EVALUATION OF TEXAS-FARMER CHOICES FOR THE 2014 U.S. FARM BILL

A Thesis

by

STEPHANIE DIANE MAZURKIEWICZ

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Chair of Committee,	Joe L. Outlaw
Committee Members,	James W. Richardson
	Chris Skaggs
Head of Department,	David J. Leatham

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ABSTRACT

The 2014 Farm Bill eliminated direct payments to farmers in favor of two alternative safety net programs; Price Loss Coverage (PLC) and Agriculture Risk Coverage (ARC). Farmers must make a one-time, irrevocable choice of PLC, a county ARC program, or an individual ARC program for each covered commodity on their farm. The main objective of this study is to determine which program would be most beneficial for Texas farmers to choose.

The study will utilize the Agricultural and Food Policy Center (AFPC) database of representative farms to determine how farmers will respond to the farm bill. Stochastic simulation will be used to examine farmers' choices and will provide insight into when the farmers should choose PLC versus ARC enrollment. By incorporating historical price and yield risk into the analyses the decision between PLC and ARC can be made knowing which of the two choices would perform best under uncertainty.

The results show that most of the Texas representative farms in this study would choose PLC as their farm program decision. A total of eleven representative farms preferred PLC as the program decision for their entire farm, including whole farm and each crop's choice. PLC is expected to be the most popular program decision based on the whole farm analysis. There were zero farms showing ARC as the whole farm program decision.

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CHAPTER I

INTRODUCTION

The Agriculture Adjustment Act of 1933, generally referred to as the first Farm Bill, was part of Franklin Roosevelt's New Deal, which allowed farmers to receive payments for not growing food on a percentage of their land, as allocated by the United States Department of Agriculture (USDA). This farm bill provided financial assistance to farmers who were struggling due to an excess crop supply, which created lower prices, and also to ensure an adequate food supply. These payments allowed the government to buy excess grain from farmers, which could be sold later if bad weather or other circumstances negatively affected output.

From the passage of the 1933 Act, the Farm Bill has generally been updated every 5 to 6 years with new or changed farm programs. The 2014 Farm Bill eliminated direct payments to farmers in favor of two alternative safety net programs. These include the Price Loss Coverage (PLC) and the Agriculture Risk Coverage (ARC) programs. Farmers must make a one-time, irrevocable choice of PLC, a county ARC program, or an individual ARC program for each covered commodity on their farm Campiche, Outlaw, and Bryant (2014). Base reallocation for this payment program will be a one-time decision for this five-year program. The producer can either reallocate their base acres based on their recent planting history without adding base acres to a farm, or retain existing base acres.

Price Loss Coverage, or PLC, will cover losses in price due to the marketing year average price for a covered commodity that falls below an established reference price. Reference prices were established in the Farm Bill for each covered commodity. The marketing year average price is the average of monthly prices received for the covered commodity as determined by USDA that weights each monthly price based on the amount of the commodity marketed in the month.

Agriculture Risk Coverage, or ARC, is a revenue support program that has the producer choose between ARC-CO (County) or ARC-IC (farm level). If the producer selects ARC-CO for a covered commodity, they will get payments when the actual county revenue for the crop year is below the county ARC revenue guarantee. ARC-IC applies to all covered commodities and cannot be elected on a commodity-by-commodity basis. Payments are provided when actual revenue falls below the revenue guarantee Richardson (2014). Producers will also have the opportunity to reallocate their base acres to crops planted on the farm at any time during the 2009 to 2012 crop years Richardson (2014).

These payment options are only available to covered commodities such as grains and oilseeds, which include: wheat, oats, barley, corn, grain sorghum, long grain rice, medium grain rice, pulse crops, soybeans, other oilseeds and peanuts, other oilseeds include: sunflower seed, rapeseed, canola, safflower, flaxseed, mustard seed, crambe, sesame seed, of any oilseed designated by the secretary. Pulse crops include, dry peas, lentils, small chickpeas, and large chickpeas Richardson (2014).

This study will assist feed grain/oilseed and rice farmers in Texas with the choices they will face in the 2014 Farm Bill. The bill requires that farmers make a one-time, irrevocable choice between entering into the PLC program, entering into a county-based ARC program, or an individual farm-based ARC program. This decision, which must be made initially for the 2014 crop year, covers the next five years of planting, 2014-18. The choice is between protecting the prices they will receive, PLC, or their revenue, ARC. Farmers will receive payments when U.S. average price is below the reference price for their commodity if they are in the PLC. If they are in the ARC, they will receive payments when their actual revenue is less than the ARC guaranteed revenue on a county or individual basis. By simulating the potential impacts of all options, this analysis will provide a range of probabilities that farmers will be able to use to inform their decisions. This study will assist farmers in choosing their program by either a crop-by-crop or whole farm decision. They will have access to both options to make the program decision of PLC or ARC easier because it will be based on their farm individually.

The provisions of the new Farm Bill are not similar to the direct payments that have existed in the previous versions of the Farm Bill. Therefore, it is essential that farmers be aware of the possible pitfalls that exist. With the current drought facing Texas, it is more important than ever for farmers to have as much protection as possible. Unfortunately, multiple problems exist that are out of the farmers' hands and are inevitable. These are problems that come with the program decision; therefore we need to identify decision-risk uncertainty problems to simulate the most accurate results. The most pressing problems faced by farmers are the uncertain yields and prices. No one knows the future or what future yields or prices will be, so an analysis of the PLC ARC decision must incorporate these risks. Along with the five-year future of the farm bill, it is a 5-year irrevocable decision and making the right decision for the farmer is extremely important because they will be living with this decision for the life of the farm bill. The 2014 Farm Bill encourages farmers to think strategically about their farms through the next five years. This study will provide guidance that Texas farmers can use right away.

Texas is the second largest state in the United States and covers over 250,000 square miles in perimeter. This causes many differences in geography, weather, cultural practices for farming, meaning every farm is different. Texas doesn't have any general rules to follow under PLC/ARC because of these vast differences. Thus we need to come up with a general rule to answer the question, "What decision is best for farmers in Texas?" This study analyzes 16 farms in Texas and will break down the possible program decisions for each farm in a crop-by-crop and whole farm decision.

Objectives

The main objective of this study is to determine which program would be most beneficial for Texas farmers to choose. The complexities of the three alternatives make it difficult for the average farmer to decide, even without accounting for random variables such as drought. A secondary objective of this study will be to conduct an analysis to determine whether a producers risk preferences will impact their program choice.

Procedures

The study will utilize the Agricultural and Food Policy Center (AFPC) database of representative farms to determine how farmers will respond to the farm bill. A spreadsheet-based model of government payments will be constructed to analyze the representative farms. Stochastic simulation will be used to examine farmers' choices and will provide insight into when the farmers should choose PLC versus ARC enrollment. One way to incorporate stochastic simulation to rank risky alternatives is stochastic efficiency with respect to a function (SERF) discussed in Hardaker et al. (2004). SERF has many advantages over other methods of ranking risky alternatives. For example, under subjective expected utility hypothesis, the underlying utility function of the decision-making individual must be known Anderson, Dillon, Hardaker (1977). However, accurately estimating a decision maker's utility function has proved to be quite difficult and led to mixed results King and Robison (1984). First order and second order stochastic dominance are useful methods of ranking risky alternatives and overcome the need to estimate a utility function. However, in empirical work these two methods often yield results without much meaning Schumann et al. (2004). Stochastic dominance with respect to a function (SDRF) was introduced by Meyer (1977). SDRF ranks risky alternatives for decision makers whose utility is defined by a lower absolute risk aversion coefficient (LRAC) and an upper absolute risk aversion coefficient (URAC). However, SDRF is limited in that if the RACs are set too far apart, the method will not produce consistent rankings. Additionally, it can only compare two risky alternatives at a time instead of ranking all alternatives simultaneously Allison (2010).

As stated above, SERF overcomes many of the limitations associated with other methods. SERF finds utility efficient alternatives for ranges of risk attitudes thus eliminating the need to estimate utility functions. SERF then separates alternatives in terms of certainty equivalents as a selected measure of risk aversion is varied over a defined range. Thus, SERF does not attempt to define rankings for a single risk aversion level, but takes risk aversion levels as given and yields rankings based on types of decision makers within ranges of risk aversion Schumann et al. (2004). Additionally, SERF can rank many risky alternatives at the same time.

Due to SERF's many strong attributes in ranking risky alternatives, SERF was used in this analysis. Decision makers are assumed to be risk averse. The commonly used negative exponential utility function was used in this analysis with a minimum RAC of zero and maximum RAC of four divided by each farms' net worth.

Organization of Remainder of Thesis

The remainder of the thesis is organized into four chapters. A review of literature covering previous analyses of the farm bill choices is presented in Chapter II. The simulation model is described in Chapter III. Chapter IV contains the model results for the representative farms. Summary and conclusions are presented in Chapter V.

CHAPTER II

LITERATURE REVIEW

The relevant literature in this study can be broken down into three major categories- History of the Farm Bill, Current Farm Bill Provisions, and Previous Studies that have been completed in this particular area of the 2014 Farm Bill. To obtain successful results, it is essential to learn the history of the farm bills to understand today's farm bill and the procedures used to make it work for today's farmers and ranchers. By looking at history and previous research in this area, functional results will evolve.

History of the Farm Bill

During the Great Depression, American citizens needed financial help and turned to the government for needed aid. President Franklin Roosevelt proposed and Congress passed the New Deal, a series of programs designed to help Americans through their difficult times. The agricultural part of the plan offered farmers who were struggling under excess supply and low prices assistance to help ensure an adequate food supply. This provision provided farmers payments for not growing food on a percentage of their land determined by the USDA.

During World War II 1939-1945, the United States government encouraged production to feed the world during hard times caused by the war. This brought about 40 million additional acres into production. The increase in planted acres for the crops increased supply causing lower prices for the commodity after the World War II saw a reduction in demand. As a result, the government provided payments to these farmers to have a safety net to fall back on. In 1958, the farm bill introduced 'price supports' and 'Soil Bank.' Price supports are a subsidy or price control, intending to keep the market price of a good higher than competitive equilibrium level. The Soil Bank set up an acreage reserve program by directing the Secretary of Agriculture to compensate producers for reducing their 1956–59 crops of basic commodities below their allotments or base acreages; land so retired from production could be put to no other use. In time, this caused the removal of about 40 million acres from production Bowers, Rasmussen, Baker (1984).

During the 1960s, farm bill provisions provided for strict acreage controls and allotments with price supports to try to balance demand and supply to help reduce government payments. This was done to limit the amount of acreage eligible for payment, thus causing a reduction in planted acres. The 1970s saw an increased demand for grains and high prices, which encouraged farmers to produce more to meet the higher grain demand. This encouraged producers to bring back millions of acres into production and low prices soon followed because of the increased production. The government initiated a farmer owned reserve program, which resulted in the USDA owning large stocks of cotton and grain Bowers et al. (1984).

The 1985 Farm Bill introduced the Conservation Reserve Program (CRP), which idled about 36 million acres that were planted to grass and trees to help with conservation efforts and to reduce supply thus supporting prices. Target prices were re-introduced and paid producers a deficiency payment of the difference between market prices and the target price.

The 1990 Farm Bill continued the CRP program and the target price program. However, the 1996 Farm Bill was a watershed change in U.S. agricultural policy as it decoupled payments from production by eliminating target prices and replacing them with decoupled payments. With decoupled payments, farmers no longer had to plant specific crops or any crop at all to receive payments. In the 2002 Farm Bill, decoupled payments were continued under a new name -- direct payments and target prices were reintroduced. Direct payments were provided to eligible producers on farms enrolled for the 2002 through 2007 crop years. Direct payments and counter cyclical payments are computed using base acres and payment yields estimated for the farm Bowers et al. (1984).

This farm bill also continued CRP to keep highly erodible land out of production, which continued to act as a supply control. In the 2008 Farm Bill, income support was continued in the form of direct and counter cyclical payments, which USDA provided payments to eligible producers on farms enrolled in the 2008-2012 crop years. Both DP and CCP are calculated using base acres and payment yields established for the farm Bowers et al. (1984).

2014 Farm Bill

Direct payments and counter cyclical payments were eliminated and replaced with a choice of Agricultural Risk Coverage (ARC) or Price Loss Coverage (PLC) for each covered commodity on each farm. With ever increasing focus on risk management and a strong emphasis on crop insurance, the 2014 Farm bill introduces new interactions between commodity and crop insurance programs. With direct payments gone, the payments that were provided to crop producers regardless of financial loss in the three previous farm bills, it is extremely important that farmers consider analyzing their entire farm and risk management portfolio for the one-time irrevocable decision they will have to make for their safety net payment (Campiche, Outlaw and Bryant 2014). This one-time irrevocable decision under the 2014 Farm Bill will last for the 2014 to 2018 crop years and farmers need to analyze projected market revenues, commodity payments, and crop insurance indemnities.

Not all commodities are covered under the current farm bill. Covered commodities include wheat, oats, barley, corn, grain sorghum, long and medium grain rice, pulse crops, soybeans, other oilseeds, and peanuts. Upland cotton is no longer a covered commodity, mainly due to the World Trade Organization Cotton case with Brazil. Once the dispute was resolved on October 1, 2014, enhanced reliance on insurance for cotton peaked causing the commodity to have its own product specific shallow loss insurance program (Orden and Zulauf 2015).

The following choices exist for covered commodities: landowner gets to choose to retain or reallocate base acres and retain or update payment yields. The farm operator may enroll base acres in PLC or ARC, purchase SCO on planted acres if not enrolled in ARC and purchase individual insurance policies. Landowners may choose to reallocate their historical base acres to covered commodities planted in the last four years Campiche et al. (2014).

Base acre reallocation, is a one-time choice for the next four years of the farm bill and the farmer can either, reallocate or retain existing base acres. They may reallocate bases other than cotton that were on the farm as of September 30, 2012. Reallocation is in proportion to the ratio of, the four-year average of planted acres to each crop from 2009 to 2012 plus prevented planting; divided by the four year average of all covered commodities planted plus prevented planting. Under planting does not affect the amount of base. The planted acres of covered commodities only affect the proportion of base acres that landowners can reallocate among commodities Campiche et al. (2014).

