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ECONOMICS AND MARKETING

Comparison of ACRE and DCP Programs with Simulation Analysis of Arkansas Delta Cotton and Rotation Crops

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ABSTRACT

A new provision of the 2008 Farm Bill allows farmers to enroll in an average crop revenue election (ACRE) program. Enrollment in ACRE requires forgoing counter-cyclical payments, as well as reduced loan rates and direct payments available in the traditional income support program. Comparisons of the program alternatives under conditions of commodity price variability indicate that revenue outcomes vary among crops that are produced in the Arkansas Delta. Selection of the optimal program depends upon farmer risk preferences and outlook for future commodity prices.

The 2008 Farm Bill (Food, Conservation, and Energy Act of 2008) establishes provisions for agricultural programs during 2009-12. Legislation continues the availability of most commodity programs contained in the 2002 Farm Bill. One new provision allows farmers to enroll in an average crop revenue election (ACRE) program. The intention of the new program is to maintain income support while addressing shortcomings in existing programs. One shortcoming of income support from the traditional direct and counter-cyclical payment (DCP) contained in the 2002 Farm Bill is that payment levels are not impacted by yield reductions that lead to decreased production.

Previous research comparing ACRE and DCP program selection includes common rotation crops of representative farms in Arkansas (Hignight, et al, 2008). Data applied were for 2009-2012 with projected prices and yield trends. Revenue results were for average revenue over the entire time period. Whole farm stochastic analysis concludes that average revenue is greater for each representative farm under the traditional DCP program than with ACRE.

Individual crop comparative analysis was conducted for corn, soybeans, and wheat to determine breakeven relationships between ACRE and the traditional DCP program (Zulauf, 2008a). Results indicate that as average market prices increase, revenue from ACRE is greater than the DCP program because: 1) ACRE's price guarantee follows market prices to higher levels, and 2) average payments from the fixed marketing loan rate and counter-cyclical target prices become smaller as market prices increase. A related report demonstrates the effects of ACRE limitations on price guarantee annual changes. Limitations on price guarantees were demonstrated as effective in maintaining ACRE payments that otherwise would not be available due to extreme market price volatility (Zulauf, 2008b).

Previous research has applied trend adjusted data to evaluate ACRE throughout the entire 2009-12 period of the 2008 Farm Bill. Prior analysis included ACRE parameters that were estimated from available data. The objective of this research is to evaluate ACRE with parameters that applied to the 2009 crop year (USDA-FSA, 2009a; 2009c). This approach represents the initial decision that farmers have concerning ACRE enrollment. Expanding a base analysis with constant prices and yields into analysis with variable prices and yields leads to generalized results that can be utilized for comparison of ACRE and DCP over the 2009-2012 period. Generalized results for the 2009 production year can be utilized by growers not electing ACRE in the initial year as they reevaluate the selection opportunity in subsequent years.

Conceptual framework. A simulation model for crop revenue is specified as:

$$R = MR + G \quad [1]$$

where R is Revenue, MR is market receipts, and G is government payments received. Government payments received are correlated with prevailing market prices and simulation analysis involves simultaneous computation of both revenue components.

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A simulation model is an organized collection of equations with relevant data to calculate output variables that represent realized outcomes in a real system as exogenous variables change values. Optimal selections for decision making can be determined by evaluating simulated outcomes. Deterministic models lead to simulated outcomes that regard all variables as fixed with constant values. Stochastic simulation models allow changes in variables that represent random occurrences that correspond to risks associated with decision making. Deterministic models are useful for a fundamental understanding of processes in a simulated system. Stochastic models represent the range of randomly distributed outcomes indicating risks associated with decision making. Stochastic models are preferred for analyzing government payments designed to provide levels of farm income support that vary with stochastic production and market conditions. Deterministic results are included in this report to demonstrate differences in outcomes from the two approaches to simulation.

