

# IMPACT OF GOVERNMENT PROGRAMS ON RISK-RETURNS OF COTTON PRODUCTION

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## Abstract

This study assesses the benefits which tenant and landlord producers of cotton have enjoyed under provisions of the 1990 Farm Bill. Based on the results of a survey of cotton producers, simulation is used to quantify the risk and returns of irrigated cotton production for a typical 75/25 crop share rental arrangement with and without government program participation. Participation in the government cotton program under 1990 Farm Bill provisions results in a \$66/acre increase in expected net returns for tenants and a \$13/acre increase for landlords in comparison to non-participation. The cotton program also reduces risk to 84% of its market level. Without participation in the government cotton program, the probability that tenants will earn negative returns increases more than threefold from 0.20 to 0.68 under the representative rental arrangement. Although landlords fare better with government programs, in comparison to tenants, they bear a relatively smaller portion of the burden of the reduced benefits under non-participation.

## Introduction

Discussion of the 1995 Farm Bill in recent months has focused on the potential economic impact of reduced government support for participating producers. This study provides a baseline for that discussion by quantifying the benefits which producers have enjoyed under the 1990 Farm Bill for cotton. The objective of the study is to use simulation to estimate the risk and returns for irrigated cotton production in Arkansas with and without participation in the government cotton program under 1990 Farm Bill provisions. Because the majority of Arkansas cotton is grown on rented land, the discussion demonstrates how tenants and landlords fare under a typical 75/25 crop share rental arrangement identified in a survey of Arkansas cotton producers. Hopefully, this comparison will provide insight into how decision makers at the micro-farm-firm level may respond to potential decreases in government support to agriculture in the future.

## Methods

Monte Carlo simulation was used to estimate risk and returns incurred by tenants and landlords under provisions

of a 75/25 straight share rental arrangement typically observed in Arkansas. Types of rental arrangements observed in Arkansas and their representative terms and provisions were based on the findings of a "Cropland Rental Arrangement Survey" conducted in Crop Reporting Districts 3, 6, and 9 of eastern Arkansas in 1991. This Mississippi Delta region of Arkansas is an important component of Arkansas' row-crop and cotton production. Although it contains only 31% of the total number of farms in Arkansas, 82% of the state's cropland and 99% of its cotton production are located in this Mississippi Delta region which occupies the eastern third of the state (AASS).

## Rental Arrangements Survey

The rental arrangements survey identified terms and provisions of typical cropland rental arrangements used in eastern Arkansas. The survey revealed that land rental for cotton was pronounced with 87% of planted cotton acreage being rented. Of the leases reported in detail by cotton producers, 51% were straight share, 25% were cash rent, and 24% were cost share. Under crop share (straight share and cost share) rental arrangements the tenant's share of crop and government payments ranged from 50% to 80%, with 75% the most frequently reported. Other details of the survey are reported in Parsch and Danforth (1995).

## Simulation Procedures

Stochastic enterprise budgets were developed for a representative 75/25 tenant/landlord straight share rental arrangement using leasing terms identified in the survey. Cost of production was taken from published enterprise budgets for irrigated cotton production on silt loam soil in eastern Arkansas (Bryant *et al*) and was assumed to be deterministic. Price of cotton, irrigated yield, and deficiency payment were modeled as random variables to reflect the production and market risk faced by the Arkansas cotton producer. All values are in 1993 dollars.

@RISK (Palisade Corporation) was used to simulate price, yield, and deficiency payment as a multi-variate normally distributed input distribution based on empirical estimates of the parameters (mean, standard deviation) of the marginal distributions and correlation matrix presented in Table 1. Input means for price and deficiency payment were measured as the five-year (1989-93) historical average of Arkansas market price (\$/lb lint) received (AASS) and the five year-historical average of deficiency payments paid to producers (USDA-ERS, 1995), respectively. Input mean for cotton yield was measured as the 10-year (1984-1993) historical average of irrigated cotton lint yield (lbs/acre) in crop reporting districts 3, 6, and 9 of eastern Arkansas. Input values for standard deviation for price, deficiency payment and irrigated yield were measured as the root mean square error (RMSE) around respective linear trend regression lines fitted through each time series. Covariance between simulation input variables was based on correlation coefficients estimated from the five and 10-year

historical data series for price, deficiency payment, and yield. (Table 1)

Net return under the 75/25 straight share was simulated over 100 draws, with and without participation in the government cotton program under the 1990 Farm Bill provisions for the 1993 cropping season. A \$15/acre set-aside cost was charged against the 7.5% of idled base acres. Normal flex acreage was 15% of base acres and optional flex acreage was assumed to be planted to cotton. ASCS program yield was set equal to the simulated mean yield of 826.4 lbs/acre. A simulated market price less than the loan rate (\$0.5235/lb) resulted in a simulated market price equal to the loan rate to reflect the non-recourse payment of the marketing loan. Similarly, a simulated deficiency payment greater than \$0.2055/lb was truncated to \$0.2055/lb in order to avoid the simulation of deficiency payments greater than the target price (\$0.7920/lb) minus the loan rate (\$0.5235/lb).