As indicated before, upland cotton is no longer a covered commodity under the 2014 Farm Bill, therefore cotton base acres become generic base acres. All cotton base acres on the farm as of September 30, 2012 are renamed Generic Base Acres. In an attempt to resolve the longstanding WTO dispute with Brazil, the only income support upland cotton will receive is through purchasing existing individual yield or revenue protection plans and a choice of two new area based insurance programs -- Stacked Income Protection Plan (STAX) or Supplemental Coverage Option (SCO). STAX is only available to upland cotton producers; however, upland cotton producers can choose either SCO or STAX while producers of other covered commodities can only purchase SCO if they elect PLC. STAX's coverage level can range from 90% of the county revenue guarantee to 70%, or the coverage level of the underlying policy, whichever is higher (Luitel, Knight, and Hudson 2014).

Price Loss Coverage (PLC)

One of the two safety net choices, Price Loss Coverage, will provide farmers payments if the prices for the covered commodity crop (with base acres) on their farms experience a marketing year average (MYA) price below the statuary reference price. This means that PLC will cover losses in income when the covered commodity price declines below the established reference price. To calculate the PLC payment, you first need to calculate the PLC payment rate. The PLC payment rate is obtained by subtracting the higher of either, National Average Marketing Year Price or Marketing Loan Rate, from the Reference Price. If greater than zero, multiply the PLC payment rate times the payment yield, base acres, and 0.85 Campiche et al. (2014).

Producers of covered commodities who elect PLC also will have the option to enroll in a new Supplemental Crop Insurance Program, SCO. This program is designed to cover the difference between 86% of an area revenue guarantee and the level of coverage for the producer's individual insurance policy. If a farmer chooses SCO that covers county-side losses, this will complement a producer's individual insurance policy. However, when farmers elect to purchase SCO, they are required to purchase individual insurance policy either, Revenue Protection or Yield Protection.

Agriculture Risk Coverage (ARC)

Agriculture Risk Coverage is the second program producers can choose from in the 2014 Farm Bill as a safety net. ARC covers losses in income for a covered commodity relative to a revenue guarantee, and can be selected at a county or individual level Campiche et al. (2014). ARC payments for the ARC-County option, are distributed when the Actual Revenue for the covered commodity is less than ARC Revenue Guarantee. Actual County Revenue is equal to the actual county yield per planted acre multiplied by the higher of the National Marketing Year Price or Marketing Loan Rate Bowers et al. (1984). To determine whether there will be an ARC payment in a given year, we need to determine the ARC revenue benchmark, which is calculated as the U.S. Olympic average marketing year price for the most recent 5 years multiplied by the Olympic average county yield for the most recent 5 years. If any of the 5 years of prices are lower than Reference Price then they are replaced with the Reference Price. If the actual county yield is less than 70% of T-yield then the low yields are replaced with the T-yield Bowers et al. (1984).

The ARC-County Revenue Guarantee can be determined by multiplying the ARC revenue benchmark by 0.86. Thus the final ARC-CO payment is the minimum of (ARC Revenue Guarantee minus Actual Revenue) or 10% of the benchmark times the base acres times 0.86 Bowers et al. (1984). ARC-CO will allow irrigated and non-irrigated acreage to be calculated separately.

ARC-Individual (ARC-IC) will apply to all covered commodities on a particular farm and does not allow for some commodities to be in PLC while others could be in ARC-Individual. Payments will be made when actual revenue falls below the Revenue Guarantee. ARC-Individual payments will be made on 65% of the farms total base acres for all covered commodities Campiche et al. (2014). Actual revenue for ARC-IC will be calculated as a, weighted average of the actual revenues for each covered commodity Bowers et al. (1984). ARC-IC will be based on the producer’s share of all covered commodities planted on all farms for which ARC has been selected. The payment equals the minimum of ARC revenue guarantee minus actual revenue, or 10% of benchmark multiplied by base acres multiplied by 0.65 Campiche et al. (2014). If the producer selects ARC-IC coverage on any crop on the farm, then the entire farm will be in ARC-IC program.

Previous Studies

Monte Carlo Simulation

Simulation has been a popular and well-accepted method for evaluating farm programs. Richardson (2008) defined a simulation model as a model that mimics or represents an actual system using mathematical equations.

Using average price (deterministic) estimates to calculate the PLC/ARC program payments, cannot account for random changes such as decreases in rainfall or increases in interest rates and inflation. Deterministic analysis can only show what happens at a single point in time. Monte Carlo simulation models utilize stochastic variables to get a more accurate picture of risk in the prices and yields. Stochastic business models can give probabilities of the occurrence of key output variables being at specified levels.

The use of Monte Carlo simulation to model financial statements was first proposed by Reutlinger (1970). He called for the estimation of a probability distribution for an investment's net present value (NPV). NPV was chosen as a good summary of the viability of an investment because it is a change in the net worth of the investor over the horizon of the investment. Richardson and Mapp (1976) presented a new variable, the probability of economic success, which was the chance the NPV would be greater than zero for the investment. The logic being that if an investment has a NPV greater than zero, then it will have an internal rate of return greater than the investor's opportunity cost meaning the investment was successful.

An economic feasibility study done by Richardson et al. (2007) applied these principles to a case study of introducing an ethanol plant in Texas to demonstrate that stochastic simulation models are more robust than deterministic models. The authors identified stochastic variables affecting the economic success for an ethanol business including the prices of corn, ethanol, distillers dried grains, natural gas, gasoline, and many others. Different distributions were used to simulate each of the random variables. For example, the prices were simulated using a multivariate empirical distribution, while the down time of the plant was estimated assuming a GRKS distribution. The GRKS distribution was developed by Gray, Richardson, Klose, and Schuman to simulate subjective probability distributions based on minimal input data Richardson (2008).

Once the variables had been simulated, pro forma financial statements were completed including an income statement, balance sheet, and cash flow statement. The results showed the probability of economic success of 9.4%, probability of negative ending NPV of 6.46%, and probability of negative return on investment of 9.12%. This type of analysis is more beneficial to business owners than simple snapshots.

Richardson, Outlaw, and Allison (2010) used Monte Carlo simulation to model a microalgae oil production farm. They determined the ranges of values for variables that are critical to the production of algae, which were used to define the probability distributions for the random variables. The simulation model used the random variables to simulate the distribution of the probable costs associated with an algae oil farm. Outlaw applied a similar methodology to sugar-based ethanol production in 2007. The major differences in these papers were the type of distributions used to simulate the variables and the key output variables analyzed.

Ranking Risky Alternatives

This study will use Monte Carlo simulation to analyze the preferred farm program choices for the representative farms. The Monte Carlo simulation model will incorporate risk into the stochastic variables. After the variables are simulated, 500 iterations of the payments will be shown, displaying all possible 500 prices or yields for that particular payment. Simulation will result in estimates of a probability distribution of payments for PLC and ARC. Farmers will have to choose between PLC and ARC based on the estimated probability distributions.

If producers are rational, they will choose the farm program that yields the highest payments. However, this assumes risk neutrality on the part of the decision maker. Risk neutrality states that an individual makes decisions on choices based on the highest expected payout without any consideration for risk. However, most producers are considered to be risk averse.

The model will include risk and probabilistic outcomes thus, ranking risky alternatives is very important. Von Neumann and Morgenstern (1944) first proposed ranking risky alternatives, which involve the concept that individuals want to maximize expected utility. For this analysis, it is assumed that producers would choose the highest expected return at the lowest level of risk and assumes risk aversion, which is consistent with the economic literature as started by Arrow (1971).

One way to rank risky alternatives is stochastic efficiency with respect to a function (SERF) discussed in Hardaker et al. (2004). SERF has many advantages over other methods of ranking risky alternatives. For example, under subjective expected utility hypothesis, the underlying utility function of the decision-making individual must be known (Anderson, Dillon, Hardaker 1977). However, accurately estimating a decision maker's utility function has proved difficult and led to mixed results (King and Robison 1984). First order and second order stochastic dominance are useful methods for ranking risky alternatives and overcome the need to find a utility function. However, in empirical work these two methods often yield results without much meaning Schumann et al. (2004). Stochastic dominance with respect to a function (SDRF) was introduced by Meyer as a more robust method of ranking risky alternatives (1977). SDRF ranks risky alternatives for decision makers whose utility is defined by a lower absolute risk aversion coefficient (LRAC) and an upper absolute risk aversion coefficient (URAC). However, SDRF is limited in that if the RACs are set too far apart, the method will not produce consistent rankings between the two RACs. Additionally, it can only compare two risky alternatives at a time instead of ranking all alternatives simultaneously Allison (2010).

As stated above, SERF overcomes many of the listed method limitations. SERF finds utility efficient alternatives for ranges of risk attitudes. SERF then separates alternatives in terms of certainty equivalents as a selected measure of risk aversion is varied over a defined range. Thus, SERF does not attempt to define a single risk aversion level, but takes risk aversion levels as given and yields rankings based on types of decision makers within ranges of risk aversion Schumann et al. (2004). Additionally, SERF can rank many risky alternatives at the same time.

Due to SERF's many strong attributes in ranking risky alternatives, SERF was used in this analysis to identify farmers' preferences between ARC and PLC in the 2014 farm bill. As previously stated, decision makers are assumed to be risk averse. The commonly used negative exponential utility function was used in this analysis with a minimum RAC of zero and maximum RAC of four divided by each farms' net worth; thus representing a range of risk aversion going from risk neutral to extremely risk averse.

As mentioned previously, stochastic simulation is a form of simulation that takes into account risk. Risk is defined in this model as a decision that is beyond the decision maker's control and often consists of yields and output prices. A stochastic model does not give point estimates, but rather a range or probability distribution of possible outcomes. The possible outcomes of Key Output Variables (KOVs) are dependent upon the distributions of the risky input variables. Monte Carlo models simulate the outcomes for alternative scenarios and the probability of target outcomes occurring. Alternative scenarios are defined and simulated by using a range of alternative input values in the model. For the present analysis of farm program decisions, the risky input stochastic variables are yield and price and the scenario variables are the PLC and ARC-County farm program options.

Thomas, Coble, and Miller (2007) conducted a study and proposed that there were two widely known farm simulation models: the FLIPSIM model and a nonparametric bootstrapping approach. FLIPSIM was developed by Richardson and Nixon (1981) and the nonparametric bootstrapping approach was used by Miller, Barnett, and Coble (2003). Both simulation models consider crop yields and prices to be stochastic and neither one makes assumptions about the form of the underlying price and yield data. However, the bootstrapping approach used by Miller et al. (2003) is used to overcome the lack of individual producer yields, which can lead to a non-continuous cumulative distribution function (CDF). The model used in this study will follow the methodology used in the FLIPSIM model. Additionally, the use of AFPC representative farm data provides the county yields, thus refuting the need to use the bootstrapping approach to simulate crop yields.

Previous Studies on ARC and PLC

The Department of Agriculture and Consumer Economics at the University of Illinois used the new CBO's (Congressional Budget Office) baseline prices and compared them to the 2014 CBO forecast to determine farmer's best choice among the farm programs. Coppess, Schnitkey, Paulson, and Zulauf, (2014) used ARC-CO and PLC as the focus of the article because they are crop-by-crop program decisions that can be compared accurately.

Coppess et al. (2014), studied five covered crops, corn, soybeans, wheat, peanuts, and long-grain rice, to determine which program decision is best for that crop as a whole. Their study is over only these five crops in the entire United States and they do not split irrigated and non-irrigated crops. They describe the program decision for each crop and show the results for both the 2014 CBO and 2015 CBO price projections. Coppess, et al. (2014) say price expectations and forecasts are one of the main factors for this decision even though the decision is between a revenue and price program.

The first covered commodity that was evaluated was corn. Coppess et al. (2014) explain how the benchmark price starts out much higher at $5.29 per bushel than the reference price, $3.70. Under the 2014 CBO forecast, the MYA price forecast for corn is above the reference price ($3.70) throughout all the years of the farm bill resulting in no PLC payments. However, the 2015 CBO forecast shows PLC payments in 2014, 2015, and a small payment in 2016 because it is below the reference price ($3.70) until about 2017 where 2015 CBO reaches above the reference price, where it triggers an ARC-CO payment.

Soybeans turned out very similar to corn. Coppess et al. explain, the 5-year Olympic average price for soybeans in ARC-CO ($12.27 per bushel) starts out far above the PLC reference price ($8.40 per bushel). The 2014 CBO price forecast line shows to be significantly above the reference price ($8.40) during all five crop-years, thus PLC would not provide a payment. However, the 2015 CBO forecast tells a different story, because it shows to be much lower than the 2014 CBO forecast. 2015 CBO forecast dives below the reference price ($8.40) in, triggering a PLC payment for the 2015 crop year, but no payments for any other crop year. For addressing price risk on soybean base, then, ARC-CO appears to be more effective program in either one of the CBO's forecast Coppess et al. (2014).

Wheat is the next covered commodity analyzed by Coppess et al (2014). Coppess, et al. (2014) find that based on the CBO price-based analysis, wheat will trigger a PLC payment under the 2015. PLC shows to be a more effective program for addressing price risk on wheat base because the 2015 CBO forecast puts MYA prices at or below the break point [$5.00] in the 2015 through 2017 crop years and very close to it in 2018. Also, the 5-year Olympic Average (benchmark) price appears to be above the reference price ($5.50) during all five crop-years on the 2015 CBO forecast.

Regarding long grain rice, Coppess, et al. (2014) conclude PLC should be a more effective program for addressing price risk for this commodity. The reference price ($14.00 per hundredweight) for long-grain rice is not only significantly higher than the FAPRI price forecast in all five crop years, it is also the only one of the crops discussed here in which the reference price is also higher than the 5-year Olympic average price for all five years Coppess et al. (2014).

In conclusion, Coppess et al. (2014) find that given the CBO Baseline forecasts show lower prices for corn, soybeans, and wheat than the 2014 forecast. This analysis does not consider risk and tends to indicate that, at least for corn, and soybean base, ARC-CO is the more effective program under the CBO forecasted price scenario. However, PLC appears to be more effective for wheat base. The high reference price for long-grain rice base acres supports the conclusion that PLC is the more effective program. The authors explain the information in this article is intended to help provide context and analysis for making the right program decision based on crop.

The second paper discussed ARC-PLC Regulation and Decision Tools Schnitkey, Coppess, Paulson and Zulauf (2014). Their paper describes the available web-based decision tools in order for U.S. farmers to choose the proper farm program decision for the next five years of the 2014 Farm Bill. Schnitkey et al. (2014) begin this article with the background of the 2014 Farm Bill and how it has revised the commodity support programs by just having ARC and PLC as available program decisions.

