Evaluation of Crop Insurance Choices for Cotton Producers under the 2014 Farm Bill

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Abstract

New crop insurance coverage offered by the 2014 Farm Bill will be available to cotton farmers beginning in 2015. Stacked Income Protection Plan (STAX) and Supplemental Coverage Option (SCO) are new crop insurance options, which are designed to protect farmers from shallow losses. STAX is only available for upland cotton producers, while SCO is available for all major farm program crops. The objective of this project is to assess the benefits of the new crop insurance offerings for cotton producers in the Texas High Plains. Representative dry land and mixed, irrigated and dry land farms were developed using consensus evaluations of panels of producers in two distinct areas of the High Plains. Our simulation analysis examined producer welfare benefits of alternative combinations of underlying yield or revenue insurance coverage and STAX or SCO. The results suggest that Revenue Protection combined with STAX is the optimal insurance selection for both risk neutral and risk averse producers.

Key words:

Farm Bill 2014, cotton representative farm simulation, crop insurance, STAX, SCO Endorsement.

Introduction

The 2014 farm bill has significant changes in commodity program (Title I) and added new shallow loss insurance coverage options to the Federal Crop Insurance Program (Title XI). The direct payment, counter-cyclical payment and Average Crop Revenue Election (ACRE) commodity programs are replaced with Price Loss coverage (PLC) and Agricultural Risk Coverage (ARC) as a one-time decision choice for the 2014-2018 crop years. Cotton is not eligible to enroll in either PLC or ARC. The Federal Crop Insurance Program has been expanded with the Supplemental Coverage Option Endorsement (SCO) and Stacked Income Protection Plan (STAX). STAX is only available for cotton producers while SCO is available for all major farm program crops; both are shallow loss insurance programs.

In the 2014 Farm bill, the previously available individual farm and county–based insurance plans are called Common Crop Insurance Policy (CCIP) and Area Risk Protection Insurance Plan (ARPI) respectively. The Supplemental Coverage Option is a continuous shallow loss insurance product that can be taken as an endorsement to an underlying CCIP. SCO cannot be taken with an Area Risk Protection Insurance Plan. STAX is a separate shallow loss insurance program for cotton producers only which can be taken as a standalone policy or coordinated with CCIP or ARPI coverage. There are two STAX products, STAX revenue protection and STAX revenue protection with harvest price exclusion. SCO coverage is of the same form as the underlying policy (i.e., Revenue Protection, Revenue Protection with Harvest Price Exclusion, or Yield Protection). Both SCO and STAX are trigger by area yield losses. However SCO liability is based under the underlying policy (CCIP) where as STAX liability is area based. The coverage level cannot overlap between STAX and an underlying insurance policy. Further, the STAX coverage range can be a minimum of 5% and maximum of 20% between 70-90%. The premium subsidy rates for STAX and SCO are 80% and 65% respectively. STAX also allows producers to take different protection factors from 80% to 120% in 1% interval. Protection factors is the percent of indemnity to be paid under that policy.

Another significant change in the Federal Crop Insurance Program is ability to make different insurance coverage choices by type and practice, allowing cotton producers to choose different insurance products and coverage levels for dry land and irrigated crops. Furthermore, the 2014 farm bill keeps the "yield plug" as before, but also enhances it by allowing producers to exclude their yields for years in which the county average yield is less than 50% of the 10–year county average from the APH yield calculation.

The policy changes described above offer producers significant new insurance options. The primary prior published study examining these new options addresses only irrigated cotton farms (Bulut and Collins 2013), in the Northern High Plains of Texas. An earlier study (Dismukes, et al. 2013) provides broad national estimates but no estimates specific to the Texas High Plains region.

The objective our study is to assess the benefits of the new crop insurance offerings for dryland and mixed dryland and irrigated cotton producers in the Texas Southern High Plains. Our simulation analysis examines producer welfare benefits of alternative combinations of underlying yield or revenue insurance coverage and STAX or SCO. The study results should be useful to policy makers and to cotton producers in the Texas Southern High Plains region. To our knowledge this is the first such analysis conducted using different farm productivity and county yield distributions and correlations based on producer assessments of these critical elements of the insurance decisions.

