively, many explanatory variables have been identified to explain producer hedging levels; some are idiosyncratic producer characteristics such as leverage levels, or sources of potential futures market inefficiencies such as basis variance (risk) while some are substitutes for hedging such as diversification. Why are these variables not sufficient to explain U.S. grain producers’ price-risk management decisions according to empirical model results to date?

⁷ Real options capture the value of managerial flexibility to adapt decisions in response to unexpected market developments

2.2.1 Institutions and Institutional Change

Institutional economics builds on traditional neoclassical economics theory as a complementary perspective. As expressed in chapter one, institutions are defined “as the formal and informal rules that constrain individual behavior and shape human interaction” (North, 1990). When institutions are present, institutional economics argue that institutional analysis must be included to fully analyze the economics of decisions. The relationship between institutions and decision-making is complex. Figure 2-1 illustrates the proposed theoretical relationship between institutions and economic outcomes [wealth] (Alston, Eggertsson and North, 1996).

Figure 2-1. Theoretical linkage between institutions and economic outcomes.



Institutional impacts within neoclassical theory are perceived through incentives created by property rights and transaction costs (Eggertsson, 1990). Property rights in a general sense are the rights of a user to an asset. Transaction costs are the decision-makers opportunity costs of establishing and maintaining internal control of resources.

Institutions, formal or informal, directly impact both the type and magnitude of property rights and transaction costs.

2.2.2 Institutional Analysis

Institutional economic theory suggests that institutional incentives should be included for a more complete understanding when analyzing and modeling producer price-risk management. Institutional analysis occurs at three primary levels depending on which variables are endogenous, given figure 2-1 (Eggertsson, 1990). The first level attempts to explain how institutional arrangements or variations within institutions affect economic outcomes [decisions]. Institutions, organizations and contractual arrangements are treated as exogenous variables. The second level attempts to explain how the institutional framework affects the structure of economic organizations and contractual arrangements. The second level analysis argument is that in each case the institutional framework defines and limits the set of economic organization forms available to decision-makers. The third level of analysis attempts to explain various elements of the institutional framework and the structure of property rights which is highly multi-disciplinary.

Studying institutional impacts is challenging. The level at which the institutional analysis is focused must be carefully specified. Additionally, endogeneity must be controlled. By definition, the institutional framework is endogenous to the decisions made within the framework. The feedback loop in figure 2-1 illustrates. Data capturing the institution across time are difficult to obtain and, since the data are collected within the institution, the endogeneity problem often persists.

Inherently, comparative methods are needed to control for this endogeneity through feedback. Comparative analyses across institutional frameworks allow the researcher to control for and test institutional impacts.

2.2.3 Institutional Analysis within Agricultural Price-risk Management Literature

The relevant economic institution and outcomes within this research are farm support programs and producer's price-risk management decisions. Figure 2-1 suggests that U.S. farm program create incentives or reduce transaction costs that producers internalize when making price-risk management decisions.

Traditional hedging literature does not account for U.S. farm program interactions such as a truncated grain price distribution. It is impossible to identify or model the incentives created by the farm program *presence* using optimal hedging models given data limitations. Also, U.S. producer surveys have been conducted *within* the U.S. farm program environment. It is difficult to identify the farm program incentives given the embedded nature of the price-risk management decision making. U.S. producer surveys to this point have not attempted to directly identify U.S. farm program incentives. The inability of identified variables in these studies to fully explain the dynamics of grain producers' hedging activities invites additional and/or competing explanations.

Authors have discussed both price support programs and crop insurance as alternative methods to market-based hedging strategies (Shapiro and Brorsen, 1988; Carter, 1999; Adam et al., 2000). The presence of farm programs is inherently involved in any grain producer's risk management decisions; U.S. farm programs as their objective decrease price (income) risk. Interestingly, government programs are often viewed by producers as both a source of risk and a mechanism to reduce both price and production

risk. One might expect farm program impacts to be reflected in the idiosyncratic characteristics or attitudes of producers.

Traditional optimal hedging models do not consider the U.S. farm programs surrounding the producer's price-risk management decisions. It is also important to note that many early models do not explicitly distinguish between optimal hedging ratios for livestock producers vs. grain producers. Due to farm programs, grain producers face a much different price "safety net" than do livestock producers.

For example, the Heifner optimal hedging ratio should be altered in practice to accurately reflect the scenario of the participating grain producer. This original ratio assumes a normal distribution of profit variances. Farm programs, particularly the marketing loan program (LDP), counter-cyclical payments and direct payments, partially eliminate some grain price and income risk. The relevant left side of the grain price distribution has been strongly affected in practice. Program participation decreases the instances where cash position profit variance is substantially large and, therefore, instances of positive hedging levels are decreased in this model.

Equation 2.5 revisits the original Heifner optimal hedging ratio. Equation 2.6 alters the Heifner ratio to reflect hypothesized farm program effects. As discussed, the LDP and counter-cyclical payments effectively reduce cash price variance by *effectively* maintaining a *perceived* price floor. The cash price variance with the marketing loan program and counter-cyclical payments is σ_{CF}^2 . In addition, direct payments are hypothesized to increase the expected profit from cash prices [farm revenues]. The expected profit from cash prices including direct payment effects is μ_{CF} . If the

relationship detailed in equation 2.7 holds, including these effects should decrease the optimal hedging ratio.

$$\text{Heifner optimal hedging ratio} = H = \frac{\chi_F}{\chi_C} = \frac{\mu_F(\sigma_C^2 - \sigma_{FC})}{\mu_C(\sigma_F^2 - \sigma_{FC})} \quad (2.5)$$

$$\text{Optimal hedging ratio with farm program effects} = H_{FP} = \frac{\chi_F}{\chi_C} = \frac{\mu_F(\sigma_{CFP}^2 - \sigma_{FC})}{\mu_{CFP}(\sigma_F^2 - \sigma_{FC})} \quad (2.6)$$

$$\text{If } \sigma_{CFP}^2 < \sigma_C^2 \text{ or } \mu_{CFP} > \mu_C, \text{ then } H < H_{FP}. \quad (2.7)$$

Moreover, according to Collins (1997) if the grain price received with certainty from farm programs is larger than the price need for the farm's financial obligations, then the producer's hedging will be zero.

Authors have tried to incorporated U.S. farm program payments [incentives] into the optimal hedging model. These authors often estimate optimal hedging strategies by modeling current crop insurance designs and program payments as a choice variable in the price-risk management portfolio. Most recently, Adam, Betts and Brorsen (2000), Coble, Heifner and Zuniga (2000), Wang (2004) and Coble, Miller and Zuniga (2004) have incorporated the effects of reduced deficiency payments and the availability of both crop insurance and loan programs into optimal marketing strategy models for grain producers. Each paper has found positive hedging ratios under various sets of assumptions.

Adam, Betts and Brorsen (2000) model the U.S. loan deficiency payment (LDP) program as a [subsidized] substitute to hedging agricultural price risk via futures and options. In 10 annual strategy simulations, the authors find marketing strategies are available that can reduce post-harvest risk as well or better than the LDP program. According to the simulation model, the authors argue that eliminating LDPs would

“motivate many producers to increase use of futures or options, but not necessarily all producers.”⁸

Coble et al (2000) examine the impact of the truncated price distribution on optimal *soybean* hedging levels for producers of three different geographical areas via LDP program’s “free put option”. The authors develop an analytical model of the *expected utility maximizing* farmer’s planting-time risk management decision problem with a government loan rate and the opportunity to hedge. The loan program impacts producer wealth according to the following:

$$\text{If } p_1 < p_L, W_L = W_0 + A[p_1 y - C + y(p_L - p_1) + h(p_0 - p_1)] \quad (2.8)$$

$$\text{Otherwise, } W_H = W_0 + A[p_1 y - C + h(p_0 - p_1)] \quad (2.9)$$

where p_0 = known planting time harvest price expectation
 p_1 = realized harvest price
 p_L = loan rate
 W_L = end-of-season wealth with prices below the loan rate
 W_0 = initial wealth
 W_H = end-of-season wealth with prices above the loan rate
 A = crop area
 Y = farm yield
 C = non-stochastic production cost
 L = hedging level indicating the quantity of production to hedge

Assuming a von Neumann-Morgenstern utility function ($U(x)$), the farmer will choose the optimal hedge level according to the following function:

$$Max_h L = \int_{\underline{p}}^{p_L} \int_0^{\bar{y}} U(W_L) f(y, p_1) dy dp_1 + \int_{p_L}^{\bar{p}} \int_0^{\bar{y}} U(W_H) f(y, p_1) dy dp_1 \quad (2.10)$$

$$\frac{\partial h}{\partial p_L} = -\frac{L_{hpL}}{L_{hh}} = -\frac{1}{L_{hh}} \left[\int_0^{\bar{y}} \int_{p_L}^{\bar{p}} U''(W_L) (p_0 - p_1) (Ay) (f(y, p_1) dy dp_1) \right] \quad (2.11)$$

⁸ Loan deficiency program (LDP) and counter-cyclical payment program details can be found in Appendix B.

Equation 2.11 shows a *negative* relationship between the *optimal hedging level* and the *loan rate*. The second derivative of the utility function is assumed negative given the maximizing function. The other questionable term $(p_0 - p_1)$ is positive because p_0 is assumed to be equal to $E(p_1)$.

The authors continue by examining the impacts of three crop insurance designs in addition to the marketing loan program on the producer's optimal hedging level. The various subsidized crop insurance plan details are available in Appendix C.

Coble et al incorporate five end-of-period wealth scenarios into a utility maximizing model to examine the combined influence of farm program loan rates and crop insurance on the optimal hedge ratio. The authors use representative farms from three geographical areas (Mississippi, Illinois and Minnesota) to compare the regional differences in optimal *soybean* hedges using a constant relative risk aversion (CRRA) utility function. Certainty equivalents (CE) from this utility function are used to compare differences in the programs' impacts due to unknown utility functions. Here, the certainty equivalent is the certain income amount that a risk-averse individual finds equally desirable as a random income with a known probability distribution. The optimal amount to forward price [hedge] occurs where the marginal gain in certainty equivalent revenue declines below the marginal cost of forward pricing.

Certainty equivalent gains⁹ and optimal hedge ratios are reported for different combinations of futures usage, loan rates and crop insurance program participation as risk management strategies. The authors first investigate certainty equivalents without the loan rate. In each of the three counties, the certainty equivalent gains for *futures only*

⁹ The CE gains reported are the differences between the CE gains from the combination strategy revenues and the CE gains without the strategy. A positive CE indicates the producer gains utility from the strategy.

are positive and continue to grow larger with the addition of multi-peril (MP) and revenue insurance at 75 percent coverage. These results indicate soybean producers gain utility from futures usage with and without insurance coverage given the price and yield assumptions.

The loan rate alone results in a certainty equivalent gain. The rate of certainty equivalent gain *increases* when futures are added to the loan rate. However, as the loan rate approaches the market price, the certainty equivalent gains from futures usage go to zero. There is little utility gained from futures as a risk management strategy when loan rates approach market prices.

Positive optimal hedge ratios ranging from 0.26 to 0.67 are reported with futures usage and 75 percent insurance (MP and revenue) coverage. When the loan rate is added to the risk management strategy, the optimal hedge ratio remains positive (0.09 to 0.59) until the loan reaches 80 percent of the market price. In one county, the optimal hedge ratio goes to zero when the loan rate hits 90 percent of the market price; the remaining counties follow at loan rates of 100 percent of the market price and above. In essence all price risk is mitigated (upside and downside) when the loan rate is 100 percent of the market price and revenue insurance is in place. In this situation, it can be argued that the minimum expected revenues given the loan rate and insurance coverage is greater or equal to the revenues needed to meet the farm financial obligations and the incentive to hedge does not exist. This conclusion is consistent with Collins' theoretical argument.

Wang et al (2004) further support Collins' argument by modeling utility maximizing wheat and barley price-risk management portfolios under the 2002 Farm Bill subsidies. The authors find that optimal risk management portfolios include revenue

insurance. Hedging is not used extensively “unless counter cyclical payments and loan deficiency payment provisions are removed from government programs or expected market prices are high relative to the government target price” The wheat and barley hedge ratios do, however, remain positive.

Empirical price risk management models incorporating farm program analysis clearly illustrate disincentives to manage price-risk as loan rates increase, but they do not explain observed grain producer hedging levels. As mentioned, many grain farmers do not formally manage price-risk. The Coble et al. model would predict that all producers in the respective counties would hedge to some degree if the loan rate is not equal to the futures price. These types of simulations have limited predictive ability and cannot explain why farmers of different sales levels choose markedly different price-risk management strategies at similar grain price and loan rate levels.

2.3 Research Contributions

The primary research gap existing within price-risk management literature is the inability to explain observed U.S. grain producer price-risk management behavior. Farm programs are inherently endogenous to producer’s price-risk management decision-making. Current studies treat farm program payments as exogenous variables within the producer’s choice set. Furthermore, the price-risk management incentives enter the producer’s decision-making through the farm program *presence* rather than discrete changes in farm policy. Regardless of changes in farm policy, I argue that producers expect some grain price protections and/or income support and this fact impacts price-risk management decision-making.

Studies incorporating farm program aspects into optimal price-risk management portfolios arrive at optimal hedging levels given the pricing data used, but these models cannot explain actual producer price-risk management decisions. Furthermore, these studies can only identify incentives created by pricing issues alone. They cannot identify incentives created by the farm program presence nor how the producers' perceive these incentives. Adam, Betts and Brorsen allude to these incentives, but their findings reflect simulation models, not actual producer price-risk management decisions.

Generally, the hedging literature to this point provides static, homogeneous hedging strategies based on past market data. Current hedging models do not explain why some U.S. producers do not hedge at all. This literature cannot provide direct predictions regarding how producers' hedging activities will change in response to changes in the farm program. The need for this predictive power is evidenced by expected upcoming reductions in U.S. farm program spending.

This dissertation addresses the current futures market literature's inability to fully explain deviations of producers from derived optimal hedging ratios. This dissertation's marginal contribution to the futures market and institutional economics literature is one of institutional impacts. This research makes the following academic contributions:

- 1) This research identifies U.S. farm program roles [incentives] as perceived by grain producers and the potential impacts on price-risk management behavior. This study is the first to seek understanding of these roles directly from the primary producer.

- 2) This study informs the futures markets literature as to how theoretically and empirically-identified producer and firm-level variables impact price-risk management behavior in a non-supported agricultural marketing environment. Building on Brown et

al. this study adds a temporal and an institutional perspective to price-risk management strategies in a non-supported environment. This study investigates producer decisions and strategies in an environment 10 years post-marketing board deregulation and the institutional change associated with the emergent agricultural financial institutions' interactions with producers' risk management choices. It has been observed that financial institutions have taken a pro-active role regarding managing lending risk through mandatory producer price-risk management

3) This study identifies the institutional impacts on producer price-risk management decisions by isolating the surrounding agricultural marketing environment using comparative methods across supported and non-supported environments. This research contributes the first comparative study to both price-risk management and institutional literature. The comparative method allows isolation of the agricultural marketing environment [institutional] effects and exploration of the *relative* theoretically-suggested firm and producer impact variables such as debt and education.

Chapter 3

U.S. Farm Program Effects on Missouri Grain Producer Price-risk Management

3.0 Introduction

As chapter two discusses, the effects of farm programs on U.S. grain producer price-risk management decision making is unclear. Authors identify demographic and farm characteristics such as age, education, debt and size through producer surveys that appear to impact price-risk management decisions, but the price-risk management incentives and substitutions created by farm programs, such as the “free put option” are hypothesized (Gardner, 1977; Irwin et al., 1988; Adam et al., 2000). Studies have empirically evaluated subsidized revenue insurance on hedging incentives within a price-risk management portfolio using price data, but these studies cannot infer the producer’s *actual* price risk-management decisions given expected farm program payments (Coble et al., 2004; Wang et al., 2004).

This chapter explores the effect of expected farm program payments as identified by interviewed producers. The producer responses should inform the empirical literature hypothesizing farm program effects on producer price-risk management from the actual producer’s perspective and actions. Empirical studies using static price data cannot capture perceived incentives created by the *presence* of a farm program; these studies can only capture the economic incentives created by corn and transaction cost differentials at that point in time. We seek to understand, by directly asking producers, the longer term incentives that producers may perceive due to operating in a supported agricultural marketing environment.¹⁰

¹⁰ See Appendix A for a historical overview of the U.S. farm program policies.

Davis et al (2005) indirectly frames the argument for this exploration. Davis et al builds on prior producer price-risk management surveys by utilizing a larger sample size and frames the producers' forward-pricing decisions as an adoption of technology decision. According to Davis et al., "the [Rogers] theory of adoption of diffusion of a new technology [forward pricing] or innovative practice suggest that the rate of adoption is influenced both by characteristics of the new technology and by the adopting agent." This study argues that surrounding institutions, such as the U.S. Farm Program, also influence adoption rates and should be included as an impact variable.

I am exploring producer perceptions of farm program effects on farm operations, but the exploration is guided by theoretically-suggested effects. The "free put" incentive of the loan deficiency program (LDP) has been illustrated through hypothetical utility-maximizing studies. The LDP provides grain producers a payment when the market price falls below the established loan rate during a specified period within harvest-time. It is expected, at minimum, that producers will perceive the U.S. farm program to establish an *effective*¹¹ grain floor price. Also, as discussed in chapter 2, Collins (1997) generally asserts producers will not hedge if expected revenues [prices] without hedging will meet the financial obligations of the farm. Following Collins coupled with observed lack of grain producer hedging, it is expected that producers will perceive income support effects from the farm program.

¹¹ None of the U.S. farm program elements create actual price floors. The perception of a farm program-provided *effective* grain price floor is due to payments paid to producers insuring a minimum level of farm revenues above a specified grain price [loan rate] which parallels a price floor from the U.S. producer's perspective only.

3.1 Data and Methods

This study is designed as an exploratory study; an exploration concerning the U.S. farm program effects on Missouri corn producers' price-risk management decision-making and farm operations. This study is conducted using individual primary farm and producer data collected during on-site farm interviews.

The Missouri producer sample was drawn from a Missouri grain-producer organization membership list. Mid-Missouri and Missouri bootheel grain producers are targeted in an attempt to attain a representative cross-section of Missouri corn producers. Bootheel producers are included to address those Missouri producers that have less costly access to irrigation. This sample is intended to emulate the Missouri grain production area identified by the Food and Agricultural Policy Research Institute (FAPRI) which is similar in production terms to the South African maize belt. Constructing the sample in this fashion allows for comparative analysis between U.S. and South African grain producers.

I contacted producers for interview permission, which resulted in a prescreened list of 100 producers. Producers were targeted to capture large and medium commercial grain producers with varying levels of debt. Included producers had a majority of household income resulting from crop revenues. These targets were based on firm-level characteristics of size and leverage, which, theoretically, should impact hedging levels of commercial grain producers. Commercial corn producers are defined as producers with US\$250,000 minimum sales, according to the USDA agricultural sales classification system. I phoned the original list of producers for consent, resulting in 44 successful on-site interviews.

I conducted on-site interviews January-February, 2007. The interviews lasted approximately two hours and consisted of a guided oral discussion of corn-price risk perceptions and the price risk-management decision process in addition to a paper farm-business demographic survey. Regarding the price-risk management process, producers were specifically asked to 1) discuss the price-risk management decision process and strategies in an *average* year given the last 10 years and 2) to focus *only on the price-risk management activities*, not speculative strategies. Producers were asked to discuss the process and strategies in an average year as to not pick-up price-risk management peculiarities that might have occurred in response both to the evolving ethanol industry and 2006 corn prices.

In addition, I asked producers four questions specific to the role of U.S. farm programs in their farm operation:¹²

1. *How important are expected farm program payments to your farm operations? (scale is from 1[not important] to 5[very important])*
2. *How important are the 2008 Farm Bill outcomes (expectations) in your farm planning? (scale is from 1[not important] to 5[very important])*
3. *What is the role of expected farm payment programs in how you run your business? (open-ended)*
4. *Which specific programs are most important to you? (open-ended)*

Each of the 44 producers responded to the first two scale interview questions; five producers chose not to answer the open-ended questions resulting in 39 responses. Table 3-1 provides summary statistics of the demographic variables and interview questions.

¹² The entire interview guide and demographic survey are included in Appendix D.