Schnitkey et al. (2014) briefly describe each decision tool beginning with the Farm Bill Toolbox on Farmdoc. The one-stop resource provides a seven-step decision process to guide producers through the program decisions and the web-based tool. The Agriculture Policy Analysis System (APAS) will provide producers the ability to calculate updated payment yields for the FSA farm for example, calculate reallocated base acres, and analyze and compare the program choices. Then the Sample Farms button will allow the user to analyze data generated from their state and county, to determine both expected program payments by a per-acre and crop-by-crop basis.

The third paper researched, Comparing ARC-CO to PLC: APAS Sample Farms and the ARC-CO-PLC Comparison Tool, by Gary Schnitkey, Nick Paulson, Jonathan Coppess, and Carl Zulauf. This article written by Schnitkey et al. (2014) from the University of Illinois was to focus on two different tools farmers could use in order to make the best possible farm program decision. APAS (Agriculture Policy Analysis System) and the ARC-CO-PLC Comparison Tool are to assist farmers in choosing between ARC-CO and PLC. The ARC-CO-PLC Comparison Tool will provide payments based on user-entered information and the APAS Sample farms will provide expected information of payments for different sets of prices and yields. The choice between ARC-CO and PLC likely will come down to three considerations: 1) payment expectations between ARC-CO and PLC, 2) type of farmer risk the farmer wishes to avoid, and 3) availability of Supplemental Coverage Option (SCO). However, this study will not involve SCO because cotton is no longer a covered commodity under the 2014 Farm Bill.

The ARC-CO-PLC Comparison Tool is described as a Microsoft Excel spreadsheet that compares payments under ARC-CO and PLC for user-entered county yields and market-year-average (MYA) prices for the years 2014 through 2018 Schnitkey et al. (2014). The spreadsheet is part of the "Farm Bill Toolbox" decision tool on the Farmdoc website. This particular decision tool requires user-entered data consisting of state, county, crop, type, and PLC payment yield. Then the input variables will incorporate two histories for evaluating the ARC-CO and PLC decisions. Yield history from 2009 through 2013 and MYA price history from 2009 through 2013. Next, the user is expected to enter in the county yields and MYA prices for 2014 through 2018 Schnitkey et al. (2014).

The APAS Sample Farms tool requires the user to make a state and county selection in order to receive the expected payments from either ARC-CO or PLC. Unlike the Excel spreadsheet, the APAS payments are not over one set of yields and prices. The APAS payments are calculated with thousands of price and yield scenarios that represent an unforeseeable event that could occur in the future. These scenarios are generated to reflect possible yield and price outcomes along with historical variability in specifying the scenarios between price and yields.

Schnitkey et al. (2014) conclude that either tool will be beneficial in the choice between the two farm program decisions. The farmer will want to choose the option with the higher payment, however future prices and yields are not known. Schnitkey et al. (2014) example farm program payment was determined to be ARC-CO, but with a specific set of price expectations in the future. Schnitkey et al. (2014) state the two decision tools will be useful in choosing the proper farm program once price and yield expectations become clearer in late February 2015, once USDA will release estimates on county yields. Thus depending on another source to get needed information to input in the tool.

The fourth paper researched, Comparison of County ARC and SCO, written by Scott Gerlt and Patrick Westhoff (2014) conducted this analysis to compare and contrast SCO and ARC-CO through county level models to determine the best farm program option for farmers in the state of Missouri.

Gerlt et al. (2014) begin their study by describing each farm program option in the 2014 Farm Bill. They constructed county level models for all counties with adequate data to compare and contrast PLC with SCO against county level ARC for corn, soybeans, and wheat. Supplemental Coverage Option (SCO) is a Title XI crop insurance program that producers must purchase to participate.

Gerlt et al. (2014) discovered numerous differences and similarities between ARC-CO and SCO in their study. ARC was calculated utilizing an Olympic Moving Average price, while SCO was calculated by a planting price determined by the futures market. However, further analysis showed the ARC benchmark values could react slowly to the market movements causing an ARC payment when there are none SCO indemnity and vice-versa. Both programs have different caps on payments, which could drastically affect the final results.

The methods that were conducted were based on assumptions that were necessary to make the models tractable. To begin, each county was represented by a single farm. Gerlt et al. (2014) analyzed the effects of using inflated county data in place of farm data. The direction of the bias is dependent upon the underlying farm distributions, but is generally found to be small at high coverage levels, such as those in the programs under the study. Second Gerlt et al. (2014) assumed base acres are about equal to plantings. However, some farmers will choose to maintain prior base area if the yield shows to expect larger payments than potential payments under base reallocation, which is new under the current 2014 Farm Bill.

The third assumption says all the payment yields are updated. The 2014 Farm Bill allows the landowner to retain their counter cyclical payment yields or to update based on the average of 90% of the 2008 to 2012 yields for PLC. The fourth assumption states the underlying crop insurance participation levels do not change. In reality, producers may have incentives to reduce coverage levels for underlying policies given that SCO and

ARC provide coverage at high levels at a lower marginal cost. All crop insurance policies are Revenue Protection, reads the fifth and final assumption. Revenue protection (RP) is overwhelmingly the most popular crop insurance program while 87% of insured corn acres in 2013 were insured.

They created a simple linear trend for each county and state yield per planted acre for soybeans, while yield per harvest acre data was used for corn and wheat. By using the Latin Hypercube, 500 normally distributed draws for each county and year in the forecast was created based upon the county residuals. This explicitly assumes that county yields are normally distributed Gerlt et al. (2014). Similarly, their study used FAPRI'S stochastic model results to create the price projections. Gerlt et al. (2014) explained the model generates 500 sets of prices for each crop and year. The stochastic model consists of approximately 2000 equations that estimate production, prices, and a variety of other variables of interest for a wide range of crop, livestock and biofuel commodities. However, livestock and biofuel commodities will not be included variables in this study, because they are not considered "risky" variables. While FAPRI was an excellent source for this study to simulate price projections, the study will incorporate risky variables to calculate forecasted county and individual farm yields and prices for the years 2014-2019.

In conclusion, Gerlt et al. (2014) found ARC provided better revenue protection than SCO. The ARC benchmark incorporates recent high prices leading to higher payments in the first couple of years. Also, ARC pays on 85% of base acres while SCO only has a 65% subsidy rate. This analysis is of limited use because the study used many averages thus altering many local yields that could affect the expected payments.

The fifth paper researched, Evaluating the Impact of Proposed Farm Bill Programs with Crop Insurance for Southern Crops, by Todd D. Davis, John D. Anderson, and Nathan B. Smith. Davis et al. (2014) simulated the return over risk management costs for an Arkansas rice farm, a Texas cotton farm, and a Georgia peanut farm. The paper provided an overview of the Senate and House versions of the Farm Bill Proposals. Stating both have eliminated direct payments, counter-cyclical payments, and the average crop revenue election programs. Their study mostly consists of Adverse Market Payment (AMP), ARC, PLC, Supplemental Coverage Option (SCO), and Stacked Income Protection Plan (STAX). However, this study will be over the two farm programs, ARC or PLC. Thus discussion will be over only their analysis of PLC and ARC.

Davis et al. (2014) used a stochastic simulation model of the net revenue from crop production to conduct their analysis. The model was used to simulate farm yield, county yield, projected price and harvest price for RP insurance, and marketing-year average price for each crop. In order to simulate the yields for the states, Arkansas, Georgia, and Texas, Davis et al. (2014) needed to determine the county yields to solve needed data for ARC payment. Davis et al. (2014) calculated the years 1996 through 2012 to conduct a de-trend analysis using OLS regression. To simulate prices, for each year of the data, Davis et al. (2014) used the ratio of the projected price to the harvest price and the marketing year average. Projected prices were then simulated as a 5-year random walk assuming a lognormal distribution, with parameters estimated from the raw data.

Davis et al. (2014) calculated results for the Arkansas rice farm. The calculations showed ARC at the individual and area levels, which triggered indemnities of 18 and

21%. As the guarantee is based on Olympic average yields and Olympic average pries, ARC provides protection against years of lower commodity prices as the guarantee declines gradually. The simulated average annualized ARC payments as $0.99/acre and $1.16/acre, respectively, for the individual and area coverage. This study conducted Olympic average yield and prices in order to solve to PLC and ARC payments. However, when the results are simulated, the ARC and PLC payments will be based from the individual farm's Net Worth and will be presented in a sum of total payments for all crops, rather than broken up by acre price.

The Arkansas rice farm analysis was conducted from Certainty Equivalent Analysis (CE) that annualized net revenues for selected risk management alternatives. The risk coefficients of relative risk aversion raged from 0 to 5. They concluded the risk management alternative of combining RP insurance at the 55% coverage level with the PLC program and SCO coverage, which provides the annualized net revenue with the largest certainty equivalents for all risk aversion coefficients. The Arkansas rice farm, based on their analysis, should combine PLC program and SCO for the best coverage option.

In conclusion Davis et al. (2014) summarized results for the six farms that were studied. Davis et al. (2014) suggested further research in safety net program decisions of the 2014 Farm Bill. Producers will need to understand the farm-level yield risk, county-level risk, and the interaction with marketing-year average and crop insurance prices in order to understand what the analysis concluded for them. It was also stated that land grant universities with access to farm record keeping project data, could develop a panel data set of farm-level yields to shed greater light on the issue Davis et al. (2014). This study will research sixteen representative farms from the Agricultural and Food Policy Center at Texas A&M University, a land grant university that collects annual data to assist farm managers in deciding the best farm program decision for their farm, and help shed greater light over the issues.

The first paper researched, by Coppess, Schnitkey, Paulson, and Zulauf was similar to the analysis in this study because they both evaluate ARC county and PLC. However the current study splits crops by irrigated and non-irrigated to present a more accurate depiction of which program to choose for the covered crop. Coppess et al. (2014) did not separate irrigated and non-irrigated crops, thus concluded with different results than from this study.

The data gathered from the representative farms are all located in Texas versus Coppess et al. (2014) gathered data from USDA and FAPRI on a national scale for all farms. Therefore this study will be more accurate because it is specifically considering the yields and prices for individual farms in Texas. Coppess et al. (2014) results were based on each individual crop presented and determined their results based off the entire crop, rather than a crop-by-crop basis on an individual farm. This study not only incorporates price and yield risk, but individual farmer risk. Depending on how risky the farmer is, risk neutral, moderately risk averse, or extremely risk averse, the farmer can choose which program payment best fits their level of risk for each crop on the farm.

The second and third papers that were reviewed are lacking as well. To begin, Schnitkey et al. (2014) analysis uses historical information for each crop using all of the country's data to incorporate into their results. This study will use individual historical data from each representative farm divided among each crop grown and also incorporates the county's historical yields to help determine future yields. Schnitkey et al. (2014) require the farmer to input their own price expectations in the tool. Therefore this could potentially be problematic because the farmer does not have a way of knowing what the future prices and yields could be, thus skewing their results.

The ARC-CO-PLC Comparison Tool is inaccurate compared to this study in terms of not depicting a particular farm in Texas. The Comparison Tool does require the user to input their state, county, crop, type, and PLC payment yield, however the PLC payment yield is the only farm-specific input. Whereas this study incorporates actual historical yields from that particular farm for over ten years per crop grown and historical county yields gathered from USDA per crop. Then combine these yields in a forecasted stochastic yield for the years 2014-2018 using a Multivariable Empirical Distribution.

In the fourth paper by Gerlt et al. (2014) constructed county level models for all the counties in Missouri. They worked with adequate data to compare and contrast the two farm program decisions for the covered commodities, corn, soybeans, and wheat. However irrigated and non-irrigated crops were not separated, thus skewing the results. Each of the crops in this study are divided among irrigated and non irrigated to conduct more accurate results for the crop's payments.

The thesis statement of Gerlt et al. (2014) says it is the first to delve into such detail in comparing the two programs, provides timely results that can be used by agents making decisions. The statement is partially correct in terms of stating their study is the only to conduct that type of analysis in detail. However, it differs from this study greatly because the data is gathered from representative farms on an individual basis in Texas instead of Missouri.

Davis et al. (2014) conducted a portion of their study over a Texas cotton farm and a Georgia peanut farm. However, this study did not cover cotton because it is not a covered commodity under the 2014 Farm Bill. Also none of the representative farms grow peanuts so analysis over the commodity was not necessary. But Davis et al. (2014) did analyze an Arkansas rice farm and a few of the representative farms analyzed in this study grow long grain rice as well. However this study is over individual farms in Texas that grow many covered commodities, thus more specific to the individual producer's farm program choice.

CHAPTER III

METHODOLOGY AND PROCEDURES

Methodology

This study will use sixteen representative farms located in Texas from AFPC's farm database. Twelve are feed grains/oilseed farms and four are predominately rice farms. The farms are explained briefly in the descriptions below. The representative farms will be analyzed using a stochastic simulation model created in Excel utilizing the Simetar add-in for conducting simulation analyses. Stochastic probability distributions for commodity prices and county yield will be developed. These risky variables will be utilized to simulate projected payments for PLC and ARC for representative feed grain/oilseed and rice farms. The simulation results will give farmers in Texas an idea of how the new Farm Bill will affect them and what their choices should be with regard to the PLC and ARC Richardson et al. (2015).

Incorporating risk is extremely important for a number of reasons because it takes into account situations farmers have little control over. Droughts, floods, and poor prices do happen and are important considerations for farmers. By incorporating historical price and yield risk into the analyses the decision between PLC and ARC can be made knowing which of the two choices would provide the best safety net under uncertainty.

This analysis will use the January 2015 FAPRI (Food and Agriculture Policy Research Institute) projections for national crop prices. Trend forecasted county yields for 2014 through 2018 were developed for each commodity using historical yields and regressing them as a function of time. Historical county yields were obtained from the USDA's National Statistics Service website.

Using all the information above, this study will be able to achieve its objective, which is to calculate the probability distributions for ARC and PLC payments and choose which farm program option is more beneficial for each farm. Both farm program choices incorporate risky alternatives and have stochastic prices and yields involved in their final equations.

Procedures

Representative Farm Data

The Agricultural and Food Policy Center (AFPC) at Texas A&M University develops and maintains data to simulate 99 representative crop, dairy, and livestock operations in major production areas in 28 states. There are 66 representative crop farms in their dataset. A subset of these farms located in Texas will be analyzed to determine the most appropriate farm program choice for each crop on each farm. The primary purpose of this analysis is to project the potential safety net payments of those farms for each farm and by commodity for 2015 through 2018 based off commodity program choices in the 2014 Farm Bill.