Simulation model

We evaluated the relative benefit of different crop insurance policies at different coverage levels. The different crop insurance policies are underlying policy only (CCIP), underlying policy with SCO endorsement, STAX revenue protection only, STAX revenue protection with harvest price exclusion only, underlying policy (CCIP) with STAX revenue protection, and underlying policy (CCIP) with STAX revenue protection with harvest price exclusion. All possible coverage levels were analyzed for these different polices. The ending wealth was calculated for each policy, which consists of initial producer's wealth, producer insurance premiums, actual revenue, and indemnities as shown in equation (1).

(1) W_{ti} = Initial Wealth + actual revenue + Indemnity – Insurance Premium

Initial wealth is directly calculated from the panel survey data. Premium cost for each insurance type is calculated using RMA base premium rates, county reference yields for the respective insurance products, cropping practice, and county (USDA-RMA, 2014a). Actual revenue and indemnity were simulated using yield distribution information obtained through the panel survey. Indemnity functions for each policy are shown in Appendix I (USDA-RMA, 2014b).

We assumed that the producer maximizes the certainty equivalent (CE) of stochastic ending wealth. The model used in this analysis is consistence with Vedenov and Power (2008); Power et al. (2009), Dismukes et al. (2013) and Bulut and Collins (2014) using Constant Relative Risk Aversion (CRRA) utility function. Mathematically, the expected utility function is shown in equation (2).

$$(2) \quad E(U_i) = \sum_{t=1}^{n} W_{ti} \frac{W_{ti}^{1-r}}{1-r}$$

In equation (2), i is for each specific insurance choice with coverage level, r is the coefficient of relative risk aversion, W represents ending wealth for the specific insurance

selection. To represent the risk neutral and risk aversion cases r was set to zero and two respectively. Certainty equivalent (CE) is calculated from expected utility to calculate the welfare benefit as shown in equation (3). The dollar value of the benefit is the difference between the CE_i , of a specific insurance choice, and CE_o of a no insurance as shown in equation (4).

(3) $$CE_i = \left((1-r)E\left[U_i\right]\right)^{\frac{1}{1-r}}$$

(4) Benefit= CE_i - CE_o

Data and Methods

Panel surveys were conducted to develop representative cotton farms for Hockley and Lynn counties with the cooperation of United Cotton Growers Cooperatives (UCG) of Levelland, Texas and Plains Cotton Growers (PCG) of Lubbock Texas respectively. Lynn County represents a dry land cotton farm and Hockley County represents an irrigated and dry land (mixed) cotton farm as 49 % and 51% of cotton acres in the county are dry land and irrigated cotton respectively (USDA – NASS, 2014). The consensus was developed among the participants (4 producers from Lynn County and 8 from Hockley County) about a typical farming operation in the county to develop the representative 2500 acres cotton farm. The inputs we obtained from the survey were financial and physical structure of initial wealth, operating costs, farm and county yield distribution characteristics and correlations between farm and county yields. Yield information regarding high productive and low productivity dry land farms for Lynn county, and high productivity and low productivity for dry land and irrigated Hockley county cotton farms were elicitation using a three point estimation method (Davidson-Cooper, 1976). The elicitation of correlation among yields was done using a strength-of-relationship method as one of the dependence-assessment methods described by Clemen, Fischer and Winkler (Clemen, Fischer and Winkler, 2000).

The information collected from the panel surveys was used to simulate different policy scenarios land of low and high productivity. For each scenario 50,000 simulated observations were generated in SAS. We used yield distribution characteristics collected to simulate beta distributions for farm and county yields (Borges and Thurman 1994; Babcock and Hennessy 1996; and Coble et al. 1996). The parameters required to simulated beta distribution are mean, variance, lower and upper bound. The three point approximation method was used to compute the mean and standard deviation of subjective yield distributions based on the elicited 10^{th} fractile, 90^{th} fractile, and mode of the distribution from the cotton producers as following (Davidson-Cooper, 1976).