Traditional government payments. Income support from the traditional DCP program is available to farmers in the form of direct payments (DP), counter-cyclical payments (CCP), and marketing assistance loan programs. Descriptions of each payment and methods for calculation as established by the 2002 Farm Act are provided by Westcott, Young, and Price (2002). DP is decoupled, meaning it is fixed for each production year and does not vary with prices or yields. CCP rates are partially decoupled since they vary with the national commodity price, but are applied to the constant program yield and acreage levels for each farm, not varying with realized production. The Farm Service Agency (FSA) administers commodity loan programs with marketing loan provisions. An alternative provision in programs for marketing assistance loans is a loan deficiency payment (LDP). Instead of putting commodities in storage for later loan repayment, a farmer may choose to receive benefits directly when marketing the commodity. Marketing loan gains from crops under loan are equivalent to gains from the LDP alternative. All quantities marketed are eligible for the LDP and total receipts vary with stochastic prices and yields.

ACRE program alternative. The 2008 Farm Bill authorizes the ACRE program as an alternative to the DCP program in the 2002 Farm Bill. This alternative allows farmers to receive revenue based payments instead of counter-cyclical payments and only 80% of DP. Enrollment in ACRE requires enrollment for all crops produced on a farm. ACRE payment levels are determined by national price and state yield.

Triggers to issue ACRE payments are determined by simultaneous occurrence of 1) actual state revenue for the production year less than ACRE program guarantee and 2) actual farm revenue for the production year less than farm ACRE benchmark revenue. Actual state revenue is the state yield per planted acre multiplied by the greater of the national market price or 70% of the national loan rate. The state ACRE guarantee is 90% of the 5-year Olympic average state yield multiplied by the average national price for the previous two years. Actual farm revenue is farm yield per planted acre multiplied by the greater of the national market price or 70% of the national loan rate. Farm ACRE benchmark revenue is 100% of the 5-year Olympic average farm yield multiplied by the average national price for the previous two years plus the per acre producer-paid crop insurance premium.

Once triggers are satisfied, ACRE payments are based on the lesser of 1) state ACRE guarantee minus actual state revenue or 2) 25% of the state ACRE guarantee. Realized payments are either (1) or (2) multiplied by 83.3% multiplied by the farm-specific productivity ratio. Productivity ratios for crops are farm 5-year Olympic average yield divided by state 5-year Olympic average yield.

Enrollment in ACRE stipulates that DP is reduced by 20% and loan rates for calculating LDP are reduced by 30% (USDA-FSA, 2009b; 2009c; 2009e). Thus, any calculation of ACRE payments must be balanced by reductions in DP and LDP, as well as complete elimination of CCP. A descriptive comparison of ACRE and traditional DCP programs is available from the Economic Research Service (USDA-ERS, 2008b).

MATERIAL AND METHODS

Production methods and corresponding costs of production do not vary by election of ACRE or DCP. Thus, comparative analysis in this report is conducted by evaluating farm revenue. Commodity revenue for comparing ACRE and DCP is derived from state and county data for yields and prices (USDA-NASS, 2009). Farm data is represented by data for Mississippi County in Arkansas. County data for prices are not

available, and actual farm prices are assumed equal to state prices. National prices are applied in determining payment levels in the relevant components of ACRE, as well as DCP. State prices for commodities are determined by applying price wedges to national prices for each commodity that are estimated by historical differences between U.S. and Arkansas prices.

ACRE program parameters are reported by the Economic Research Service (USDA-FSA, 2009a; 2009d). U.S. price guarantees and benchmark yields for ACRE are presented in Table 1 and English unit equivalents are reported in Table 1a. Benchmark ACRE yields reported for soybeans and corn in Arkansas include irrigated and non-irrigated yields. This analysis applies benchmark yields for all soybeans and corn, and represents a farm with irrigated and non-irrigated acreage mixes that are equal to the state averages. Farm benchmark yields are estimated by applying historical differences between state and county yields to the ACRE benchmark Arkansas yield. Expected state and farm yields are estimated by applying yield trends to state and farm benchmark yields. Yields trends are determined by differences in moving 5-year averages for the two most recent periods of available data. Expected prices for each commodity are assumed equal to the ACRE price guarantee.

