Evaluating the Impact of Proposed Farm Bill Programs with Crop Insurance for Southern Crops

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Introduction

Crop insurance has become the foundation of farm risk management. Proposals for the 2014 Farm Bill increase the importance of crop insurance to the point that it will become the nation's primary agricultural safety-net tool. Previous Farm Bills had policies that clearly separated crop insurance from commodity support programs like direct and counter-cyclical payments. Producers were free to make a decision about a commodity program essentially independent of their decision regarding crop insurance. With declining Federal budgets, policy-makers are constructing programs that are integrating these two different approaches in order to reach a policy goal of an improved safety-net.

The challenge for farm managers is quantifying and understanding the stochastic interactions between the policy tools and crop insurance. To make an informed decision, farm managers will need to consider the correlation between farm-level and county-level yields, as well as the volatility in U.S. marketing-year average prices. This is complicated enough for a two-crop production system but becomes even more complicated as more crop enterprises are added to the decision and as some farm programs require enrollment of all crops under operational control of the producer in the same program. Other proposals would allow managers to make enrollment decisions by crop and by farm which increases the number of comparisons managers will have to consider to make an informed decision.

Another component to this decision is the managers' attitude towards risk. A risk neutral producer would choose the risk-management alternative that would provide the largest expected return over risk management costs. Alternatively, a producer that is more risk averse would be expected to choose an alternative with a lower expected return in exchange for reduced down-side risk. Managers may not be accustomed to thinking in terms of risk aversion coefficients; however, Extension specialists may be able to provide some guidance to generally describe which alternatives would be preferred by risk neutral producers and which alternatives would be preferred by producers with more conservative attitudes toward risk.

Preferred risk management alternatives are expected to be location specific as the relative risks are expected to depend on the production system used (irrigated or non-irrigated) and crop enterprise selection. The policy tools being proposed appear to have components that would be preferred by specific commodities or regions. For instance, rice and peanuts have fixed reference prices in a counter-cyclical like payment program while cotton producers only have one insurance-based policy option.

This paper will simulate the return over risk management costs for an Arkansas rice farm, a Texas cotton farm, and a Georgia peanut farm. As the Farm Bill has not been finalized when the analysis was conducted, the policies modeled will reflect the Senate's and the House's version of the Farm Bill (S. 954

and HR. 2642) passed by each chamber. The effects of risk preferences on the risk-efficient set of risk management alternatives are determined for varying levels of risk-aversion.

Overview of the Senate (S.954) and House (HR. 2642) Farm Bill Proposals

Title I Commodity Programs

Both the Senate and House Farm Bill proposals eliminate direct payments, counter-cyclical payments and the average crop revenue election program. The proposed policies in S.954 and HR. 2642 are mostly designed to interact with crop insurance. It is envisioned that farm managers will purchase crop insurance to best cover the yield or revenue risk coupled with the policy tools available in Title I of each proposal to provide payments for losses that are not significant enough to trigger a crop insurance indemnity.

The Senate bill proposes two different tools for the farm safety-net. A reference price program, called the Adverse Market Payment (AMP), would provide protection when the U.S. marketing-year average price is below the reference price. The motivation for this program is that a reference price program may provide better risk protection during periods of sustained low prices. The reference price is set as 55 percent of the Olympic average U.S. marketing-year average price for all covered commodities except rice and peanuts. The reference price for rice and peanuts are fixed at $13.30/cwt. and $523.77/ton, respectively, for the life of the Farm Bill (S.954). The producers of commodities most desirous of this program (e.g. rice and peanuts) believe there are inadequate crop insurance revenue protection products available for their specific commodities. Producers would receive an AMP payment on eighty-five percent of their base acres per their counter-cyclical payment yield. Producers have the option of buying crop insurance but it is not required to participate in the AMP program.

The other Title I policy in the Senate proposal is called the Agricultural Risk Coverage (ARC) program. This program is commonly called a "shallow-loss" program where payments would be triggered after a "small" deviation below historic revenue. Farm managers have the choice of participating in either an individual (farm) level or an area (county) level program. Managers will have a one-time, irreversible election of participating in either level. All covered commodities and all acres under operational control must be enrolled in the same program; that is; a producer can't enroll rice in ARC at the individual level and peanuts in ARC at the area level (S.954).

The ARC program guarantees revenue based on the product of Olympic average yield and Olympic average U.S. marketing-year average price. The use of Olympic averages provides some protection against multiple years of low commodity prices as the effect of lower prices will reduce the revenue guarantee gradually over time. Conversely, ARC support levels will only rise slowly should market prices jump as has been observed in the recent past.

An ARC payment is made whenever the actual revenue is less than the guaranteed revenue. Payments are made on 65 percent of planted acres for the individual coverage, 80 percent of planted acres if the producer choses the area coverage option. In the case of prevented planting a producer will receive payments on 45 percent of prevented-planted acres for either the individual or area coverage. The ARC payment rate is capped at 10 percent of the benchmark revenue. This means that the maximum ARC payment rate is 6.5 percent of the benchmark revenue for the individual coverage and 8 percent of the benchmark revenue for the area coverage (S.954).

The reference price program in the House proposal (HR. 2642) is called the Price Loss Coverage (PLC). This program functions similarly to AMP except that PLC has fixed reference prices for the life of the program for all covered crops. The reference price for rice and peanuts are $14/cwt. and $535/ton, respectively. The other difference with AMP is that PLC payments are based on planted acres instead of base acres.