Table 3-1. U.S. variable definitions and summary statistics.

Producer demographic variables	Definition	Producer respondents (n=44, data obtained January 2007)				†Missouri producers (N=106,000)
		Mean	Median	Std. Dev.	Mean	
Age	Producer age	49.32	51.50	11.10		54.46
Edu	Producer years of formal education	14.39	14.00	1.96		
Exp	Producer years of farm experience since 18	28.55	29.50	12.20		
Farm demographic variables						
Assets	Total farm assets	\$ 2,332,636.34	\$ 1,600,000.00	\$ 2,145,215.96		
TotalMZmt	Total maize production (mt)	2676.47	2540.00	1831.08		3139.62
MZincomeshare	Farm income percentage attributed to maize production	0.42	0.45	0.13		
Debt	Total farm leverage percentage	0.31	0.25	0.23		0.13
Irr	Irrigated percentage of maize crop	0.41	0.28	0.42		
ProdOFI	Total household off-farm income as percentage of total household income	0.05	0.00	0.12		
MZCI	Percentage of expected maize yields insured	0.60	0.70	0.27		
Price-risk management (PRM) variables						
PrePLI	Producer pre- or at-planting price lock-in percentage of expected maize yields	0.16	0.13	0.16		
PreHLI	Producer pre-harvest price lock-in percentage of expected maize yields	0.39	0.40	0.24		

†Missouri means were obtained from Missouri Ag Statistics and the USDA Economic Research Service. These numbers may be misleading due to the inclusion of non-commercial farmers within the Missouri data.

Table 3-1 contd. U.S. variable definitions and summary statistics.

Farm program variables		Mean	Median	Std. Dev.
PyntsImp	Producer rating of farm program payment importance in business operations: scale 1 (not important) to 5 (very important)	3.04	3.00	1.38
FB08Imp	Producer rating of expected 2008 Farm Bill outcomes importance in business operations: scale 1 (not important) to 5 (very important)	3.40	3.00	1.33
<i>Farm program effects*</i>				
SNFPGuar	Farm programs are important as a price safety net by guaranteeing a floor price: 1 if identified, 0 otherwise	0.43	0.00	0.50
Cash Flow (CF)	Farm programs are important for cash flow provision: 1 if yes, 0 otherwise	0.54	1.00	0.51
CF-EnsureP	Farm programs are important for cash flow provision by ensuring profit: 1 if yes, 0 otherwise	0.33	0.00	0.47
CF-CashRent	Farm programs are important for cash flow provision for cash rent: 1 if yes, 0 otherwise	0.05	0.00	0.22
CF-LowPRevBst	Farm programs are important for cash flow provision by adding a revenue boost at low corn prices: 1 if yes, 0 otherwise	0.08	0.00	0.27
CF-Loan	Farm programs are important for cash flow provision through operating loan provision: 1 if yes, 0 otherwise	0.10	0.00	0.31
MktsStrat	Farm programs are important as a marketing strategy benchmark: 1 if yes, 0 otherwise	0.18	0.00	0.39
PreferNone	Producer prefers no farm program payments: 1 if identified, 0 otherwise	0.08	0.00	0.27
<i>Important farm programs*</i>				
LDP	Loan deficiency payments are important to farm operation: 1 if identified, 0 otherwise	0.64	1.00	0.49
DP	Direct payments are important to farm operation: 1 if identified, 0 otherwise	0.33	0.00	0.48
CRP	Conservation reserve program payments are important to farm operation: 1 if identified, 0 otherwise	0.05	0.00	0.22
SubCI	Subsidized crop insurance is important to farm operation: 1 if identified, 0 otherwise	0.03	0.00	0.16
FSALoans	Farm Service Agency loan programs are important to farm operation: 1 if identified, 0 otherwise	0.10	0.00	0.31

*Producers identified farm program effects and important programs through open-ended interview questions; 39 responded representing 88.6 percent of the sample. Effects not important programs are mutually exclusive.

Interviewed producers identified three primary roles of expected farm program payments within their business operations: safety net and floor price (SNFPGuar), cash flow facilitation (CF), and a marketing strategy guide (MktgStrat). Cash flow facilitation is further segmented into specific cash flow issues. Safety net/floor price and cash flow facilitation were the primary roles identified by 43 percent and 54 percent of producers, respectively.

Producers also identified farm program elements thought to be most important within their operation. Five elements were identified: loan deficiency payments (LDPs), direct payments (DPs), conservation reserve program payments (CRP), crop insurance [subsidized] (SubCI), and Farm Service Agency operating loan programs (FSA Loans). LDPs are the most commonly mentioned element (64 percent) with direct payments next (33 percent).

It is important to note that both farm program effects and elements are *producer-identified*. The interview questions were open-ended and producers were not guided in their responses by a pre-conceived list of important effects or elements.

3.2 Government Role Exploration and Analysis

Building from the producer-identified effects and important programs as described in Table 3-1, the analysis continues with further discussion of identified farm program effects across producer and farm characteristics, how farm program effects and farm program elements are related. The data analysis concludes with an investigation of identified farm program effects on producer's actual price risk-management decisions.

Table 3-2 provides the results of producer and farm demographic variables means comparison across those producers stating the respective farm program effect. Producers identifying safety net/floor price as a primary farm program role have significantly less

debt and a larger asset base than those who do not. This group's comments indicate that they may be less likely to actively manage price risk at low prices relative to LDP payments due to relative costs of risk management tools (i.e. option premiums, futures contract margins, etc.).

Producers stating cash flow facilitation as an important role vary within the sub-categories. Producers who feel farm programs ensure profit are significantly older than those who do not. Also, producers that feel farm programs are important as lenders are significantly younger with higher debt levels and a smaller asset base.

Producers stating that farm programs function as a marketing strategy guide are similar across age, education, debt, and assets. Producers who stated that they prefer not to utilize farm programs have a significantly larger asset base than those who did not; their comments indicate they may be more actively managing grain price risk.

Table 3-2. Means comparison of selected demographic variables across responses and identified farm program effects.

<i>Effect</i>	<i>Response</i>	<i>Age</i>	<i>Edu</i>	<i>Debt</i>	<i>Assets</i>	<i>Comments †</i>
Safety net/ floor price guarantee (SNFPGuar)	no	48.77	14.00	44%	\$1,698,571	LDP is floor; relative option premium too expensive...important if prices are low; LDP will get you by...important if gone; dangle at govt strings...allows me to be more bullish; can gamble in a low mkt.
	yes	49.24	14.76	26%***	\$3,074,411**	
Cash Flow (CF)	no	47.67	14.22	36%	\$2,433,333	
	yes	50.10	14.43	38%	\$2,206,750	
CF-EnsureP	no	46.27	14.31	38%	\$2,187,500	Programs ensure a profit; expect to remain similar...income boost; don't expect much change...important esp. if renting...guaranteed \$...adds profit margin...more important than in past.
	yes	54.38**	14.38	35%	\$2,588,333	
CF-CashRent	no	48.76	14.41	36%	\$2,359,305	change...important esp. if renting...guaranteed \$...adds profit margin...more important than in past.
	yes	53.00	13.00	46%	\$1,500,000	
CF-LowPRevBst	no	49.36	14.25	38%	\$2,275,285	profit margin...more important than in past.
	yes	44.33	15.33	27%	\$2,766,666	
CF-Loans	no	50.71	14.37	34%	\$2,528,823	
	yes	33.75***	14.00	56%**	\$ 488,750*	
Marketing strategy guidance (MktgStrat)	no	49.69	14.38	34%	\$2,491,935	At low prices, don't do much, look at LDP...LDP guide to selling; Forward contracts + LDP = storage gain...LDP adds to price...do nothing at 1.80-2.40 b/c LDP.
	yes	45.71	14.14	48%	\$1,526,428	
PreferNone	no	48.64	14.25	36%	\$2,086,714	Direct payment budgeted in, but prefer no pymts...doesn't need the safety net; creates own.
	yes	53.00	15.33	43%	\$4,966,666**	

Means are significantly different from zero within sub-sample at the ***0.01 level **0.05 level *0.10 level. †Producer comments stating respective program effects.

Table 3-3 provides the Pearson's chi-square test results between farm program elements identified as "very important" to farm business and producer-identified farm program roles within farm business. This test evaluates whether a significant relationship exists between the stated categorical variables (farm program elements and effects) i.e. the null hypothesis is that the variables are independent. The frequencies of farm program elements observed within the farm program effect categories are compared to

the frequencies one might expect to fall within the farm program effect categories by chance. It is important to note the chi-square test is one of association, not direction.

Table 3-3. Pearson's chi-square testing between farm program elements stated as "very important" and producer-identified farm program effects.

	LDP	DP	CRP	SubCI	FSALoans
SNFPGuar	100%***	17.6%*	5.90%	5.90%	0%*
Cash flow (CF)	42.9%***	61.9%***	9.50%	0.00%	4.8%*
CF-EnsureP	38.5%**	84.6%***	15.4%*	0.00%	7.70%
CF-CashRent	0.00%	100%*	0.00%	0.00%	0.00%
CF-LowPRevBst	100.00%	0.00%	0.00%	0.00%	0.00%
CF-Loans	25.00%	25.00%	0.00%	0.00%	100%*
MktgStrat	100%**	0.00%	0.00%	0.00%	14.30%

Farm program effects significantly related to the producer-identified farm program elements at the *** 0.01 level **0.05 level *0.10 level.

All producers (100 percent) who stated that the U.S. farm programs acts as a safety net and floor price guarantee also identified the loan deficiency payments as important farm program elements indicated a strong relationship between the safety net/floor price effect and these producer-identified elements; direct payments are also related to the safety net/floor price effect. LDPs, direct payments, conservation research program payments, and Farm Service Agency loans are each related to the cash flow facilitation effect, particularly to ensure profit, pay cash rent, and provide operating loans. LDPs are significantly identified by all producers (100 percent) identifying U.S. farm programs as a marketing strategy guide.

OLS regression is used to explore potential impacts of perceived farm program roles on actual producer price risk-management behavior. Equation 1 is used to model impacts on *pre-planting* lock-in percentages; Equation 2 is used to model *pre-harvest* lock-in percentages.

$$PrePLI = \alpha + \beta_1 SNFPGuar + \beta_2 CF-EnsureP + \beta_3 CF-LowPRevBst + \beta_4 MktgStrat + \varepsilon \quad (3.1)$$

$$PreHLI = \alpha + \beta_1 SNFPGuar + \beta_2 CF-EnsureP + \beta_3 CF-LowPRevBst + \beta_4 MktgStrat + \varepsilon \quad (3.2)$$

Both hedging relationships are modeled as linear relationships. There is no theoretical reason to expect a non-linear relationship between the explanatory variables and pre-plant or pre-harvest hedging levels. I am estimating general effects only, not elasticities.

The expected signs on the explanatory variables are SNFPGuar (-), CF-EnsureP(-) and MktgStrat (?). As theory suggests, if producers see the farm program as creating a floor price or securing profits and/or revenues that will impact [increase] their ability to pay farm expenses, then a negative relationship between hedging levels and these farm program perceptions is expected. The relationship between the perception of farm programs as a marketing guide and hedging levels is less clear. At low price expectations, a negative relationship is expected. However, at high prices, there may be a different relationship.

In addition to farm program perception variables, it is important to control for potential producer and farm variable effects. Age, education, debt and percentage of income attributed to maize are included to address theoretically suggested impacts. The expected signs are age (-), education (+), debt (+), percentage of income attributed to maize (+).

The data for both pre-plant and pre-harvest hedging levels have a potential data censoring issue. Hedging percentages are naturally bound between 0 and 1. In this sample, some zero hedging levels are observed. These zero observations are considered “at the limit”. Using OLS regression with censored data may result in biased estimates and standard errors. Therefore, conclusions drawn regarding causation may be biased.

Tobit regression is used to correct for censored data issues. This method utilizes a maximum likelihood function to estimate the coefficients for the explanatory variables.

Table 3-4 provides the tobit regression results for Equation 3.1.

Table 3-4. Equation 3.1 tobit estimation results with theoretical explanatory variables (dep. var. = PrePLI).

The QLIM Procedure					
Summary Statistics of Continuous Responses					
Standard Variable	Mean	Error	Type	Lower Bound	N Obs Lower Bound
PrePLI	16.53846	15.932169	Censored	0	12
Model Fit Summary					
Number of Endogenous Variables					1
Endogenous Variable					PrePLI
Number of Observations					39
Missing Values					6
Log Likelihood					-126.83913
Maximum Absolute Gradient					4.40715E-6
Number of Iterations					33
AIC					273.67826
Schwarz Criterion					290.31388
Parameter Estimates					
Parameter	Estimate	Standard Error	t Value	Approx one-sided P> t	Pr> t
Intercept	-29.573069	38.020198	-0.78	0.4367	
Age	-0.240882	0.318401	-0.76	0.4493	
Debt	0.344115	0.200902	1.71	0.0867	0.0433
Edu	2.318904	1.746128	1.33	0.1842	0.0921
ProdOFI	-28.646234	31.668107	-0.90	0.3657	
%Mzshare	0.206230	0.261272	0.79	0.4299	
SNFPGuar	-1.545449	9.135198	-0.17	0.8657	
CFensureP	4.268314	6.918081	0.62	0.5372	
MktgStrat	8.064941	9.244704	0.87	0.3830	
Sigma	18.261388	2.685575	6.80	<.0001	

Debt (+) and education (+) are found to significantly impact pre-planting lock-in levels as expected. These findings are consistent with theoretical expectations.

However, significant correlation does exist across the explanatory variables included in this equation, particularly debt and the safety net/price floor government effect, which may be competing with any variation in pre-plant lock-in levels explained by the

producer's perceived farm program effect. Table 3-5 provides the correlation matrix.

Correlation among the variables may be causing multi-collinearity which impacts the ability to estimate biased coefficients for perceived farm program effects. .

Table 3-5. Correlation matrix across pre-plant explanatory variables.

		PrePLI	Age	Edu	Debt	MZincome share	SNFPGuar	CF-EnsureP	CF-LowPRevBst	MktgStrat
Pearson Correlation	PrePLI	1.00	-0.14	0.09	0.36	0.10	-0.31	-0.05	0.13	0.25
	Age	-0.14	1.00	0.10	-0.29**	-0.25*	0.02	0.34**	-0.12	-0.14
	Edu	0.09	0.10	1.00	-0.16	-0.40***	0.19	0.02	0.15	-0.05
	Debt	0.36***	-0.29**	-0.16	1.00	0.03	-0.39***	-0.16	-0.07	0.32
	MZincomeshare	0.10	-0.25*	-0.40***	0.03	1.00	-0.14	-0.13	0.10	0.02
	SNFPGuar	-0.31**	0.02	0.19	-0.39***	-0.14	1.00	-0.18	0.13	-0.41***
	CF-EnsureP	-0.05	0.34**	0.02	-0.16	-0.13	-0.18	1.00	-0.20	0.33**
	CF-LowPRevBst	0.13	-0.12	0.15	-0.07	0.10	0.13	-0.20	1.00	0.12
	MktgStrat	0.25*	-0.14	-0.05	0.32**	0.02	-0.41***	-0.33**	0.12	1.00

Correlations significant at ***0.01 level, **0.05 level and *0.10 level (1-tailed).

To eliminate multi-collinearity and estimate the impacts of perceived farm program effects on pre-planting lock-in, the model is run with the farm program effects only. Table 3-6 provides these results.

Table 3-6. Equation 3.1 tobit estimation results with farm program effects only (dep.var. = PrePLI).

The QLIM Procedure					
Summary Statistics of Continuous Responses					
Standard				Lower	N Obs
Mean	Error	Type	Bound	Bound	Lower
PrePLI	16.53846	15.932169	Censored	0	12
Model Fit Summary					
Number of Endogenous Variables					1
Endogenous Variable					PrePLI
Number of Observations					39
Missing Values					6
Log Likelihood					-130.12844
Maximum Absolute Gradient					3.82239E-6
Number of Iterations					11
AIC					270.25688
Schwarz Criterion					278.57469
Parameter Estimates					
Estimate	Error	t Value	Standard	Approx	Parameter
			Pr > t		
Intercept	14.052843	6.957717	2.02	0.0434	
SNFPGuar	-8.536925	7.634003	-1.12	0.2634	
CFensureP	1.598559	7.222882	0.22	0.8248	
MktgStrat	9.311163	9.923176	0.94	0.3481	
Sigma	19.985426	2.935654	6.81	<.0001	

According to table 3-6, perceived farm program effects do not appear to directly impact pre-planting lock-in levels. At this point in the planting/marketing decision, it appears that debt and education are the primary drivers. Education has a particularly strong effect. Pre-plant lock-in levels increase by 2.31% for every additional year of education received.

Equation 3.2 parallels equation 3.1 by hypothesizing the relationship between farm program effects and pre-harvest lock-in levels. Again, theoretically suggested variables are included to control for debt, education, off-farm income and diversification. The expected signs remain the same. Table 3-7 provides the tobit estimation results for equation 3.1.

Table 3-7. Equation 3.2 tobit estimation results with theoretical explanatory variables (dep. var. = PreHLI).

The QLIM Procedure						
Summary Statistics of Continuous Responses						
Standard Mean	Error	Type	Bound	Lower Bound	N Obs Lower	Variable
PreHLI	40.69231	23.928791	Censored	0	4	
Model Fit Summary						
Number of Endogenous Variables						1
Endogenous Variable						PreHLI
Number of Observations						39
Missing Values						6
Log Likelihood						-158.52887
Maximum Absolute Gradient						3.4062E-6
Number of Iterations						29
AIC						337.05773
Schwarz Criterion						353.69335
Parameter Estimates						
Parameter	Estimate	Standard Error	t Value	Approx Pr > t	one-sided Pr > t	
Intercept	-0.645465	39.871243	-0.02	0.9871		
Age	-0.686863	0.332442	-2.07	0.0388	0.0194	
Debt	0.245597	0.202038	1.22	0.2241		
Edu	4.828349	1.844278	2.62	0.008	0.0040	
ProdOFI	-37.385398	33.021736	-1.13	0.2576		
%Mzshare	0.027545	0.269320	0.10	0.9185		
SNFPGuar	-13.266951	9.058464	-1.46	0.1430	0.0715	
CFensureP	4.674528	7.264159	0.64	0.5199		
MktgStrat	7.387415	9.862525	0.75	0.4538		
Sigma	19.907424	2.440656	8.16	<.0001		

Age, education and perceived safety net and floor price guarantee are found to impact pre-harvest hedging levels. Age has a negative impact as expected from producer surveys. Age likely enters as an explanatory because older U.S. producers are found to begin hedging later in the growing season [post-planting]. Education has a positive sign as expected. Education has a larger impact on pre-harvest lock-in levels than pre-planting lock-in levels. For each additional year of education received, it is expected that the producer will lock-in 4.82% more pre-harvest.

Perceived safety net and floor price guarantee has strong negative impact on pre-harvest lock-in levels. If producers perceive the farm program to exhibit this effect, it is expected their lock-in level will be 13.26% less than those who do not.

To be consistent, equation 3.2 is also estimated with farm program effect variables only given potential multi-collinearity. Table 3-8 provides these results. Safety net and price floor guarantee farm program effect increases in magnitude and significance.

Table 3-8. Equation 3.2 tobit estimation results with farm program effects only (dep. var. = PreHLI)

The QLIM Procedure							
Summary Statistics of Continuous Responses							
Standard					N Obs		
Error	Type	Bound	Bound	Lower	Lower	Variable	Mean
PreHLI	40.69231	23.928791	Censored	0	4		
Model Fit Summary							
						1	
						PreHLI	
						39	
						6	
						-165.56127	
						3.14915E-7	
						11	
						341.12254	
						349.44035	
Parameter Estimates							
Parameter	Estimate	Standard		Approx	one-sided		
		Error	t Value	Pr > t	Pr > t		
Intercept	43.352126	7.887800	5.50	<.0001			
SNFPGuar	-15.255785	8.698355	-1.75	0.0795	0.0398		
CFensureP	2.515478	8.257740	0.30	0.7607			
MktgStrat	10.574232	11.509328	0.92	0.3582			
Sigma	23.726461	2.925844	8.11	<.0001			

3.3 Discussion and Conclusions

Regarding price risk-management behavior, three identified roles—floor price establishment, cash flow via operating loans, and marketing guidance—are particularly interesting when exploring the role of farm programs within farm operations. Each of these three roles indicates some influence on price risk-management decision-making. The “floor price establishment” role indicates that the “free put option” hypothesized within price risk-management literature is perceived by producers. If producers perceive the marketing loan program to establish a grain floor price, then using commodity options is redundant for this purpose at the same strike price. However, this relationship exists primarily at low prices. When prices are higher, producers may use commodity options to set their grain price floor above the loan rate.