Base yields in Table 1 for DP and CCP are for Mississippi County (USDA-ERS, 2008a). ACRE excludes counter-cyclical payments and reduces DP to 80% of levels for farms enrolled in the DCP program. Loan deficiency payments (LDP) or equivalent marketing loan gains for cotton and rice are determined by the relationship between U.S. prices and adjusted world prices (AWP). Cotton AWP is estimated by a applying a price wedge to annual U.S. prices. The price wedge is determined by the historical relationship between U.S. prices (USDA-NASS, 2009) and AWP (USDA-FAS, 2008). Rice AWP is estimated in two stages. The first stage applies the average differences in 2007 and 2008 between U.S. price to long grain and medium grain rice prices. Applying the differences for long grain and medium grain leads to a U.S. price for all rice equal to \$0.323 kg^{-1} (\$14.65 cwt^{-1}). Estimates from the Food and Agricultural Policy Research Institute (FAPRI, 2008) indicate an expected difference between U.S. price and AWP of \$0.048 kg^{-1} (\$2.17 cwt^{-1}). This leads to an expected AWP for application to long grain rice and medium grain rice of \$0.275 kg^{-1} (\$12.48 cwt^{-1}).

Table 1. Commodity Prices and Yields for Comparing Average Crop Revenue Election (ACRE) and Direct/Counter-cyclical (DCP) Programs

	Unit	Cotton	Soybeans	Corn	Rice, LG	Rice, MG
Price Guarantee	dollars/kg	1.195	0.358	0.163	0.302	0.392
Benchmark State Yield	kg/ha	1,161	2,420	9,098	7,641	7,663
Benchmark Farm Yield	kg/ha	1,080	2,602	10,334	7,837	7,859
Expected State Yield	kg/ha	1,190	2,413	9,317	7,658	7,680
Expected Farm Yield	kg/ha	1,109	2,588	10,547	7,853	7,875
DP Base Yield	kg/ha	624	1,291	4,423	5,075	5,075
CCP Base Yield	kg/ha	704	1,425	7,015	5,819	5,819
Expected AWP	dollars/kg	1.107	NA	NA	0.275	0.275

Table 1a. Commodity Prices and Yields for Comparing Average Crop Revenue Election (ACRE)

	Cotton[1]	Soybeans[2]	Corn[2]	Rice, LG[3]	Rice, MG[3]
Price Guarantee	0.542	9.73	4.15	13.70	17.80
Benchmark State Yield	1,036	36.0	145.0	68.20	68.40
Benchmark Farm Yield	964	38.7	164.7	69.95	70.15
Expected State Yield	1,062	35.9	148.5	68.35	68.55
Expected Farm Yield	990	38.5	168.1	70.09	70.29
DP Base Yield	557	19.2	70.5	45.30	45.30
CCP Base Yield	628	21.2	111.8	51.94	51.94
Expected AWP	0.502	NA	NA	12.48	12.48

[1]Price is \$/lb.; Yield is lb./acre

[2]Price is \$/bu.; Yield is bu./acre

[3]Price is \$/cwt.; Yield is cwt./acre

Comparisons of ACRE and DCP in this report consist of deterministic analysis and stochastic analysis. Deterministic analysis is with data in Table 1 applied to each of the program alternatives. Stochastic analysis applies expected values in Table 1 as means to generate stochastic variables. Variability for stochastic variables is determined by a 10-year historical period for U.S. price, state yield and county yield applied in multivariate data generation. Means for stochastic commodity prices are equal to the ACRE price guarantee. Stochastic U.S. prices are generated in simulation, and for ACRE, are evaluated with benchmark yields having averages presented in Table 1. Actual farm prices are estimated with historical differences between U.S. prices and state prices.

The multivariate empirical (MVE) distribution is applied for simulated stochastic commodity prices and yields. The MVE distribution accounts for interrelationships occurring in the data and avoids enforcing a specific distribution on the variables. Simulating commodity prices and yields with an MVE distribution includes a correlation matrix that generates correlated stochastic variables (Richardson, Klose, and Gray, 2001). Simulation with MVE results in simulated random variables that are bounded by historical minimums and maximums of the original data. This simulation of program alternatives applies the MVE function of Simetar© (Richardson, Schumann, and Feldman, 2006). Simetar© generates random variables with means of price and yield in Table 1 and covariance structures determined by 1999-2008 prices and yields (USDA-NASS, 2009).