The House version of a shallow-loss program is called Revenue Loss Coverage (RLC). Under the House's proposal, farmers would make a one-time, irrevocable decision between PLC and RLC for each crop and each farm. RLC is similar to the ARC area coverage program as RLC is only offered with the area (county) level coverage. RLC is paid on 85% of the planted acres and 30% of prevented planting acres.

The AMP, ARC, PLC and RLC programs would be administered by the Farm Service Agency (FSA) and would have no direct cost to producers for participation in the programs; however, participation in either Title I program requires producers to adhere to conservation compliance requirements and wetland protection requirements (S.954). The House proposal also has conservation compliance requirements but does not include similar wetland protection requirements (HR. 2642).

Title XI Crop Insurance Programs

The crop insurance titles in both proposals include a new crop insurance product called the Supplemental Coverage Option (SCO). The SCO program is innovative as it would allow managers to couple an individual or area insurance product with another area product as a wrap to cover losses at the area level that would otherwise not trigger a payment for the underlying product. The SCO insurance policy is designed to insure a portion of the deductible of the underlying crop insurance product. SCO is an area (county) based risk management program similar to the currently available Group Risk Income Protection (GRIP) insurance product. Unlike GRIP, SCO would not have the harvest-price option or a multiplication factor that allows producers to buy-up revenue protection above the expected county revenue. For managers that do not participate in ARC, the SCO deductible is a 10 percent revenue loss at the county-level. The deductible is increased to 22 percent for those participating in ARC. If a loss is triggered, an SCO payment is made and is capped by the coverage level of the underlying policy. Like GRIP, it is assumed that a SCO

payment would be based on the percentage loss in excess of the deductible multiplied by the expected county revenue (S.954). The House proposal only has a 10 percent SCO deductible and can only be combined with the PLC program. RLC is not eligible to be combined with SCO under the House proposal (HR. 2642).

Since SCO is an insurance product, it will be administered by the Risk Management Agency (RMA). Producers will receive a 65 percent subsidy on the premium and a 100 percent subsidy on the Administrative and Overhead expense (A&O). Since it is not administered by the FSA, producers who only use SCO would not be bound by the same producer compliance agreements outlined in Title I. Producers are required to have an underlying insurance product before purchasing SCO.

The crop insurance titles also include a new crop insurance product only available to cotton producers called the Stacked Income Protection Plan (STAX). STAX is similar to SCO as it is consistent with a GRIP insurance policy. STAX, however, has the Harvest Revenue Option and producers may elect a protection factor of up to 120 percent which allows producers to increase their protection above the expected county revenue. STAX allows producers to protect against losses at the area level with a product capped at 70 percent of expected county revenue. A STAX payment is triggered after a 10 percent loss at the county-level. Once a loss is triggered, a STAX payment is paid up to the coverage level chosen. Like SCO, STAX can be coupled with an underling individual or area product. However, producers do not have to purchase insurance as a requirement for purchasing STAX. The only requirement is that STAX coverage can't exceed the deductible of the underlying product to avoid double-payments for the same loss. The House and Senate proposals have identical proposals for the STAX program.

STAX will also be administered by the Risk Management Agency (RMA) with a premium subsidy of 80 percent and a 100 percent subsidy on A&O. Since STAX is only available to cotton, cotton producers are not eligible to participate in ARC, AMP, PLC, RLC, or SCO.

Revenue Protection (RP) Crop Insurance

The risk-management foundation in the Farm Bill is the crop insurance program. For this analysis, the revenue protection (RP) product is analyzed for combination with the policy alternatives. Revenue protection insurance provides protection against yield risk, price risk or both lower yields and prices. Revenue protection is based on a farm's Actual Production History (APH) yield which is the average of a minimum of four and maximum of 10 consecutive years of farm-level yields. The prices used to determine the revenue guarantees and if an indemnity is paid are from the futures market. RP insurance uses the futures market to determine a projected price before planting to provide a minimum revenue guarantee for the producer. The futures price just before harvest is also used to increase the revenue protection of the crop if the harvest price is greater than the projected price. Insuring at a higher harvest-time price would allow a farmer to forward contract a percentage of production without fear of having to buy more expensive bushels

at harvest if there is a production loss. The harvest price is also used to determine if there is a loss and if an indemnity is paid. An indemnity is triggered whenever actual revenue is less than the guaranteed revenue.

Peanuts do not have a revenue protection insurance product available to manage risk so this study will analyze the risk reduction of the policy proposals when combined with yield protection insurance. Under YP insurance, an indemnity is triggered whenever harvested production is less than the guaranteed production.

Description of Stochastic Simulation Model

A stochastic simulation model of the net revenue from crop production is developed for an Arkansas rice farm, a Texas cotton farm, and a Georgia peanut farm. This model is used to simulate farm yield, county yield, projected price and harvest price for RP insurance, and marketing-year average price for each crop. Yield and price distributions are used to generate distributions of crop revenue, RP (YP for peanuts) crop insurance indemnities, AMP program payments, ARC program payments for individual coverage and area coverage, PLC and RLC program payments, and SCO payments with and without ARC for corn, soybeans and rice. The stochastic cotton county yields, farm yields, crop insurance prices and marketing-year average prices are used to generate distributions of cotton revenue, RP insurance indemnities, STAX program payments, and STAX program payments combined with crop insurance.