Mean= (x_0.10 fractile + 2 * Mode + x_90 fractile) /4
Standard Deviation = (x_0.90 fractile - x_0.10 fractile)/2.65

The upper and lower bounds for the beta distribution were calculated using *lower bound* = max ($\mu - 4s$, 0) and *upper bound* = $\mu + 2s$, where, μ is mean, and s is standard deviation (Babcock, Hart, and Hayes, 2002). Harvest prices where simulated assuming a lognormal distribution function as described in the RMA document (USAD-RMA, 2014a). The correlations among random yields and prices were constructed using the Phoon, Quek, and Huang (PQH) multivariate simulation method (Phoon, Quek, and Huang, 2002; Anderson, Harri, and Coble, 2009). For each observation simulated insurance indemnities were calculated for different 2014 Farm bill policies.

Results

This study focuses on upland cotton farms if Lynn and Hockley counties. We examined high productivity and low productivity farms in both counties. The preliminary results are discussed below. We want to emphasize that these results are indeed preliminary and have not been fully validated. Thus they are subject to updating prior to the January 31 SAEA meeting.

For the dry land cotton farm in Lynn County, the optimal insurance product is same for both high and low productivity farms. The risk neutral case is the profit maximizing scenario and its net benefit is less than risk aversion scenario (Table 1, 2, 3, and 4). If the producer has only CCIP than the optimal insurance product is revenue protection at 75% coverage level. If the producer has SCO endorsement then the optimal insurance product is revenue protection at 75% coverage level. If producer has STAX than the optimal insurance product is revenue protection at 75% coverage level and STAX RP between 75-90 % coverage ranges, which is also the most optimal insurance products.

For a mixed dryland and irrigated cotton farm in Hockley County the optimal insurance product is again same for both high and low productivity farms. The risk characteristics are similar to Lynn County for risk neutral and risk averse scenarios (Table 5, 6, 7, and 8). If producer has only CCIP than the optimal insurance product is revenue protection at 75% coverage level. If producer has SCO endorsement than the optimal insurance product is revenue protection at 75% coverage level. If the producer has STAX then the optimal insurance product is revenue protection at 70% coverage level and STAX RP between 70-90 % coverage ranges, which is also the most optimal insurance products.

In dollar amount, the optimal choice will payout approximately one dollar or more in Lynn County and sixteen dollar or more in Hockey County compare to optimal underlying policy only. We can see in some case the benefit of taking addition insurance with underlying policy has lower benefit compare to underlying policy only, especially in Lynn County, where we can see the effect of one crop practice only. When we look at SCO, the premium cost for taking addition insurance is higher and the trigger for payment is not often. The benefit of taking

addition STAX or SCO insurance products is more beneficial to Hockley County, which has mix mixed practices, than for Lynn County, which has only dry land cotton. The higher payout with addition insurance products may be due to loss in one is compensated by the gain in other cropping practice.

In other studies, for revenue protection only the optimal coverage is at 85% (Dismukes et al., 2013; Davis, Anderson and Smith, 2014) and 80% (Bulut, and Collins, 2014). In case of SCO, Dismukes et al. results suggest lower coverage while, Bulut, and Collins, results are similar our Lynn county. Likewise similar to our results, Bulut, and Collins also found the revenue protection with STAX is the most optimal at 75% coverage level. Fewer cotton producers' take higher coverage than for many other crops, as in 2013, only 5% of the cotton producer took coverage of more than 80% (Dismukes et al., 2013).

Conclusion

Cotton is excluded from Title I program, in part due to World Trade Organization (WTO) ruling. STAX has been designed for cotton producers to give them similar benefit compared to Title I as an insurance product. The results in this study are at an early stage of analysis.

The most optimal insurance choice from our study is revenue protection at 70% or 75% with STAX RP on top of it as continuous shallow loss coverage till 90%. STAX may not pay out when a farm has a loss due to being based on a county yields for both the loss trigger and coverage determination. SCO is triggered at the county level but the amount of coverage is determined at the farm level. Cotton producers may not change their coverage levels much to substitute for STAX as they normally don't take higher coverage levels. Due to the high premium subsidy, our preliminary results suggest that STAX is preferred to SCO. Introduction of STAX makes it important for producers to understand the correlation between their farm yield and the county yield. This is a relationship that most producers have likely not previously closely examined and is a significant challenge for producers now confronted with the options of shallow and deep loss coverage. An important educational opportunity exists in assisting producers in understanding the details of the new programs and the importance of farm-to-county yield correlations in making future insurance choices.