The “marketing guidance” role indicates that producers look to the farm program, particularly the loan deficiency payment program, for marketing, a fact that suggests producers will not have a consistent market-based strategy, especially at low prices. At low prices, producer price-risk management strategy incorporates LDP payments. Little incentive exists to use market-based price-risk management tools unless they can significantly surpass expected prices. The gain from market-based price-risk management must have expected gains large enough to cover tool costs in addition to actual expected prices received.

Producers stating that the farm programs function as a marketing strategy guide are similar across age, education, debt and assets. This result may be biased by the fact that many older producers indicated they did not have a marketing strategy.

The “cash flow via operating loans” role is less clear. If higher-risk producers are obtaining non-commercial operating loans through the Farm Service Agency, there is less incentive to manage price risk. Without the Farm Service Agency operating loans, higher risk producers would need to obtain commercial loan where incentives to manage price-risk exist with lower interest rates and potentially larger loan amounts. While agricultural lenders do not require hedging, locked-in expected prices from hedging inform the producer’s expected loan repayment ability. Without locked-in expected prices [revenues], agricultural lenders use the government loan rate as the default within the producer’s expected loan repayment ability calculations.

The loan deficiency payment program and direct payments are found to be the most important to producers. Interestingly, producers did not generally mention subsidized crop insurance revenue or multi-peril as important to their farm operations. Crop revenue insurance has been found empirically to strongly substitute for hedging in expected price risk-management portfolios (Mahul, 2003; Wang et al., 2004).

Producer-stated importance of farm programs within their farm operations are found to be inconsistent with the attitudinal impact found on producer’s actual price-risk management behavior. When asked to rate farm program importance within their farm operations, producers rated importance an average of 3.04 on a 1 [not important] to 5 [very important] Likert scale, which indicates, on average, producers perceived farm programs to have a moderate level of importance within their farm operations.¹³ However, all producers interviewed are receiving some farm program payments and Table 3-7 tobit results indicate that regardless of perceived farm program importance

¹³ Note that many producers indicated they did not expect future changes in farm programs when answering this question.

level, the perceived farm program effect *significantly impacts actual producer price risk-management behavior*.

However, direct farm program effect impacts are found primarily during pre-harvest lock-in decisions. During the pre-planting period, debt and education are more important impact factors on the lock-in levels. Thus, while farm program effects are present, market-based incentives such as debt are also present and impact pre-planting lock-in decisions.

The consistent positive impact of education on both pre-planting and pre-harvest lock-in levels should be noted. The finding supports the hypothesis that education is a significant transaction cost within price-risk management.

These results prompt the conclusion that the *presence* of the U.S. farm program affects producer (market-based) price-risk management incentives and behavior beyond traditional price and transaction cost incentives considered by empirical optimal hedging models. If observed U.S. producer's price-risk management decisions are influenced by U.S. farm program elements, then how do producers manage price-risk in environments without floor price or farm income payments? How do these decisions differ across environments?

The dissertation continues with an analysis of South African grain producer price-risk management decisions in chapter four. These decisions represent price-risk management decision made in a non-supported agricultural marketing environment. Emergent producer price-risk management strategies 10 years post-marketing boards are explored and analyzed according to theoretically-motivated producer and firm variables.

Chapter five follows with a comparative of the producer price-risk management decisions across the U.S. and South Africa, supported and non-supported agricultural marketing environments, respectively. This chapter culminates the dissertation by isolating the agricultural marketing environment impacts across actual producer hedging decisions in both countries.

Chapter 4

Institutional Change and Emergent Grain Price-risk Management in South Africa

4.0 Introduction

The South African agricultural marketing landscape has undergone significant changes in the last 10 years. Prior to 1996, South Africa agriculture operated under a marketing board scheme where all producer prices were determined prior to planting by their respective commodity marketing boards. The passage of the 1996 Marketing of Agricultural Products Act began the elimination of all agricultural marketing boards in response to South African free trade prioritization and World Trade Organization negotiations. Since the Maize Board's official elimination, commercial maize producers are now fully exposed to world maize market prices, which now exhibit price volatility. In the years following deregulation, the South African agricultural industry has been forced to react to the new levels of price risk within the industry.

In anticipation of the maize marketing board elimination, the South African Futures Exchange (SAFEX) introduced the Agricultural Derivatives Division (ADD) in 1995 with chilled beef and potato futures contracts—the first market-based grain pricing mechanism in South Africa.¹⁴ All agricultural commodity pricing is now based on the traded market prices of this exchange in Johannesburg. The introduction of the ADD was an industry-supported measure to serve as an agricultural pricing and risk management tool when the South African Department of Agriculture ended its role in agricultural price subsidization (R. Gravelet-Blondin, personal communication, June, 2006). The initial futures contracts offered did not succeed; however, the white and

¹⁴ SAFEX ADD merged with Johannesburg Stock Exchange (JSE) in 2001, but retains a separate financial structure regarding agricultural contracts.

yellow maize contracts introduced in 1999 have gained volumes and liquidity in each of the following years.

The ADD was intended to be a market based on fundamentals; the target users were buyers (millers) and sellers (primary producers). Initial product “marketing” to producers was education. Initially, the core ADD organizers went in person to rural areas to educate producers on issues such as basis determination and the need for speculation; the SAFEX ADD now offers producer education classes and continues to meet with producer groups. Due to cash flow requirements, the SAFEX ADD organizers expected *larger* farmers to hedge with futures contracts directly and *smaller* farmers to use the contracts through elevators (R. Gravelet-Blondin, personal communication, June, 2006). The Bureau of Food and Agricultural Policy (BFAP) at the University of Pretoria argues that currently 30 to 40 percent of grain farmers are hedging on SAFEX (Meyer, 2004).¹⁵

The 2002 South African Commercial Agriculture census estimates a loss of 12,162 commercial farming units since 1993, which represents a 21 percent decrease since deregulation; this leaves 45,818 remaining commercial farms in 2002 (Statistics South Africa, 2002).¹⁶ The gross farming income, however, has increased from R39 billion (US\$5.57B) to R53 billion (US\$7.57B) in real terms during this time period, which supports the industry assertion that the remaining 79 percent are non-marginal and competitive (Statistics South Africa, 2002). Grain producers competing in the post-marketing board environment have been observed using various price-risk management strategies. To what degree is producer price-risk management via forward/futures

¹⁵ Industry representatives estimate that grain producers entered the hedging market directly during 1999-2000 (Trader Interview, 2006).

¹⁶ According to StatsSA and South African agricultural industry discussions, crop producers represent approximately 30-40 percent of the remaining commercial farms.

marketing a contributing factor to the remaining producers' ability to compete in the global maize market? To what degree do firm variables and institutional environments (past and present) impact the South African producers' price-risk management decision process? These questions are the motivation for this study.

4.1 Literature Review

South African price-risk management is a relatively new phenomenon and existing academic literature on the topic is limited. U.S. literature regarding producer hedging¹⁷ as a grain price-risk management tool, however, has an extensive academic literature behind it with some 60 years of theoretical modeling.¹⁸ This study will use the extensive U.S. hedging literature as a guide to theory-based research hypotheses.

A general consensus has not been reached regarding the usefulness of hedging to primary producers and has been identified as a topic needing further primary research (Brorsen & Irwin, 1996; Carter, 1999). A commonly noted observation is that the level of U.S. grain producers' hedging is not consistent with theoretical and empirical literature prescribing positive hedging ratios (Berck, 1981; Brorsen, 1995; Commodity and Futures Trading Committee, 2001; Carter, 1999; Harwood et al., 1999).

Most U.S. producers are not forward marketing as a price-risk management strategy. While the data is not overly specific, the Economic Research Service has published numbers estimating marketing contract use by U.S. farmers. In 2003, it is reported that approximately 36 percent of all U.S. commercial farms (sales of \$250,000

¹⁷ Hedging is traditionally defined as the producer taking equal and off-setting positions in the cash and futures market to lock-in the net commodity price. Here, we will extend this definition to include forward contracting and options as hedging tools in addition to futures contracts.

¹⁸ See Gray and Rutledge (1971), Carter (1999), and Garcia and Leuthold (2004) for in-depth literature reviews of commodity futures markets. Carter (1999), particularly, brings forward the issue of direct usefulness of futures markets for primary producers.

and above) used marketing contracts¹⁹ and 6.2 percent of crop farms used marketing contracts (MacDonald & Korb, 2006). The percentage of corn produced under marketing contracts in 2003 is reported to be 13.8 percent. Unless producers are actively substituting futures contracts and options for marketing contracts, these numbers indicate less than half of crop producers and production is forward marketed. However, each of these numbers has increased slightly since 1991.

Theoretical models have prescribed optimal hedging levels close to one (Telser, 1955; Johnson, 1960; McKinnon, 1967); empirical models have tested optimal hedging models by modeling the impacts of many firm- and price-related variables. Variables including the ability to predict price variations, farm leverage, basis variance, cash price variance, and production risk are shown to impact hedging effectiveness and optimal hedging levels (Turvey, 1989; Castelino, 1992; Grant, 1989; Lapan & Moschini, 1994; Kahl, 1983; Peck, 1975). Farm-level variables including education (+), leverage (-), farm size (+), and off-farm income (-) have also been identified by U.S. producer surveys as impact variables in the decision to forward market as a price-risk management strategy (Shapiro & Brorsen, 1988; Makus et al., 1990; Goodwin & Schroeder, 1994; Sartwelle et al., 1998).

The substitution of the Loan Deficiency Program (LDP) and subsidized revenue insurance for market-based price-risk management tools has also been suggested as a possible reason why U.S. producers exhibit less than prescribed forward-marketing levels. It is argued that LDP payments operate as subsidized put options when price levels fall below the posted county price (PCP) level (Gardner, 1977; Irwin et al., 1988;

¹⁹ The use of marketing contracts is used as a proxy for hedging due to unavailable data for levels of producers' futures hedging activities.

Adam et al., 2000). Turvey and Baker (1990) find that corn and soybean producers decreased use of futures and options contracts when receiving government program payments. However, government program payment levels are not significant when modeling producer adoption of forward-pricing methods utilizing survey data from 509 U.S. producers (Goodwin & Schroeder, 1994).

Recently, literature has analyzed the substitutability of LDP payments with crop insurance for hedging within the price-risk management portfolio. Mahul (2003) finds that crop revenue insurance is a substitute for futures hedging where crop yield insurance is a complement. In the presence of the LDP payments and positive transaction costs, optimal hedge ratios approach zero for selected producer price scenarios as the futures price approaches the loan rate (Coble et al., 2004; Wang, Makus & Chen, 2004). These authors provide empirical evidence that when program commodity prices are low, LDP payments and crop revenue insurance substitute for hedging in the producer's price-risk management choice set.

The intuition behind the interaction between LDP payments, crop insurance and producer price-risk management is one of market price levels. The LDP payment is a payment received when the market corn price drops below the posted country price. The producer can either sell the crop to the government at the posted county price or receive a payment for the difference between the market price and the posted country price. The national loan rate for corn is currently set at \$1.95 and county differentials are added or subtracted. Revenue insurance, a crop insurance product, ensures that the producer receives some minimum level of revenue via yield or prices received. Producer's pay approximately 40 percent of the actuarial insurance product costs. Therefore, these

elements of the farm program can be used to create a price floor for the producers and there may be much substitution of farm programs for market-based price-risk management at low prices. At high prices, there exist more incentives for producers to lock-in prices.

Given the discussion above, this study seeks to identify emergent maize price-risk management strategies in an environment void of maize price supports and to test the impact of firm-level variables identified in the existing literature in the context of a non-supported maize marketing environment. The South African maize marketing environment, created by a relatively recent institutional change, provides a unique opportunity to investigate these strategies and impact variables.

Using data from a 1996 producer mail survey, Brown, Ortmann and Darroch (2000) identified factors affecting the adoption of price-risk management tools by large commercial South African maize producers in the immediate response to the maize marketing board elimination. Variables found to significantly impact the adoption of price-risk management tools as measured by an index include use of on-farm or commercial maize storage (+), off-farm employment (+), crop insurance coverage (+), education (+), proportion of income derived from maize (+), and self-rated marketing ability (-).

The Brown, Ortmann and Darroch (BOD) study was conducted one year after the beginning of the commodity marketing board eliminations which is quite early to analyze emergent producer price-risk management strategies. Market-based price-risk management tools were only available beginning in 1995 with the introduction of the SAFEX ADD. Furthermore, it is reasonable to expect the producer's price-risk

management learning curve should reflect a period longer than one year needed to adjust to the new agricultural marketing system. Limited inference regarding producer price-risk management strategies can be drawn from the BOD study.

This study builds on the BOD 1996 survey results by adding both time and depth to the understanding of emergent maize price-risk management. Producer price-risk management strategy emergence is investigated over the last 10 years. The investigation focuses on identifying impacts on the producer's price-risk management decisions, including producer and firm characteristics, the introduction of SAFEX ADD and evolving lender and procurer strategies. Depth is added by identifying the specific elements of the price-risk management strategies and outlining the decision-making process.

This study is guided by general hypotheses regarding price-risk management tool prioritization and usage, variables that affect usage and institutional interactions with tool choice. It is expected that all producers competing in the South African maize market prioritize price-risk management and use tools to establish a minimum level of expected revenue. Producers are expected to use price-risk management tools in addition to other methods of risk management, including diversification and off-farm income. Given the varying complexity of the price-risk management tools examined, education is likely to impact the tool choice. Prior and developing institutions within the agricultural marketing system are also expected to impact tool choice. Producers with marketing board experience are expected to use more familiar tools such as fixed-price (cash) contracts. The evolving institutions such as commercial agricultural lending are also expected to contribute to fixed-price (cash) contract usage.

The following section provides a brief background of the evolving South African agricultural marketing and lending environment. We then present the formally stated hypotheses and the analysis and results of interview data from 52 South African maize producer interviews, including statistical analysis of codifiable variables and qualitative discussion based on interview responses.

4.2 Grain Marketing and Lending Background

Historically, South Africa's agricultural grain marketing has followed a marketing board model. The 1937 Marketing Act established single-channel commodity marketing via commodity-specific marketing boards. According to Vink and Kirsten (2000), from that point on "agricultural policy and agricultural marketing were virtually synonymous." In this marketing model, the commodity-specific board performed all marketing functions, particularly pricing and physical buying. During or around planting season, the maize board determined the commodity selling/buying price through a formula incorporating representative costs and an allowed profit margin, and then announced the maize price.

For maize, compulsory producer-member regional cooperatives acted as marketing board agents and performed the middle-man function of input financing and grain handling. The Agricultural and Land Bank financed land and other large capital improvements; both the cooperatives and the Land Bank were partially supported by the South Africa Department of Agriculture. Commercial banks were not involved in agricultural lending. Maize price risk was not an issue for industry players aside from maintaining margins given announced seasonal prices.

A variety of changes to the South African maize marketing system have ensued after the dissolution of marketing boards. The majority of prior compulsory maize marketing cooperatives have morphed into privately held companies now called “converted cooperatives.” The agricultural financing industry, which was monopolized by both the Land Bank and cooperatives, has expanded with commercial banks. While the milling industry has consolidated, maize millers may now buy directly from maize producers vis-à-vis prior single-channel buying from the regional cooperative. Both buyers and financiers have a role in how price-risk management has evolved. Each of these industry players are also now exposed to maize price volatility as are the producers.

Historically, grain cooperatives’ main function was to market agricultural output, but often the functions spanned the entire production and marketing system including financing, storage, processing, packaging, distribution, sales, and exports (Competition Commission, 2006). As repositioned investor-owned firms (IOFs), converted cooperatives continue to serve both financing and buying roles, but have added brokerage functions. Approximately 20 percent of South African farmers’ debts were financed by agricultural cooperatives during the period 1990-2000 (Competition Commission). Higher-risk producers are required by lenders to contract grain as collateral for input financing.

Without marketing boards, converted cooperatives also must consider price volatility. The converted cooperatives maintain fully hedged buying positions and thus most operate a registered SAFEX trading desk. Grain procurement within converted cooperatives involves purchasing grain from producers via a continuum of forward-price contracts (which are directly backed by grain futures and options). The converted

cooperatives also offer producer brokerage services involving producer-hedging account maintenance and executing producer speculative trading. The brokers (grain procurement) often advise producer clients to use a consistent marketing strategy which can be characterized stereotypically as “lock-in first 1/3 crop price by planting, lock-in second 1/3 mid-season and market the remaining 1/3 after harvest to minimize yield risk” (A. Pretorius [AFGRI Grain Procurement], personal communication, June, 2006).

Until the 1980s, the land bank and compulsory cooperatives (now converted cooperatives) were the pre-dominant agricultural lending sources (Competition Commission, 2006). The general consensus is that producers worked primarily through converted cooperatives during the initial deregulation period (2-4 years post); this period exhibited a large learning curve for producers. Post-deregulation, commercial banks have entered agricultural operations financing and provide producer risk-management services.

Commercial banks entered the price-risk management function in 2001. First National Bank (FNB) was the forerunner to become involved in commercial bank agricultural forward contracting. The bank both offers and mandates forward contracting. When a producer applies for an annual operating loan, the loan is classified into a risk category according the producer’s balance sheet. Higher-risk producers²⁰ are required to forward contract expected grain production (based on long-term average yields) sufficient to cover the loan directly with the bank. The bank is the grain owner and, in turn, hedges these contracts on SAFEX and arranges sale via a converted cooperative or directly with a maize miller. Forward contracting through the lender is also an option for lower-risk agricultural clients but is not mandated (First National Bank

²⁰ High risk is loosely defined as greater than 35-40 percent leveraged.

[FNB], personal communication, June 2006). An obvious, but interesting, note is that banks will not contract with or lend to higher-risk clients at market prices below costs of production. Therefore, some producers will not be able to obtain financing (or produce) in times of extremely low market prices. ABSA, a major player in the South African agricultural lending market, also offers forward grain contracting and follows similar guidelines (ABSA Bank, personal communication, June 2006).

White maize²¹ millers, such as African Products and Tiger Milling, also have entered the price-risk management scene. In the face of maize price volatility, millers now offer forward contracting to producers in order to stabilize inventories and expected costs. The contracts are usually fixed-price (cash) contracts and do not contain various derivative-based pricing options such as the contracts offered by converted cooperatives and commercial banks. Direct forward contracting is usually offered to larger producers who have the ability to contract larger quantities. Otherwise, producers contract with millers via converted cooperatives that function as middlemen.

In the post-marketing board era, South African grain marketing, operations financing, and price-risk management are intertwined. A South African grain producer has several options for orchestrating a price-risk management strategy; these options may be guided by a broker or not. For certain producers, particularly those leveraged, the operating costs financing decision is not independent of the price-risk management strategy.

²¹ White maize is intended for human consumption and accounts for approximately 50 percent of the total South African maize crop.

4.3 Research Hypotheses

Drawing on the existing price-risk management literature and the specific institutional details of the South African case, we developed several hypotheses concerning expected patterns of price-risk management following the elimination of price support programs. Some of the hypotheses test whether the existing price-risk management theory, which is based primarily on U.S. farmer behavior, is predictive of South African farmer behavior. Other hypotheses specifically address the institutional changes experienced in South Africa.

H1: Attitudes Toward and Practice of Price-risk management

The first set of hypotheses addresses the anticipated effect of the elimination of price support programs on the perception of price risk exposure, the use of market-based tools to manage price risk, and the type of price-risk management strategy objectives pursued. The elimination of price support programs exposed producers to the full range of possible maize prices. Therefore, we expect producers to have a greater sense of price-risk exposure since the elimination of price programs (H1a). Moreover, we expect producers with more experience under the marketing board to be more sensitive to, or aware of, price risk exposure relative to younger farmers with less marketing board experience.

Because South African farmers do not have income or price guarantees, or floors, we also hypothesize (H1b) that a greater percentage of South African farms will engage market-based price-risk management. However, because market-based tools were not available under the marketing board scenario, we cannot compare before and after.