To simulate yields, county yields for Arkansas County, Illinois; Hockley County, Texas; and Tift County, Georgia from 1996 through 2012 were de-trended using OLS regression. To derive a proxy for a farm-level yield series, error terms from the regression were multiplied by an expansion factor, resulting in a series with essentially the same mean but greater standard deviation than the original de-trended county data. This empirical data was used to define parameters of beta distributions (one for county and one for farm yield) that were used in the stochastic simulation. A county/farm correlation coefficient (ρ_{fc}) of 0.45 was exogenously imposed.

To simulate prices, for each year of the data[1], the ratio of the projected price to the harvest price and the marketing year average price was calculated. Projected prices were them simulated as a 5-year random walk assuming a lognormal distribution, with parameters estimated from the raw data. Price ratios were also simulated from lognormal distributions and used to calculate, for each simulated projected price outcome, a corresponding harvest price and MYA outcome. Simulated price and yield outcomes were correlated using a

[1] For all states/crops, price data was available through 2012; however, the beginning year was determined by the availability of reported RP projected prices. For Arkansas rice and Texas Cotton, price data started in 1998.

modification of the procedure described by Anderson, Harri, and Coble (2009).[2] For each crop/county combination, a set of 500, 5-year time paths for yields and prices were simulated.

The farmer's cost of the risk management product is included in the net revenue calculation. The AMP, ARC, PLC and RLC programs will be administered by FSA and will not have a direct cost paid by the farmer. In contrast, SCO is administered through RMA and producers will pay 35 percent of the insurance premium with RMA subsidizing 65 percent of the premium and 100 percent of the overhead cost. STAX is also administered by RMA and producers will pay 20 percent of the insurance premium with RMA subsidizing 80 percent of the premium and 100 percent of the overhead costs. The distributions of RP, SCO, SCO with ARC and STAX program payments were used in calculating the actuarially fair insurance premium based on the 500 iterations per year for the five years simulated in this study. Because the model lacks farm-level data, the actuarially fair premiums for some risk alternatives are zero whenever zero indemnities are triggered. Therefore, this study assumes that farmers will pay a share of the A&O expense of the crop insurance products to keep RP, SCO and STAX from becoming zero-cost programs in the model. The A&O expense used in this study is the average of RMA's per acre insured cost of administrative expense reimbursement, other program fund costs, and other administrative and operative fund costs from 2003-2012 (USDA-RMA). This average cost is $6.04 per acre insured and is applied to all of the insurance products – RP insurance, SCO, SCO with ARC, and STAX. The farmer's share of the premium is calculated as the actuarially fair premium plus the A&O expense less the insurance subsidy.

The revenues and the risk management alternatives net of the farmer's share of the cost for each simulated year for five years are discounted into present value dollars using a discount rate of 5 percent. Using a 5-year average is a little burdensome as it does not account for the time value of money and one extreme year could influence the average. Discounting the revenues to a present value reduces the effect of the extreme iterations. The Net Present Value Revenue after risk management costs for covered commodity i is calculated for each risk management alternative using equation 1:

$$\widetilde{NetPVRev}^{\iota} = \sum_{t=1}^{5}\Big\{\Big(\widetilde{MYAPrice}_t^{i} \times \widetilde{FarmYield}_t^{i}\Big) + \delta^{RP}\Big(\widetilde{RPIndem}_t^{\iota} - \overline{RPPrem^{\iota}}\Big) + \delta^{AMP}\Big(\widetilde{AMP}_t^{\iota}\Big) + \delta^{PLC}\Big(\widetilde{PLC}_t^{\iota}\Big) + \delta^{RLC}\Big(\widetilde{RLC}_t^{\iota}\Big) + \delta^{ARCIND}\Big(\widetilde{ARCInd}_t^{\iota}\Big) + \delta^{ARCAREA}\Big(\widetilde{ARCArea}_t^{\iota}\Big) + \delta^{SCOONLY}\Big(\widetilde{SCOonly}_t^{\iota} - \overline{SCOonlyPrem^{\iota}}\Big) + \delta^{SCOARC}\Big(\widetilde{SCOARC}_t^{\iota} - \overline{SCOARCPrem^{\iota}}\Big)\Big\} \div (1+r)^t \quad (1)$$

The $\widetilde{MYAPrice}_t^{i}$ and $\widetilde{FarmYield}_t^{i}$ are the stochastic marketing-year average price and farm-level yield for covered commodity *i* in year *t* and are used simulate the actual farm revenue. The terms

[2] The modification to the procedure used by Anderson, Harri, and Coble was to substitute a Cholesky decomposition of the rank correlation matrix for the Eigen decomposition described in their work. This made it possible to implement the procedure in a spreadsheet environment.