The data necessary to simulate the economic activity of these operations is developed through ongoing cooperation with panels of agricultural producers in the state Richardson et al. (2015). Sixteen farms in Texas will be used to evaluate the program choices for farmers. Figure 1 indicates the location of each of the farms in this analysis.

Information necessary to simulate the safety net payments on the representative farms is developed from panels of producers using a consensus-building interview process. Often, two farms are developed in each region using separate panels of producers: one is representative of moderate size full-time farm operations, and the second panel usually represents farms two to three times larger. The producer panels are provided pro-forma financial statements for their representative farm and are asked to verify the accuracy of their data.

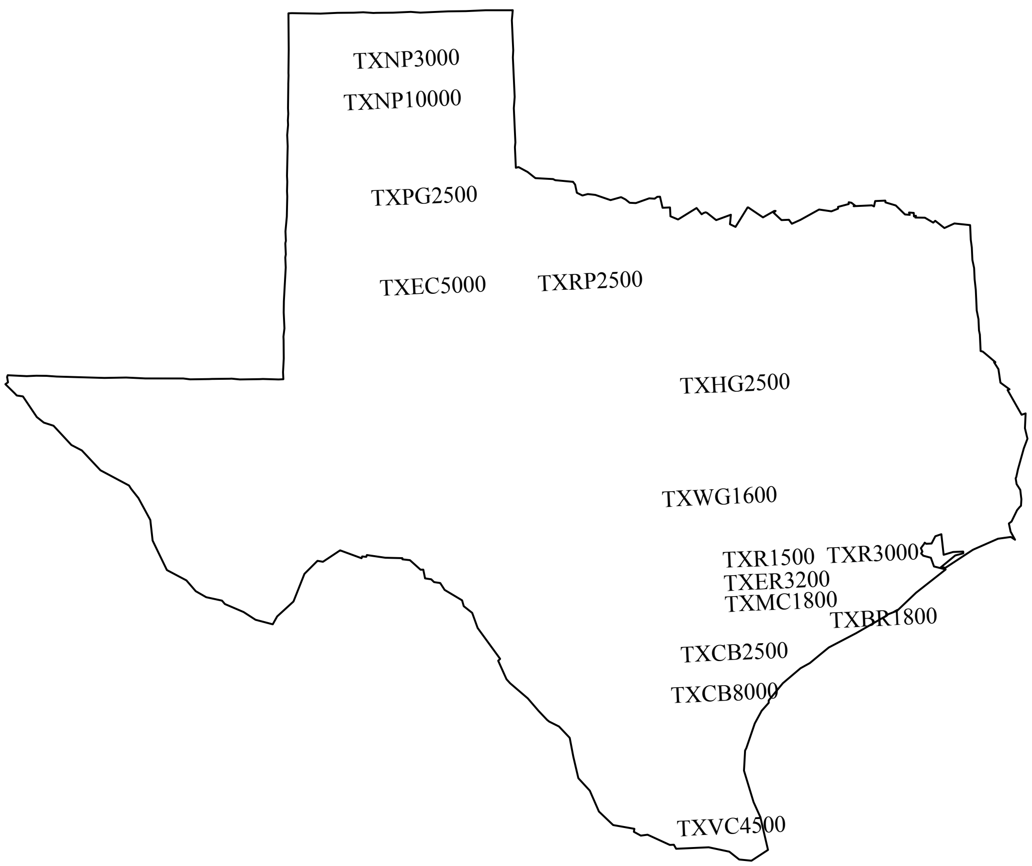

Figure 1. Location of Texas Representative Farms.

All farms used in the analysis have been updated through panel discussions since January 2007; with the majority being updated in the last two years Richardson et al. (2015). Characteristics for each of the operations in terms of location, size, and crop mix are listed below in detail and in Table 3.1. The general naming convention for the representative farms follows the pattern: the first two letters of a farm name indicate the state in which it is located. If a farm has four letters, the third is generally a regional indicator. The last letter of a farm name indicates the type of operation (i.e. G for feed grain/oilseed, W for wheat, and R for rice). A few exceptions exist where the third and fourth letters of the farm name are both regional indicators. Numbers on crop farm names indicate the size of the operation in total acres.

The characteristics of the representative farms are as follows:

- **TXNP3000** is a 3,000-acre diversified grain farm located on the northern High Plains of Texas (Moore County). This farm plants 960 acres of irrigated corn, 240 acres of irrigated sorghum for seed production, and 870 acres of irrigated wheat annually.
- **TXNP10000** is a large-sized diversified grain farm located in the Texas Panhandle (Moore County). This farm annually plants 3,200 acres of irrigated corn 2,500 acres of grain sorghum (1,000 irrigated for seed production/500 dryland/1,000 irrigated for commercial use); and 1,500 acres of winter wheat (1200 irrigated/300 dryland).
- **TXHG2500** is a 2,500-acre grain farm is located on the Blackland Prairie of Texas (Hill County). On this farm, 800 acres of irrigated corn, 900 acres of irrigated sorghum, and 500 acres of irrigated wheat are planted annually.
- **TXWG1600** is a 1,600-acre farm is located on the Blackland Prairie of Texas (Williamson County). TXWG1600 plants 750 acres of irrigated corn, 300 acres of irrigated sorghum, and 150 acres of irrigated winter wheat annually.

- **TXUG1600** is a farm located in Uvalde County, Texas. This farm plants 150 acres of irrigated corn.
- **TXRP2500** is a 2,500-acre farm located in the Rolling Plains of Texas (Jones County). This farm plants 1,000 acres of irrigated winter wheat each year.
- **TXCB2500** is a 2,500-acre farm located on the Texas Coastal Bend (San Patricio County) that farms 1,125 acres of irrigated sorghum and 125 acres of irrigated corn annually.
- **TXCB8000** is an 8,000-acre farm in Nueces County, Texas. Annually 4,400 acres are planted to irrigated sorghum.
- **TXVC4500** is a 4,500-acre farm is located in the lower Rio Grande Valley of Texas (Willacy County) and plants 2,880 acres to irrigated sorghum.
- **TXPG2500** is a 2,500-acre farm in the Texas Panhandle Deaf Smith County. Annually, 1270 acres planted to irrigated corn and irrigated grain sorghum.
- **TXMC1800** This 1,800-acre farm is located on the Coastal Plain of southeast Texas (Wharton County). TXMC1800 farms 300 acres of irrigated sorghum, 600 acres of irrigated corn, and 900 acres of rice.
- **TXEC5000** is a 5,000-acre farm is located on the Eastern Caprock of the Texas South Plains (Crosby County). Annually, 550 acres of sorghum are planted (250 irrigated and 300 dryland).
- **TXR1500** is a 1,500-acre rice farm located west of Houston, Texas (Colorado County) is moderate-sized for the region. TXR1500 harvests 600 acres of rice.
- **TXR3000** is a 3,000-acre, large-sized rice farm located west of Houston, Texas (Colorado County). This farm harvests 1,200 acres of rice annually.

- **TXBR1800** is an 1,800-arce rice farm in the Texas Gulf Coast (Matagorda County) TXBR1800 generally plants a third of its acres to rice annually and fallows the remainder; however, in 2014, the farm received prevented planting crop insurance indemnities for rice due to limited irrigation water allocation.
- **TXER3200** is a 3,200-acre rice farm is located in the Texas Gulf Coast (Wharton County). TXER3200 harvests 1,067 acres of rice each year. The farm also grows 320 acres of irrigated soybeans and 747 acres of irrigated grain sorghum annually.

Table 3.1-Characteristics of Representative Farms Used in This Study.

Farm Name	County	Acres	Crops Grown	Total Crops
TXNP3000	Moore	3000	IWheat, IGS, ICorn, DWheat	3
TXNP10000	Moore	10000	IWheat, IGS, ICorn, DWheat, DGS	5
TXHG2500	Deaf Smith	2500	IGS, IWheat, ICorn	3
TXWG1600	Williamson	1600	IGS, IWheat, ICorn	3
TXUG1600	Uvalde	1600	ICorn	1
TXRP2500	Jones	2500	IWheat	1
TXCB2500	San Patricio	2500	IGS, ICorn	2
TXCB8000	Nueces	8000	IGS	1
TXVC4500	Willacy	4500	IGS	1
TXPG2500	Deaf Smith	2500	ICorn, IWheat	2
TXMC1800	Wharton	1800	IGS, ICorn, Rice	3
TXEC5000	Crosby	5000	DGS, IGS	2
TXR1500	Colorado	1500	Rice	1
TXR3000	Colorado	3000	Rice	1
TXBR1800	Matagorda	1800	Rice	1
TXER3200	Wharton	3200	Rice, IGS, Soybeans	3

I-irrigated, D-non-irrigated, GS-grain sorghum

Model Development

Typically an analysis of this type will utilize capital budgeting or partial budgeting, however, for the current analysis the only key output variable that will decide a producer's decision between PLC or ARC for a commodity is total payments.

Therefore, all of the farm program data necessary to calculate payments for each representative farm was entered into an Excel spreadsheet with each farm being a separate tab. The individual farm information consisted of, the crops grown, base acres, planted acres, and average yield over the past ten years for each crop. Irrigated and non-irrigated crops were separated with different yields. Some of the representative farms grow non-program crops that would not be protected by the government program. Non-program crops were dropped from the analysis. Also several farms grow cotton, which is no longer a covered commodity under the 2014 Farm Bill and not of interest in this study. Any cotton on the farms was also dropped from the analysis.

Historical USDA National Agricultural Statistics Service (NASS) county yield data were obtained for each crop and county. The crops grown on at least one of the representative farms are: corn, soybeans, wheat (both irrigated and non-irrigated), sorghum, and long-grain rice. The price data utilized was from the Food and Agricultural Research Institute (FAPRI) January 2015 Baseline. The analysis used their 500 stochastic prices for each crop and year. The average of the 500 iterations by crop and year are summarized in Table 3.2. Reference prices and loan rates were obtained from the 2014 Farm Bill (Table 3.3). T-yields were obtained from USDA Farm Service Agency (FSA).

Table 3.2- March 2015 U.S. Crop Farm Price Projections by FAPRI.

Crop	2014	2015	2016	2017	2018
Corn ($/bu.)	3.69	3.93	3.95	3.99	4.11
Soybeans ($/bu.)	10.13	9.31	9.66	10.00	10.35
Wheat ($/bu.)	6.08	5.20	5.26	5.43	5.68
Sorghum ($/bu.)	3.87	3.68	3.69	3.79	3.91
Rice LGR ($/cwt)	12.46	12.59	12.73	12.68	12.73

Source: Food and Agricultural Policy Institute, University of Missouri-Columbia, March Baseline, March 2015.

Table 3.3- 2014 Farm Bill Reference Prices, 2014-2018.

Crop	Reference Price
Corn ($/bu.)	3.70
Soybeans ($/bu.)	8.40
Wheat ($/bu.)	5.50
Sorghum ($/bu.)	3.95
Long-grain rice ($/cwt.)	14.00

Source: Food and Agricultural Policy Institute, University of Missouri-Columbia, March Baseline, March 2015.

Calculating PLC Payment

PLC payments for each representative farm were simulated using the stochastic FAPRI prices, farm specific data and farm program data that apply to all farms in Equation 1.

PLC Payment = Base Acres *CCP Yield *0.85*PLC Payment Rate (1)

Where: PLC Payment Rate = (Reference Price – Higher of the *Marketing Year Average Price* or Loan Rate)

Base Acres = the number of base acres for the crop on the farm

CCP Yield = to the Counter-Cyclical Payment Yield for the crop on the farm

0.85 = to the farm bill specified payment fraction for PLC payments

As indicated by Equation 1, this is a straightforward calculation, however, payments for a crop are either zero or a positive number. An "If-Then" statement checked to make sure that the PLC payment rate was positive or zero to ensure negative payments were not calculated. The only risky variable in this equation is the Marketing Year Average Price, which is in italics above. Equation 1 was simulated for each of the FAPRI 500 price projections for each crop using Simetar to estimate the probability distribution for PLC payments.

The sum of the crop's payments for the life of the farm bill years 2014 to 2018 is calculated for each crop grown on a particular representative farm. This is the PLC payment by crop, and the PLC payment for all crops during the life of the farm bill (2014-2018) for the representative farm is the sum of payments for all crops. This was done for each of the sixteen representative farms.

Calculating ARC Payment

The ARC payment calculated is for the ARC-County or ARC-CO version, which is directly comparable to the PLC payment and does not require the entire farm choosing the option, as the ARC-IC option requires. Therefore ARC-IC is not evaluated in this analysis. The ARC-CO payment involves more calculations and is less straightforward than the PLC payment (Equation 2).

<u>ARC-CO Payment</u> = [Minimum of (ARC Revenue Guarantee - *Actual Revenue*) OR 10% of the Benchmark Revenue] * Base Acres * 0.85 (2)

Where: ARC Revenue Guarantee = 0.86 * Benchmark Revenue

*Actual Revenue = Actual Marketing Year Average Price * Actual County Yield*

Benchmark Revenue = *5 year Olympic Moving Average of Marketing Year Average Prices * 5 year Olympic Moving Average of County Yields*

Base Acres = the number of base acres for the crop on the farm

0.85 = to the farm bill specified payment fraction for PLC payments

The 5-year Olympic moving average county yields were calculated using Equation 3. The 5-year Olympic moving average prices were calculated similarly.

5-Year Moving Average for 2014-2018:

$$
\begin{aligned}
\hat{Y}2014 &= ((Y2009 + Y2010 + Y2011 + Y2012 + Y2013) - \text{minimum} - \text{maximum})/\ 3 \\
\hat{Y}2015 &= ((Y2010 + Y2011 + Y2012 + Y2013 + Y2014) - \text{minimum} - \text{maximum})/\ 3 \\
\hat{Y}2016 &= ((Y2011 + Y2012 + Y2013 + Y2014 + Y2015) - \text{minimum} - \text{maximum})/\ 3 \\
\hat{Y}2017 &= ((Y2012 + Y2013 + Y2014 + Y2015 + Y2016) - \text{minimum} - \text{maximum})/\ 3 \\
\hat{Y}2018 &= ((Y2013 + Y2014 + Y2015 + Y2016 + Y2017) - \text{minimum} - \text{maximum})/\ 3
\end{aligned}
\quad (3)
$$

Any annual county yield in Equation 3 that was below 70% of the T-yield was replaced with 70% of the county T-yield. An "If-Then" statement was used to ensure that only positive ARC-CO payments were reported. The ARC-CO payments for each crop over the years 2014-2018 were summed as the final ARC-CO payment for a representative farm.