Nonetheless, theoretical models of price-risk management predict all farmers will engage in some form of price-risk management.

The price-risk management literature typically assumes producers' objectives are to guarantee a minimum level of income or revenue rather than to maximize expected revenue. We test this hypothesis (H1c) based on the type of price-risk management strategy objective expressed by respondents.

H2: Producer Characteristics and Hedging Behavior

While the first set of hypotheses focuses on risk perception and strategy objectives, the second set of hypotheses focuses on producer and farm-specific characteristics, as well as systematic differences in the type and degree of hedging behavior undertaken. The existing literature asserts that producers are more likely to hedge a greater portion of their production (regardless of hedging mechanism) when they are younger, more educated, more highly leveraged, less diversified, and have a larger asset base. We examine these relationships as Hypothesis H2a. The existing literature also suggests that larger, more educated producers are more likely to use futures trading as a hedging tool. We examine these relationships as Hypothesis H2b

H3: Institutional Determinants of Price-risk management Behavior

The third set of hypotheses examines the implications of agricultural institutions in South Africa for the use and choice of price-risk management tools. We expect that producers with marketing board experiences will be more resistant to traditional hedging via futures and options due to lack of knowledge and understanding. Forward contracting with converted cooperatives would be most similar to the marketing procedure during the marketing board era. Producers without marketing board

experience (or with *less* MBE) would be expected to have more focus on understanding price-risk management strategies as these producers have little or no experience with fixed maize prices. These producers would be expected to market to the most competitive buyer.

The evolving South African agricultural lending practices are expected to impact producers' choices through the price-risk management tool of choice. As discussed earlier, many commercial lenders entering agricultural lending are requiring higher-leveraged producers to forward contract maize with the lending institution.

Therefore, we propose two hypotheses: H3a) producers with more marketing board experience are more likely to use fixed-price forward contracts, and H3b) producers with commercial loans are more likely to use forward contracts.

4.4 Data and Methods

This study is designed as a single-case case study; the case is identified as commercial South African maize producers' emergent grain price-risk management decisions. The 1996 South African agricultural deregulation represents a *critical* case in analyzing emergent market-based price-risk management and testing theoretical hedging impact variables in a market-based environment is the rationale for the single-case design.

The case study analysis is conducted using individual primary farm data collected during on-site farm interviews in the South African maize belt, including the Mpumalanga, NorthWest and Free State provinces.²² The producer sample was drawn

²² Data collection was completed via on-site interviews in lieu of mail surveys due to low expected mail survey response rates as described by University of Pretoria researchers and prior mail survey results (13 percent received by Brown et al., 2000).

from the GrainSA²³ membership list. GrainSA personnel initially contacted producers for interview permission, which resulted in a list of 70 producers. These producers were targeted in order to capture large and medium commercial grain producers with varying levels of debt. Commercial maize producers were defined as the relative South African equivalent minimum sales of US\$250,000 as defined by the USDA agricultural sales classification system. The majority of the included producers' household income should come from crop revenues. These targets were based on firm-level characteristics of size and leverage, which are theoretically supposed to impact hedging levels of commercial grain producers. Producers from the original list were then phoned for consent, resulting in 52 successful on-site interviews.

I conducted the interviews on-site. An Afrikaans translator provided by the University of Pretoria was present for 10 Free State province interviews. The interviews lasted approximately two hours and consisted of a paper farm business demographic survey, in addition to a guided oral discussion of maize price risk perceptions and the price-risk management decision process. The interview guide and demographic survey are included in Appendix E.

Table 4-1 presents summary statistics of respondent demographics. The sample demographics are relatively consistent with the sample demographics in Brown et al. (2000). In this dissertation, the average producer is slightly younger, more educated, and less experienced in absolute terms. With regard to farm demographics, the average producer is much larger with similar maize production levels and less income derived from maize. The mean debt level is 24 percent, as compared to 30 percent of those in the

²³ Established in 1999, GrainSA is the national lobby organization for all commercial South African grain producers. This organization has approximately 4,000 dues-paying members; this membership is approximately 10 percent of total South African commercial agricultural producers.

Brown et al study. According to the Statistics South Africa, the mean debt level in 2002 of producers in the regions interviewed was 35 percent.

Table 4-1 also shows summary data regarding price-risk management strategies used by respondents. Producers interviewed were found using combinations of fixed-price (cash) contracts, options, and futures to achieve their price-risk management objectives. Fixed-price (cash) contracts are the most common tool used by producers (44 percent). Fixed-price (cash) contracts are often used in combination with options in order to capture upside price potential (35 percent). Of the producer sample, 49 percent use options as some part of the price-risk management strategy.²⁴ Traditional futures hedging has increased slightly since the Brown et al. (2000) study.

²⁴ White and yellow maize options (puts and calls) have been available through SAFEX since 1998; maize futures since 1996.

Table 4-1. South Africa variable definitions and summary statistics.

Producer demographic variables	Definition	Producer Respondents (n=52, data obtained July 2006)		
		Mean	Median	Std. Dev.
Age	Producer age	43.87	45.00	10.64
Edu	Producer years of formal education	14.92	16.00	2.21
Exp	Producer years of farm experience since 18	20.79	18.50	9.09
MBE	Producer marketing board experience: 1 if farmed before 1997, 0 otherwise	0.90	1.00	0.30
Farm demographic variables				
Assets*	Total farm assets (USD)	\$ 2,076,691.12	\$ 1,178.57	\$ 3,347,063.17
TotalMZ	Total maize production (mt)	3785.86	2475.00	3922.26
%Mzshare	Farm income percentage attributed to maize production	0.57	0.62	0.24
Debt	Total farm leverage	0.24	0.20	0.28
HighRsk	Producers with 34 percent or more leverage: 1 if leverage ≥ 34 percent, 0 otherwise	0.19	0.00	0.40
ProducerOFI	Total producer off-farm income as percentage of total household income	0.11	0.00	0.21
Contractloans	Producers with operating loans under forward contract: 1 if yes, 0 otherwise	0.27	0.00	0.45

Table 4-1 contd. South Africa variable definitions and summary statistics.

Price-risk management (PRM) variables		Mean	Median	Std. Dev.
MBMR	Producer maize price-risk rating during marketing boards (1-5 scale)	1.04	1.00	0.20
PostMBMR	Producer maize price-risk rating post-marketing boards (1-5 scale)	4.56	5.00	0.83
PostMBMRmbe	Producer maize price-risk rating post-marketing boards of those with MBE (1-5 scale)	4.62	5.00	0.77
PostMBMRnombe	Producer maize price-risk rating post-marketing boards of those w/o MBE (1-5 scale)	4.00	4.00	1.22
PrePLI	Producer pre- or at-planting price lock-in percentage of expected maize yields	0.41	0.33	0.16
PreHLI	Producer pre-harvest price lock-in percentage of expected maize yields	0.58	0.63	0.17
Lock-in>33%	Producer choice to lock-in prices for greater than 33 percent of expected maize crop pre-harvest via any PRM strategies (1 if locking-in greater than 33 percent, 0 otherwise)	0.83	1.00	0.38
Comfort	Comfort level with strategy and buyer is a consideration when choosing which PRM strategy to utilize: 1 if yes, 0 otherwise	0.13	0.00	0.34
Knowledge	Knowledge level of strategy is a consideration when choosing which PRM strategy to utilize: 1 if yes, 0 otherwise	0.23	0.00	0.43
<i>PRM strategy objectives</i>				
LockBE	Manage price-risk to lock-in break even prices, qtys: 1 if objective, 0 otherwise	0.44	0.00	0.50
LockBEwUp	Manage price-risk to lock-in break even prices, qtys and allow upside potential: 1 if objective, 0 otherwise	0.15	0.00	0.36
LockProfit	Manage price-risk to lock-in profit price, qtys: 1 if objective, 0 otherwise	0.27	0.00	0.45
MaxProfit	Manage price-risk to maximize profits: 1 if objective, 0 otherwise	0.08	0.00	0.27
DivRisk	Manage price-risk to diversify risk: 1 if objective, 0 otherwise	0.02	0.00	0.14
AddValue	Manage price-risk to add value to maize: 1 if objective, 0 otherwise	0.04	0.00	0.19
BuySecurity	Manage price-risk to maintain a secure buyer: 1 if objective, 0 otherwise	0.02	0.00	0.14
<i>PRM strategies**</i>				
RM#1	Fixed-price (cash) contracts: 1 if using, 0 otherwise	0.44	0.00	0.50
RM#2	Fixed-price (cash) contracts covered by options: 1 if using, 0 otherwise	0.35	0.00	0.48
RM#3	Traditional hedge with futures contracts: 1 if using, 0 otherwise	0.12	0.00	0.32
RM#4	Fixed-price (cash) contracts plus futures hedging: 1 if using, 0 otherwise	0.04	0.00	0.19
RM#5	Options (first 1/3) plus fixed (cash) price contracts: 1 if using, 0 otherwise	0.02	0.00	0.14
RM#6	Options only: 1 if using, 0 otherwise	0.12	0.00	0.32
RM#7	Collective traditional hedge: 1 if using, 0 otherwise	0.04	0.00	0.19
RM#8	Plant less maize to decrease supply in efforts to support prices: 1 if using, 0 otherwise	0.17	0.00	0.38
FPCContracts ONLY	Fixed-price (cash) contracts only: 1 if using, 0 otherwise	0.40	0.00	0.50
SpotOnly	Producer spot marketing only (not engaging in PRM): 1 if yes, 0 otherwise	0.04	0.00	0.19

*Exchange rate R7=US\$1 used for financial conversions. **All producers are spot marketing some percentage of actual maize production.

4.5 Analysis and Results

H1: Attitudes Toward and Practice of Price-risk Management

H1a: The price-risk management incentive is proxied by the market maize price volatility (risk) as perceived by the producer. Interviewers asked producers to rate maize price risk pre- and post-marketing boards on a Likert scale.²⁵ To test the presence of market price risk incentives, the mean perception of maize price risk is compared pre- and post-1996 marketing board deregulation. To further test the incentive dynamics, post-deregulation producer price risk ratings with and without marketing experience are compared. If producers perceive maize price volatility (risk) to be significantly larger *post*-marketing board deregulation, H1a is supported.

Table 4-2 provides the average producer ratings of maize price risk *pre*- and *post*-marketing board elimination. As expected, post marketing board maize price risk rates significantly larger than maize price risk during the existence of marketing boards. Those producers *with* marketing board experience rate post-deregulation maize price risk higher than those *without* marketing board experience.

Table 4-2. Producer perceived maize price risk pre- and post-marketing boards.

	N	Minimum	Maximum	Mean	Std. dev.
MBMR	47	1	2	1.04	0.20
PostMBMR	52	2	5	4.63*	0.76
PostMBMRmbe	47	2	5	4.70	0.69
PostMBMRnombe	5	2	5	4.00	1.22

*PostMBMR is significantly larger than MBMR (p-value=0.000).

Two management trends appear within those producers (MBE and no MBE) who rate PostMBMR at three or less on the Likert scale. The first consists of an attitudinal

²⁵ The Likert scale used is a 1 to 5 scale where 1 rates maize price risk as very low and 5 rates maize price risk as very high.

response regarding maize price risk. Those rating price risk as lower felt that “price risk can be managed through SAFEX” and “the markets [SAFEX] worked well [until last year].”²⁶ Other producers “wanted SAFEX out of the system” and felt “one major marketing problem will kill farming.” The second trend found from this group is that they were often sons (next generation respondent) farming with fathers (primary operators) and would gradually taking over maize marketing. In these scenarios, the father (primary operator) rated maize price risk *higher* than the sons (next generation respondent).

H1b: The usage and spectrum of price-risk management strategies used are identified to test the hypothesized price-risk management usage. Each producer was asked to identify what, if any, price-risk management strategy is used, as well as the strategy objective. Frequency analysis is used to identify the proportion employing a price-risk management strategy. It is expected that all producers utilize some price-risk management strategy given that no government-provided price safety net exists.

Table 4-3 provides the observed price-risk management strategy usage and corresponding average ages and education for those using the respective strategies. All producers except one (51 of 52) employ some type of price-risk management strategy. The sole producer not using a price-risk management strategy (spot marketing only) is “adding value to the maize by feeding cattle.” This producer has had negative prior experience with hedging on SAFEX.

²⁶ In 2005, the South Africa Department of Agriculture overestimated the South African maize crop by approximately 15 percent which resulted in a relatively large drop in maize market prices. Some producers feel that the markets “failed” during this time period due to inaccurate crop estimates.

Table 4-3. South African maize producers observed price-risk management strategies.

Producer PRM strategy*	Number		Mean age	Mean edu
	using	Percentage		
RM#1 FC	23	44.23%	42.04	14.57
RM#2 FC+Options	19	34.60%	44.83	15.33
RM#3 Futures	6	11.54%	43.17	16.50
RM#4 FC+Futures	2	3.85%	47.00	14.00
RM#5 Options 1/3 +FC	1	1.92%	54.00	12.00
RM#6 Options only	6	11.54%	40.33	16.00
RM#7 Collective Futures	2	3.85%	57.50	16.00
RM#8 Plant less MZ	9	17.31%	44.89	15.11

*Strategies may be part of combination strategies.

Producer strategies include locking-in maize prices through some combination of forward contracting, futures contracts, and options. Forward contracting is a more guided strategy, whereas managing price risk through futures contracts and options is a more independent process. The table shows that producers using more independent strategies such as futures contract hedging (RM#3) and commodity options (RM#6), tend to be younger and/or more educated than those using some combination of forward contracts.

Older producers with MBE confirm the evolving price-risk management prioritization by commenting that “before we were producers and now we are forced to be marketers.” Producers generally discuss their movement toward a consistent [annual] price-risk management strategy; the producers are often advised by brokers, including those of converted cooperatives, to maintain consistency.

H1c: In a marketing environment where maize prices are fully exposed to world price fluctuations, it is expected that producers will use price-risk management strategies with the objective of minimizing revenue volatility associated with fluctuating maize prices. The expectation is based on the theoretical purpose of price-risk management

(hedging), which is to lock-in a realized price for some portion of production. Frequency analysis is used to identify stated producer strategy objectives and the strategies used to achieve these objectives.

Table 4-4 summarizes all price-risk management objectives as identified by producers. The PRM strategies used to achieve these objectives are included for each objective. The majority of producers' objectives are consistent with the theoretical intentions of price-risk management to secure prices [revenues] with 84.6 percents of producers interviewed using their price-risk management strategy to lock-in at least break-even revenues. Break-even revenues refer to producers covering variable operating costs, primarily operating loans. This objective is achieved by a diverse set of PRM strategies. The diverse set of PRM strategies used infers that there is a large degree of substitutability across the market-based tools.

Table 4-4. Producer price -risk management strategy objectives and strategies used to achieve stated objective

<i>Objective</i>	<i>Count</i>	<i>Sample percentage</i>	<i>PRM strategies used</i>
LockBE	23	44.2%	#1, 2,3,4,6,8
LockProfit	13	25.0%	#1,2,3,6,8,8
LockBEwUp	8	15.4%	#1,2,5,8
MaxProfit	4	7.7%	#1,2,8
AddValue	2	3.8%	#2,7
BuySecurity	1	1.9%	#1
DivRsk	1	1.9%	#1
Total	52	100.0%	

Variations of the locking-in break-even revenues as an objective are found. Another large percentage of producers (40.4 percent) intend to lock-in break even revenues plus some profit or upside potential with their price-risk management strategy. As the objective becomes more specific, fewer PRM strategies are used. Forward contracting and options are consistently used across all theoretically-consistent objectives (lock-in break even revenues only or with profit and upside potential). Furthermore,

some variation of forward contracting (RM #1, RM #2) is found to be used to execute all price-risk management objectives.

Interestingly, planting less maize is used as a PRM strategy associated with locking-in revenues. Producers indicated this indirect strategy is a long-term attempt to affect maize prices by decreasing supply and, ultimately, enabling the producers to lock-in higher expected maize prices. This collective supply restricting strategy is often encouraged by producers groups; however, economic theory says this strategy is ineffective for the agricultural price-taker, particularly given the individual producer's incentive to deviate.

The remaining strategies (max profit, add value, maintain buyer security, diversify risk) are not actually controlling maize price risk. Approximately, 15.3 percent of producers have these objectives. Specifically, maximizing profit is more of a speculative objective than price-risk minimizing. Forward contracting, a more guided strategy, is used by these producers to achieve the respective objectives.

H2: Producer Characteristics and Hedging Behavior

H2a: This hypothesis is analyzed using analysis of variance (ANOVA). ANOVA investigates the variation of the dependent variable (South African producer hedging levels) across classes of variables (Kennedy, 2003). This analysis essentially tests whether there is a significant variation in the dependent variable between classes. This test does not show causation due to small sample issues; however, it illustrates the differences in characteristics across the hedging level. Ordinary least square (OLS) would be useful to understand causation of these variables. However, this method was

tested, but no significant causation was found within the variables. This could either be attributed to small sample size or minimal variation within producer hedging levels.

Price-risk management literature suggests that producer hedging levels are affected by age (-), education (+), off-farm income (-), crop diversification (-), yield risk (-), size (+), asset base (-) and debt (+). These variables represent the ANOVA class variables. Size (maize production) is not included due to the significant, positive correlation to asset base (0.64 at the 0.01 level). The dependent variable, producer hedging levels, is measured in two ways. I use pre-planting and pre-harvest expected price lock-in levels (%) as reported by the South African producers as a measure of hedging levels. Variation across both measures is investigated. This lock-in level is non-discriminant regarding the market-based tool used. Crop diversification is measured by the percentage of crop revenues attributed to maize receipts (%MZshare); yield risk is measured by percentage of irrigated maize on the farm; debt is measured by farm operation leverage percentage not including non-farm assets such as housing and vehicles. The remaining variables are self-explanatory.

Tables 4-5 and 4-6 provide the ANOVA results. The variation in pre-planting producer hedging levels is not significantly contributed to by any of the identified variable [classes]. Producer asset base is found to be the only class that significantly contributes to the variation in pre-harvest producer hedging levels.

Table 4-5. Analysis of variance results (dep. var. = PrePLI).

ANOVA

		Sum of Squares	Df	Mean Square	F	Sig.
Age	Between Groups	805.744	13	61.980	.474	.926
	Within Groups	4968.314	38	130.745		
	Total	5774.058	51			
Educ	Between Groups	44.340	13	3.411	.631	.813
	Within Groups	205.352	38	5.404		
	Total	249.692	51			
ProdOF%	Between Groups	.626	13	.048	1.151	.350
	Within Groups	1.590	38	.042		
	Total	2.216	51			
%MZshare	Between Groups	3632.044	13	279.388	.532	.889
	Within Groups	18894.978	36	524.861		
	Total	22527.023	49			
% Irr	Between Groups	22045.079	13	1695.775	.947	.517
	Within Groups	68023.440	38	1790.091		
	Total	90068.519	51			
Debt (%)	Between Groups	.792	13	.061	.694	.757
	Within Groups	3.336	38	.088		
	Total	4.128	51			
Assets	Between Groups	1809.702	13	139.208	.202	.998
	Within Groups	26186.174	38	689.110		
	Total	27995.877	51			

Table 4-6. Analysis of variance results (dep. var. = PreHLI).

		ANOVA				
		Sum of Squares	df	Mean Square	F	Sig.
Age	Between Groups	1731.905	14	123.708	1.132	.364
	Within Groups	4042.153	37	109.247		
	Total	5774.058	51			
Educ	Between Groups	67.926	14	4.852	.988	.484
	Within Groups	181.766	37	4.913		
	Total	249.692	51			
ProdOF%	Between Groups	.370	14	.026	.530	.899
	Within Groups	1.846	37	.050		
	Total	2.216	51			
%MZshare	Between Groups	6853.026	14	489.502	1.093	.397
	Within Groups	15673.997	35	447.828		
	Total	22527.023	49			
% Irr	Between Groups	24650.954	14	1760.782	.996	.477
	Within Groups	65417.565	37	1768.042		
	Total	90068.519	51			
Debt (%)	Between Groups	.653	14	.047	.497	.920
	Within Groups	3.475	37	.094		
	Total	4.128	51			
Assets	Between Groups	11186.425	14	799.030	1.759	.085*
	Within Groups	16809.452	37	454.310		
	Total	27995.877	51			

Variation between groups significant at *0.10 level.