$\widetilde{RPIndem_t^l}$ and $\overline{RPPrem^l}$ represent the stochastic indemnity for RP insurance at varying coverage levels and the associated deterministic premium for each covered commodity and each simulated year. The term $\widetilde{AMP_t^l}$ is the stochastic AMP program payment while $\widetilde{ARCInd_t^l}$ and $\widetilde{ARCArea_t^l}$ are the stochastic ARC program payments at the individual and area levels, respectively. The terms $\widetilde{PLC_t^l}$ and $\widetilde{RLC_t^l}$ are the stochastic PLC and RLC payments. The terms $\widetilde{SCOonly_t^l}$ and $\overline{SCOonlyPrem^l}$ represent the stochastic SCO program payment and the associated premium for each commodity and each simulated year. Similarly, $\widetilde{SCOARC_t^l}$ *and* $\overline{SCOARCPrem^l}$ are the stochastic SCO program payment and premium when SCO is combined with ARC at either the individual level or area level. The net revenue for each commodity for each year is discounted using the discount rate *r* which is assumed to be 5 percent. The variables δ^{RP}, δ^{AMP}, δ^{PLC}, δ^{RLC}, δ^{ARCIND}, $\delta^{ARCAREA}$, $\delta^{SCOONLY}$, and δ^{SCOARC} are indicator variables equal to one for the alternative where the corresponding risk management product is simulated. The legislation prohibits $\delta^{ARCIND}$and $\delta^{ARCAREA}$ from being used simultaneously. Similarly, $\delta^{SCOARC}$and $\delta^{SCOONLY}$can't both be one simultaneously. The legislation prohibits δ^{PLC} and δ^{RLC} from being used simultaneously. In addition, δ^{AMP}, δ^{ARCIND}, or $\delta^{ARCAREA}$ cannot be combined with δ^{PLC} or δ^{RLC}. The $\delta^{SCOONLY}$and δ^{SCOARC} must both be used with δ^{RP} as an underlying insurance policy must be purchased in order to qualify for the SCO insurance product. The δ^{SCOARC} must be used with either δ^{ARCIND} or $\delta^{ARCAREA}$. Legislation prohibits δ^{RLC} being used with δ^{SCOARC}.

The net present value revenue less risk management costs were converted into an annualized value using the present value annuity factor (PVAF) shown in equation 2:

$$PVAF = \frac{1-(1+r)^{-t}}{r} \quad (2)$$

which is equal to 4.3294 for a discount rate, r, of 5 percent for the five-year annuity. The annualized net revenue less risk management cost is calculated as the Net Present Value Revenue divided by the PVAF (equation 3).

$$AnnualRevenue^i = \frac{NetPVRev^i}{PVAF} \quad (3)$$

The simulation model generates distributions of annualized net revenues for each covered commodity simulated for the various risk management alternatives. Each distribution has 500 simulated five-year annualized net revenues. The certainty equivalent of each distribution is determined assuming a power expected utility functions and coefficients of relative risk aversion (CRRA) ranging from 0 to 5. The natural log utility function is used when the CRRA is 1 (Gray, et al). A CRRA of zero represents a risk neutral producer that is only interested in maximizing the expected net revenue. The producer becomes more risk averse with larger CRRA values. A CRRA of 5 represents a producer that is extremely risk averse. In this manner, the risk efficient set of alternatives are mapped by crop enterprise.

Risk Management Alternatives Simulated

Sixteen different risk management alternatives were simulated each for rice and peanuts for this study and are described in Table 1. The Do-Nothing alternative is just the revenue of the crop at harvest and assumes that no other risk management product was used while the RP only alternative combines the crop revenue with RP insurance at the 55, 60, 65, 70, 75, 80 or 85 percent coverage levels. The AMP only alternative combines the crop revenue with the AMP program without any other risk management product. Similarly, the ARC only combines the ARC program payments at the individual level or the area level with the crop revenue without additional risk management products. Likewise, the PLC and RLC only alternatives are the crop revenue plus any PLC or RLC payment (Table 1).

The RP+AMP alternative combines the crop revenue with RP insurance at the 55 through 85 percent coverage levels and the AMP program. Similarly, the RP+ARC alternative combines the crop revenue with the various coverage levels of RP insurance with ARC at the individual level or ARC at the area level. The RP+PLC alternative combines the crop revenue with RP insurance at the 55 percent to 85 percent coverage levels and PLC. Similarly, the RP+RLC alternative combines crop revenue with RP insurance at the 55 percent to 85 percent coverage levels and RLC. The RP+AMP+ARC combines the crop revenue with the various coverage levels of RP insurance with AMP plus ARC at the individual level or ARC at the area level. The RP+SCO alternative combines crop revenue with RP insurance at the 55 percent to 85 percent coverage levels and SCO. The RP+SCO+AMP alternatives combine crop revenue, RP insurance at the varying coverage levels, SCO program payments and AMP program payments. The RP+SCO+ARC alternative combines crop revenue with RP insurance at the 55 to 75 percent coverage levels, SCO with the larger deductible, and ARC at the individual or area level. The RP+SCO+PLC alternatives combine crop revenue, RP insurance at the varying coverage levels, SCO program payments and PLC program payments. The RP+AMP+ARC+SCO combines the crop revenue with the various coverage levels of RP insurance with AMP plus ARC at the individual level or ARC at the area level plus SCO with the larger deductible (Table 1).

The Texas cotton farm has fewer risk management alternatives to simulate. The Do Nothing strategy is the farm-level yield priced at the simulated marketing-year average price. RP insurance is simulated for the 55 percent to 85 percent coverage levels and combined with crop revenues. The STAX program is simulated and combined with crop revenue. The last risk management alternative for cotton is to combine crop revenue, with RP insurance at the 55 percent to 85 percent level with STAX.

Results

Arkansas Rice Farm

The summary statistics for the annualized net revenue for the risk management alternatives available for an Arkansas rice farm are reported in Table 2. As discussed above, the 'Revenue' line represents the market generated annualized revenue for the operation which average $1,197 per acre. Net payment rates for the various options are also shown. Recall that the RP and SCO programs require the producer to purchase the program benefit and for purposes of this study, the premium rates are the actuarially sound rates plus an administrative cost of $6.04 per acre less the premium subsidy for that product.