RESULTS

Deterministic analysis. Deterministic results are from simulation with parameters applied as presented in Table 1. Deterministic results comparing ACRE and the traditional DCP programs are presented in Table 2. Each crop has greater revenue per hectare with the DCP program. For soybeans and corn the difference is less than 1%. For long grain rice the difference is 2% and for medium grain rice the difference is 1%. The differences between rice and the other two crops are due to the greater value of DP per hectare for rice relative to soybeans and corn. Deterministic simulation with ACRE price guarantees and benchmark yields leads to no ACRE payments for all crops. Price guarantees for soybeans, corn, and rice are at such levels that do not result in either loan deficiency payments (LDP) or counter-cyclical payments (CCP) revenue for these crops. Greater revenue with traditional DCP is due to reduced DP that is mandated for ACRE. Evaluation of cotton with price guarantees and benchmark yields leads to no ACRE payments as with other crops, but results for the DCP program differ between cotton and other crops. Total revenue for cotton with DCP is 5% greater than with ACRE. Specified parameters in Table 1 have U.S. price and corresponding AWP that lead to LDP and CCP revenue for cotton. Cotton DP is reduced with ACRE as for other crops.

Stochastic analysis. Results from stochastic analysis are presented in Table 3 and are averages of 500 iterations with Simetar©. Revenue outcomes are greater with ACRE than DCP for all crops except cotton. Revenue variability as indicated by the coefficient of variation is reduced with ACRE for soybeans, corn, and rice, but cotton has lower variability with DCP. Because DP is fully decoupled, Table 3 shows that DP is identical to deterministic results for all crops. Prices do not decrease sufficiently for LDP under either ACRE or DCP for soybeans, corn, or rice. Cotton LDP averages $88 with DCP, but only $1 with ACRE due to the mandated 30% reduction in loan rates. All crops receive ACRE payments, but only cotton receives CCP revenue. Cotton receives greater total GP with DCP than ACRE. Other crops have greater total GP with ACRE than DCP.

Table 2. Deterministic Comparisons of Average Crop Revenue Election (ACRE) and Direct/Counter-cyclical Payment (DCP) Programs

	dollars/ha									
	Cotton		Soybeans		Corn		Rice, LG		Rice, MG	
	ACRE	CCP	ACRE	CCP	ACRE	CCP	ACRE	CCP	ACRE	CCP
Revenue[1]	1,470	1,669	857	860	1,571	1,580	2,400	2,444	3,101	3,145
GP	61	260	14	17	32	41	175	219	175	219
DP	61	76	14	17	32	41	175	219	175	219
LDP	0	47	0	0	0	0	0	0	0	0
ACRE or DCP	0	137	0	0	0	0	0	0	0	0

[1]Revenue is sum of market crop revenue and all government payments (GP)

Table 3. Stochastic Comparisons of Average Crop Revenue Election (ACRE) and Direct/Counter-cyclical Payment (DCP) Programs, Averages of 500 Iterations

	dollars/ha									
	Cotton		Soybeans		Corn		Rice, LG		Rice, MG	
	ACRE	CCP	ACRE	CCP	ACRE	CCP	ACRE	CCP	ACRE	CCP
Revenue[1]	1,517	1,716	894	867	1,600	1,562	2,481	2,427	3,166	3,130
Minimum Revenue	1,148	1,365	690	519	1,374	1,200	2,016	1,616	2,708	2,246
Maximum Revenue	2,113	2,131	1,353	1,356	2,558	2,567	4,038	4,082	4,791	4,835
Revenue C.V. (%)	15.0	10.7	19.2	23.4	21.6	24.2	19.8	23.9	16.6	19.2
GP	84	283	44	17	79	41	273	219	255	219
DP	61	76	14	17	32	41	175	219	175	219
LDP	1	88	0	0	0	0	0	0	0	0
ACRE or DCP	22	119	30	0	47	0	98	0	80	0

[1]Revenue is sum of market crop revenue and all government payments (GP)

Stochastic simulation provides the basis for graphical analysis of the relationship between price and total revenue among crops. Figures 1 through Figure 5 are scatter plots of U.S. price and total revenue. Figure 1 shows that cotton revenue is greater with DCP than ACRE at all price levels. Table 4 shows the number of outcomes where revenue is greater with ACRE and confirms that at no price level is ACRE revenue greater than DCP revenue.