H2a is further investigated through a means comparison of the identified variables across the producer's choice to lock-in prices for more than 33 percent of the expected maize crop pre-harvest. Locking-in more than 33 percent of expected maize crop represents the producer's decision to lock-in prices beyond basic operating costs. South African producers indicated that approximately 33 percent of crop revenues covered input costs. Input costs are narrowly defined as purchased variable inputs including seed, fertilizer and labor. The 33 percent cut-off point is meant to capture those producer locking-in prices to cover operating loans versus targeting profit.

Table 4-7 provides the means comparison results. Those producers locking-in more than 33 percent pre-harvest are significantly younger and more leveraged than those producers choosing to lock-in less. While the other means are not statistically significant, the absolute differences are as expected. Those choosing to lock-in *more* are more educated with more producer off-farm income, less diversification, more irrigated maize, and a smaller asset base. Age and education are significantly negatively correlated (-0.33 at the 0.05 level), so it follows that the younger producers are more educated in this scenario.

Table 4-7. Selected variables means comparison across the producer's binary choice to lock-in >33%.

Lock-in >33%		Age*	Educ	ProdOFI	TotalMZIncome	Irr	Assets	Debt***
NO	Mean	49.67	14.00	5.56%	52.78%	16.44	\$ 23,188,888.89	15.06%
	N	9	9	9	9	9	9	9
	Std. dev.	9.41	2.83	13.33%	23.39%	33.32	\$ 51,408,011.16	15.50%
Yes	Mean	42.65	15.12	11.97%	60.49%	32.35	\$ 12,725,943.44	25.70%
	N	43	43	43	41	43	43	43
	Std. dev.	10.58	2.05	22.05%	21.73%	43.45	\$ 11,990,943.55	30.28%
P-values [†]		0.07	0.27	0.16	0.36	0.16	0.56	0.00

[†] P-values indicate the significance level that the observed explanatory variables' averages are significantly different within the yes/no classification at the ***0.01 level *0.10 level; these values do not imply causation.

H2b: Hypothesis testing for H2b involves a binary logit regression of total maize production and education on the probability of choosing futures (*RM#3*) as a price-risk management strategy. Choosing futures as price-risk management tool within the producer's overall strategy is a binary choice represented by a dummy variable (1=yes, 0=otherwise). Binary logit is a commonly used method to estimate the independent variable impacts of the probability of attaining the dependent variable.

Independent variables included in the logistic model to test the hypotheses are age, education, assets, irrigation and maize production. Equation 4.1 details the logit model. Education is a measure of transaction costs; using futures as a hedging tool

requires an understanding of market dynamics in order to execute and is costly in terms of time and effort. We would expect that more education increases the probability of choosing futures hedging as a price-risk management strategy. Total maize tonnage is also expected to positively impact the choice probability; each SAFEX maize futures contract is 100 metric tons. Given learning and transaction costs, producers would need to produce enough maize to cover several contracts for hedging efficiency. Irrigation usage is a measure of maize yield risk and is expected to have a positive relationship with futures usage. Age and assets are included because price-risk management literature suggests they may have a relationship with futures usage. The expected signs are age (-) and assets (+).

$$Prob(futures\ usage=yes) = f(age, edu, assets, irr, totalMZ) \quad (4.1)$$

Table 4-7 provides the binary logit regression results. The Nagelkerke R^2 is a measure of goodness of fit for the binary logit model; the larger the number, the better the model fits the data.

Table 4-8. Binary logit regression results (dep. var. = futures usage).

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1(a)	Age	0.047	0.072	0.436	1.000	0.255	1.049
	Edu	1.643	0.735	4.994	1.000	0.013**	5.171
	Assets	0.073	0.042	2.950	1.000	0.043**	1.076
	Irr	0.027	0.021	1.664	1.000	0.099*	1.027
	TotalMz	1.921	1.567	1.503	1.000	0.110	6.827
	Constant	-33.593	14.288	5.528	1.000	0.010	0.000
Independent variables are significant (one-tailed) at the ***0.01 level, **0.05 level and *0.10 level.							
Model Summary							
	-2 Log likelihood	Nagelkerke R Square					
	19.642(a)	.561					

Generally, the significant variables are consistent with theory. Education, assets and irrigation levels are found to be significant; producers with higher education levels,

less yield risk and larger assets bases are more likely to manage price risk with traditional futures contract hedging. Irrigation mitigates yield risk which allows more maize to be hedged via futures contracts. Economies of size are gained with multiple futures contracts; average transaction costs (learning and commission) decrease as futures usage increases.

H3: Institutional Determinants of Price-risk management Behavior

H3a and b: H3 hypotheses are tested concurrently tested via equation 4.2. These hypotheses are testing prior and current institutional impacts on tools used to manage producer price-risk. The price-risk management tool in question is forward contracts. The dependent variable in question measures whether or not producers use forward contract *only*, not in combination with other tools.

$$Prob(\text{forward contract usage only=yes}) = f(\text{age, MBE, edu, ContractLoans, debt, totalMZ}) \quad (4.2)$$

Two institutional aspects are expected to affect the choice to use forward contracts: familiarity and evolving agricultural lending practices. Producers operating within the marketing board era are expected find forward contracting as a more familiar tool than futures or options. Many forward contracts are executed through the converted cooperatives where producers marketed prior to marketing board elimination. A literal marketing board experience variable *MBE* exists, but suffers from small sample issues (n=5). Marketing board experience is loosely measured through the continuous variable *Age*. Age is expected to have a positive relationship with using forward contracts only. Marketing board experience is included, but likely has little explanatory power given the small sample size.

As discussed in section 4.2, commercial lenders have entered agricultural lending. These lenders require higher risk producers to lock-in expected prices to cover the operating loan. Forward contracts are offered by the commercial banks and usage is encouraged. The evolving financial institutions' effects on price-risk management tool choice is measured by the variable *ContractLoans* and is expected to have a positive sign. Contract loans indicated whether or not the producer is required to lock-in maize prices to sufficiently cover the operating loan.

There is little theory regarding why other variables would be expected to impact forward contract usage. However, with inverse reasoning to futures usage, it is expected that producers with less maize production will be more likely to use forward contracts. Total maize production is included to control for these potential size impacts and is expected to have a negative sign. Education is included to control for learning costs required by other price-risk management tools. Education is expected to be negatively related to using forward contracts only.

Table 4-8 provides the binary logit results testing hypotheses 3a and 3b. Variables found to significantly impacts forward contract only usage are education and contract loan usage. The signs are as expected. The results indicate that as education increases the probability of using forward contracts only decreases. Hence, producers are using other methods as education increases.

Table 4-9. Binary logit regression results (dep. var.= forward contract usage only).

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1(a)	Age	-.048	.033	2.088	1	.150	.953
	MBE	.600	1.088	.304	1	.291	1.822
	Edu	-.231	.163	2.017	1	.078*	.793
	ContractLoans	1.670	.721	5.364	1	.011**	5.312
	Debt	-1.317	1.499	.772	1	.190	.268
	TotalMz	.161	.687	.055	1	.473	1.175
	Constant	4.374	3.127	1.956	1	.081*	79.326

Significant at the ***0.01 level **0.05 level *0.10 level (one-sided).

Step	-2 Log likelihood	Nagelkerke R Square
1	61.223(a)	.213

The contract loan result indicates the producer tool use is affected by the evolving agricultural lending institutions. Producers with contract loans are 1.6 times more likely to use forward contracts only. *Age* is not found to have a significant impact on the choice to use forward (fixed-price) contracts. This result loosely indicates that producers are choosing to forward contract for reasons other than familiarity.

Discussion and Conclusion

“I was a producer; I am now forced to be a marketer,” a common anecdote heard among South African grain producers, is telling as to the relative importance managing price risk has reached post-marketing boards within farm management.²⁷ From interview discussions and statistical analysis, it appears that price-risk management prioritization has played a large role since 1996 in maintaining competitiveness as a producer in the South African maize market. Firm or producer-level impacts seem to impact the price-risk management process in terms of degree; past and evolving institutions appear to be more relevant within the decision process reasoning and tool choice.

²⁷ When discussing price-risk management, producers generally thought of it as part of marketing, which is not consistent with the academic marketing definition.

Producers interviewed are actively managing maize price risk with a variety of tools. The lone producer found to use cash marketing only with no price-risk management strategy only represents 1.9 percent of the sample as compared to 17 percent of Brown et al's (2000) sample. This study finds a similar proportion of producers hedging with futures (11.5 percent) as that found in Brown et al (9 percent). The impacts of marketing board experience are minimal within the sample, appearing primarily within the decision process. Older farmers tend to show knowledge and comfort as being important factors when choosing a price risk- management strategy. Other variables, such as off-farm income, irrigation, and asset levels, that have previously been found to significantly impact price-risk management adoption in other studies were not found to significantly differ across producers' price-risk management levels in this study. This finding may indicate that these alternative overall revenue risk-mitigation strategies have become more complementary to price-risk management in the South African maize-pricing environment.

Producers locking-in a larger degree of their expected maize crop are significantly younger and have more debt.²⁸ Debt is consistent with prior U.S. surveys, but was not found to be a significant factor in the Brown et al (2000) study. The direction of the debt-induced price-risk management incentive flow is not clear. It is reasonable that producers with high debt levels would lock-in expected prices for a larger proportion of the maize crop in order to cover debt payments. However, those higher leveraged producers with commercial operating loans are also expected to forward contract enough maize to cover the operating loan. The incentives are intertwined.

²⁸ Debt and age were found not to be highly correlated within this sample.

Education and size (maize production) both positively impact the probability of managing maize price risk with a futures contract hedge, which are both consistent with prior studies. Educational impacts imply there are transaction “learning” costs associated with using futures, which can be mitigated by increased education. Similarly, larger producers evidently perceive themselves to be more capable of managing cash flow (margin) and contract tonnage. Also, as economies of scale take effect, the “learning” costs of education per contract decreases as the amount of maize hedged increases.

Producers without futures and options expertise generally indicated a plan to obtain training with these tools. Also, many producers indicated they encouraged their sons to go to college prior to returning to the farm. As farm families become more educated and possibly larger due to consolidation, it is expected that direct futures hedging will continue to gain momentum with those producers able to secure funds for margin maintenance.

It is expected that, generally, maize price-risk management will continue to grow as an imperative part of South African maize production. While futures usage is expected to grow, it will likely not outpace the use of forward (cash) contracts given both the ease of use and lender requirements.

An interesting extension of this research includes investigating the crop insurance impacts on price-risk management and revisiting producer price-risk management choices 10 years later. U.S. price-risk management portfolio literature empirically finds crop insurance to be a substitute for price-risk management, particularly futures and options usage. In this study, 71 percent of producers bought maize crop insurance.

In a deregulated environment, crop insurance may serve a more complementary role to price-risk management strategies. Producers may not be willing to hedge a large share of their crop given yield risk. Crop insurance mitigates this risk. In the U.S., some crop insurance policies are specifically designed to remove much of the yield risk as well as much of the revenue risk which is where the substitution for price-risk management enters.

Chapter four establishes that South African producers are actively managing price-risk in a non-supported agricultural environment. These price-risk management decisions regarding degree and market-based tool usage are impacted by variables suggested by currently literature, namely age, education, debt and size. Chapter five compares the hedging decisions of U.S producers analyzed in Chapter three with those of the interviewed South African producer. Comparing these decisions across institutions allows a relative analysis of both the agricultural marketing environment effects and the suggested producer and farm characteristic variables.

Chapter 5

Producer Price-risk Management Comparison across the United States and South Africa

5.0 Introduction

U.S. grain producers have produced under some variation of the U.S. Farm Program since the 1933 Agricultural Adjustment Act which first established the New Deal mix of commodity-specific price and income support programs. While the program specifics are dynamic and will continue to change with the expected 2007 Farm Bill, producer income support and stability is a priority in the United States, as evidenced by the historical presence of income support payments and grain price protections²⁹.

While price support payments exist, U.S. grain prices received by the producers are allowed to fluctuate according to world market dynamics with the U.S. Farm Program. Given the nature of agricultural price fluctuations and the implications for volatility of expected income, U.S. corn producers are expected to utilize price-risk management tools in attempt to lock-in some level of expected income. However, many U.S. grain producers choose not to utilize price-risk management tools to lock-in some level of expected revenues. These choices prompt the question of incentives created by the U.S. farm program. What impact does the *presence* of a federal farm income and price support program have on producer price-risk management activities?

A significant literature has been devoted to creating normative models of appropriate producer price-risk management. While the expected tools and lock-in levels vary according to producer and farm characteristics, some positive level of price-risk management is prescribed theoretically and empirically. Hedging theory often prescribes

²⁹ Original program crops included corn, wheat, cotton, rice, peanuts, tobacco and milk; oilseeds are now included.

hedging ratios close to one and university marketing extension specialists often suggest locking-in prices (managing price risk) for no less than 30 percent and not more than 80 percent of expected yields. In practice, grain producers surveyed within academic and USDA studies deviate from theoretical expectations in terms of price-risk management activities.

Various authors have attempted to explain these deviations using empirical models with aggregated data and producer surveys. However, the interaction of the U.S. Farm Program presence and producer decision-making is not clear. Producer risk management literature hypothesizes that programs such as the Loan Deficiency Program (LDP) serve as *theoretical* substitutes for managing risk via market-based price-risk management mechanisms. Carlton (1984) argues the widespread increase in agricultural products futures trading in the 1970s is due, in part, to the temporary absence of major agricultural programs that previously removed uncertainty from grain prices. Understanding price-risk management incentives created by operating in a price supported environment is a critical first step to evaluating the implications of farm program policy changes for the economic sustainability of crop farmers and to building more accurate theories and models of producer price-risk management behavior.

I am testing the existence and impacts of the hypothesized agricultural marketing environment incentives using a novel comparison of price-risk management practices between United States and South African grain producers. South Africa provides a unique non-supported agricultural marketing environment to compare producer-level price-risk management decision making. South Africa has been without grain price support since the 1996 agricultural commodity boards deregulation.

This study seeks to understand the role of the U.S. price support programs within the producer's *actual* price-risk management strategy decision. If agricultural price support programs do create incentives against managing price risk, how will U.S. producers' risk management practices change with the absence of farm programs? These questions are the motivation for this study.

The current political landscape supports this study's timeliness. The decreasing lack of political base for agricultural funding, World Trade Organization (WTO) negotiations and the increasing trends toward urbanization suggest that a reduction in agricultural price support programs is likely. The WTO Doha Rounds are expected to be completed by the end of 2007; expected compromises during this round and in previous trade negotiations signal a continuing force toward a less government supported, more market oriented global agricultural pricing environment. Understanding the implications of such changes for producers is critical.

5.1 Literature Review

U.S. literature regarding producer hedging³⁰ as a grain price-risk management tool has an extensive academic literature behind it with some 60 years of theoretical modeling.³¹ Still, a general consensus regarding the usefulness of hedging to primary producers has not been reached and has been identified as a topic needing further primary research (Brorsen and Irwin, 1996; Carter, 1999). A commonly noted observation is that the level of U.S. grain producers' hedging is not consistent with theoretical and empirical

³⁰ Hedging is traditionally defined as the producer taking equal and off-setting positions in the cash and futures market to lock-in the net commodity price. Here, we will extend this definition to include forward contracting and options as hedging tools in addition to futures contracts.

³¹ See Gray and Rutledge (1971), Carter (1999) and Garcia and Leuthold (2004) for in-depth literature reviews of commodity futures markets. Carter (1999) particularly brings forward the issue of direct usefulness of futures markets for primary producers.

literature prescribing positive hedging ratios (Berck, 1981; Brorsen, 1995; CFTC, 2001; Carter, 1999; Harwood et al., 1999). Anecdotally, forward contracting use is often argued to be substituted by grain producers for traditional hedging via futures contracts. In 2003, the USDA reports that approximately 36 percent of all U.S. commercial farms (sales of \$250,000 and above) used marketing contracts³² in 2003 with 22.5 percent of production value under contract (MacDonald and Korb, 2006). United States corn value produced under forward marketing contracts was 13.8 percent in 2003 (MacDonald and Korb, 2006). Grain producer surveys indicate that 14-70% of producers interviewed hedge or forward contract up to 35% of expected grain production (Makus et al., 1990; Goodwin and Schroeder, 1994; Sartwelle et al., 1998; Davis et al., 2005).³³ According to these numbers, some U.S. producers are not forward marketing any expected grain production as a price-risk management strategy.

Theoretical models have prescribed optimal hedging levels close to one (Telser, 1955; Johnson, 1960; McKinnon, 1967); empirical models have tested optimal hedging models by modeling the impacts of many firm and price related variables. Variables including the ability to predict price variations, farm leverage, basis variance, cash price variance and production risk have been found to impact hedging effectiveness and optimal hedging levels (Robinson and Barry, 1987; Turvey, 1989; Castelino, 1992; Grant, 1989; Lapan and Moschini, 1994; Kahl, 1983; Peck, 1975). Farm-level variables including education (+), leverage (-), farm size (+) and off-farm income (-) have also been identified by U.S. producer surveys as impact variables in the decision to forward

³² The use of marketing contracts is used as a proxy for hedging due to unavailable data for levels of producers' futures hedging activities.

³³ Self-selection bias is questioned within the mail survey method.

market as a price-risk management strategy (Shapiro and Brorsen, 1988; Makus et al., 1990; Goodwin and Schroeder, 1994; Sartwelle et al., 1998).

The substitution of the Loan Deficiency Program (LDP) and subsidized revenue insurance for market-based price-risk management tools has also been suggested as a possible reason why U.S. producer exhibit less than prescribed forward marketing levels. It is argued that LDP payments operate as subsidized put options when price levels fall below the posted county price (PCP) level (Gardner, 1977; Irwin et al., 1988; Adam et al., 2000). Turvey and Baker (1990) find that corn and soybean producers decreased use of futures and options contracts when receiving government programs payments. However, government program payment levels are not found significant when modeling producer adoption of forward pricing methods utilizing survey data from 509 U.S. producers (Goodwin and Schroeder, 1994).

Recently literature has analyzed the substitutability of LDP payments and crop insurance for hedging within the price-risk management portfolio. Mahul (2003) finds that crop revenue insurance is a substitute for futures hedging where crop yield insurance is a complement. In the presence of the LDP payments and positive transaction costs, optimal hedge ratios are found to approach zero for selected producer price scenarios as the futures price approaches the loan rate (Coble et al., 2004). These authors provide empirical evidence that when program commodity prices are low, LDPs and crop revenue insurance substitute for hedging within a utility maximization framework. These models incorporating LDPs and subsidized revenue insurance would predict that all producers would hedge to some degree if the loan rate is not equal to the futures price.

These studies cannot explain why some grain producers do not manage price risk at any price level.

To date, agricultural price-risk management literature has prescribed homogenous optimal hedging levels and suggested why producers deviate from expected price-risk management activities. Previous price-risk management research has been conducted *within* the constructs of a mature institution, the U.S. farm program, making it difficult to isolate the effects of farm programs on producer behavior. The presence of farm programs is inherently involved in any grain producer's risk management decisions. Our study aims to isolate the U.S. farm program impacts on producer price-risk management through comparative research methods and inform how price-risk management activities may change in response to changes in U.S. farm program policy shifts in terms of particular program changes and/or overall spending.

Recent changes in the South African agricultural marketing institutions provide a unique opportunity to compare similar producers' price-risk management choices in differing decision environments. The 1996 South Africa Marketing of Agricultural Products Act eliminated the marketing board system for all commodities and created a fully-exposed, market based agricultural commodity marketing environment. Comparing price-risk management decisions across institutions provides a better understanding of the role of agricultural institutions within producer price-risk management and, in turn, a better understanding of the expected impacts of changing agricultural policies. The South African comparative is especially useful in separating common reasons suggested for U.S. producer price-risk management levels e.g. leverage from the incentives created by

the U.S. farm program. South African producer price-risk management decisions are used as a control for institutional environment.

The general hypothesis of this study is that the existence of the U.S. farm program impacts producer price-risk management in a more general manner. Historically, U.S. farm program policies have, in effect, reduced the expected cash price variance and the perceived benefits of price-risk management practices. Impacts of this nature would create general disincentives against acquiring needed knowledge and actively managing price risk.