The average annualized net indemnity for RP insurance for the 500 iterations were negative for all coverage levels. The probability of triggering a positive net indemnity was 11 and 28 percent, respectively, for the 80 and 85 percent coverage levels. The expected value of an RP indemnity at the 85 percent coverage level is $13.23 per acre (Table 2).

SCO triggered a positive annualized net indemnity more frequently in about 75 percent of the iterations for SCO at the 85 percent coverage level (Table 2). However, as SCO is assumed to be structured, the larger expected annualized net indemnities occur at the lower coverage levels. For example, SCO at the 75 percent coverage level has an average annualized net value of $15.67/acre while SCO at the 85 percent coverage level has an average annualized value of $8.58/acre. While the simulation may suggest a greater degree of accuracy than actually exists, recognize that the band eligible to receive payments in conjunction with the underlying 85 percent RP insurance coverage is fairly small. However, SCO when coupled with ARC has a significantly lower probability of a positive net indemnity of about 16 percent of the iterations and the average annualized net indemnity is negative for all coverage levels (Table 2).

ARC at the individual and area levels trigger indemnities of 18 percent and 21 percent, respectively, for the Arkansas rice simulation. As the guarantee is based on Olympic average yields and Olympic average prices, ARC provides protection against years of lower commodity prices as the guarantee declines gradually. In contrast, the revenue guarantee for RP and SCO is determined annually and the guarantee would decrease immediately in periods of low commodity prices. The simulated average annualized ARC payments are $0.99/acre and $1.16/acre, respectively, for the individual and area coverage (Table 2).

AMP triggers an indemnity in about 64 percent of the iterations due to the fixed reference price set at $13.30/cwt. Similarly, the PLC program triggers a payment about 76 percent of the iterations due to the fixed reference price of $14/cwt. The expected value of the annualized AMP and PLC payments are $33.91 and $41.71 per acre, respectively (Table 2). An RLC payment is triggered less frequently than a PLC payment at about 57 percent of the iterations with the expected value of the annualized RLC payment of $23.77 per acre (Table 2).

Texas Cotton Farm

The Texas cotton crop is assumed to be produced under irrigation; however, given the great production risk RP insurance could still be triggered through yield as well through price risk. The average annualized net RP indemnities for all coverage levels are positive for the Texas cotton farm (Table 3). A positive annualized net RP indemnity at the 85 percent coverage level is triggered in about 83 percent of the observations illustrating the extreme revenue risk in Texas cotton production (Table 3). The expected value of a RP indemnity at the 85 percent coverage level is $67.86 per acre demonstrating the benefit of revenue risk protection even for an irrigated production system (Table 3).

The STAX program with the 120 percent multiplier which increases the revenue protection and the 80 percent premium subsidy provides strong revenue protection for cotton. The simulated average annualized net STAX payment is $163/acre and a payment would be triggered with almost certainty due to the multiplication factor increasing the protection above the expected county revenue. Combining STAX with crop insurance still provides a positive average annualized net payment; however, producers may decide to reduce their RP coverage in order to benefit from larger average STAX payments and lower insurance premiums (Table 3).

Georgia Peanuts

Like rice, the average net indemnity for YP insurance was negative for all coverage levels and the probability of triggering a positive indemnity was only at the highest coverage level (Table 4). SCO triggered payments about 78 percent of the iterations with the average annualized SCO payment ranging from $14.40 per acre at 70 percent coverage to $7.40 per acre at the 85 percent coverage level (Table 4). SCO when combined with ARC triggered positive indemnities about 18 percent of the iterations and had negative average annualized indemnities for all coverage levels.

ARC at the individual and area levels triggered payments in 69 percent and 57 percent of the iterations with the average annualized ARC payments at $7.10 and $6.25 per acre, respectively, for the individual and area program (Table 4). The AMP and PLC programs triggered payments almost 100 percent of the iterations due to the fixed reference price of $523.77/ton and $535/ton, respectively. The average annualized payments are simulated at $87.32 per acre and $98.47 per acre, respectively, for the AMP and PLC programs (Table 4). The RLC program is simulated to trigger positive annuity payments 99 percent of the iterations with average annualized payment of $33.04 per acre (Table 4).

Results from Certainty Equivalent Analysis

Arkansas Rice

The certainty equivalents (CE) of the annualized net revenues for selected risk management alternatives for the Arkansas farm are reported in Table 5 for coefficients of relative risk aversion ranging

from 0 to 5. The risk management alternative of combining RP insurance at the 55 percent coverage level with the PLC program and SCO coverage provides the annualized net revenue with the largest certainty equivalents for all risk aversion coefficients. This strategy dominates as the PLC protection is fixed at $14/cwt. throughout the 5-year period. SCO triggers a positive indemnity about 78 percent of the iterations but requires the purchase of an insurance product. The cheapest insurance that provides the largest potential SCO payment is at the 55 percent coverage level (Table 5).

Texas Cotton

The certainty equivalent results for the Texas cotton farm is reported in Table 6. The CE maximizing alternative is to purchase RP insurance at the 60 percent coverage level with STAX. The next largest CE results are from only participating with the STAX program without insurance. The CE for RP and STAX at the 60 percent coverage level is much larger than the CE at the 85 percent coverage level. This may suggest producers who are currently buying up insurance may purchase at lower coverage levels or only use STAX as their insurance protection (Table 6).