Table 1. Lynn County per Acre High Productivity Dry Land Cotton Farm Certainty Equivalent Difference (Dollar Benefit over No Insurance) for Risk Neutral Scenario (coefficient of risk aversion, r = 0)

Insurance Policy		Per Acre Benefit Over No Insurance Case			
		No Insurance Underlying	Yield Protection	Revenue Protection	Revenue Protection HPE
Underlying policy	Benefit Over No Insurance Case		$5.93	$7.87	$6.12
	Optimal Coverage Level		75%	75%	75%
SCO	Benefit Over No Insurance Case		$4.08	$6.18	$4.22
	Optimal Coverage Level		75%	75%	75%
STAX_RP	Benefit Over No Insurance Case	$1.39	$7.23	$9.17	$7.42
	Optimal Coverage Level	90%-70% , 1.2	75%, 90%-75% , 1.2	75%, 90%-75% , 1.2	75%, 90%-75% , 1.2
STAX_RP_HPE	Benefit Over No Insurance Case	$0.87	$6.80	$8.74	$6.99
	Optimal Coverage Level	90%-70% , 1.2	75%, 90%-75% , 1.2	75%, 90%-75% , 1.2	75%, 90%-75% , 1.2

Table 2. Lynn County per Acre High Productivity Dry Land Cotton Farm Certainty Equivalent Difference (Dollar Benefit over No Insurance) for Risk Averse Scenario (coefficient of risk aversion, r = 2)

Insurance Policy		Per Acre Benefit Over No Insurance Case			
		No Insurance Underlying	Yield Protection	Revenue Protection	Revenue Protection HPE
Underlying policy	Benefit Over No Insurance Case		$21.25	$24.63	$21.93
	Optimal Coverage Level		75%	75%	75%
SCO	Benefit Over No Insurance Case		$20.60	$23.91	$21.10
	Optimal Coverage Level		75%	75%	75%
STAX_RP	Benefit Over No Insurance Case	$5.59	$23.89	$26.99	$24.50
	Optimal Coverage Level	90%-70% , 1.2	75%, 90%-75% , 1.2	75%, 90%-75% , 1.2	75%, 90%-75% , 1.2
STAX_RP_HPE	Benefit Over No Insurance Case	$4.74	$23.41	$26.52	$23.96
	Optimal Coverage Level	90%-70% , 1.2	75%, 90%-75% , 1.2	75%, 90%-75% , 1.2	75%, 90%-75% , 1.2

Table 3. Lynn County per Acre Low Productivity Dry Land Cotton Farm Certainty Equivalent Difference (Dollar Benefit over No Insurance) for Risk Neutral Scenario (coefficient of risk aversion, r = 0)

Insurance Policy		Per Acre Benefit Over No Insurance Case			
		No Insurance Underlying	Yield Protection	Revenue Protection	Revenue Protection HPE
Underlying policy	Benefit Over No Insurance Case		$7.66	$9.21	$7.77
	optimal coverage level		75%	75%	75%
SCO	Benefit Over No Insurance Case		$6.52	$8.17	$6.60
	optimal coverage level		75%	75%	75%
STAX_RP	Benefit Over No Insurance Case	$1.39	$8.96	$10.51	$9.06
	optimal coverage level	90%-70% , 1.2	75%, 90%-75% , 1.2	75%, 90%-75% , 1.2	75%, 90%-75% , 1.2
STAX_RP_HPE	Benefit Over No Insurance Case	$0.87	$8.53	$10.08	$8.64
	optimal coverage level	90%-70% , 1.2	75%, 90%-75% , 1.2	75%, 90%-75% , 1.2	75%, 90%-75% , 1.2

Table 4. Lynn County per Acre Low Productivity Dry Land Cotton Farm Certainty Equivalent Difference (Dollar Benefit over No Insurance) for Risk Averse Scenario (coefficient of risk aversion, r = 2)