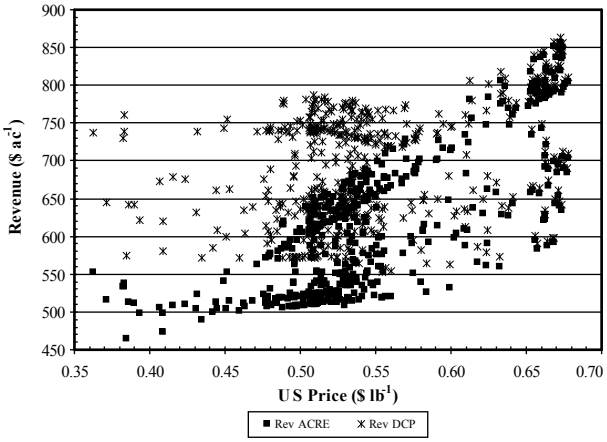

Figure 1. Cotton Revenue Comparison with ACRE and DCP

Figure 2 indicates that greater soybean revenue with ACRE is mainly due to significant differences at lower price levels. As soybean price approaches and exceeds the price guarantee, revenue is greater with DCP. Table 4 shows that 179 (36%) of the stochastic iterations have greater revenue with selection of ACRE, and 321 (64%) iterations are greater with DCP.

Corn revenue with ACRE in Figure 3 has a minimum value of $556. This indicates that the cluster of points below $550 in revenue and less than a $4.00 price level is exclusively DCP revenue outcomes. Points in Figure 3 consist of 234 iterations (47%) with greater revenue from ACRE selection with the balance of 266 (53%) greater with DCP selection.

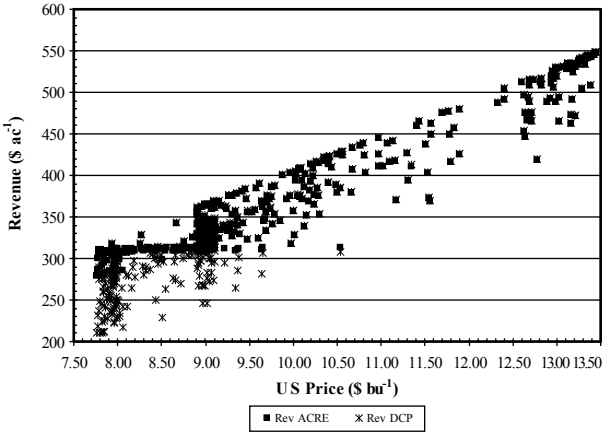

Figure 2. Soybean Revenue Comparison with ACRE and DCP

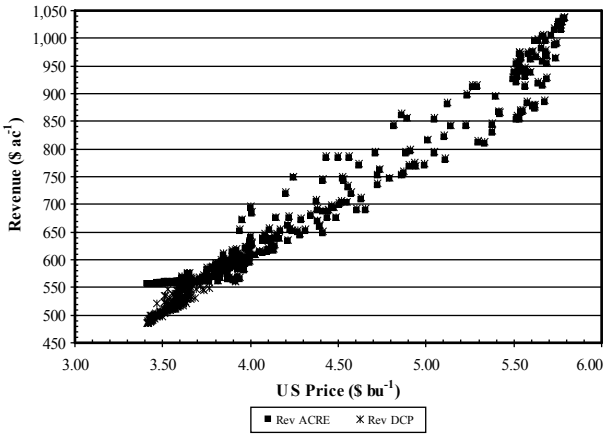

Figure 3. Corn Revenue Comparison with ACRE and DCP

Figure 4 is a scatter plot of price and revenue for long grain rice. There is a concentration of DCP revenue below $800 revenue and at a price level less than $12.00. The minimum point of ACRE revenue for long grain rice is $816. Table 4 shows there are 190 (38%) iterations with ACRE resulting in greater revenue than DCP. Medium grain rice, Figure 5, has an interpretation similar to long grain rice. There is a concentration of DCP revenue below $1,100 revenue and at a price level less than $16.00. The minimum point of ACRE revenue for medium grain rice is $1,110. Table 4 shows there are 170 (34%) iterations with ACRE resulting in greater revenue than DCP.