Georgia Peanut Farm

The alternative which generates the largest certainty equivalent for the Georgia peanut farm is to combine YP insurance at the 55 percent coverage level with PLC and SCO. The PLC fixed reference price provides the largest average annual payment. SCO is simulated to trigger positive indemnities about 77 percent of the iterations which provides additional revenue. Since insurance must be purchased with SCO, the YP insurance at the 55 percent coverage level is the cheapest insurance product (Table 7).

Conclusions and Suggestions for Further Research

The interaction between crop insurance, AMP, PLC, and SCO is important for farm managers to understand as there may be an opportunity for producers to shift some of the risk management costs of insurance at the highest coverage level to the AMP, PLC or SCO program. In this manner, producer would benefit from premium savings and other programs would provide some coverage for losses that would not trigger an RP insurance indemnity. Producers would need to understand the farm-level yield risk, county-level risk and the interaction with marketing-year average and crop insurance prices. Land grant universities with access to farm record keeping project data that can develop a panel data set of farm-level yields would be able to shed greater light on this issue. The effect of these risk management alternatives on farm financial conditions could also be studied using the financial information of those participating in the record keeping associations.

This study prices the cost of the insurance products using actuarially fair premiums plus an A&O charge. The lack of detailed farm-level yield data grossly undervalues the actual cost of these programs.

Further research will incorporate the actual cost of the RP, SCO and STAX programs to analyze the robustness of the certainty equivalent maximizing alternatives.

The risk management alternative that maximizes the certainty equivalent of the annualized net revenue differs by crop and by location. However, the results are robust for the varying levels of risk aversion. If the robustness of results remains with better defined yield risk and insurance costs, Extension economists may be able to provide guidelines applicable within an individual state; thus helping producers make better management decisions.

Further research could consider analyzing the cropping system by determining the certainty equivalent maximizing crop-mix and risk-management alternatives to account for the benefits of enterprise diversification which reduces farm-level revenue risk.

Finally, further research could consider the effect of capping program and insurance benefits on the certainty equivalent maximizing risk-management alternatives. Similarly, there have been proposals in Congress to reduce crop insurance subsidies based on producers' Adjusted Gross Income. The impact of reduced subsidies on the certainty equivalent maximizing risk-management alternatives would help decision-makers and Extension economists understand the potential impact of this change in policy.

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Table 1. Risk Management Alternatives Simulated for Rice and Peanuts.

Alternative	Description
Do Nothing	Do not participate in crop insurance, AMP, ARC or SCO
RP Only	Only purchase RP insurance at the 55% to 85% level
AMP Only	Only participate in AMP
ARC Only	Only participate in ARC at individual or area level
PLC Only	Only participate in PLC
RLC Only	Only participate in RLC
RP + AMP	RP insurance at the 55% to 85% levels plus participation in AMP
RP + ARC	RP insurance at the 55% to 85% levels plus participation in ARC at either the individual or area level
RP + PLC	RP insurance at the 55% to 85% levels plus participation in PLC
RP + RLC	RP insurance at the 55% to 85% levels plus participation in RLC
RP + AMP + ARC	RP insurance at the 55% to 85% levels plus participation in ARC at either the individual or area level plus participation in AMP
RP + SCO	RP insurance at the 55% to 85% level plus participation in SCO
RP + SCO + AMP	RP insurance at the 55% to 85% levels plus SCO plus the AMP program
RP + SCO + ARC	RP insurance at the 55% to 75% levels plus SCO plus ARC at either the individual or area level
RP + SCO + PLC	RP insurance at the 55% to 75% levels plus SCO plus PLC
RP + AMP + ARC+ SCP	RP insurance at the 55% to 85% levels plus participation in ARC at either the individual or area level plus participation in AMP plus SCO

Table 2. Summary Statistics of the Simulated Annualized Net Revenues for Arkansas Rice ($/Acre)

	---------- Total Distribution ----------				Positive Net Annualized Values	
					Probability	Expected Value
Alternatives [1/]	Mean	Std. Dev.	Max	Min	of Payment [2/]	of Payment [3/]
Revenue	$1,197	$189	$1,842	$782		
RP55	-$2.30	$0.00	-$2.30	-$2.30	0.0%	$0.00
RP60	-$2.51	$0.00	-$2.51	-$2.51	0.0%	$0.00
RP65	-$2.51	$0.00	-$2.51	-$2.51	0.0%	$0.00
RP70	-$2.82	$0.71	$9.15	-$2.89	0.8%	$4.52
RP75	-$2.87	$2.64	$23.71	-$3.36	4.2%	$8.15
RP80	-$2.61	$6.22	$37.38	-$4.73	11.4%	$11.98
RP85	-$1.52	$12.28	$73.26	-$8.90	28.7%	$13.23
SCO-55	$16.41	$26.14	$163.80	-$12.63	66.9%	$28.38
SCO-60	$16.41	$26.14	$163.80	-$12.63	66.9%	$28.38
SC0-65	$16.40	$26.12	$163.81	-$12.63	66.9%	$28.36
SCO-70	$16.24	$25.62	$163.89	-$12.54	66.9%	$28.09
SCO-75	$15.67	$23.95	$150.17	-$12.24	67.3%	$26.93
SCO-80	$13.80	$20.25	$123.03	-$11.22	70.3%	$22.68
SCO-85	$8.58	$12.47	$63.29	-$8.39	75.0%	$13.27
ARC-SCO55	-$0.86	$6.72	$37.17	-$3.30	16.4%	$10.93
ARC-SCO60	-$0.86	$6.72	$37.17	-$3.30	16.4%	$10.93
ARC-SCO65	-$0.87	$6.65	$36.87	-$3.29	16.4%	$10.86
ARC-SCO70	-$1.03	$5.66	$35.06	-$3.21	16.6%	$9.35
ARC-SCO75	-$1.59	$2.96	$14.63	-$2.90	17.4%	$4.18
ARC Individual	$0.99	$3.11	$32.51	$0.00	18.4%	$5.38
ARC Area	$1.16	$3.33	$26.36	$0.00	21.2%	$5.49
AMP	$21.87	$30.42	$156.28	$0.00	64.5%	$33.91
PLC	$31.97	$38.01	$180.09	$0.00	76.6%	$41.71
RLC	$13.62	$16.26	$70.35	$0.00	57.3%	$23.77