Evaluation of PLC/ARC Choice Based on Producer Risk Preferences

With a simple assumption of a decision maker (DM) who prefers more to less, then we can rank risky alternatives with the certainty equivalent (CE). The DM will always prefer the risky alternative with the greater CE. In order to calculate the CE it must be assumed that the DM is rational and consistent. According to Anderson and Dillon (1977), a Relative Risk Aversion (RRAC) definition was proposed. For risk neutral 0.0 was to be used as the relative risk aversion coefficient (RRAC), 2.0 was the RRAC for moderately risk averse, and 4.0 was the RRAC for extremely risk averse decision makers.

The certainty equivalent function in Simetar was used to calculate the CEs for a risk neutral, moderately risk averse, and an extremely risk averse decision maker. Using a range of RRACs the CE risk ranking procedure will help the DM make his choice of ARC or PLC based on what type of risk averse person they are. Stochastic Efficiency with Respect to a Function (SERF) calculates CEs for 25 different RRAC levels. However for this study, the CE will be calculated for three RRAC levels: neutral, moderate, and extremely risk averse. Using three RRACs will simplify the risk rankings procedure given that we are dealing with only two risky alternatives and there are 16 farms in the analysis.

CHAPTER IV

RESULTS

Two sets of results are presented for each of the 16 representative farms. The first provides the annual payments by crop for PLC and ARC deterministically (with zero risk) on prices and/or yields. The second table summarizes the SERF analysis stochastically, (with risk) of the ARC and PLC payments and provides an indication of which is preferable for a risk neutral, moderately risk averse, and an extremely risk averse producer.

The first representative farm, TXNP3000 grows three crops: irrigated wheat, seed grain sorghum (irrigated sorghum), and irrigated corn. Annual payments (deterministically) for PLC and ARC are contained in Table 4.1. These are the calculated payments for PLC/ARC before risk is incorporated. For irrigated wheat and Seed GS, the preferred program is PLC whereas; ARC is preferred for irrigated corn. Table 4.2 calculates the certainty equivalent for each of the three crops along with the whole farm. The whole farm choice is listed first followed by each of the three covered commodities. For whole farm choice, PLC is preferred for risk neutral producer, however ARC is preferred for moderately and extremely risk averse decision maker. Thus, the less risk the farmer is willing to take, the preferred choice becomes ARC. Additional risk measures are included in the table.

The CE values are shown for the whole farm and by crop. Their number values are shown under each risk choice for both ARC and PLC (Table 4.2). This table lists the CE values once risk is incorporated (stochastically). The whole farm (sum of all crops) certainty equivalent for a risk neutral DM for PLC is \$307,543 versus \$263,194 for ARC.

Additional risk measures (mean, standard deviation, CV, minimum, and maximum values) are also provided in Table 4.2.

Table 4.1-Average Annual Payments for PLC and ARC by Crop for TXNP3000.

	Wheat Irr		Seed GS		Corn Irr		Wheat Dry	
	PLC	ARC	PLC	ARC	PLC	ARC	PLC	ARC
2014	-	-	3,440	-	10,688	95,723	-	-
2015	17,087	-	7,692	-	-	-	-	-
2016	11,483	-	6,473	-	-	-	-	-
2017	1,007	-	4,369	-	-	-	-	-
2018	-	-	2,161	-	-	-	-	-
Total	**29,576**	-	**24,135**	-	**10,688**	**95,723**	-	-

Table 4.2-Ranking of Results for TXNP3000 Under Alternative Risk Preferences.

	Risk Neutral	Moderately Risk Averse	Extremely Risk Averse
Risk Rankings Based on CE			
Whole Farm	PLC Preferred	ARC Preferred	ARC Preferred
Irrigated Wheat	PLC Preferred	ARC Preferred	ARC Preferred
Sorghum for Seed	PLC Preferred	PLC Preferred	PLC Preferred
Irrigated Corn	ARC Preferred	ARC Preferred	ARC Preferred

	PLC Risk Neutral	PLC Moderate RA	PLC Extemely RA	ARC Risk Neutral	ARC Moderate RA	ARC Extemely RA
CE Values for Whole Farm						
Whole Farm	307,543	6,247	3,607	263,194	35,030	32,088
CE Values By Crop						
Irrigated Wheat	109,347	2,319	1,162	54,669	3,419	1,710
Sorghum for Seed	46,973	4,718	2,547	10,931	2,191	1,119
Irrigated Corn	151,223	3,040	1,549	197,595	4,877	2,446

Whole Farm	PLC Statistics ($)	ARC Statistics ($)
Mean	307,543	263,194
Standard Deviation	202,170	86,180
CV	66	33
Minimum	794	29,116
Maximum	923,047	494,558
Irrigated Wheat		
Mean	109,347	54,669
Standard Deviation	87,648	22,514
CV	80	41
Minimum	-	-
Maximum	370,952	118,215
Sorghum for Seed		
Mean	46,973	10,931
Standard Deviation	26,491	5,779
CV	56	53
Minimum	-	-
Maximum	142,890	28,408
Irrigated Corn		
Mean	151,223	197,595
Standard Deviation	115,942	73,349
CV	77	37
Minimum	-	-
Maximum	522,984	386,634

The second representative farm studied was the largest farm in terms of the most crops grown. TXNP10000 grows a total of five crops, irrigated and dry wheat, seed grain sorghum (irrigated sorghum), irrigated corn, and dry sorghum. Annual (deterministic) payments for PLC and ARC are summarized in Table 4.3. Assuming zero risk, PLC is preferred for all crops based on the highest average payments over the life of the farm bill, except irrigated corn, which prefers ARC. Table 4.4 provides the certainty equivalent for each of the five crops along with the whole farm. The whole farm choice is listed first followed by each of the five covered commodities. Across all three levels of risk aversion, PLC is the preferred choice for irrigated sorghum, dry wheat, and dry sorghum when taking risk into consideration. For whole farm and irrigated wheat PLC is preferred for a risk neutral producer but prefers ARC, as they become more risk averse. Irrigated corn prefers ARC across all three-risk measures. Additional risk measures are included in Table 4.4.

The CE values are shown for whole farm and values by crop. Their number values are shown under each risk choice for both ARC and PLC (Table 4.4). The whole farm (sum of all crops) certainty equivalent for a risk neutral DM for PLC is $858,877 versus $691,542 for ARC. Thus the risk neutral DM will prefer PLC as the preferred program for the whole farm decision. Additional risk measures (mean, standard deviation, CV, minimum, and maximum values) are also provided in Table 4.4.

Table 4.3- Average Annual Payments for PLC and ARC by Crop for TXNP10000.

	IWHEAT		SEED GS		CORN		DWHEAT		D SORG	
	PLC	ARC	PLC	ARC	PLC	ARC	PLC	ARC	PLC	ARC
2014	-	-	12,764	-	36,256	284,057	-	-	4,877	6,755
2015	15,207	-	28,535	-	-	-	1,206	-	10,903	3,392
2016	10,219	-	24,016	-	-	-	811	-	9,176	-
2017	896	-	16,208	-	-	-	71	-	6,193	-
2018	-	-	8,018	-	-	-	-	-	3,064	-
Total	**26,323**	-	**89,541**	-	**36,256**	**284,057**	**2,088**	-	**34,211**	**10,146**

Table 4.4- Ranking of Results for TXNP10000 Under Alternative Risk Preferences.

	Risk Neutral	Moderately Risk Averse	Extremely Risk Averse
Risk Rankings Based on CE			
Whole Farm	PLC Preferred	ARC Preferred	ARC Preferred
Irrigated Wheat	PLC Preferred	ARC Preferred	ARC Preferred
Irrigated Seed Grain Sorghum	PLC Preferred	PLC Preferred	PLC Preferred
Irrigated Corn	ARC Preferred	ARC Preferred	ARC Preferred
Non Irrigated Wheat	PLC Preferred	PLC Preferred	PLC Preferred
Non Irrigated Sorghum	PLC Preferred	PLC Preferred	PLC Preferred

	PLC Risk Neutral	PLC Moderate RA	PLC Extemely RA	ARC Risk Neutral	ARC Moderate RA	ARC Extemely RA
CE Values for Whole Farm						
Whole Farm	858,877	47,039	27,143	691,542	91,246	69,727
CEs By Crop						
Irrigated Wheat	97,319	17,227	9,349	49,740	27,016	15,728
Irrigated Seed Grain Sorghum	174,270	34,258	19,543	40,768	16,780	9,006
Irrigated Corn	512,984	24,347	12,719	582,333	38,067	19,412
Non Irrigated Wheat	7,720	5,782	4,540	4,416	4,254	4,095
Non Irrigated Sorghum	66,584	25,901	16,028	14,285	13,008	11,755
Whole Farm	PLC Statistics ($)			ARC Statistics ($)		
Mean	858,877			691,542		
Standard Deviation	560,152			238,104		
CV	65			34		
Minimum	4,071			47,409		
Maximum	2,753,793			1,323,822		
Irrigated Wheat						
Mean	97,319			49,740		
Standard Deviation	78,007			19,684		
CV	80			40		
Minimum	-			-		
Maximum	330,147			100,024		
Irrigated Seed Grain Sorghum						
Mean	174,270			40,768		
Standard Deviation	98,281			21,836		
CV	56			54		
Minimum	-			-		
Maximum	530,121			99,445		
Irrigated Corn						
Mean	512,984			582,333		
Standard Deviation	393,301			221,049		
CV	77			38		
Minimum	-			-		
Maximum	1,774,086			1,155,029		
Non Irrigated Wheat						
Mean	7,720			4,416		
Standard Deviation	6,188			1,628		
CV	80			37		
Minimum	-			-		
Maximum	26,190			10,899		
Non Irrigated Sorghum						
Mean	66,584			14,285		
Standard Deviation	37,551			4,582		
CV	56			32		
Minimum	-			-		
Maximum	202,545			29,123		

TXHG2500 is the third representative farm that was studied for the program decisions. TXHG2500 grows three crops: irrigated wheat, irrigated grain sorghum, and irrigated corn. Annual deterministic payments for PLC and ARC are presented in Table 4.5. ARC is preferred for irrigated corn and PLC is preferred for irrigated sorghum and wheat based on highest average payments over the life of the farm bill. Table 4.6 calculates the certainty equivalent for each of the three crops along with the whole farm.

First, the whole farm choice is listed followed by each of the three covered commodities. Across all three levels of risk aversion, ARC is the preferred choice for irrigated wheat and corn, however irrigated sorghum prefers PLC. The whole farm prefers PLC for a risk neutral producer. Additional risk measures are included in Table 4.6.

The CE values are shown for whole farm and by crop. The CE number values are shown under each risk choice for both ARC and PLC (Table 4.6). The whole farm's certainty equivalent for a risk neutral DM, under PLC is $69,270 versus $40,003 for ARC. Therefore the producer will prefer PLC for whole farm decision. Additional risk measures (mean, standard deviation, CV, minimum, and maximum values) are also provided in Table 4.6.

Table 4.5- Average Annual Payments for PLC and ARC by Crop for TXHG2500.

	SORGH		WHEAT		CORN	
	PLC	ARC	PLC	ARC	PLC	ARC
2014	15,765	-	-	-	1,326	3,533
2015	-	-	-	-	-	-
2016	13,898	-	7,050	-	-	-
2017	-	-	-	-	-	-
2018	-	-	-	-	-	-
Total	**29,663**	-	**7,050**	-	**1,326**	**3,533**

Table 4.6 - Ranking of Results for TXHG2500 Under Alternative Risk Preferences.

	Risk Neutral	Moderately Risk Averse	Extremely Risk Averse
Risk Rankings Based on CE			
Whole Farm	PLC Preferred	ARC Preferred	ARC Preferred
Irrigated Sorghum	PLC Preferred	PLC Preferred	PLC Preferred
Irrigated Wheat	ARC Preferred	ARC Preferred	ARC Preferred
Irrigated Corn	ARC Preferred	ARC Preferred	ARC Preferred

	PLC Risk Neutral	PLC Moderate RA	PLC Extemely RA	ARC Risk Neutral	ARC Moderate RA	ARC Extemely RA
CE Values for Whole Farm						
Whole Farm	69,270	3,952	1,988	40,003	4,403	2,315
CEs By Crop						
Irrigated Sorghum	57,225	3,388	1,727	17,626	1,857	932
Irrigated Wheat	4,490	685	361	4,801	2,365	1,325
Irrigated Corn	7,555	1,455	845	17,575	2,703	1,379

Whole Farm	PLC Statistics ($)	ARC Statistics ($)
Mean	69,270	40,003
Standard Deviation	69,404	16,764
CV	100	42
Minimum	-	-
Maximum	521,439	90,453
Irrigated Sorghum		
Mean	57,225	17,626
Standard Deviation	60,701	10,722
CV	106	61
Minimum	-	-
Maximum	426,348	51,236
Irrigated Wheat		
Mean	4,490	4,801
Standard Deviation	5,867	2,340
CV	131	49
Minimum	-	-
Maximum	26,997	11,565
Irrigated Corn		
Mean	7,555	17,575
Standard Deviation	11,436	8,307
CV	151	47
Minimum	-	-
Maximum	95,091	41,847

Next, TXWG1600 representative farm, located in Williamson County Texas, shows a good mix of payment decisions of all three of its crops; irrigated sorghum, wheat, and corn. TXWG1600 is the fourth representative farm that was studied for the program decisions. Annual deterministic payments for PLC and ARC are contained in Table 4.7. ARC is preferred for all three crops before risk is incorporated, based on highest average payments over the life of the farm bill. Table 4.8 calculates the certainty equivalence for each of the three crops and the whole farm. The whole farm choice is listed first followed by each of the three covered commodities. Whole farm prefers PLC for a risk neutral producer and ARC for moderately and extremely risk averse. Irrigated sorghum and wheat prefer PLC for a risk neutral DM and irrigated corn shows ARC across all three risk alternatives. Additional risk measures are included in the table.

The CE values are shown for whole farm and values by crop. Their number values are shown under each risk choice for both ARC and PLC (Table 4.8). The whole farm (sum of all crops) certainty equivalent for a risk neutral DM for PLC is $59,450 versus $56,919 for ARC. Thus the decision maker prefers PLC for whole farm decision as their best safety-net program for the life of the farm bill. Additional risk measures (mean, standard deviation, CV, minimum, and maximum values) are also provided in Table 4.8.

Table 4.7- Average Annual Payments for PLC and ARC by Crop for TXWG1600.