Insurance Policy		Per Acre Benefit Over No Insurance Case			
		No Insurance Underlying	Yield Protection	Revenue Protection	Revenue Protection HPE
Underlying policy	Benefit Over No Insurance Case		$19.61	$21.95	$19.91
	Optimal Coverage Level		75%	75%	75%
SCO	Benefit Over No Insurance Case		$19.07	$21.49	$19.32
	Optimal Coverage Level		75%	75%	75%
STAX_RP	Benefit Over No Insurance Case	$4.82	$21.88	$24.11	$22.18
	Optimal Coverage Level	90%-70% , 1.2	75%, 90%-75% , 1.2	75%, 90%-75% , 1.2	75%, 90%-75% , 1.2
STAX_RP_HPE	Benefit Over No Insurance Case	$3.98	$21.40	$23.65	$21.66
	Optimal Coverage Level	90%-70% , 1.2	75%, 90%-75% , 1.2	75%, 90%-75% , 1.2	75%, 90%-75% , 1.2

Table 5. Hockley County per Acre High Productivity Certainty Equivalent Difference (Dollar Benefit over No Insurance) for Risk Neutral Scenario (coefficient of risk aversion, r = 0)

Insurance Policy		Per Acre Benefit Over No Insurance Case			
		No Insurance Underlying	Yield Protection	Revenue Protection	Revenue Protection HPE
Underlying policy	Benefit Over No Insurance Case		$10.85	$13.81	$8.65
	Optimal Coverage Level		75%	75%	70%
SCO	Benefit Over No Insurance Case		$17.77	$22.19	$16.96
	Optimal Coverage Level		75%	75%	70%
STAX_RP	Benefit Over No Insurance Case	$18.42	$27.48	$29.88	$27.07
	Optimal Coverage Level	90%-70%, 1.2	70%, 90%-70%, 1.2	70%, 90%-70%, 1.2	70%, 90%-70%, 1.2
STAX_RP_HPE	Benefit Over No Insurance Case	$14.96	$24.02	$26.55	$23.61
	Optimal Coverage Level	90%-70%, 1.2	70%, 90%-70%, 1.2	75% 90%-75%, 1.2	70%, 90%-70%, 1.2

Table 6. Hockley County per Acre High Productivity per acres Certainty Equivalent Difference (Dollar Benefit over No Insurance) for Risk Averse Scenario (coefficient of risk aversion, r = 2)

Insurance Policy		Per Acre Benefit Over No Insurance Case			
		No Insurance Underlying	Yield Protection	Revenue Protection	Revenue Protection HPE
Underlying policy	Benefit Over No Insurance Case		$22.32	$26.67	$21.78
	Optimal Coverage Level		75%	75%	80%
SCO	Benefit Over No Insurance Case		$31.26	$36.68	$29.90
	Optimal Coverage Level		75%	75%	70%
STAX_RP	Benefit Over No Insurance Case	$23.98	$40.51	$44.22	$40.43
	Optimal Coverage Level	90%-70%, 1.2	70%, 90%-70%, 1.2	75%, 90%-75%, 1.2	70%, 90%-70%, 1.2
STAX_RP_HPE	Benefit Over No Insurance Case	$20.37	$37.57	$41.54	$36.95
	Optimal Coverage Level	90%-70%, 1.2	75%, 90%-75%, 1.2	75%, 90%-75%, 1.2	70%, 90%-70%, 1.2

Table 7. Hockley County per Acre Low Productivity per acres Certainty Equivalent Difference (Dollar Benefit over No Insurance) for Risk Neutral Scenario (coefficient of risk aversion, r = 0)