1/ Simulated risk management alternatives. Revenue is the harvested yield multiplied by the U.S. Marketing-Year Average Price; RP is revenue protection insurance for varying coverage levels; SCO is the Supplemental Coverage Option for varying RP coverage levels; ARC-SCO is the SCO coupled with theAgricultural Risk Coverage (ARC) program for varying RP insurance coverage levels; ARC-Individual is the ARC progarm with the individual coverage level; ARC-Area is the ARC program with the area coverage level; AMP is the Adverse Market Program; PLC is the Price Loss Coverage program and RLC is the Revenue Loss Coverage program.

2/ The probability of triggering a risk management payment that exceeds the producer's share of the program cost based on the 500 simulated annualized net revenues.

3/ The expected value of the risk management payment net of the producer's cost based on the 500 simulated annualized net revenues.

Table 3. Summary Statistics of the Simulated Annualized Net Revenues for Texas Cotton ($/Acre)

	---------- Total Distribution ----------				Positive Net Annualized Values	
					Probability	Expected Value
Alternatives [1/]	Mean	Std. Dev.	Max	Min	of Payment [2/]	of Payment [3/]
Revenue	$651	$136	$1,158	$368		
RP55	$1.82	$10.66	$71.88	-$4.33	33.3%	$13.41
RP60	$5.55	$15.94	$94.81	-$6.17	47.7%	$17.66
RP65	$11.09	$22.52	$118.38	-$8.90	58.5%	$24.24
RP70	$18.63	$30.47	$154.46	-$12.61	67.5%	$32.29
RP75	$28.32	$39.05	$190.82	-$17.38	74.9%	$42.02
RP80	$40.20	$47.78	$226.10	-$23.23	79.6%	$54.05
RP85	$54.16	$56.85	$281.40	-$30.11	83.4%	$67.86
STAX	$163.12	$79.95	$522.46	-$3.54	99.8%	$163.46
STAX55	$163.12	$79.95	$522.46	-$3.54	99.8%	$163.46
STAX60	$163.12	$79.95	$522.46	-$3.54	99.8%	$163.46
STAX65	$146.15	$68.44	$435.32	$0.71	100.0%	$146.15
STAX70	$124.82	$55.78	$349.27	$5.17	100.0%	$124.82
STAX75	$98.95	$42.12	$264.35	$2.30	100.0%	$98.95
STAX80	$68.95	$28.18	$180.47	$0.26	100.0%	$68.95
STAX85	$35.18	$14.07	$91.05	-$0.83	99.8%	$35.25

[1/] Simulated risk management alternatives. Revenue is the harvested yield multiplied by the U.S. Marketing-Year Average Price; RP is revenue protection insurance for varying coverage levels; STAX is the Stacked Income Protection Plan without RP insurance; STAX55 to STAX85 is the STAX program coupled with RP insurance coverage at the 55 percent to the 85 percent level.

[2/] The probability of triggering a risk management payment that exceeds the producer's share of the program cost based on the 500 simulated annualized net revenues.

[3/] The expected value of the risk management payment net of the producer's cost based on the 500 simulated annualized net revenues.

Table 4. Summary Statistics of the Simulated Annualized Net Revenues for Georgia Peanuts ($/Acre)

	---------- Total Distribution ----------				Positive Net Annualized Values	
Alternatives [1/]	Mean	Std. Dev.	Max	Min	Probability of Payment [2/]	Expected Value of Payment [3/]
Revenue	$818	$81	$1,134	$628		
YP55	-$2.30	$0.00	-$2.30	-$2.30	0.0%	$0.00
YP60	-$2.51	$0.00	-$2.51	-$2.51	0.0%	$0.00
YP65	-$2.51	$0.00	-$2.51	-$2.51	0.0%	$0.00
YP70	-$2.86	$0.00	-$2.86	-$2.86	0.0%	$0.00
YP75	-$3.14	$0.00	-$3.14	-$3.14	0.0%	$0.00
YP80	-$3.51	$0.71	$0.82	-$3.75	0.2%	$0.82
YP85	-$2.96	$5.05	$25.58	-$6.56	23.0%	$4.82
SCO-55	$14.40	$16.91	$76.58	-$11.50	77.8%	$20.26
SCO-60	$14.40	$16.91	$76.58	-$11.50	77.8%	$20.26
SC0-65	$14.40	$16.91	$76.58	-$11.50	77.8%	$20.26
SCO-70	$14.40	$16.91	$76.58	-$11.50	77.8%	$20.26
SCO-75	$14.22	$16.56	$73.85	-$11.40	77.8%	$20.00
SCO-80	$12.64	$14.26	$58.34	-$10.56	79.4%	$17.39
SCO-85	$7.40	$8.50	$34.78	-$7.73	78.8%	$10.32
ARC-SCO55	-$1.62	$2.65	$11.43	-$2.89	18.2%	$3.38
ARC-SCO60	-$1.62	$2.65	$11.43	-$2.89	18.2%	$3.38
ARC-SCO65	-$1.62	$2.65	$11.43	-$2.89	18.2%	$3.38
ARC-SCO70	-$1.62	$2.65	$11.43	-$2.89	18.2%	$3.38
ARC-SCO75	-$1.80	$1.93	$7.50	-$2.79	18.4%	$1.93
ARC Individual	$7.10	$7.71	$37.90	$0.00	69.5%	$10.22
ARC Area	$6.25	$8.26	$38.57	$0.00	57.7%	$10.84
AMP	$87.32	$35.25	$174.70	$0.00	99.8%	$87.49
PLC	$98.47	$37.02	$189.00	$0.00	99.8%	$98.66
RLC	$33.04	$12.00	$69.08	$0.00	99.0%	$33.37