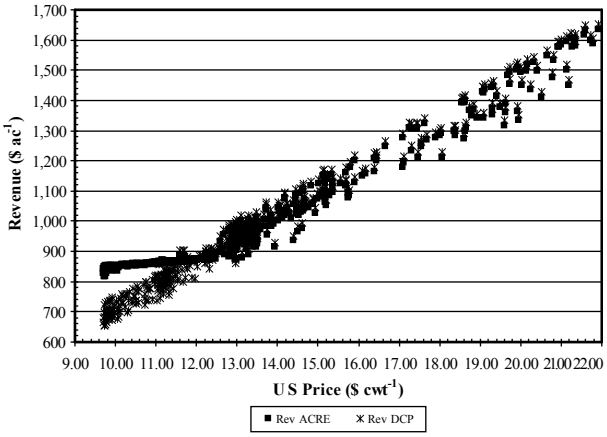

Figure 4. Long Grain Rice Revenue Comparison with ACRE and DCP

Table 4. Counts of Average Crop Revenue Election (ACRE) and Direct/Counter-cyclical Payment (DCP) Programs with Greatest Revenue Outcomes

	ACRE	DCP
Cotton	**0**	**500**
Soybeans	**179**	**321**
Corn	**234**	**266**
Rice, LG	**190**	**310**
Rice, MG	**170**	**330**

Revenue outcomes in Table 3 are supported by distributions in Figure 1 that demonstrate selection of DCP is optimal for cotton acreage. Although average outcomes in Table 3 for soybeans, corn, and rice support selection of ACRE over DCP, examination of revenue distributions in Figures 2 through Figure 5 suggests that selection should also be based on expectations of commodity prices. Increased revenue from ACRE is concentrated at low price levels. As prices increase, ACRE payments decrease and GP is composed of only DP. Mandates of ACRE reduce DP to a level that is 80% the DCP program. For farmers with risk preferences that are to avoid revenue outcomes from low prices, the clear selection is ACRE. However, for farmers anticipating prices stable at current levels or increasing, the optimal choice may be receipt of higher DP with selection of the DCP program. Provisions of ACRE stipulate that all crops on a farm must be enrolled in the same program. Thus, selection of ACRE or DCP should consider the relative level of base acreage on a farm that is composed of cotton.

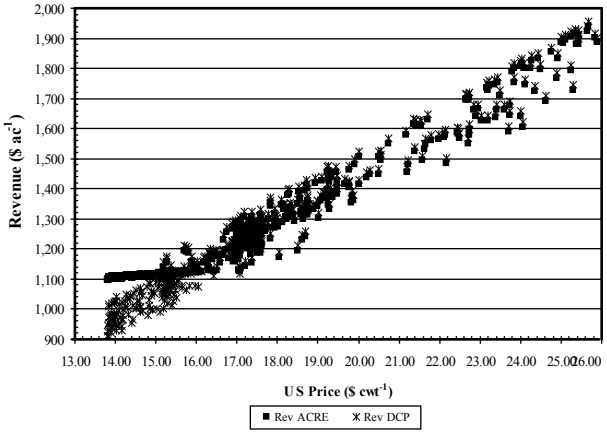

Figure 5. Medium Grain Rice Revenue Comparison with ACRE and DCP

Sensitivity of cotton analysis. There is the opportunity to select ACRE in any year, but once a farm enrolls in ACRE, it must remain in the program for the duration of the farm bill. At current prices, cotton acreage is subject to greater average revenue and less risk with DCP. Analysis of cotton at alternative prices provides information about when ACRE should be considered, and gives insight into general conditions for comparing ACRE and DCP. Table 5 contains deterministic and stochastic outcomes for cotton under assumptions that the price guarantee is equal to the target price of $1.571 kg^{-1} ($0.7125 lb^{-1}) used to calculate DCP revenue in the traditional program. Stochastic analysis is conducted with market prices distributed around means set equal to the target price.