This study is guided by general hypotheses regarding price-risk management in supported and non-supported agricultural environments. In absence of any corn price “safety net”, it is expected that similar producers in a non-supported environment will perceive larger price risk exposure and manage price risk more actively. Theoretically suggested variables including debt and diversification are expected to impact price-risk management decisions in light of institutional differences due to the nature of the variables. The price range of price-risk management tools used is expected to be larger within a non-supported environment and, therefore, education is expected to play a larger role in price-risk management within a non-supported environment.

The paper follows with an explanation of data collection and methods used. We then present the analysis and results of interview data from 96 South African and United States corn producer interviews through statistical analysis and codifiable variables and qualitative discussion resulting from the interviews.

5.2 Data and Methods

This study is designed as a comparative case study; a comparative of decision-making in two opposing institutional environments. The decision process being analyzed is the commercial corn producers' grain price-risk management strategy and tool choices; the institutional environments are the agricultural marketing environments of South Africa and the United States. South Africa represents a market-based corn marketing environment absent of producer income support policies; the United States represents a corn marketing environment consisting of federal corn price and income support policies.

The comparative study design rationale is based on the necessity and difficulty of isolating institutional impacts on decision-makers operating within the environment in question. To the extent that social, cultural and organizational differences between South Africa and the United States can be controlled, the differences found within the price-risk management choices are expected to be explained by the non-constant variable-the corn marketing environment.

The case study analysis is conducted using individual primary farm data collected during on-site farm interviews in South Africa and the United States. The Food and Agricultural Policy Research Institute (FAPRI) at the University of Missouri-Columbia identified geographical regions in Missouri that mimic the South African provinces of Mpumalanga, NorthWest and Free State³⁴. These provinces are the South Africa "corn belt" which is comparable to the United States "corn belt". Producer sampling was focused in these parallel production areas. In terms of production revenues and net returns, Table 5-1 provides a general average comparison between Missouri and

³⁴ On-site interviews were chosen for the South African data collection in lieu of mail surveys due to low expected mail survey response rates as described by University of Pretoria researchers and prior mail survey results (13 percent received by Brown et al., 2000).

NorthWest-Free State provinces. For reference, Northwest and Free State yields tend to be lower than Missouri yields with higher variable costs resulting in lower profits per acre.

Table 5-1. Comparison of corn production and returns across the U.S. and South Africa, 2002-03.

	NW Freestate (SA)	Missouri(USA)
Receipts		
Yield (bushels/acre)	61.82	135
Producer price (\$/bushel)	\$ 3.18	\$ 2.30
Net government program payment (per acre)		14.15
Total receipts (\$/acre)	\$ 196.59	\$ 324.65
Variable cost		
Seed	\$ 10.05	\$ 32.50
Fertilizer and lime	\$ 42.68	\$ 70.60
Chemicals	\$ 8.06	\$ 24.00
Fuel, Repairs & maintenance	\$ 43.29	\$ 16.08
Labor	\$ 11.99	\$ 23.42
Other costs	\$ 31.37	\$ 24.00
Total variable costs (\$/acre)	\$ 147.45	\$ 190.60
Variable Cost (\$/bushel)	\$ 2.39	\$ 1.41
Profit (per acre)	\$ 49.14	\$ 134.05
Per bushel:	\$ 0.79	\$ 0.99
Variable cost as % of receipts	75%	59%
Calculations: PG Strauss	Source: GRAIN SA	Source: Missouri Farm Financial Outlook, 2003.
*South Africa portion taken from the 2003 "The Agricultural Sector in South Africa" Food and Agricultural Policy Research Institute Presentation (FAPRI) by Pat Westhoff, Julian Binfield, Ferdinand Meyer and PG Struass.		

The South Africa producer sample was drawn from the GrainSA³⁵ membership list. Producers were initially contacted by GrainSA personnel for interview permission resulting in a list of 70 producers. Commercial corn producers were defined as the relative South African equivalent minimum sales of US\$250,000 as defined by the USDA agricultural sales classification system. Producers from the original list were phoned for consent resulting in 52 successful on-site interviews.

³⁵ Established in 1999, GrainSA is the national lobby organization for all commercial South African grain producers. This organization has approximately 4,000 dues paying members; this membership is approximately 10% of total South African commercial agricultural producers.

The United States (Missouri) producer sample was drawn from a Missouri grain producer organization membership list. Producers were initially contacted by the authors for interview permission and pre-screening resulting in a list of 100 producers. In the U.S., commercial corn producers were defined as producers with US\$250,000 minimum sales as defined by the USDA agricultural sales classification system. Producers from the original list were phoned for consent resulting in 48 successful on-site interviews

Within both country samples, the producers were targeted to capture large and medium commercial grain producers with varying levels of debt. Included producers should have a majority of household income resulting from crop revenues. These targets were based on firm-level characteristics of size and leverage theoretically supposed to impact hedging levels of commercial grain producers.

I conducted the interviews on-site. An Afrikaans translator provided by the University of Pretoria was present for 10 Free State province interviews. The interviews were approximately two hours and consisted of a guided oral discussion of corn price risk perceptions and the price-risk management decision process in addition to a paper farm business demographic survey. The interview guide and demographic survey are included in Appendix E.

Comparative summary statistics of respondent demographic data are presented in table 2. Producer demographics are similar across South Africa and the U.S. The U.S. producers are slightly older with more experience. Mean farm demographic variables are similar across producers. However, it should be noted that median assets and irrigation levels in the South African sample are significantly smaller than those in within the U.S. sample. Mean risk attitudes are also found to be similar across producers, but mean corn price lock-in levels vary significantly across countries.

Table 5-2. South Africa and United States variable definitions and summary statistics.

		South Africa producers (n=52)				U.S. producers (n=44)			
Producer demographic variables		Mean	Median	Std. Dev.		Mean	Median	Std. Dev.	
Age	Producer age	43.87	45.00	10.64		49.32	51.50	11.10	
Edu	Producer years of formal education	14.92	16.00	2.21		14.39	14.00	1.96	
Exp	Producer years of farm experience since 18	20.79	18.50	9.09		28.55	29.50	12.20	
Farm demographic variables									
Assets	Total farm assets (USD)	\$ 2,076,691.12	\$ 1,178.57	\$ 3,347,063.17		\$ 2,332,636.34	\$ 1,600,000.00	\$ 2,145,215.96	
TotalMzbu	Total maize production (bu)	3785.86	2475.00	3922.26		2676.47	2540.00	1831.08	
%Mzshare	Farm income percentage attributed to maize production	0.57	0.62	0.24		0.42	0.45	0.13	
Debt	Total farm leverage percentage	0.24	0.20	0.28		0.31	0.25	0.23	
Irr	Irrigated percentage of maize crop	0.30	0.03	0.42		0.41	0.28	0.42	
ProdOFI	Total household off-farm income as percentage of total household income	0.11	0.00	0.21		0.05	0.00	0.12	
MZCI	Percentage of expected maize yields covered by crop insurance	0.56	0.68	0.43		0.60	0.70	0.27	
Price-risk management (PRM) variables									
PrePLI	Producer pre- or at-planting price lock-in percentage of expected maize yields	0.41	0.33	0.16		0.16	0.13	0.16	
PreHLI	Producer pre-harvest price lock-in percentage of expected	0.58	0.63	0.17		0.39	0.40	0.24	
FuturesContractHedge	Producer uses maize futures contracts as part of PRM strategy: 1 if yes, 0 otherwise	0.12	0	0.32		0.09	0.00	0.29	
OptionsUsage	Producer uses maize options as part of PRM strategy: 1 if yes, 0 otherwise	0.13	0	0.34		0.16	0.00	0.37	
RiskAtt	Producer average risk attitude as measured by 3 decision scenarios with 6 scaled options for each scenario: choosing 1st option (1) indicates less risky attitudes and choosing 6th option (6) indicates riskier attitudes	3.01	3.00	1.02		3.67	3.70	0.79	
Dummy and interaction variables									
SA	South Africa dummy variable: 1 if South African producer, 0 otherwise								
SAEdu	Interaction variable between South African dummy and								
SATotalMzbu	Interaction variable between South African dummy and total maize production								
SAMZCI	Interaction variable between South African dummy and maize crop insurance								

5.3 Research Hypotheses

Hypothesis one establishes if attitudes and, therefore, price-risk management differs across supported and non-supported agricultural marketing environments. Do producers without an institutional corn price “safety net” more actively manage price risk given a larger potential downside? Additionally, do producers in non-supported environments require more revenue security when making planting decisions? Perceived price risk differences are expected to materialize through corn price lock-in decisions pre-harvest and pre-planting.

H1a: Producers managing price risk without a perceived price floor will lock-in a larger percentage of expected revenues prior to harvest.

H1b: Producers in non-supported environments will lock-in a larger percentage of expected revenues prior to or at planting.

5.3.1 Testing and Analysis

H1: South African and U.S. corn producers were asked to describe their corn price-risk management (PRM) strategies in an average year. During the PRM description, producers were asked to differentiate between percentage of expected yields (expected revenues) lock-in at or before planting and harvest. Equations 5-1a and 5-1b are used to test for price-risk management attitudinal and behavioral differences across South Africa and the United States corn producers.

Tobit regression is used to test the linear relationships in hypothesis one. A possible estimation issues exists concerning censored data in this model. The producer’s hedging level naturally ranges from 0 percent to 100 percent. If many responses are at either extreme, then censored data will potentially bias the estimates and affect the standard error estimates and, ultimately, the p-value interpretations. Approximately 5.2

percent of responses lie at 0 percent. The tobit estimation utilizes a maximum likelihood function to estimate the explanatory variable coefficients.

Hypothesis 1a examines overall pre-planting expected price lock-in percentages and is testing using equation 1a.

$$PrePLI = \alpha + \beta_1 SA + \beta_2 Exp + \beta_3 Edu + \beta_4 ProdOFI + \beta_5 \%MZshare + \beta_6 Irr + \beta_7 Assets + \beta_8 Debt + \beta_9 MzCI + \beta_{10} RiskAtt + \varepsilon \quad (5.1a)$$

To test for differences across the country samples, a *South African dummy variable* (SA) is used to account for the impact on lock-in percentage that may be attributed to *farming in South Africa only*. Other variables included are proxies for variables theoretically suggested to impact producer price-risk management; these variables control for these effects. Experience has been found to negatively impact hedging levels in prior producer survey and education has been found to positively impact hedging levels. Producer off-farm income and income from corn revenues measure diversification, irrigation measures yield risk, and debt measures the ability to withstand price (revenue) volatility. Risk attitude is a qualitative of risk preferences across producers³⁶. In questions regarding risk perceptions, a larger number response indicates the producer is more likely to take risks. Assets measure size, but it also measures the ability of the producer to withstand revenue shocks. The expected relationship between assets and hedging levels is uncertain. The expected relationships between the explanatory variables and pre-planting lock-in levels are as follows: SA (+), Exp (-), Edu (+), ProdOFI (-), %MZshare (+), Irr (+), Assets (?), Debt (+), MZCI (-), RiskAtt (-). Table 5-3 provides hypothesis 1a tobit results.

³⁶ The relevance of risk attitude to producer price-risk management behavior is argued in the literature (CITE).

Table 5-3. Equation 5.1a tobit estimation results (dep. var. = PrePLI).

The QLIM Procedure					
Summary Statistics of Continuous Responses					
N obs					
Lower		Standard		Lower	
Variable	Mean	Error	Type	Bound	
PrePLI	29.31915	20.642483	Censored	0	
17					
Model Fit Summary					
		Number of Endogenous Variables		1	
		Endogenous Variable		PrePLI	
		Number of Observations		94	
		Missing Values		2	
		Log Likelihood		-341.10158	
		Maximum Absolute Gradient		5.33355E-6	
		Number of Iterations		94	
		AIC		706.20316	
		Schwarz Criterion		736.72270	
Parameter Estimates					
Parameter	Estimate	Standard Error	t Value	Approx Pr > t	one-sided Pr > t
Intercept	-15.066862	18.398951	-0.82	0.4128	
SADummy	29.439172	6.592789	4.47	<.0001	<.0001
Exp	-0.193313	0.182729	-1.06	0.2901	
Edu	0.627073	0.911459	0.69	0.4915	
ProdOFI	3.785658	10.607970	0.36	0.7212	
%Mzshare	0.268368	0.111333	2.41	0.0159	0.0080
Irr	0.172197	0.051176	3.36	0.0008	0.0004
Assetsscaled	0.239547	0.657564	0.36	0.7156	
Debt	0.187633	0.136826	1.37	0.1703	0.0852
MZCI	-0.001951	0.006233	-0.31	0.7543	
RskAtt	-0.012141	0.009863	-1.23	0.2184	
Sigma	16.883170	1.411254	11.96	<.0001	

Variables found to significantly impact pre- or at-plant lock-in percentages include the SA dummy variable (+), income percentage from corn revenues (+) and irrigation levels (+). Operating in a non-supported environment has a strong, positive impact on pre-planting hedging levels. Operating in South African increases the pre-plant lock-in levels by 29.44%. Diversification (%Mzshare), irrigation and debt also

positively impact pre-plant lock-in level across producers in both countries which is consistent with theory. South Africa interactions of each explanatory variable were also tested in the model to assess if a different slope exists for the same variables in South Africa, but no significance was found within the interactions.

Hypothesis 1b is tested by the relationships defined by equation 5-1b with pre-harvest expected price (revenue) lock-in as the dependent variable. The explanatory variables remain constant with equation 5-1a. While I expect similar signs, I would expect less magnitude from the impacts given locking-in price pre-harvest exhibits less uncertainty than locking-in prices pre-planting.

$$PreHLI = \alpha + \beta_1 SA + \beta_2 Exp + \beta_3 Edu + \beta_4 ProdOFI + \beta_5 \%MZshare + \beta_6 Irr + \beta_7 Assets + \beta_8 Debt + \beta_9 MzCI + \beta_{10} RiskAtt + \varepsilon \quad (5.1b)$$

Hypothesis 1b is tested using tobit regression. The tobit estimation results are presented in table 5-4.

Table 5-4. Equation 5.1b tobit estimation results (dep. var. = PreHLI).

The QLIM Procedure						
Summary Statistics of Continuous Responses						
Error	Type	Standard	Lower	Variable	Mean	
PreHLI	49.01064	22.768349	Censored 0			
Model Fit Summary						
Number of Endogenous Variables				1		
Endogenous Variable				PreHLI		
Number of Observations				94		
Missing Values				2		
Log Likelihood				-387.42718		
Maximum Absolute Gradient				0.0000595		
Number of Iterations				56		
AIC				798.85435		
Schwarz Criterion				829.37389		
Parameter Estimates						
Parameter	Estimate	Standard Error	t Value	Approx Pr > t	One-sided Pr > t	Intercept
7.638126	18.826254	0.41	0.6850			
SADummy	17.978400	6.582322	2.73	0.0063	0.0032	
Exp	-0.600212	0.184961	-3.25	0.0012	0.0006	
Edu	1.810481	0.931179	1.94	0.0519	0.0258	
ProdOFI	0.006441	11.010720	0.00	0.9995		
%Mzshare	0.178062	0.114168	1.56	0.1188	0.0594	
Irr	0.235446	0.052209	4.51	<.0001	<.0001	
Assetsscaled	0.158831	0.673774	0.24	0.8136		
Debt	0.142618	0.133649	1.07	0.2859		
MZCI	-0.000092	0.006172	-0.02	0.9880		
RskAtt	-0.002913	0.009026	-0.32	0.7469		
Sigma	17.579779	1.336781	13.15	<.0001		

Variables found to significantly impact pre-harvest consistent with equation 5-1a include the SA dummy variable (+), experience (-), education (+), income percentage from corn revenues (+) and irrigation levels (+). As expected, both operating in a non-supported environment (SA) and income percentage from corn revenues (%MZshare) have smaller coefficients than equation 5-1a. Irrigation levels (Irr), however, have a slightly larger impact on pre-harvest hedging levels. This may be explained by the fact that the producer must have more certain yield to increase his lock-in levels.

Experience and education as significant variables is an interesting result. In absolute interpretation, these results are consistent with the producer survey. In comparison with pre-planting results, it appears the education and experience impacts increase as the growing season progresses. Older, more experienced farmers were observed to begin locking-in prices at later stages in the growing season than younger, less experienced farmers. Also, more educated producers were observed to be generally more involved in hedging than less educated producers. South Africa interactions of each explanatory variable were also tested in the model to assess if a different slope exists for the same variables in South Africa, but no significance was found within the interactions.

Producing in South Africa has strong, positive impact on lock-in levels, particularly pre-planting lock-in levels. However, producer and farm idiosyncratic variables across both countries continue to remain significant in the lock-in choice. Debt impacts at early stages which is consistent with the need for reduced variance in revenues. Yield risk (diversification and irrigation) becomes important as the growing season continues.

Hypothesis one identifies the cross-country differences in the producers' general incentives to manage price risk and price-risk management behaviors. Hypothesis two seeks to identify differences across institutions in regard to futures and options usage. It is expected that without government-provided grain price protections, producers in a non-supported environment will be more likely to utilize the equivalent market-based price-risk management tools such as futures and options. This expectation implies that education will be more important in non-supported environments with regard to tool usage. Debt is generally expected to positively impact futures and options given less tolerance for volatile revenues. In addition to education and debt, farm size (corn bushels) and yield risk are expected to impact futures usage.

Options usage has less theoretically identified impact variables. However, it is expected that producers in a price supported environment will substitute available programs for options as a price-risk management tool and be less likely to use options. Debt and education are expected to positively impact options usage for similar reasons as futures usage.

H2a: Producing in a non-supported environment significantly impacts corn futures usage as a price-risk management tool in addition to size and education.

H2b: Education in a non-supported environment has larger impacts on futures and options usage.

Testing and Analysis

H2a: Producers were asked to state which tools were used to execute their PRM strategies, if using. A binary logit model is used to test the impacts of model variables on

the probability of producers choosing to hedge via corn futures contracts as a PRM strategy and tool. Equation 2a is the hypothesized model used.

$$\text{prob}(\text{FuturesContractHedge}) = f(\text{SA}, \text{Exp}, \text{Edu}, \text{TotalMzbu}, \text{Irr}, \text{Debt}, \text{MZCI}, \text{SAEdu}, \text{SATotalMzbu}, \text{SAMZCI}) \quad (5.2a)$$

The South Africa dummy variable (SA) proxies the impact of producing in a non-supported environment and is expected to have a positive sign. Producer demographic and farm-level variables are included to control for theoretically supposed impacts particularly of education (+), size (TotalMzbu) (+) and lack of yield risk (Irr) (+). Significant interaction variables of those discrete variables that were found significantly initially are included in the final model. South African education interaction is expected to have a larger positive impact than education alone.

Table 5-5 provides the binary logit regression results. The Nagelkerke R² measuring goodness of fit indicates that approximately 44 percent of variation in the probability of choosing futures contracts to hedge is explained by the model.

Table 5-5. Binary logit regression results (dep. var. = FuturesContractHedge). Variables in the Equation

		B	S.E.	Wald	Sig.	Exp(B)
Step 1(a)	SADummy	-21.965	11.290	3.785	.052*	.000
	Exp	-.041	.051	.635	.426	.960
	Edu	-.090	.386	.055	.815	.914
	TotalMz	.095	.050	3.624	.057*	1.099
	Irrpercent	-.005	.014	.134	.714	.995
	Debtpercent	-.062	.056	1.244	.265	.940
	MZCIpercent	.676	2.738	.061	.805	1.967
	SAEdu	1.042	.629	2.746	.049**	2.836
	SAMZCI	5.077	3.690	1.893	.169	160.237
	Constant	.191	6.866	.001	.978	1.211

Significance at ***0.10 level **0.05 level *0.10 level.

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	35.804(a)	.226	.440

Variables found to significantly impact the probability of producers choosing futures contracts as PRM tool include operating within South Africa, size as measured by total maize produced and the interaction term between South African and education. Size has a positive sign as expected given the economies of scale gained with hedging multiple futures contracts. The South Africa dummy variable is significant; the odds ratio (Exp B) indicates that producing in South Africa has a significant negative effect on the odds of a futures contracted hedge outcome. This result is inconsistent with the expectation that producing in South Africa would have a neutral or positive effect on futures usage. The South African education interaction is found to positively impact the probability to use corn futures contracts by 3.398 at the 0.10 level. This is relative to the total education impact of 0.963. The inclusion of two South Africa interaction variables may explain the inconsistent findings associated with the South Africa dummy variable; estimates including South Africa are competing for explanatory power.