[1/] Simulated risk management alternatives. Revenue is the harvested yield multiplied by the U.S. Marketing-Year Average Price; YP is yield protection insurance for varying coverage levels; SCO is the Supplemental Coverage Option for varying YP coverage levels; ARC-SCO is the SCO coupled with theAgricultural Risk Coverage (ARC) program for varying YP insurance coverage levels; ARC-Individual is the ARC progarm with the individual coverage level; ARC-Area is the ARC program with the area coverage level; AMP is the Adverse Market Program; PLC is the Price Loss Coverage program and RLC is the Revenue Loss Coverage program.

[2/] The probability of triggering a risk management payment that exceeds the producer's share of the program cost based on the 500 simulated annualized net revenues.

[3/] The expected value of the risk management payment net of the producer's cost based on the 500 simulated annualized net revenues.

Table 5. Certainty Equivalents of the Simulated Annualized Net Revenues for Selected Risk Management Alternatives for Arkansas Rice ($/Acre).

CRRA [1/]	Revenue [2/]	Revenue + RP55	Revenue + RP55 + SCO	Revenue + AMP	Revenue + RP55 AMP + SCO	Revenue + PLC	Revenue + RP55 PLC + SCO
0	$1,196.47	$1,194.17	$1,210.56	$1,218.38	$1,232.47	$1,228.50	$1,242.59
1	$1,182.03	$1,179.70	$1,195.74	$1,207.60	$1,221.32	$1,218.73	$1,232.45
2	$1,167.93	$1,165.58	$1,181.25	$1,197.42	$1,210.78	$1,209.55	$1,222.90
3	$1,154.20	$1,151.82	$1,167.15	$1,187.82	$1,200.83	$1,200.93	$1,213.92
4	$1,140.86	$1,138.45	$1,153.46	$1,178.78	$1,191.47	$1,192.85	$1,205.51
5	$1,127.94	$1,125.50	$1,140.21	$1,170.29	$1,182.68	$1,185.27	$1,197.62

[1/] CRRA is the coefficient of relative risk aversion used in calculating the Certainty Equivalent for each risk management alternative

[2/] Selected risk management alternatives as summarized in Table 2 for the Arkansas rice farm.

Table 6. Certainty Equivalents of the Simulated Annualized Net Revenues for Selected Risk Management Alternatives for Texas Cotton ($/Acre).

CRRA [1/]	Revenue [2/]	Revenue + RP60	Revenue + RP85	Revenue + STAX	Revenue + RP60 + STAX60	Revenue + RP85 + STAX85
0	$651.12	$656.69	$705.34	$814.29	$819.86	$740.52
1	$637.54	$643.10	$691.29	$796.02	$800.93	$725.29
2	$624.42	$630.01	$677.84	$778.25	$782.57	$710.70
3	$611.76	$617.41	$664.96	$760.96	$764.72	$696.71
4	$599.57	$605.32	$652.63	$744.09	$747.33	$683.29
5	$587.87	$593.74	$640.83	$727.63	$730.37	$670.41

[1/] CRRA is the coefficient of relative risk aversion used in calculating the Certainty Equivalent for each risk management alternative

[2/] Selected risk management alternatives as summarized in Table 3 for the Texas cotton farm.

Table 7. Certainty Equivalents of the Simulated Annualized Net Revenues for Selected Risk Management Alternatives for Georgia Peanuts ($/Acre).

CRRA [1/]	Revenue [2/]	Revenue + YP55	Revenue + YP55 + SCO	Revenue + AMP	Revenue + PLC	Revenue + RLC	Revenue + YP55 PLC + SCO55
0	$817.73	$815.43	$829.82	$905.06	$916.21	$850.73	$928.31
1	$813.76	$811.44	$825.53	$903.13	$914.37	$847.24	$926.39
2	$809.80	$807.47	$821.23	$901.21	$912.55	$843.75	$924.49
3	$805.85	$803.51	$816.94	$899.30	$910.73	$840.28	$922.59
4	$801.92	$799.57	$812.65	$897.40	$908.92	$836.83	$920.70
5	$798.01	$795.65	$808.38	$895.52	$907.12	$833.39	$918.83

[1/] CRRA is the coefficient of relative risk aversion used in calculating the Certainty Equivalent for each risk management alternative

[2/] Selected risk management alternatives as summarized in Table 4 for the Georgia Peanut farm.