	SORGH		WHEAT		CORN	
	PLC	**ARC**	**PLC**	**ARC**	**PLC**	**ARC**
2014	4,767	16,404	-	-	361	1,910
2015	10,657	16,404	1,636	3,022	-	3,147
2016	8,969	11,679	1,099	2,828	-	1,801
2017	6,053	-	96	567	-	-
2018	2,995	-	-	-	-	-
Total	**33,441**	**44,486**	**2,831**	**6,416**	**361**	**6,859**

Table 4.8- Ranking of Results for TXWG1600 Under Alternative Risk Preferences.

	Risk Neutral	Moderately Risk Averse	Extremely Risk Averse
Risk Rankings Based on CE			
Whole Farm	PLC Preferred	ARC Preferred	ARC Preferred
Irrigated Sorghum	PLC Preferred	ARC Preferred	ARC Preferred
Irrigated Wheat	PLC Preferred	ARC Preferred	ARC Preferred
Irrigated Corn	ARC Preferred	ARC Preferred	ARC Preferred

	PLC Risk Neutral	PLC Moderate RA	PLC Extemely RA	ARC Risk Neutral	ARC Moderate RA	ARC Extemely RA
CE Values for Whole Farm						
Whole Farm	59,450	4,832	3,084	56,919	10,612	8,550
CEs By Crop						
Irrigated Sorghum	43,487	3,537	1,825	41,621	5,235	3,182
Irrigated Wheat	10,852	1,474	783	8,250	3,982	2,062
Irrigated Corn	5,111	1,403	822	7,048	4,289	3,011

Whole Farm	PLC Statistics ($)	ARC Statistics ($)
Mean	59,450	56,919
Standard Deviation	31,730	13,984
CV	53	25
Minimum	1,100	6,486
Maximum	171,944	93,683
Irrigated Sorghum		
Mean	43,487	41,621
Standard Deviation	23,479	12,165
CV	54	29
Minimum	-	1,118
Maximum	135,763	74,667
Irrigated Wheat		
Mean	10,852	8,250
Standard Deviation	9,043	2,233
CV	83	27
Minimum	-	-
Maximum	46,459	13,434
Irrigated Corn		
Mean	5,111	7,048
Standard Deviation	3,918	2,054
CV	77	29
Minimum	-	1,027
Maximum	17,675	12,275

TXUG1600 is the next representative farm with irrigated corn the only crop grown on this farm. The farm is located in Uvalde County. Annual payments (deterministically) for PLC and ARC for this representative farm are shown in Table 4.9. ARC is the preferred program for irrigated corn, based on highest average payments over the life of the farm bill, 2014-2018. ARCs average payment over the life of the farm bill is significantly higher than PLCs. Table 4.10 calculates the certainty equivalent for the crop along with the whole farm, which will be the same payments, thus ARC is the preferred choice for both whole farm and irrigated corn. The whole farm (and irrigated corn), certainty equivalent for a risk neutral DM for PLC is $71,900 versus $143,281 for

ARC. If the producer were risk neutral, ARC would be the preferred program because of the significantly higher payments than PLC. Additional risk measures (mean, standard deviation, CV, minimum, and maximum values) are also provided in Table 4.10.

Table 4.9- Average Annual Payments for PLC and ARC by Crop for TXUG1600.

	CORN I	
	PLC	ARC
2014	5,082	48,496
2015	-	52,974
2016	-	38,559
2017	-	-
2018	-	-
Total	5,082	140,028

Table 4.10-Ranking of Results for TXUG1600 Under Alternative Risk Preferences.

	Risk Neutral	Moderately Risk Averse	Extremely Risk Averse			
Risk Rankings Based on CE						
Whole Farm	ARC Preferred	ARC Preferred	ARC Preferred			
Irrigated Corn	ARC Preferred	ARC Preferred	ARC Preferred			
	PLC Risk Neutral	PLC Moderate RA	PLC Extemely RA	ARC Risk Neutral	ARC Moderate RA	ARC Extemely RA
CE Values for Whole Farm						
Whole Farm	71,900	1,297	659	143,281	51,021	49,759
CEs By Crop						
Irrigated Corn	71,900	1,297	659	143,281	51,021	49,759
Whole Farm	PLC Statistics ($)			ARC Statistics ($)		
Mean	71,900			143,281		
Standard Deviation	55,125			30,549		
CV	77			21		
Minimum	-			48,496		
Maximum	248,658			227,741		
Irrigated Corn						
Mean	71,900			143,281		
Standard Deviation	55,125			30,549		
CV	77			21		
Minimum	-			48,496		
Maximum	248,658			227,741		

TXRP2500 is another representative farm that showed data for one crop. This farm and others in this study had more crops grown, but they were deleted from this study if they were not program crops. Irrigated wheat is the only crop grown on this representative farm that provided base acres to calculate the potential program payments.

Annual deterministic payments for PLC and ARC are calculated in Table 4.11. ARC is the preferred program for wheat, based on highest average payments over the life of the farm bill. Table 4.12 calculates the certainty equivalent for the crop along with the whole farm, which will be the same payments. Therefore ARC is the preferred choice for both a moderately and extremely risk averse DM for whole farm and irrigated wheat. However, PLC is the preferred choice for a risk neutral DM. The whole farm (and irrigated wheat), certainty equivalent for a risk neutral DM for PLC is $29,337 versus $23,417 for ARC. Additional risk measures (mean, standard deviation, CV, minimum, and maximum values) are also provided in Table 4.12.

Table 4.11- Average Annual Payments for PLC and ARC by Crop for TXRP2500.

	WHEAT	
	PLC	**ARC**
2014	-	-
2015	4,584	8,916
2016	3,081	-
2017	270	-
2018	-	-
Total	**7,935**	**8,916**

Table 4.12- Ranking of Results for TXRP2500 Under Alternative Risk Preferences.

	Risk Neutral	Moderately Risk Averse	Extremely Risk Averse
Risk Rankings Based on CE			
Whole Farm	PLC Preferred	ARC Preferred	ARC Preferred
Irrigated Wheat	PLC Preferred	ARC Preferred	ARC Preferred

	PLC Risk Neutral	PLC Moderate RA	PLC Extemely RA	ARC Risk Neutral	ARC Moderate RA	ARC Extemely RA
CE Values for Whole Farm						
Whole Farm	29,337	3,103	1,615	23,417	8,380	4,201
CEs By Crop						
Irrigated Wheat	29,337	3,103	1,615	23,417	8,380	4,201

Whole Farm	PLC Statistics ($)	ARC Statistics ($)
Mean	29,337	23,417
Standard Deviation	23,515	5,978
CV	80	26
Minimum	-	-
Maximum	99,524	37,791
Irrigated Wheat		
Mean	29,337	23,417
Standard Deviation	23,515	5,978
CV	80	26
Minimum	-	-
Maximum	99,524	37,791

TXCB2500 is a representative farm located in San Patricio County, that grows two crops, irrigated corn and irrigated sorghum. Annual deterministic payments for PLC and ARC are shown in Table 4.13. ARC is preferred for irrigated corn and PLC for irrigated sorghum, based on highest average payments over the life of the farm bill. Table 4.14 calculates the certainty equivalent for both crops along with the whole farm. The whole farm choice is listed first, followed by both of covered commodities. Across all three levels of risk (risk neutral, moderately risk averse, and extremely risk averse), PLC is the preferred choice for the whole farm and irrigated sorghum. However, ARC is the preferred choice for irrigated corn for a moderately and extremely risk averse producer, and PLC for a risk neutral producer.

The CE values are shown for whole farm and values by crop. Their number values are shown under each risk choice for both ARC and PLC. The whole farm (sum of all crops) certainty equivalent for a risk neutral DM for PLC is $134,560 versus $70,653 for ARC. Therefore a risk neutral DM would prefer PLC to ARC as their safety-net program for the life of the farm bill. Additional risk measures (mean, standard deviation, CV, minimum, and maximum values) are also provided in Table 4.14.

Table 4.13- Average Annual Payments for PLC and ARC by Crop for TXCB2500.

	SORGH		CORN	
	PLC	ARC	PLC	ARC
2014	9,406	26,748	434	1,226
2015	21,029	-	-	-
2016	17,698	-	-	-
2017	11,944	-	-	-
2018	5,909	-	-	-
Total	65,985	26,748	434	1,226

Table 4.14- Ranking of Results for TXCB2500 Under Alternative Risk Preferences.

	Risk Neutral	Moderately Risk Averse	Extremely Risk Averse
Risk Rankings Based on CE			
Whole Farm	PLC Preferred	PLC Preferred	PLC Preferred
Irrigated Sorghum	PLC Preferred	PLC Preferred	PLC Preferred
Irrigated Corn	PLC Preferred	ARC Preferred	ARC Preferred

	PLC Risk Neutral	PLC Moderate RA	PLC Extemely RA	ARC Risk Neutral	ARC Moderate RA	ARC Extemely RA
CE Values for Whole Farm						
Whole Farm	134,560	1,575	787	70,653	1,270	640
CEs By Crop						
Irrigated Sorghum	128,424	1,575	787	64,894	1,089	544
Irrigated Corn	6,136	751	414	5,759	988	511

Whole Farm	PLC Statistics ($)	ARC Statistics ($)
Mean	134,560	70,653
Standard Deviation	76,095	25,903
CV	57	37
Minimum	-	-
Maximum	411,879	136,000
Irrigated Sorghum		
Mean	128,424	70,653
Standard Deviation	72,426	25,903
CV	56	37
Minimum	-	-
Maximum	390,659	136,000

TXCB8000 only has one crop, irrigated sorghum, thus the whole farm information will be the same as the single crop's information. Annual payments (deterministically) for PLC and ARC are contained in Table 4.15. PLC is the preferred program for sorghum, based on highest average payments over the life of the farm bill, without risk incorporated. Table 4.16 calculates the certainty equivalent for the crop along with the whole farm, which will be the same payments. However, once risk is incorporated into the study, PLC is the preferred choice for all three risk averse choices because the payments are significantly higher for PLC than ARC. The whole farm (and irrigated sorghum), certainty equivalent for a risk neutral DM for PLC is $578,129 versus $303,190 for ARC. Additional risk measures (mean, standard deviation, CV, minimum, and maximum values) are also provided in Table 4.16.

Table 4.15- Average Annual Payments for PLC and ARC by Crop for TXCB8000.

	SORGH	
	PLC	**ARC**
2014	42,342	78,753
2015	94,665	144,088
2016	79,670	50,144
2017	53,770	-
2018	26,600	-
Total	**297,047**	**272,986**

Table 4.16- Ranking of Results for TXCB8000 Under Alternative Risk Preferences.

	Risk Neutral	Moderately Risk Averse	Extremely Risk Averse
Risk Rankings Based on CE			
Whole Farm	PLC Preferred	PLC Preferred	PLC Preferred
Irrigated Sorghum	PLC Preferred	PLC Preferred	PLC Preferred

	PLC Risk Neutral	PLC Moderate RA	PLC Extemely RA	ARC Risk Neutral	ARC Moderate RA	ARC Extemely RA
CE Values for Whole Farm						
Whole Farm	578,129	3,581	1,791	303,190	3,132	1,566
CEs By Crop						
Irrigated Sorghum	578,129	3,581	1,791	303,190	3,132	1,566

Whole Farm	PLC Statistics ($)	ARC Statistics ($)
Mean	578,129	303,190
Standard Deviation	326,043	112,758
CV	56	37
Minimum	-	-
Maximum	1,758,642	603,576
Irrigated Sorghum		
Mean	578,129	303,190
Standard Deviation	326,043	112,758
CV	56	37
Minimum	-	-
Maximum	1,758,642	603,576

TXVC4500 is another representative farm that showed data for one crop, irrigated sorghum. Annual deterministic payments for PLC and ARC are provided in Table 4.17. ARC is the preferred program for sorghum, based on highest average payments over the life of the farm bill. Table 4.18 calculates the certainty equivalent for the crop along with the whole farm, which will be the same payments. Thus PLC is the preferred choice across all three risk averse decisions for whole farm and irrigated sorghum. The whole farm (and irrigated sorghum), certainty equivalent for a risk neutral DM for PLC is $221,164 versus $111,656 for ARC.

Table 4.17- Average Annual Payments for PLC and ARC by Crop for TXVC4500.

	SORGH	
	PLC	**ARC**
2014	16,198	50,363
2015	36,214	50,363
2016	30,478	35,856
2017	20,570	-
2018	10,176	-
Total	**113,636**	**136,582**

Table 4.18- Ranking of Results for TXVC4500 Under Alternative Risk Preferences.

	Risk Neutral	Moderately Risk Averse	Extremely Risk Averse
Risk Rankings Based on CE			
Whole Farm	PLC Preferred	PLC Preferred	PLC Preferred
Irrigated Sorghum	PLC Preferred	PLC Preferred	PLC Preferred

	PLC Risk Neutral	PLC Moderate RA	PLC Extemely RA	ARC Risk Neutral	ARC Moderate RA	ARC Extemely RA
CE Values for Whole Farm						
Whole Farm	221,164	8,879	4,506	111,656	8,499	4,306
CEs By Crop						
Irrigated Sorghum	221,164	8,879	4,506	111,656	8,499	4,306

Whole Farm	PLC Statistics ($)	ARC Statistics ($)
Mean	221,164	111,656
Standard Deviation	124,728	36,848
CV	56	33
Minimum	-	-
Maximum	672,772	207,939
Irrigated Sorghum		
Mean	221,164	111,656
Standard Deviation	124,728	36,848
CV	56	33
Minimum	-	-
Maximum	672,772	207,939

TXPG2500 is a representative farm that grows two crops, irrigated corn and irrigated wheat. Annual deterministic payments for PLC and ARC are contained in Table 4.19. ARC is preferred for irrigated corn based on highest average payments for the years 2014-2018. Table 4.20 calculates the certainty equivalent for both crops along with the whole farm. The whole farm choice is listed first followed by both of covered commodities. Across all three levels of risk (risk neutral, moderately risk averse, and extremely risk averse), ARC is the preferred choice for irrigated wheat, while PLC is the preferred choice for corn and the whole farm based on a risk neutral producer. As the risk preference becomes more risk averse, for whole farm and irrigated corn, the preferred program is ARC.

The CE values are shown for whole farm and values by crop. Their number values are shown under each risk choice for both ARC and PLC. The whole farm (sum of both crops) certainty equivalent for a risk neutral DM for PLC is $142,629 versus $81,091 for ARC. Additional risk measures (mean, standard deviation, CV, minimum, and maximum values) are also provided in Table 4.20.

Table 4.19- Average Annual Payments for PLC and ARC by Crop for TXPG2500.