Deterministic results in Table 5 have DCP with greater revenue than ACRE, and similar to Table 2, the difference is the greater value of DP under the DCP program. In contrast to Table 3, stochastic results in Table 5 have the greatest revenue with ACRE. Revenue from ACRE payments of $23 compared to $4 of DCP revenue is sufficient to exceed greater DP and LDP received under the DCP program. Figure 6 shows the distribution of revenue outcomes for a range of prices that have a mean value that is equal to

the target price. Greater average revenue for ACRE is due to differences in revenue occurring at prices less than the target price. At prices near to and above the target price, revenue from DCP has greater DP and exceeds ACRE revenue. There are 407 (81%) outcomes having greater revenue under DCP and 93 (19%) having greater revenue under ACRE.

Table 5. Cotton Comparisons of Average Crop Revenue Election (ACRE) and Direct/Counter-cyclical Payment (DCP) Programs, U.S. Guaranteed Price Set Equal to Target Price

	dollars/ha			
	Deterministic		Stochastic	
	ACRE	CCP	ACRE	CCP
Revenue[1]	1,917	1,932	1,966	1,963
GP	61	76	84	81
DP	61	76	61	76
LDP	0	0	0	1
ACRE or DCP	0	0	23	4

[1]Revenue is sum of market crop revenue and all government payments (GP)

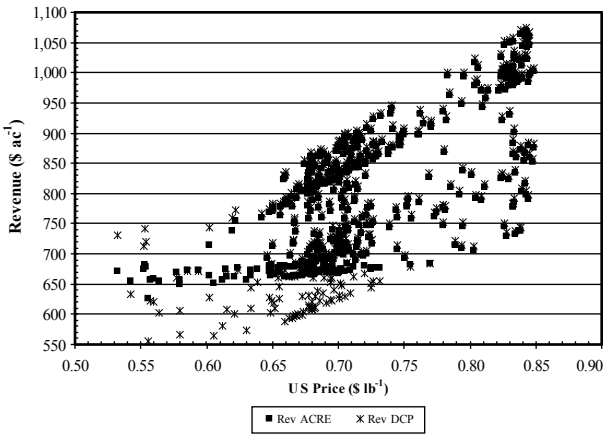

Figure 6. Cotton Revenue Comparison with ACRE and DCP, US Price Guarantee Set Equal to Target Price

Comparing sensitivity of cotton outcomes with alternative price guarantees suggests a generalized interpretation for evaluating ACRE and DCP. Over the assumed distribution of prices, ACRE averages greater revenue than DCP. Evaluating program selection at specific prices indicates that advantages of ACRE are limited to stochastically simulated points in which price is below the price guarantee. Since occurrences of prices below the price guarantee are unknown, selection of ACRE for all crops is dependent upon farmer risk preferences and outlook for commodity prices. Differing revenue outcomes for ACRE and DCP under current market prices indicate differences among cotton and other crops that may have implications in future U.S. agricultural policy discussions. Policy initiatives designed to benefit soybeans, corn, and rice may not be desirable for cotton production.

SUMMARY AND CONCLUSIONS

A new provision of the 2008 Farm Bill allows farmers to enroll in the ACRE program instead of the traditional DCP program. Comparisons of the program alternatives under conditions of commodity price variability indicate that revenue outcomes vary among cotton, soybeans, corn, and rice produced in the Arkansas Delta. An evaluation of program alternatives with deterministic analysis in which prices and yields are constant at current levels results in each crop having greater revenue with the traditional DCP program. A second method is with stochastic analysis in which prices and yields vary based on historical relationships in the variables. Stochastic cotton results favor DCP over ACRE as in the deterministic results. Average stochastic outcomes for soybeans, corn, and rice support selection of ACRE over DCP, but examination of revenue distributions indicates that increased revenue from ACRE is concentrated at low price levels. For farmers with risk preferences aimed at avoiding revenue outcomes from low prices, ACRE may be the preferred choice. However, for farmers anticipating prices stable at current levels, the optimal choice may be the traditional DCP program. However, increasing prices over a long time period leads to higher price guarantees for ACRE while payment parameters for the traditional DCP are constant. In this circumstance, occurrence in one year of significantly reduced prices could result in government payments from ACRE that exceed payments from the traditional DCP. Provisions of ACRE stipulate that all crops on a farm must be enrolled in the same program, and selection of ACRE or DCP is also dependent upon the relative level of base acreage for each crop. Thus, selecting enrollment in ACRE is dependent on U.S. regional farm location and crop mixes.

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