H2b: Producers interviewed also report options usage. The South African dummy variable (SA) again measures the impact of the non-supported environment. Fewer *a priori* expectations exists regarding producer and farm-level demographic variables with regard to options usage. However, it is expected that education and debt should positively impact options usage given the complexity and functions of options and the relatively manageable premiums. Equation 2b details the binary logit model used to test hypothesis 2b.

$$prob (OptionsUsage) = f (SA, Exp, Edu, TotaMzbu, Irr, Debt, MZCI) \quad (5.2b)$$

Table 5-6 provides the results of the binary logit regression. The Nagelkerke R^2 measuring goodness of fit indicates that approximately 15 percent of the variation in the probability of producers using options is explained by this model

Table 5-6. Binary logit regression results (dep. var. = OptionsUsage).

Variables in the Equation		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1(a)	SADummy	.983	1.353	.528	1	.467	2.673
	Exp	-.016	.036	.208	1	.648	.984
	Edu	.042	.181	.055	1	.814	1.043
	TotalMzscale	.037	.025	2.125	1	.145	1.037
	Irrpercent	.003	.009	.123	1	.726	1.003
	Debtpercent	.051	.029	3.235	1	.036**	1.053
	MZCIpercent	1.003	1.059	.896	1	.344	2.725
	SADebt	.296	1.324	.050	1	.823	1.344
	Constant	-4.588	3.755	1.493	1	.222	.010

Significance at ***0.10 level **0.05 level *0.10 level.

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	56.400(a)	.084	.150

The only variable found to impact the probability of options usage is the producer's debt level. Options premiums may be easier for high-debt producers to manage than futures contract commission and margin accounts. Significant interaction variables of those discrete variables that were found significantly initially are included in the final model. The slope of debt impact is consistent across countries as the debt interaction variable is not found significant.

5.4 Discussion and Conclusions

“I was a producer; I am now forced to be a marketer”, a common anecdote heard among South African corn producers, is telling regarding the relative importance of managing price risk in a non-supported environment when compared to U.S. anecdotes

such as “I’m a grower, not a marketer... should do more marketing, just never have done it.”³⁷

The general differences in price-risk management across institutions are evidenced by hypothesis one. Producers in a non-supported environment are found to consistently lock-in price for a larger percentage of expected corn yields. Pre-harvest and pre- or at- plant corn price lock-in percentages are both significantly, positively impacted by being a South African producer when controlling for other demographic variables. This difference attributed to producer in a non-supported environment is as expected; we would expect producers operating with larger downside price risk would more actively secure expected revenues.

Interestingly, these results suggest that South African price actually affects production decisions; planting and PRM decisions appear to be made simultaneously. These results infer that U.S. producers [in an average year] plant first then manage price risk as the seasonal prices evolve. U.S. producers do react to actual (and expected) commodity price differentials by shifting crop choice, but U.S. producers do not appear to simultaneously lock-in prices for the crop chosen as compared to South African producers. South African producers also indicated their PRM strategies remain consistent more often than U.S. producers with PRM strategies indicated.

U.S. farm programs appear to impact the likelihood to lock-in prices primarily when corn prices are low relative to the posted county price (PCP). Many Missouri producers indicated the presence of the loan deficiency program (LDP) allowed them “to be more bullish and gamble in a low market.” Little incentive exists to actively market at

³⁷ When discussing price-risk management, producers generally thought of PRM as part of “marketing.” The academic definitions for marketing (strategic selling) and price-risk management (securing revenues) are not synonymous.

prices \$1.80-\$2.40 according to Missouri producer discussion. Essentially, the loan deficiency program and countercyclical payments provides payments when corn prices fall below posted county prices which are usually higher than the national target price of \$1.95/bushel.³⁸ In addition, the direct payment “adds the profit margin” to many producers' income statements. These program-corn price interactions, particularly the LDP, explain why a consistent PRM strategy is observed less with those U.S. producers surveyed.

Hypothesis two focuses on PRM tool choices across institutions. While futures usage is slightly larger in South Africa (SA 12 percent, US 9 percent), options usage is slightly less (SA 13 percent, US 16 percent). The primary impact variable found to impact the probability of using corn futures as PRM tool in the interaction variable between South Africa and education. Education has a larger impact in South Africa than the U.S. on choosing corn futures as a PRM; a one year increase in education increases the odds of using corn futures 2.84 times.

From the interviews, it is noted that education has become a higher priority for South African farmers post-deregulation. Due to the financial and political uncertainties within South African agriculture and the agricultural marketing abilities needed, many producers indicated they would not let their sons [next generation] return to the farm after high school equivalent without pursuing some type of higher education level first. Of those beginning U.S. farmers interviewed, all immediately began farming post-high school. These anecdotes support the binary logit results that education has a larger impact on futures usage in South Africa. It is reasonable that more focus on education would lead to more complicated PRM tool usage.

³⁸ See appendix B for a more complete discussion of payment details.

The probability of using options as part of the PRM strategy is found to be impacted primarily by debt. Producing in South Africa was found to have no significant impact on the probability of using options. Given a lack of *a priori* expectations regarding options usage, the result is reasonable. Options allow the producer to secure the option to sell [buy] at a particular strike price which would be useful for securing expected revenues to cover debt. Options usage is less complicated than a futures hedge and does not likely exhibit the transaction costs of futures hedging including margin calls and education.

Given the holistic nature of this study, it is important to discuss the agricultural lending environments behind South African and U.S. PRM behaviors. As part of the agricultural marketing system, South African agricultural lending practices were found to play a larger role in both South African producer lock-in percentages and tool choices than expected. Higher debt (approximately greater than 34 percent leverage) producers in South Africa are required to contract (lock-in) pre-planting with the bank enough expected corn yield to cover the operating loan. In some cases, producers are not granted operating loans in some years and cannot plant. This lending practice is directly related to the observed level of South African pre- or at-planting price lock-in percentages.³⁹ Given bank-provided forward contracts, these higher risk South African producers would be likely using forward contracts in lieu of options to secure minimum expected revenues to cover operating loans.

U.S. agricultural lending practices are more “hands-off” and are intertwined with U.S. farm program payments. Parallel Missouri agricultural lenders indicate they “cannot tell farmers how to run their business [force contracting or PRM]”, but do

³⁹ Higher risk producers accounted for 34 percent of the South African producers interviewed.

encourage managing price risk. Thus, there is no mandatory price lock-in requirement to obtain an agricultural operating loan.⁴⁰ These lenders also indicated that both the Direct Payment (DP) and LDP price level are both included in producer annual cash flow projections which ultimately prescribes operating loan repayment ability.⁴¹

An additional and interesting interaction between U.S. agricultural lending and the farm program involves beginning farmers who are often deemed “high risk” in terms of a lacking asset base and debt levels. U.S. beginning farmers involved in this study indicated that farm service agency (FSA) beginning farmers loans are the most important aspect of the U.S. farm program for them. These loans provide operating loans at a significantly reduced interest rate (approximately one-half current market rate). Parallel South African beginning farmers do not have this subsidized operating loan option and would be required to lock-in some level of expected yields if deemed high risk.

In conclusion, interviewed producers in a non-supported environment lock-in prices for larger percentages of expected corn yields than producers in supported environments. It appears that price risk actually affects production decisions in non-supported environments.

Producers in supported environments appear to make price-risk management decisions relative to the perceived (farm program) price floor rather than the full price distribution realized by producers in non-supported environments. Price-risk management incentives are lacking when corn prices are within range of the farm program target price (*perceived* price floor).

⁴⁰ Missouri agricultural lenders involved in this study indicated that above 50 percent debt was considered higher risk.

⁴¹ According to the January 2007 agricultural lender interviews, the LDP posted county price is used as the default corn price if the producer is not currently locked-in at a higher price through some PRM strategy.

With regard to institutional impacts, it is important to note that, in addition to farm program impacts, the entire set of agricultural institutions including financial markets creates incentives for and against actively managing corn price risk.

This study prompts further inquiry into both comparative agricultural lending practices and the relative costs of corn price-risk management tools. Why is contracted lending accepted in South Africa and is not practiced in the United States? To what extent do forward contracts differ across agricultural marketing environments in terms of crop and contract insurance (*force majeure*)? In terms of PRM tools, are corn option premiums priced in the U.S. relative to the LDP price or the full option value?

Chapter 6

Dissertation Conclusions

This dissertation informed the surrounding agricultural marketing environment's impact on grain producers' price risk management decisions. Specifically, this dissertation informed how producer price-risk management behaviors differ across supported and non-supported agricultural marketing environments. The following research questions motivated this study:

- 1) "How do U.S. grain producers perceive U.S. farm programs and how do program elements impact U.S. grain producers' price risk management behavior?"
- 2) "Do grain producers manage price-risk in a non-supported agricultural marketing environment according to theoretical expectations?"
- 3) Do supported and non-supported agricultural marketing environments incentivise different grain producer price-risk management behaviors?

A research gap exists in the agricultural price risk management literature regarding U.S. grain producer's actual hedging (expected grain price lock-in) behavior. The current literature is unable to consistently predict observed U.S. producer's hedging levels; U.S. grain producers have been found to hedge a lesser percentage of expected grain production than theoretically prescribed. Potential explanations for these deviations such as producer and farm characteristics have been modeled empirically, but these models provide aggregate results that are difficult to apply to actual producer decisions and still do not prescribe zero hedging levels.

This research addressed this research gap regarding producer price risk management within the agricultural price risk management literature by adding a New Institutional Economics perspective. New Institutional Economics argues that decision-makers and consequent decisions are influenced by their surrounding institutional environments. In

this case, I hypothesized that the U.S. farm program existence, particularly the LDP and the Direct Payment programs, influences grain producer price risk management. Adding the institutional dimension to agricultural price risk management literature pushes the literature toward a more holistic view of the producer's hedging decision.

This research built on prior price risk management literature incorporating U.S. farm programs into the producer's hedging decision by investigating the incentives created by the farm program *presence* rather than a discrete farm program policy change impact. This dissertation makes two primary additions: 1) identifies the role producers perceive U.S. farm program elements to play with their farm business and the perceived roles' impacts; and 2) employs comparative methods to isolate the agricultural marketing environment impacts on producer hedging decisions across countries. These results informed how marketing environments impact *actual* producer hedging decisions rather than the current optimized modeled (hypothetical) decisions.

The dissertation research questions were addressed through a three-part process found in chapters three through five. Chapter three investigated the role of U.S. farm programs within agricultural marketing decisions from a Missouri grain producer's perspective. These producers saw the farm program primarily as a grain price safety net and a farm income booster. These roles are achieved through the LDP and Direct Payment programs as they were identified as the most important farm program elements to the producers' farm businesses. From the role perception exploration, it was found the identification of the farm program as a grain price safety net negatively impacted the actual percentage producers hedged prior to harvest.

Chapter four explored grain producer price risk management and tested hypotheses regarding price risk management in the South African maize belt, a non-supported agricultural marketing environment. South African producers were found to be actively managing price risk via fixed-price contracts, futures and options. Little variation was found across producer hedging levels. Education and size were found to positively impact futures contract usage, but these variables were found to significantly impact options usage.

Chapter five isolated agricultural marketing environment impacts by comparing actual grain producer price risk management hedging levels across environments. Operating in South Africa was found to positively impact the amount of grain locked-in at some expected price.

Together, these results are telling regarding grain producer price risk management practices across supported and non-supported environments. Differences in producer hedging levels were found to be *significantly* impacted by operating in a non-supported agricultural marketing environment. The U.S. farm program creates disincentives to hedge when producers perceive the program as creating a price floor; grain producers regularly substitute government-provided perceived grain price security for locking-in expected grain revenues via market-based tools. In a non-supported agricultural marketing environment, grain price uncertainty appears to override commonly stated reasons (age, education, diversification and size) impacting producer hedging; South African producers were found to hedge according to market incentives including debt and lending constraints.

The dissertation results also inform institution replacement. From this study, it is inferred that market-based institutions evolve to replace prior government-provided functions when needed. In the case of South Africa, market forces are replacing grain price certainty previously provided by the South African marketing boards. Commercial agricultural lending is evolving within the South African agricultural marketing system. Lenders pro-actively manage risk exposure by mandating producer hedging practices which moves toward market-based price certainty.

In general, if the next U.S. farm bill (expected 2007) suddenly changes, we would expect to see *competitive* grain producers increasing price-risk management activities to replace the perceived grain price and income security aspects of the farm program. Educated producers would likely have an advantage over less educated producers. Given the varying abilities and attitudes of producers, it is expected that lenders will be forced to take a more active role in producers' price-risk management activities. Agricultural lenders will also have to replace the price protections currently maintained by the U.S. farm program. As mentioned, this floor impacts producer repayment ability and, ultimately, the lenders bottom line.

It is unclear whether producers would be better off without grain price security and income supports. In South Africa, the number of farmers declined by 21 percent post-deregulation. However, the remaining producers are likely more competitive. These farms do bear the full financial costs of operations including transaction costs associated with price-risk management activities. According to economic theory, better social outcomes (less deadweight loss) occur when decision-makers bear the costs of transactions and resources are allocated accordingly.

This study prompts a few interesting issues for further research. Producers in both South African and the U.S. commented that grain option premiums are “too expensive”. South African producers utilized maize options in spite of the premium costs. This observation prompts investigation into option pricing in both countries. Is the U.S. grain floor price level priced into option premiums? If so, U.S. grain options should be relatively less expensive than South African grain options.

Also, the evolving South African agricultural lenders’ involvement in producer hedging activities is curious. When asked, U.S. agricultural lenders said this involvement is impossible in the United States. What factors would need to be in place for these lending practices to evolve in the United States? Will agricultural lending practices change with a changing U.S. farm program?

APPENDICES

Appendix A. U.S. Farm Program History.

Milestones in U.S. agricultural policy

1933

Agricultural Adjustment Act: First “farm bill” established the New Deal mix of commodity-specific price and income support programs.

1936

Soil Conservation and Domestic Allotment Act: First direct links created between soil conservation and commodity programs.

1949

Agricultural Act: Established policy of high, fixed-price supports and acreage allotments as permanent farm policy.

1954

Agricultural Act: Introduced flexible price supports to commodity programs.

1956

Agricultural Act: Established Soil Bank, which introduced use of conservation reserve in addition to acreage control for supply management. The program ended after only 2 years.

1965

Food and Agricultural Act: Introduced new income support payments in combination with reduced price supports and continued supply controls.

1970

Agriculture Act: First inclusion of title for Rural Development in a farm bill.

1973

Agriculture and Consumer Protection Act: Introduced target prices and deficiency payments to replace price supports, coupled with low commodity loan rates, to increase producer reliance on markets and allow for free movement of commodities at world prices.

1977

Food and Agriculture Act: First inclusion of title for Food Stamps and other commodity distribution programs in a farm bill.

1985

Food Security Act: Introduced marketing loan provisions to commodity loan programs to reduce forfeitures by allowing repayment of loans at lower rate when market prices fell, with the intention of aiding in reducing Government-held surplus grain. Re-established a conservation reserve.

1996

Federal Agriculture Improvement and Reform Act: Replaced price support and supply control program with program of direct payments based on historical production. Introduced nearly complete planting flexibility.

2002

Farm Security and Rural Investment Act: Introduced counter-cyclical payments program, payments paid based on historical production. Introduced working-lands conservation payments. Continued planting flexibility and program of direct payments based on historical production.

Expected 2007

New Farm Program Legislation

Source: Compiled by Economic Research Service, USDA. The complete texts of U.S. farm bills from 1933 to 2002 are available on the website of the National Agricultural Law Center (<http://www.nationalaglawcenter.org/farmbills>)

Appendix B. Loan Deficiency Program (LDP) and Counter-Cyclical Payments.

Loan Deficiency Payments (LDPs)

Commodity loan programs allow producers of designated crops to receive a loan from the government at a commodity-specific loan rate per unit of production by pledging production as loan collateral. After harvest, a farmer may obtain a loan for all or part of the new commodity production.

Selected Marketing Assistance Loan Rates

Commodity	Unit	2002-03	2004-07
Wheat	Bushel	\$2.80	\$2.75
Corn	Bushel	\$1.98	\$1.95
Soybeans	Bushel	\$5.00	\$5.00

Loan program benefits can also be taken directly as loan deficiency payments. The LDP option allows the producer to receive the benefits of the marketing loan program without having to take out and subsequently repay a commodity loan. The LDP rate is *the amount by which the loan rate exceeds the posted county price or prevailing world market price*, and thus is equivalent to the marketing loan gain that could alternatively be obtained for crops under loan.

Payment Limits: \$75,000 per person, per crop year; the three-entity rule is in place (\$150,000 total potential payment).

Counter-Cyclical Payments (CCPs)

CCPs are available for covered commodities whenever the effective price is less than the target price. The payment amount is equal to the product of the payment rate, the payment acres, and the payment yield. These payments were introduced in the 2002 Farm Bill.

For example the payment for an individual corn farmer is determined as:
$$\text{Payment rate}_{\text{corn}} = (\text{Target price})_{\text{corn}} - (\text{Direct payment rate})_{\text{corn}} - (\text{Higher of commodity price or loan rate})_{\text{corn}}$$

$$\text{CCP}_{\text{corn}} = [(\text{Base acres})_{\text{corn}} \times 0.85] \times (\text{Payment yield})_{\text{corn}} \times (\text{Payment rate})_{\text{corn}}$$

Producers must enroll into the program annually. The payments are based on chosen base acre and yield formulas.

Payment Limits: \$65,000 per person, per crop year; the three-entity rule is in place (\$130,000 total potential payment).

Source: Compiled by Risk Management Agency, USDA. More details are available at <http://www.rma.usda.gov/policies/>.

Appendix C: U.S. Crop Insurance Details.

Since the 1930s, producers of specific crops can purchase insurance policies at a subsidized rate under Federal crop insurance programs. These insurance policies make indemnity payments to producers based on current losses related to either below-average yields (crop yield insurance) or below-average revenue (revenue insurance). Policies are sold through private insurance companies, but the *USDA's Risk Management Agency (RMA) subsidizes the insurance premiums, subsidizes a portion of the companies' administrative and operating expenses, and shares underwriting gains and losses with the companies under the Standard Reinsurance Agreement.* Farmers sign up for insurance *prior* to planting, but usually pay premiums after harvest.

Note: The Agricultural Risk Protection Act of 2000 budgeted an additional \$8.2 billion over 10 years for premium subsidies.

Yield Insurance

Multi-Peril (MP)

These policies insure producers against yield losses due to natural causes such as drought, excessive moisture, hail, wind, frost, insects, and disease. The most common yield coverage occurs when the farmer selects the amount of average yield he or she wishes to insure; from 50 to 75 percent (in some areas to 85 percent). The farmer also selects the percent of the predicted price he or she wants to insure; between 55 and 100 percent of the crop price established annually by RMA. If the harvest is less than the yield insured, the farmer is paid an indemnity based on the difference. Indemnities are calculated by multiplying this difference by the insured percentage of the established price selected when crop insurance was purchased.

Revenue Insurance (RI)

Revenue insurance is an insurance product introduced after the 1994 reforms. All revenue-based options determine revenue differently.

Pure

This insurance design protects producers against reductions in gross income when either a crop's price or yield declines from early-season expectations. Revenue Assurance (RA) provides dollar-denominated coverage by the producer selecting a dollar amount of target revenue at a minimum of 65 percent of expected revenue.

Crop Revenue Coverage (CRC)

This insurance design provides revenue protection based on price and yield expectations by paying for losses below the guarantee at the higher of an early-season price or the harvest price.

Source: Compiled by Risk Management Agency, USDA. More details are available at <http://www.rma.usda.gov/policies/>.

Appendix D: United States (Missouri) Producer Survey Instruments

D-1: U.S. DEMOGRAPHIC INFORMATION

1. What is your **age**?
_____ Years
2. How many years of **farming experience** (since age 18) do you have?
_____ Years
3. How many **years of formal education** do you have? _____ years
(e.g. High School = 12, Associates Degree =14, Bachelors = 16)
4. Please circle the phrase which best describes your **farm business**.