	CORN-I		IRRWHT	
	PLC	**ARC**	**PLC**	**ARC**
2014	10,059	13,072	-	-
2015	-	-	-	-
2016	-	-	-	-
2017	-	-	-	-
2018	-	-	-	-
Total	**10,059**	**13,072**	-	-

Table 4.20- Ranking of Results for TXPG2500 Under Alternative Risk Preferences.

	Risk Neutral	Moderately Risk Averse	Extremely Risk Averse
Risk Rankings Based on CE			
Whole Farm	PLC Preferred	ARC Preferred	ARC Preferred
Irrigated Corn	PLC Preferred	ARC Preferred	ARC Preferred
Irrigated Wheat	ARC Preferred	ARC Preferred	ARC Preferred

	PLC Risk Neutral	PLC Moderate RA	PLC Extemely RA	ARC Risk Neutral	ARC Moderate RA	ARC Extemely RA
CE Values for Whole Farm						
Whole Farm	142,629	7,855	4,131	81,091	12,500	6,373
CEs By Crop						
Irrigated Corn	142,332	7,855	4,131	65,358	9,381	4,776
Irrigated Wheat	297	65	35	15,733	6,549	3,533

Whole Farm	PLC Statistics ($)	ARC Statistics ($)
Mean	142,629	81,091
Standard Deviation	109,620	30,634
CV	77	38
Minimum	-	-
Maximum	503,821	157,308
Irrigated Corn		
Mean	142,332	65,358
Standard Deviation	109,125	27,831
CV	77	43
Minimum	-	-
Maximum	492,237	138,760

TXMC1800 is another larger sized representative farm that grows three crops: irrigated sorghum, irrigated corn, and rice. TXMC1800 shows a good mix of payment decisions of all three of its crops. Annual deterministic payments for PLC and ARC are contained in Table 4.21. PLC is preferred for sorghum and rice, based on highest average payments over the life of the farm bill, and ARC is preferred for irrigated corn. Table 4.22 calculates the certainty equivalent for each of the three crops along with the whole farm. The whole farm choice is listed first followed by each of the three covered commodities. Across all three levels of risk (risk neutral, moderately risk averse, and extremely risk averse), PLC is the preferred choice for sorghum and rice. Whole farm prefers PLC for a risk neutral producer and ARC for the more risk averse DM. However, irrigated corn stays with ARC and prefers this decision across all three levels of risk. Additional risk measures are included in the table.

The CE values are shown for whole farm and values by each crop. Their number values are shown under each risk choice for both ARC and PLC. The whole farm (sum of all crops) certainty equivalent for a risk neutral DM for PLC is $113,558 versus $68,001 for ARC. Additional risk measures (mean, standard deviation, CV, minimum, and maximum values) are also provided in Table 4.22.

Table 4.21- Average Annual Payments for PLC and ARC by Crop for TXMC1800.

	SORGH		CORN		RICE	
	PLC	ARC	PLC	ARC	PLC	ARC
2014	4,716	-	2,750	9,554	567	-
2015	10,543	-	-	24,791	629	-
2016	8,873	-	-	7,739	1,224	-
2017	5,989	-	-	-	1,293	-
2018	2,963	-	-	-	1,154	-
Total	**33,084**	-	**2,750**	**42,083**	**4,866**	-

Table 4.22- Ranking of Results for TXMC1800 Under Alternative Risk Preferences.

	Risk Neutral	Moderately Risk Averse	Extremely Risk Averse
Risk Rankings Based on CE			
Whole Farm	PLC Preferred	ARC Preferred	ARC Preferred
Irrigated Sorghum	PLC Preferred	PLC Preferred	PLC Preferred
Irrigated Corn	ARC Preferred	ARC Preferred	ARC Preferred
RICE	PLC Preferred	PLC Preferred	PLC Preferred

	PLC Risk Neutral	PLC Moderate RA	PLC Extemely RA	ARC Risk Neutral	ARC Moderate RA	ARC Extemely RA
CE Values for Whole Farm						
Whole Farm	113,558	14,204	9,011	68,001	22,301	16,758
CEs By Crop						
Irrigated Sorghum	64,389	9,845	5,488	18,750	6,304	3,370
Irrigated Corn	38,913	5,529	3,080	47,494	11,629	5,964
RICE	10,255	5,817	3,929	1,756	710	425

Whole Farm	PLC Statistics ($)	ARC Statistics ($)
Mean	113,558	68,001
Standard Deviation	64,980	21,332
CV	57	31
Minimum	2,500	10,495
Maximum	352,620	126,205
Irrigated Sorghum		
Mean	64,389	18,750
Standard Deviation	36,313	9,189
CV	56	49
Minimum	-	-
Maximum	195,869	42,278
Irrigated Wheat		
Mean	38,913	47,494
Standard Deviation	29,834	16,183
CV	77	34
Minimum	-	-
Maximum	134,576	90,109

TXEC5000 grows one crop, but in this analysis it counts as two crops because one is irrigated sorghum and the other is non-irrigated (dry) sorghum. They are calculated as separate crops because the yields will be different. Annual payments (deterministically) for PLC and ARC are contained in Table 4.23. ARC is preferred for irrigated sorghum while PLC shows a larger payment for dry sorghum. However once risk is incorporated in the calculation, Table 4.24 shows different results. Table 4.24 calculates the certainty equivalent for both crops along with the whole farm. The whole farm choice is listed first followed by both of covered commodities. Across all three levels of risk (risk neutral, moderately risk averse, and extremely risk averse), PLC is the preferred choice for dry sorghum. For a risk neutral producer PLC is preferred for whole farm and irrigated sorghum. However, the more risk averse ARC becomes the preferred choice.

The CE values are shown for the whole farm and values by crop. Their number values are shown under each risk choice for both ARC and PLC. The whole farm (sum of all crops) certainty equivalent for a risk neutral DM for PLC is $65,685 versus $28,487 for ARC. Additional risk measures (mean, standard deviation, CV, minimum, and maximum values) are also provided in Table 4.24.

Table 4.23- Average Annual Payments for PLC and ARC by Crop for TXEC5000.

	I SORG		D SORG	
	PLC	ARC	PLC	ARC
2014	1,660	8,126	3,150	-
2015	3,712	7,729	7,044	-
2016	3,124	5,503	5,928	-
2017	2,108	-	4,001	-
2018	1,043	-	1,979	-
Total	11,648	21,358	22,102	-

Table 4.24- Ranking of Results for TXEC5000 Under Alternative Risk Preferences.

	Risk Neutral	Moderately Risk Averse	Extremely Risk Averse
Risk Rankings Based on CE			
Whole Farm	PLC Preferred	ARC Preferred	ARC Preferred
Irrigated Sorghum	PLC Preferred	ARC Preferred	ARC Preferred
Non-Irrigated Sorghum	PLC Preferred	PLC Preferred	PLC Preferred

	PLC Risk Neutral	PLC Moderate RA	PLC Extemely RA	ARC Risk Neutral	ARC Moderate RA	ARC Extemely RA
CE Values for Whole Farm						
Whole Farm	65,685	2,754	1,401	28,487	10,916	9,538
CEs By Crop						
Irrigated Sorghum	22,669	2,471	1,342	19,849	3,230	1,689
Non-Irrigated Sorghum	43,016	2,671	1,391	8,638	1,937	969

Whole Farm	PLC Statistics ($)	ARC Statistics ($)
Mean	65,685	28,487
Standard Deviation	37,044	7,329
CV	56	26
Minimum	-	8,107
Maximum	199,810	48,990
Irrigated Sorghum		
Mean	22,669	19,849
Standard Deviation	12,785	5,759
CV	56	29
Minimum	-	112
Maximum	68,959	35,017
Irrigated Corn		
Mean	43,016	8,638
Standard Deviation	24,259	3,365
CV	56	39
Minimum	-	-
Maximum	130,851	18,594

TXR1500 and TXR3000 show similar results; in terms of neither representative farm will receive any ARC payments, both farms only grow rice, and they are both located in Colorado County. Thus their results will be similar in terms of one farm (TXR3000) will have payments twice as large as TXR1500, because TXR1500 is half the size of TXR3000. Annual deterministic payments for PLC and ARC, for farms TXR1500 and TXR3000 respectively, are contained in Table 4.25 and Table 4.26. PLC is preferred for both farms and their single crop, based on highest average payments over the life of the farm bill. TXR1500 shows a PLC payment of $42,877 and TXR3000 shows PLC payment of $87,728, about twice as much as TXR1500. Table 4.27 and Table 4.28 calculate the certainty equivalent for both of the crops along with both of the whole farms. The whole farm choice is listed first, followed by each of the three covered commodities. Across all three levels of risk (risk neutral, moderately risk averse, and extremely risk averse), PLC is the preferred choice for the whole farm and for both of the crops. Additional risk measures are included in the tables.

The CE values are shown for whole farms and values by crop. Their number values are shown under each risk choice for both ARC and PLC. The whole farm (sum of all crops) certainty equivalent for a risk neutral DM for TXR1500, PLC is $90,364 versus $7,385 for ARC. TXR3000 shows $184,887 for PLC and $15,713 for ARC. Additional risk measures (mean, standard deviation, CV, minimum, and maximum values) are also provided in Table 4.27 and Table 4.28.

Table 4.25- Average Annual Payments for PLC and ARC by Crop for TXR1500.

	RICE	
	PLC	**ARC**
2014	4,997	-
2015	5,542	-
2016	10,785	-
2017	11,390	-
2018	10,164	-
Total	**42,877**	-

Table 4.26- Average Annual Payments for PLC and ARC by Crop for TXR3000.

	RICE	
	PLC	**ARC**
2014	10,223	-
2015	11,339	-
2016	22,065	-
2017	23,304	-
2018	20,797	-
Total	**87,728**	-

Table 4.27- Ranking of Results for TXR1500 Under Alternative Risk Preferences.

	Risk Neutral	Moderately Risk Averse	Extremely Risk Averse			
Risk Rankings Based on CE						
Whole Farm	PLC Preferred	PLC Preferred	PLC Preferred			
RICE	PLC Preferred	PLC Preferred	PLC Preferred			
	PLC Risk Neutral	PLC Moderate RA	PLC Extemely RA	ARC Risk Neutral	ARC Moderate RA	ARC Extemely RA
CE Values for Whole Farm						
Whole Farm	90,364	10,742	7,010	7,385	517	265
CEs By Crop						
RICE	90,364	10,742	7,010	7,385	517	265
Whole Farm	PLC Statistics ($)			ARC Statistics ($)		
Mean	90,364			7,385		
Standard Deviation	45,650			17,077		
CV	51			231		
Minimum	2,581			-		
Maximum	248,938			114,572		
RICE						
Mean	90,364			7,385		
Standard Deviation	45,650			17,077		
CV	51			231		
Minimum	2,581			-		
Maximum	248,938			114,572		

Table 4.28- Ranking of Results for TXR3000 Under Alternative Risk Preferences.

	Risk Neutral	Moderately Risk Averse	Extremely Risk Averse			
Risk Rankings Based on CE						
Whole Farm	PLC Preferred	PLC Preferred	PLC Preferred			
RICE	PLC Preferred	PLC Preferred	PLC Preferred			
	PLC Risk Neutral	**PLC Moderate RA**	**PLC Extemely RA**	**ARC Risk Neutral**	**ARC Moderate RA**	**ARC Extemely RA**
CE Values for Whole Farm						
Whole Farm	184,887	9,793	7,587	15,713	274	138
CEs By Crop						
RICE	184,887	9,793	7,587	15,713	274	138
Whole Farm	**PLC Statistics ($)**			**ARC Statistics ($)**		
Mean	184,887			15,713		
Standard Deviation	93,402			34,784		
CV	51			-		
Minimum	5,280			-		
Maximum	509,335			190,818		
RICE						
Mean	184,887			15,713		
Standard Deviation	93,402			24,209		
CV	51			-		
Minimum	5,280			-		
Maximum	509,335			107,364		

TXBR1800 is another representative farm that grows one crop, rice. This farm is located in Matagorda County, Texas and shows the results of PLC preferred as the farm's program decision deterministically. Annual deterministic payments for PLC and ARC are provided in Table 4.29. PLC is the preferred program for rice, based on highest average payments over the life of the farm bill, for years 2014-2018. Table 4.30 calculates the certainty equivalent for the crop along with for the whole farm, which will be the same payments. However, PLC is the preferred choice across all three risk levels in Table 4.30. The whole farm (and rice), certainty equivalent for a risk neutral DM for PLC is $124,443 versus $16,278 for ARC.

Table 4.29- Average Annual Payments for PLC and ARC by Crop for TXBR1800.

	RICE	
	PLC	ARC
2014	6,881	-
2015	7,632	-
2016	14,852	-
2017	15,685	-
2018	13,998	-
Total	59,048	-

Table 4.30- Ranking of Results for TXBR1800 Under Alternative Risk Preferences.

	Risk Neutral	Moderately Risk Averse	Extremely Risk Averse
Risk Rankings Based on CE			
Whole Farm	PLC Preferred	PLC Preferred	PLC Preferred
RICE	PLC Preferred	PLC Preferred	PLC Preferred

	PLC Risk Neutral	PLC Moderate RA	PLC Extemely RA	ARC Risk Neutral	ARC Moderate RA	ARC Extemely RA
CE Values for Whole Farm						
Whole Farm	124,443	6,734	5,181	16,278	397	201
CEs By Crop						
RICE	124,443	6,734	5,181	16,278	397	201

Whole Farm	PLC Statistics ($)	ARC Statistics ($)
Mean	124,443	16,278
Standard Deviation	62,867	24,209
CV	51	149
Minimum	3,554	-
Maximum	342,821	107,364
RICE		
Mean	124,443	16,278
Standard Deviation	62,867	24,209
CV	51	149
Minimum	3,554	-
Maximum	342,821	107,364

TXER3200 is the final representative farm in this study that is located in Wharton County, Texas. Three crops are grown on this farm, rice, irrigated sorghum, and irrigated soybeans. Annual deterministic payments for PLC and ARC are contained in Table 4.31. PLC is preferred for two crops, sorghum and rice, based on highest average payments over the life of the farm bill. However, ARC is preferred to irrigated soybeans before risk is incorporated. Table 4.32 calculates the certainty equivalent for each of the three crops along with the whole farm. The whole farm choice is listed first followed by each of the three covered commodities. Across all three levels of risk (risk neutral, moderately risk averse, and extremely risk averse), PLC is the preferred choice for the whole farm, rice, and irrigated sorghum. However, irrigated soybeans shows ARC as the preferred choice across all three levels of risk. Additional risk measures are included in the table.