Insurance Policy		Per Acre Benefit Over No Insurance Case			
		No Insurance Underlying	Yield Protection	Revenue Protection	Revenue Protection HPE
Underlying Policy	Benefit Over No Insurance Case		$10.27	$12.38	$8.87
	Optimal Coverage Level		75%	75%	70%
SCO	Benefit Over No Insurance Case		$14.25	$17.19	$13.64
	Optimal Coverage Level		75%	75%	70%
STAX_RP	Benefit Over No Insurance Case	$18.42	$27.57	$29.35	$27.29
	Optimal Coverage Level	90%-70%, 1.2	70%, 90%-70%, 1.2	70%, 90%-70%, 1.2	70%, 90%-70%, 1.2
STAX_RP_HPE	Benefit Over No Insurance Case	$14.96	$24.11	$25.90	$23.83
	Optimal Coverage Level	90%-70%, 1.2	70%, 90%-70%, 1.2	70%,90%-70%, 1.2	70%, 90%-70%, 1.2

Table 8. Hockley County per Acre Low Productivity per acres Certainty Equivalent Difference (Dollar Benefit over No Insurance) for Risk Averse Scenario (coefficient of risk aversion, r = 2)

Insurance Policy		Per Acre Benefit Over No Insurance Case			
		No Insurance Underlying	Yield Protection	Revenue Protection	revenue protection HPE
Underlying policy	Benefit Over No Insurance Case		$17.43	$20.16	$16.21
	Optimal Coverage Level		75%	75%	80%
SCO	Benefit Over No Insurance Case		$22.36	$25.84	$21.37
	Optimal Coverage Level		75%	75%	70%
STAX_RP	Benefit Over No Insurance Case	$22.36	$35.77	$37.90	$35.60
	Optimal Coverage Level	90%-70%, 1.2	70%, 90%-70%, 1.2	70%, 90%-70%, 1.2	70%, 90%-70%, 1.2
STAX_RP_HPE	Benefit Over No Insurance Case	$18.77	$32.42	$34.58	$32.15
	Optimal Coverage Level	90%-70%, 1.2	70%, 90%-70%, 1.2	70%,90%-70%, 1.2	70%, 90%-70%, 1.2

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Appendix I

$$Yield\ protection\ Indemnity_{CL} = Max\ (0, (Projected\ price * rate\ yield * coverage\ level - \ projected\ price * actual\ yield))$$

Where, rate yield is the farm APH yield.

$$Revenue\ protection\ Indemnity_{CL} = \ MAx\ (0, (Max(harvest\ price, Projected\ \ Price) * rate\ yield * coverage\ level - harvest\ price * actual\ yield))$$

Where, rate yield is the farm APH yield.

$$Revenue\ protection\ with\ harvest\ price\ \ exclusion\ Indemnity_{CL} = Max\ (0, (Projected\ price * rate\ yield * coverage\ level - harvest\ price * actual\ yield))$$

Where, rate yield is the farm APH yield.

$$SCO\ indemnity\ _{CL_i} = \left\{ min\left(max\left[0, \frac{0.86 - \frac{Final\ Area\ Revenue}{Expected\ Area\ Revenue}}{0.86 - Cl_i} \right], 1 \right) \right\} * (0.86 - Cl_i) * \frac{Underlying\ liability}{Cl_i}$$

Where, final area revenue and expected area revenue is calculated as defined in underlying policy (CCIP).

$$STAX\ RP\ indemnity_{\ STAX\_CL_i}$$
$$= \left\{ min\left(max\left[0, \frac{STAX\ Area\ Trigger - \frac{Final\ Area\ Revenue}{Expected\ Area\ Revenue}}{STAX\ Coverage\ Range} \right], 1 \right) \right\} * Expected\ Area\ Yield$$
$$* Max(harvest\ price, Projected\ \ Price) * STAX\ coverage\ range * Protection\ Factor_i$$

Where, final area revenue is calculated using $Max(harvest\ price, Projected\ \ Price)$ and expected area revenue is calculated using projected price.

$$STAX\ RPHPE\ indemnity_{\ STAX\_CL_i}$$
$$= \left\{ min\left(max\left[0, \frac{STAX\ Area\ Trigger - \frac{Final\ Area\ Revenue}{Expected\ Area\ Revenue}}{STAX\ Coverage\ Range} \right], 1 \right) \right\} * Expected\ Area\ Yield * Projected\ \ Price$$
$$* STAX\ coverage\ range * Protection\ Factor_i$$

Where, final area revenue is calculated using projected price and expected area revenue is calculated using harvest price.