Individual owner	Company
Trust	Close Corporation
Partnership	Other (please specify) _____
5. Please provide details of the **main crops** on your farm in an average year. For production, please use bushels. For gross income, indicate dollars (\$) **and/or** percentage of farm income arising from each crop.

Specific Crop	Production (total bu)	Specific Crop income as a percentage of total farm income (%)
Corn		
Soybeans		
Wheat		
Livestock		
Others (please specify)		
TOTAL		100%

6. a). This question deals with **off-farm employment** by yourself and your spouse 2006.

	Yourself		Your spouse	
Did you or your spouse have off-farm employment in 2006?	YES	NO	YES	NO
If so, was it part-time (P) or full-time (F)?	P	F	P	F
Annual gross off-farm income as % of total household income (\$)				

b) Has the off-farm income proportion of you household income changed significantly since 1996? Please check one: _____ Yes _____ No

If yes, please check one of the statement that best describes your situation:

_____ MORE Income proportion from off-farm sources
 _____ LESS Income proportion from off-farm sources

7. How many **acres** of arable and pasture land does the farm business:

	Arable land	Pasture
Own?		
Rent?		
Rent out?		

8. a) Do you **irrigate** any of your corn? Please tick one: _____ Yes _____ NO

b) If yes, what **% of planted area is irrigated**? _____%

9. What was your farm business **gross sales** for the most recent financial year (e.g. 2005/06)? Please check the correct sales category.

_____ \$500,000 or more
 _____ \$250,000-\$499,999
 _____ \$100,00-\$249,999
 _____ Less than \$100,000

10. What is the total value of your farm **assets** (i.e. realistic *market value* of land, fixed improvements, machinery, livestock, etc.) as at your most recent financial year-end?
\$ _____

11. What is your approximate **Debt:Asset** ratio? _____

12. What is the **distance** from your farm to the nearest:

Grain elevator	_____	mi
Cattle auction	_____	mi
Feedlot	_____	mi
Large town	_____	mi
Packer	_____	mi

13. Please indicate whether you have access to the following: (Please check all that apply.)

Dial-up Internet		High Speed Internet		Land line		Cell phone		Fax	
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14. Where do you go for the **majority** of the **information you use** to make decisions regarding corn marketing and price risk management? **Please check only one.**

- _____ Fellow producers
- _____ USDA/University publications
- _____ Popular farm publications
- _____ Producer Organization (ex. MO Soy or MO Corn Growers)
- _____ CBOT (via internet)
- _____ Cooperatives
- _____ Market advisory Service

15. a) Since 1996, do you seek (please check one):

- _____ MORE information regarding local corn crop conditions
- _____ SAME AMOUNT of information regarding local corn crop conditions
- _____ LESS information regarding local corn crop conditions

b) Since 1996, do you seek (please check one):

- _____ MORE information regarding international corn crop conditions
- _____ SAME AMOUNT of information regarding international corn crop conditions

_____ LESS information regarding international corn crop conditions

16. Please rate the importance of the following **sources of risk** facing your farm business on a scale of 1 to 5, where 1 = not important and 5 = very important (where a risk source is not applicable, tick the N/A box):

Source of risk	N/A	Importance				
		Low		High		
Variability in crop yields		1	2	3	4	5
Variability in crop prices		1	2	3	4	5
Variability in livestock prices (e.g. beef prices)		1	2	3	4	5
Changes in U.S. farm policy		1	2	3	4	5
Changes in input costs (e.g. fertilizer, chemicals, feed)		1	2	3	4	5
Changes in interest rates		1	2	3	4	5
Changes in the exchange rate		1	2	3	4	5
Further reduction in import tariffs		1	2	3	4	5
Theft		1	2	3	4	5
Other (please specify)		1	2	3	4	5

Decision Scenarios

I would like to understand how you would react regarding the following management situations. Please read through the scenario and choose the option which best describes the action you would advise the person to take.

1. Mr. Liles is in the middle of corn harvesting when his combine has a major breakdown and it begins to rain. Mr. Liles could purchase a new combine which is currently available from his machinery dealer to be delivered in the morning. Or Mr. Liles could arrange for the repair of his combine which would be much less costly than a new combine. The combine would have several years of life remaining after the repairs. However, the machinery dealer does not know when the needed parts will be obtained and repairs can be completed. If Mr. Liles is unable to resume harvesting after the rain, there will be extra harvesting losses.

Imagine you are advising Mr. Liles. Listed below are several possibilities or odds that the repairs will be completed before Mr. Liles would be able to resume harvesting and avoid extra harvesting losses.

Please check the lowest probability you would consider acceptable for Mr. Liles to repair the old combine.

☐ Place a check here if you think Mr. Liles should not consider repair to the old combine no matter what the probabilities.

☐ The chances are 9 in 10 that the combine will be repaired before harvesting can be resumed.

☐ The chances are 7 in 10 that the combine will be repaired before harvesting can be resumed.

☐ The chances are 5 in 10 that the combine will be repaired before harvesting can be resumed.

☐ The chances are 3 in 10 that the combine will be repaired before harvesting can be resumed.

☐ The chances are 1 in 10 that the combine will be repaired before harvesting can be resumed

2. Ray, a 28-year old married farmer, has been share leasing cropland from several landowners for more than five years. Mrs. Wilson, a widow, is offering Ray the opportunity to buy her land at a price slightly below the current market value. Ray can obtain the necessary financing, although the land purchase would involve a large debt and put him in a vulnerable financial situation. Purchase of the land would be a good investment, if no major adversity occurs in agriculture. On the other hand, a significant adversity could force Ray out of farming.

Imagine you are advising Ray. Listed below are several possibilities or odds of no significant adversity occurring in agriculture.

Please check the lowest probability that you would consider acceptable for Ray to purchase Mrs. Wilson's land.

_____ Please place a check here if you think Ray should not buy the land, no matter what the probabilities.

_____ The chances are 9 in 10 that no significant adversity will occur.

_____ The chances are 7 in 10 that no significant adversity will occur.

_____ The chances are 5 in 10 that no significant adversity will occur.

_____ The chances are 3 in 10 that no significant adversity will occur.

_____ The chances are 1 in 10 that no significant adversity will occur

3. Lee, a 35 year old farmer, has recently been informed by his physician that he has developed a severe heart ailment. The disease would be serious enough to force Lee to change many of his life activities-giving up his farming activities, drastically changing his diet, reducing many of his most favorite leisure activities. The physician suggests a delicate medical operation could be attempted which would completely relieve the heart condition if successful. But if not successful, the operation might prove fatal.

Imagine you are advising Lee. Listed below are several possibilities or odds that the operation will prove successful.

Please check the lowest probability you would consider acceptable for the operation to be performed.

_____ Please place a check here if you think Lee should not have the operation no matter what the probabilities.

_____ The chances are 9 in 10 the operation will be a success.

_____ The chances are 7 in 10 the operation will be a success.

_____ The chances are 5 in 10 the operation will be a success.

_____ The chances are 3 in 10 the operation will be a success.

_____ The chances are 1 in 10 the operation will be a success.

**Missouri Corn Producer Interviews
Question Guide**

Risk Management Strategies

Interviewer: I would like to understand your price risk management decisions. I am particularly interested in the decision making process (decisions and important factors) you go through during the season.

1. Prior to 1996, how would you characterize your exposure to price risk? Please rate your exposure on a scale of 1-5 with 5 being highly exposed.
2. a. Since 1996, has your exposure to price risk increased or decreased? Please rate your perceived change in price exposure on a scale of 1-5 with 5 being “much different exposure than before 1996.”
b. farm income risk?
3. What are other important sources of risk and uncertainty? Please rate these sources on a scale of 1-5 with 5 being very important.
4. a) How important is it to you to have a secure price level? Please rate its importance on a scale of 1-5 with 5 being very important.

b) Do you engage in strategies to reduce price risk? 1=yes; 0=no
What level of security do you prefer? (What % of expected PRODUCTION do you want to have locked in a price in advance [at planting]?)

c) What level of security do you prefer? (What % of expected PRODUCTION do you want to have locked in a price in advance [at planting]?)
5. a) In a typical year, how do you market your corn? (What do you do with the physical product?)

b) Who are your buyers? Percentages?

c) Do your customers provide price risk management services? 1= yes; 0=no
6. I would like to understand the dynamic of your price risk management process.
 - a. What is the strategy’s objective?
 - b. How do you define the strategy? Hedging, forward contracting, etc.
 - c. Please describe the thought process you go through when deciding to use this strategy?
 - d. Exactly how is the strategy executed? Do you personally execute the strategy?

- e. What yields is the strategy based on (expected yield, average yield, etc.)?
 - f. What proportion of the yield (crop) price is secured by this strategy?
 - g. Do you have on-farm storage?
7. What factors are critical when choosing which strategies to execute?
Please rate the importance of each factor in your risk management process on a scale of 1-5 with 5 being very important.
8. Do your strategies change each year? 1=yes; 0=no
9. Why do you not choose particular strategies? I.e. What impediments do you see regarding using particular strategies?
- a. Hedging
 - b. Options
 - c. Forward Contracting
10. How do you perceive the current market conditions (market transparency)?
Examples of potential transparency arenas: transport differential [fair], CBOT price [manipulation], USDA crop estimates [accurate].
11. a. What is the role of expected farm payment programs in how you run your business? 1-5 scale
b. How important is the 2008 Farm Bill outcomes (expectations) in your farm planning?
c. Which farm payment programs are important? Discuss how.
12. Do you borrow capital for agricultural operations (operating loans =short term)?
From which entities? Differentiate here between long-term and short-term.
13. Do your agricultural lenders promote using any particular price risk management strategies? How? (possibly lower interest rate, etc.)
If yes, do you feel the lender's preference is similar across all clients?
14. Do you purchase crop insurance?
- a) From who?
 - b) What type of insurance is it?
 - c) How much do you purchase?
 - d) What are the coverage levels in terms of yield or revenue guarantees?
 - e) Would you continue to purchase crop insurance if the price were to increase by 50%? 100%?

Appendix E: South Africa Producer Survey Instruments

E-1: SA DEMOGRAPHIC INFORMATION

1. What is your **age**?
 Years

2. How many years of **farming experience** (since age 18) do you have?
 Years

3. How many **years of formal education**
 (e.g. Matric = 12 years, 3-year degree/diploma = 15 years)
 do you have? Years
 does your spouse have? Years

4. Please circle the phrase which best describes your farm business.
 Individual owner
 Partnership
 Company
 Trust
 Close Corporation
 Other (please specify)

5. Please provide details on the **main enterprises** on your farm in an average year. For size, please use the measure given in brackets after the enterprise. For gross income, indicate rands **and/or** percentage of farm income arising from each enterprise.

Enterprise	Size	Enterprise gross income in a normal year (R)	Enterprise income as a percentage of total farm income (%)
White maize (Ha)			
Yellow maize (Ha)			
Soyabeans (Ha)			
Sunflowers (Ha)			
Groundnuts (Ha)			
Sorghum (Ha)			
Wheat (Ha)			
Livestock			
Others (please specify)			

TOTAL			100%
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6. a) This question deals with **off-farm employment** by yourself and your spouse 2005.

	Yourself		Your spouse	
Did you or your spouse have off-farm employment in 2005?	YES	NO	YES	NO
If so, was it part-time (P) or full-time (F)?	P	F	P	F

Annual gross income from off-farm employment (Rand) _____

c) Has the off-farm income proportion of you household income changed significantly since 1996? Please circle one: Yes or No

If yes, please mark one of the following statements that best describes your situation:

_____ MORE Income proportion from off-farm sources

_____ LESS Income proportion from off-farm sources

7. How many **hectares** of arable and veld land does the farm business:

	Arable land	Veld
Own?		
Cash rent?		
Share lease?		
Rent out?		

8. What was your farm business= **gross income** (turnover) for the most recent financial year (e.g. 2005/06)? _____R

9. What is the total value of your farm **assets** (i.e. realistic market value of land, fixed improvements, machinery, livestock, etc.) as at your most recent financial year-end?

R_____ Financial year-end

10. What is the size of your farm business debt as a percentage of last year's crop receipts?

_____ %

11. What is the **distance** from your farm to the nearest:

Maize depot/silo _____ km

Cattle sales pen _____ km

Large town _____ km

Abattoir _____ km

12. Please indicate whether you have access to the following: (Please tick the appropriate block)

PARTY- LINE		DIRECT LINE		CELL PHONE		FAX	
----------------	--	----------------	--	---------------	--	-----	--

13. Do you have access to the **Internet**? (Please circle yes or no)

YES

NO

14. Where do you go for the majority of the information you use to make decisions regarding maize marketing and price risk management? Please tick the most visited resource.

- ____ Fellow producers
____ Government/University publications
____ Trade group (GrainSA)
____ Industry (SAFEX)
____ Respective Marketing Cooperative
____ _____ (please write-in)

15. Do you regularly keep informed regarding world maize crop conditions?

____ Yes ____ No

16. Please rate the importance of the following **sources of risk** facing your farm business on a scale of 1 to 5, where 1 = not important and 5 = very important (where a risk source is not applicable, tick the N/A box):

Source of risk	N/A	Importance				
		Low			High	
Variability in crop yields		1	2	3	4	5
Variability in crop prices		1	2	3	4	5
Variability in livestock production (e.g. due to drought)		1	2	3	4	5
Variability in livestock prices (e.g. beef prices)		1	2	3	4	5
Changes in input costs (e.g. fertilizer, chemicals, feed)		1	2	3	4	5
Changes in interest rates		1	2	3	4	5
Changes in the Rand exchange rate		1	2	3	4	5
Changes in labor legislation		1	2	3	4	5
Further reduction in import tariffs		1	2	3	4	5
Further government land redistribution		1	2	3	4	5
Theft		1	2	3	4	5
Other (please specify)		1	2	3	4	5
		1	2	3	4	5

Decision Scenarios

I would like to understand how you would react regarding the following management situations. Please read through the scenario and choose the option which best describes the action you would advise the person to take.

1. Jo, a 35 year old farmer, has recently been informed by his physician that he has developed a severe heart ailment. The disease would be serious enough to force Jo to change many of his life activities-giving up his farming activities, drastically changing his diet, reducing many of his most favorite leisure activities. The physician suggests a delicate medical operation could be attempted which would completely relieve the heart condition if successful. But if not successful, the operation might prove fatal.

Imagine you are advising Jo. Listed below are several possibilities or odds that the operation will prove successful.

Please check the lowest probability you would consider acceptable for the operation to be performed.

☐ Please place a check here if you think Jo should not have the operation no matter what the probabilities.

☐ The chances are 9 in 10 the operation will be a success.

☐ The chances are 7 in 10 the operation will be a success.

☐ The chances are 5 in 10 the operation will be a success.

☐ The chances are 3 in 10 the operation will be a success.

☐ The chances are 1 in 10 the operation will be a success.

2. Mr. L is in the middle of maize harvesting when his combine has a major breakdown and it begins to rain. Mr. L could purchase a new combine which is currently available from his machinery dealer to be delivered in the morning. Or Mr. L could arrange for the repair of his combine which would be much less costly than a new combine. The combine would have several years of life remaining after the repairs. However, the machinery dealer does not know when the needed parts will be obtained and repairs can be completed. If Mr. L is unable to resume harvesting after the rain, there will be extra harvesting losses.

Imagine you are advising Mr. L. Listed below are several possibilities or odds that the repairs will be completed before Mr. L would be able to resume harvesting and avoid extra harvesting losses.

Please check the lowest probability you would consider acceptable for Mr. L to repair the old combine.

☐ Place a check here if you think Mr. L should not consider repair to the old combine no matter what the probabilities.

_____ The chances are 9 in 10 that the combine will be repaired before harvesting can be resumed.

_____ The chances are 7 in 10 that the combine will be repaired before harvesting can be resumed.

_____ The chances are 5 in 10 that the combine will be repaired before harvesting can be resumed.

_____ The chances are 3 in 10 that the combine will be repaired before harvesting can be resumed.

_____ The chances are 1 in 10 that the combine will be repaired before harvesting can be resumed.

3. George, a 28-year old married farmer, has been share leasing cropland from several landowners for more than five years. Mrs. W, a widow, is offering George the opportunity to buy her land at a price slightly below the current market value. George can obtain the necessary financing, although the land purchase would involve a large debt and put him in a vulnerable financial situation. Purchase of the land would be a good investment, if no major adversity occurs in agriculture. On the other hand, a significant adversity, such as a drought or commodity price decline, could force George out of farming.

Imagine you are advising George. Listed below are several possibilities or odds of no significant adversity occurring in agriculture.

Please check the lowest probability that you would consider acceptable for George to purchase Mrs. W's land.

_____ Please place a check here if you think George should not buy the land, no matter what the probabilities.

_____ The chances are 9 in 10 that no significant adversity will occur.

_____ The chances are 7 in 10 that no significant adversity will occur.

_____ The chances are 5 in 10 that no significant adversity will occur.

_____ The chances are 3 in 10 that no significant adversity will occur.

_____ The chances are 1 in 10 that no significant adversity will occur.

E-2: South Africa. Price-risk Management Producer Interview Guide

Interviewer: I would like to understand your price risk management decisions. I am particularly interested in how your decisions and/or strategies have emerged or changed since the 1996 marketing board elimination.

1. Prior to 1996, how would you characterize your exposure to price risk? Please rate your exposure on a scale of 1-5 with 5 being highly exposed.
2. Since 1996, has your exposure to price risk increased or decreased? Please rate your perceived change in price exposure on a scale of 1-5 with 5 being “much different exposure than before 1996.”
3. What are other important sources of risk and uncertainty? Please rate these sources on a scale of 1-5 with 5 being very important.
4. a) How important is it to you to have a secure price level? Please rate its importance on a scale of 1-5 with 5 being very important.

b) What level of security do you prefer? (What % of expected revenues would you prefer to have a secure price?)

c) Do you engage in strategies to reduce price risk?
5. a) In a typical year, how do you market your white (yellow) maize? (How do you get rid of the physical product?)

b) Who are your customers? What % is sold to an elevator or marketing cooperative (in the U.S. sense)?

c) Do your customers provide price risk management services?
6. I would like to understand the dynamic of your price risk management process.

For each strategy:

What is the strategy's objective?

How do you define the strategy? Hedging, forward contracting, etc.

Please describe the thought process you go through when deciding to use this strategy?

Exactly how is the strategy executed? Do you personally execute the strategy?

What yields is the strategy based on (expected yield, average yield, etc.)?

What proportion of the yield (crop) price is secured by this strategy?

Generally:

What factors are critical when choosing which strategies to execute?

Please rate the importance of each factor in your risk management process on a scale of 1-5 with 5 being very important.

Do your strategies change each year?

Why do you not choose particular strategies?

What impediments do you see regarding using particular strategies?

If hedging/forward contracting is NOT used:

Please discuss why you do not hedge. (Need to define hedging here if not discussed before.)

Please discuss why you do not forward contract. (Need to define forward contracting here if not discussed before.)

If managing price risk through cooperatives/elevators, how does this process work?

7. How do you perceive the current market conditions (market transparency)? 1-5
8. Has the SA Department of Agriculture facilitated any marketing strategies by way of education or subsidy?
9. Do you borrow capital for agricultural operations? From which entities?
10. Do your agricultural lenders promote using any particular price risk management strategies? How? (possibly lower interest rate, etc.)
If yes, do you feel the lender's preference is similar across all clients?
11. Do you have access to crop insurance? If so, do you purchase this insurance?
 - e) From who?
 - f) What type of insurance is it?
 - g) How much do you purchase?
 - h) Is it subsidized by the government?

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VITA

Andrea Elizabeth Woolverton, daughter of Gerald Woolverton and Lynn McElrath Woolverton, was born on December 8, 1979 in Poplar Bluff, Missouri. She attended Malden High School and graduated in May 1998 as valedictorian. Andrea pursued her undergraduate work at the University of Missouri-Columbia. In May 2002, she graduated cum laude with a Bachelor of Science in agricultural economics and a minor in biology. Andrea continued her education with graduate courses at The Ohio State University in healthcare administration. She entered the agricultural economics doctoral program at the University of Missouri-Columbia in August 2003 as a National Needs Fellow. During her doctoral work, Andrea worked as a graduate instructor, teaching assistant and student-athlete mentor. During her time in school, Andrea learned from experiences in ten countries.