The CE values are shown for whole farm and values by each crop. Their number values are shown under each risk choice for both ARC and PLC. The whole farm (sum of all crops) certainty equivalent for a risk neutral DM for PLC is $178,527 versus $35,214 for ARC. Additional risk measures (mean, standard deviation, CV, minimum, and maximum values) are also provided in Table 4.32.

Table 4.31- Average Annual Payments for PLC and ARC by Crop for TXER3200.

	RICE		SORGH		SOYBN	
	PLC	**ARC**	**PLC**	**ARC**	**PLC**	**ARC**
2014	8,527	-	1,574	-	-	1,917
2015	9,458	-	3,518	-	-	1,985
2016	18,404	-	2,961	-	-	1,765
2017	19,437	-	1,998	-	-	-
2018	17,346	-	988	-	-	-
Total	**73,173**	-	**11,039**	-	-	**5,667**

Table 4.32- Ranking of Results for TXER3200 Under Alternative Risk Preferences.

	Risk Neutral	Moderately Risk Averse	Extremely Risk Averse
Risk Rankings Based on CE			
Whole Farm	PLC Preferred	PLC Preferred	PLC Preferred
RICE	PLC Preferred	PLC Preferred	PLC Preferred
Irrigated Sorghum	PLC Preferred	PLC Preferred	PLC Preferred
Irrigated Soybeans	ARC Preferred	ARC Preferred	ARC Preferred

	PLC Risk Neutral	PLC Moderate RA	PLC Extemely RA	ARC Risk Neutral	ARC Moderate RA	ARC Extemely RA
CE Values for Whole Farm						
Whole Farm	178,527	12,655	10,878	35,214	5,128	3,711
CEs By Crop						
RICE	154,211	7,490	5,976	23,896	281	141
Irrigated Sorghum	21,484	2,716	1,491	6,121	1,563	821
Irrigated Soybeans	2,832	690	379	5,198	3,721	2,989

Whole Farm	PLC Statistics ($)	ARC Statistics ($)
Mean	178,527	35,214
Standard Deviation	85,288	42,592
CV	48	121
Minimum	9,094	2,099
Maximum	457,035	206,186
RICE		
Mean	154,211	23,896
Standard Deviation	77,905	41,904
CV	51	175
Minimum	4,404	-
Maximum	424,827	199,547
Irrigated Sorghum	21,484	6,121
Mean	12,116	3,083
Standard Deviation	56	50
CV	-	-
Minimum	65,354	16,021
Maximum	-	-
Irrigated Soybeans	2,787	5,198
Mean	98	1,289
Standard Deviation	-	25
CV	13,383	1,917
Minimum	-	8,666
Maximum	-	-

Summary

The simulation and risk rankings results show that most representative farms in this study would choose PLC as their farm program decision. Looking at the alternative risk preferences tables for each farm, the CE values for whole farm and each individual crop incorporate risk into the calculations, thus summarization will be over those tables. A total of fifteen representative farms preferred PLC as the program decision for their whole farm decision once risk was incorporated into the model. However, in the deterministic results, a total of eight representative farms preferred ARC for the whole farm decision. Once risk was incorporated into the model (stochastically), seven of the original eight ARC preferred farms, flipped to PLC for whole farm decision. This can be seen in Table 4.33. Thus without risk incorporated many farms would have preferred ARC, and with risk all but one farm chose PLC as the preferred choice. Therefore risk is extremely important when calculating ARC/PLC payments because many farms would have chosen the wrong program for the next five years.

Table 4.33 presents with and without risk results for PLC/ARC for each representative farm. TXUG1600 is the only farm that stayed with ARC for the whole farm before and after risk was incorporated and the only crop it grows is irrigated corn. When looking back at equations 1 and 2 to calculate PLC and ARC, PLC does not require a benchmark in order to calculate payment and ARC requires a benchmark to be set every year of the farm bill. The benchmark is the 5-year Olympic moving average of marketing year average prices multiplied by the 5-year Olympic moving average of county yields. This is recalculated every year of the farm bill to calculate ARC payment. If a farm grows one crop and it's irrigated, the benchmark will be high because of the high yields from irrigation. The ARC revenue guarantee is 0.86 multiplied by benchmark revenue. Actual revenue is the actual marketing year average price multiplied by actual county yield. The minimum of (ARC revenue guarantee-actual revenue) or 10% of the benchmark revenue is calculated into the final ARC payment. Thus if the farm has one irrigated crop, their ARC payments will be high each time because of the higher yields and yearly benchmark. Therefore ARC will be preferred with or without risk incorporated into the payments.

In addition, eight farms showed ARC as the preferred program for a certain crop across all three DM risk levels. For example, TXNP3000 grows three crops: irrigated wheat, irrigated sorghum, and irrigated corn. Irrigated corn was the only crop shown to prefer ARC across all three levels of risk. TXNP10000 grows irrigated corn as well and ARC was the preferred choice across all three risk levels. Also, TXHG2500 grew three crops and ARC was the preferred for irrigated wheat and irrigated corn across all three risk levels. TXWG1600, TXUG1600, and TXMC1800 grow irrigated corn and ARC was the preferred program across all three risk levels.

To summarize the results from this study, risk was important to incorporate into the analysis of which program decision would be the best choice for each representative farm. Incorporating risk aided the results to be as accurate as possible is extremely important for a number of reasons because it takes into account situations farmers have little control over. Droughts, floods, and poor prices do happen and are important considerations for farmers. By incorporating historical price and yield risk into the analyses the stochastic decision between PLC and ARC can be made knowing which of the two choices would perform best under uncertainty. Also the different alternative risk preferences allowed the study to cater to each different type of risk aversion the DM could be to make the decision process even more accurate and specialized to each farm.

Table 4.33-Results For Whole Farm Level ARC/PLC Payments Before Risk (Deterministically) and With Risk (Stochastically).

	Without Risk (Deterministic)		With Risk (Stochastic)	
Farm Name	PLC	ARC	PLC	ARC
TXNP3000	64,399	95,723	307,543	263,194
TXNP10000	188,419	294,204	858,877	691,542
TXHG2500	38,038	3,533	69,270	40,003
TXWG1600	36,633	57,762	59,450	56,919
TXUG1600	5,082	140,028	71,900	143,281
TXRP2500	7,935	8,916	29,337	23,417
TXCB2500	66,419	27,974	134,560	70,653
TXCB8000	297,047	272,986	578,129	303,190
TXVC4500	113,636	136,582	221,164	111,656
TXPG2500	10,059	13,072	142,629	81,091
TXMC1800	40,700	42,083	113,558	68,001
TXEC5000	33,749	21,358	65,685	28,487
TXR1500	42,877	-	90,364	7,385
TXR3000	87,728	-	184,887	15,713
TXBR1800	59,048	-	124,443	16,278
TXER3200	84,212	5,667	178,527	35,214

CHAPTER V

SUMMARY AND CONCLUSION

Summary

The Agriculture Adjustment Act of 1933, generally referred to as the first Farm Bill, was part of Franklin Roosevelt's New Deal, which allowed farmers to receive payments for not growing food on a percentage of their land. The '33 Act provided financial assistance to farmers who were struggling due to an excess crop supply, which created lower prices, and also to ensure an adequate food supply.

Following the 1933 Act, the Farm Bill has generally has been updated every 5 to 6 years with new or changed farm programs. The 2014 Farm Bill eliminated direct payments to farmers in favor of two alternative safety net programs. These include the Price Loss Coverage (PLC) and the Agriculture Risk Coverage (ARC) programs. Farmers must make a one-time, irrevocable choice of PLC, a county ARC program, or an individual ARC program for each covered commodity on their farm (Campiche, Outlaw, and Bryant 2014). Base reallocation for this payment program will be a one-time decision for the five-year program. The producer can either reallocate their base acres; means they cannot add base acres to a farm, or retain existing base acres.

Price Loss Coverage, or PLC, will cover losses in price due to the marketing year average price for a covered commodity that falls below an established reference price. Reference prices were established in the Farm Bill for each covered commodity. The marketing year average price is the average of monthly prices received for the covered commodity as determined by USDA that weights each monthly price based on the amount of the commodity marketed in the month.

Agriculture Risk Coverage, or ARC, is a revenue support program that has the producer choose between ARC-CO (County) or ARC-IC (farm level). If the producer selects ARC-CO for a covered commodity, they will get payments when the actual county revenue for the crop year is below the county ARC revenue guarantee. ARC-IC applies to all covered commodities and cannot be elected on a commodity-by-commodity basis. Payments are made when actual revenue falls below the revenue guarantee Richardson (2014). Producers will also have the opportunity to reallocate their base acres to crops planted on the farm at any time during the 2009 to 2012 crop years Richardson (2014).

This study assisted feed grain/oilseed and rice farmers in Texas with the choices they will face in the 2014 Farm Bill by either a crop-by-crop or whole farm decision. The bill requires that farmers make a one-time, irrevocable choice between entering into the PLC program or a county-based ARC program. They will have access to both options in order to make the program decision of PLC or ARC easier because they were based on their farm individually.

The provisions of the new Farm Bill are not similar to the direct payments that have existed in the previous versions of the Farm Bill. Therefore, it was essential that farmers were aware of the possible pitfalls that exist. The most popular problems faced by farmers are the uncertain yields and prices. No one knows the future or what future yields or prices will be, so our simulation model incorporated risk into our results. Along with the five-year future of the farm bill, it is a 5-year irrevocable decision and making the right decision for the farmer is extremely important because they will be living with this decision for the life of the farm bill. Therefore the calculated 5-year moving average stochastic price was incorporated into this model.

Objectives

The main objective of this study was to determine which program (ARC or PLC) would be most beneficial for Texas farmers. The complexities of the program alternatives make it difficult for the average farmer to decide, even without accounting for random variables such as drought and low prices. A secondary objective of this study was to conduct an analysis to determine whether a producers risk preferences will impact their program choice.

Methods and Procedures

The study utilized the Agricultural and Food Policy Center (AFPC) database of representative farms to determine how farmers will respond to the farm bill. A spreadsheet-based model of government payments was constructed to analyze the representative farms. Stochastic simulation was used to examine farmers' choices and provide insight into when the farmers should choose PLC versus ARC enrollment.

USDA-NASS (National Agriculture Statistics Service) database provided the historical county yields used in this study and FAPRIs (Food and Agriculture Policy Research Institute) projected national crop prices for the years 2014-2018. Stochastic prices and yields were used to calculate the PLC and ARC-CO payments for each farm and each crop. Stochastic simulation was used to examine farmers' choices and will provide insight into when the farmers should choose PLC versus ARC enrollment.

Three levels of risk aversion were used in the model to cover three different types of risk averse farmers in choosing ARC or PLC. Three RRACs (Relative Risk Aversion

Coefficient) were used to model three different risk averse producers, risk neutral, moderately risk averse, and extremely risk averse. The coefficients used to calculate the RRACs were 0, 2, and 4 respectively. The CEs (Certainty Equivalents) were calculated using the RRACs and each farm's net worth. This study wanted to incorporate the size of the farms into the risk averse decision maker's final preferred program choice. Thus the CEs were calculated as RRAC coefficient divided by the farm's net worth for each level of risk aversion.

The CE of ARC/PLC choices for each RRAC were ranked using SERF (Stochastic Efficiency with Respect to a Function) to help determine farmer choices. SERF compares CE at each level and one with the highest CE is preferred. Three levels of risk aversion were tested to simplify the SERF analysis, risk neutral, moderately risk averse, and extremely risk averse. For each level of risk, the higher CE payment of either PLC/ARC was chosen.

Results

The results from this study indicate that the majority of the representative farms preferred PLC once risk was incorporated (stochastically) into the payments. The deterministic results before risk was incorporated showed eight representative farms that preferred ARC. TXR1500, TXR3000, and TXBR1800 showed zero ARC payments because they only grew rice. Their ARC revenue guarantee calculations were never greater than ARC actual revenue, thus violating the ARC formula, so no ARC payments were shown deterministically.

Once risk was incorporated stochastically into the model, seven of the original eight ARC preferred farms switched to PLC preferred. This shows seven farms choosing the correct program once risk was incorporated and helped save them from making a horrible decision that cannot be changed for the life of the farm bill. TXUG1600 is the only farm that stayed ARC deterministically and stochastically because it only grew one crop, irrigated corn. The benchmark revenue was higher because of the higher yields on this farm due to irrigation, thus allowing higher ARC payments.

Data Limitations and Need for Further Research

This study did not have any data limitations but several additions to the study could be done. Producers of covered commodities who elect PLC will have the option to enroll in a new Supplemental Crop Insurance Program (SCO). SCO is insurance that covers a portion of the loss deductible that is only available if the farmer chooses the PLC. This program is designed to cover the difference between 86% and the level of coverage of the producer’s individual insurance policy. If one chooses this program that covers county-wide losses, this will complement a producers individual insurance policy. However, they are required to purchase individual insurance policy either, revenue protection or yield protection. SCO was not included in this study.

The second program decision that was left out of this study was ARC-IC or the ARC Individual option. As stated previously, Agriculture Risk Coverage is the second program ranchers can choose from in the 2014 Farm Bill as a safety net payment. This study defined the preferred program ARC as ARC-CO each time that program decision was used. ARC covers losses in income for a, covered commodity relative to a revenue guarantee, and can be selected at a county or individual level Richardson (2015). ARC-IC shows many limitations that would have greatly affected this study and made it difficult to compare the alternatives. As stated before, ARC-Individual will apply to all covered commodities under the 2014 Farm Bill and cannot be decided upon a commodity-by-commodity basis. Payments will be given when actual revenue falls below the Revenue Guarantee. They will be made on 65% of the farms total base acres for all covered commodities Bowers et al. (1984).

As seen in the previous results, very few farms showed ARC as their preferred program decision. These representative farms only showed individual crops to be covered under ARC and not the whole farm decision. If the DM were to choose ARC-IC for that particular crop then the whole farm will be under the ARC-IC program, according to the ARC rules. This would confuse the results in this study because if the DM chose that particular crop to be entered in ARC-IC then the entire farm would be under that program, even if this study shows their whole farm decision should be under PLC. If this were incorporated into the study, it would have changed the results significantly. Thus changing the most preferred program decision provided for the DM to choose under the life of the farm bill, which was the objective of this study; to provide the best possible program decision for each representative farm to choose for the life of the 2014 Farm Bill.

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