Published enterprise budgets for Arkansas (Bryant *et al*) show \$436.56/acre in production costs for irrigated cotton on silt loam soil (Table 2). Total specified cost in these published enterprise budgets includes variable costs (fertilizer, seed, chemicals, fuel, labor, etc.) and fixed cost for machinery and irrigation, but excludes a charge for land, management, risk, overhead capital, and overhead labor. At the simulated mean yield (826.4 lbs/acre) and price (\$0.6430/lb), gross receipts for cotton production are \$531.12/acre and net returns above total specified non-land costs are \$94.56/acre (Table 2). Under provisions of the 1990 Farm Bill given above, participation in the government cotton program augments these returns to \$173.71 per base acre, an increase of \$79.15 (i.e., 15%) over the market value of the crop.

The published enterprise budget in Table 2 implicitly reflects owner-operator costs and returns under a non-rental scenario. Because only a small portion of Arkansas cotton acreage (13%) is operated by land owners, the more important issue is to determine how tenants and landlords fare under typical cotton rental arrangements both in terms of risk and returns.

## Results

Sample statistics for simulated net returns based on 100 pseudo random observations are presented in Table 3 for tenants and landlords. Results are presented for the representative 75/25 straight share rental arrangement with and without participation in the government cotton program. Because national participation rates in government farm programs for cotton have exceeded 84% of base acreage over the past five years (USDA-ERS, 1995), the “with program” columns of Table 3 are representative of net returns for the majority of cotton produced in Arkansas under the 1990 Farm Bill.

## Expected Returns

Under government program participation, tenant expected net returns in Table 3 are \$38.45/acre compared to landlord returns of \$134.98/acre. Under non-participation, both tenant and landlord returns diminish to -\$27.82/acre and \$122.39/acre, respectively. Thus, non-participation in government programs results in a dramatic decrease in expected net returns for tenants but only a minor decrease for landlords. The decrease in expected net returns is \$66.27/acre for tenants compared to only \$12.59/acre for landlords.

## Risk-Return Tradeoffs

The standard deviation (SD) provides an absolute measure of the risk associated with net returns in each scenario. Comparison of SDs in Table 3 provides quantitative documentation that tenants bear 75% of the risk associated with cotton production under a 75/25 straight share arrangement. In contrast, landlords bear 25% of the total risk measured as sum of the standard deviations for both tenant and landlord returns. This result is consistent with expectations because the sources of risk in this analysis (yield, price and deficiency payments) affect gross revenues directly, and consequently the relative proportion of risk borne by the tenant is proportional to the share of gross revenues (market plus government support) which the tenant incurs. Nevertheless, as measured by the coefficients of variation in Tables 3, tenants bear considerably greater risk—relative to expected net returns—than landlords with or without government program participation.

Table 3 also documents the magnitude of risk for a government program vs. a market (non-participation) situation. For example, the standard deviation for tenants increases from 43.63 (\$/acre) with government programs to 51.73 (\$/acre) under non-participation, an increase of 19%. Alternatively stated, participation in government programs reduces risk to 84% of its market level. Tenants and landlords incur the same proportionate increase in risk when comparing government program scenarios to non-government programs. For example, the relative increase in risk with non-participation for both tenant and landlord is 19% even though the tenant’s absolute increase in standard deviation (8.10 \$/acre) is greater than that of the landlord (2.70 \$/acre).

Minimum and maximum values in Table 3 reflect worst case and best case scenarios of the simulated outcome distributions, but they provide little indication of the likelihood of attaining specified levels of income. The bottom row in Table 3 provides this information by documenting the probability that economic returns to tenant and landlord residual will be negative. With government programs, the tenant incurs a moderate chance (0.20) of negative returns with a 75/25 straight share arrangement. In the absence of government programs, however, the probability of negative returns increases more than threefold to 0.68, a dramatic increase. In comparison, the

probability that landlord returns will be negative are zero with and without government program participation.

Table 4 augments the information in Table 3 by providing estimates of the probability that landlord returns will exceed a specified return to land (%/year). Whereas all estimates of net returns in Table 3 exclude a specific charge for land, Table 4 computes the probability that returns to landlord land will fall below a specified opportunity charge expressed as a percent of land value. Based on an average value of \$886/acre for Arkansas irrigated cropland (USDA-ERS, 1991), the chances of returns to land falling below 6%, 8% or 10% are zero with government programs. In the absence of government programs the landlord incurs a zero probability of annual returns to land less than 8%, and only a low (0.03) probability of incurring returns below 10% per year.

### Conclusion

Results of this baseline study have implications for cropland rental arrangements. High rates of participation in the government cotton program in recent years provide evidence that both tenants and landlords have enjoyed profit-able cotton production at an acceptable level of risk. Although this study shows that cotton production without government programs results in reduced profit and increased risk, the more important finding is that a relatively larger portion of the burden of the reduced benefits under non-participation is borne by tenants. Thus, a re-evaluation of the provisions of cropland rental arrangements may be necessary to ensure that landlords provide adequate incentives to tenants as the threat of reduced government support becomes a reality in future farm bills.

### References

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Table 1. Estimated parameters and correlation coefficients for simulation input distributions, irrigated cotton.

		Yield (lbs/ac)	Price (\$/lb)	Def. Pmt. (\$/lb)
<i>Estimated Parameters</i>	Mean	826.4 <sup>1</sup>	0.643 <sup>2</sup>	0.147 <sup>3</sup>
	Std Dev <sup>4</sup>	101.9	0.035	0.050
<i>Correlation Coefficients</i>	Yield	1.00	---	---
	Price	-0.022	1.00	---
	Def Pmt	-0.161	-0.605	1.00

<sup>1</sup> Ten-year (84-93) mean yield for irrigated cotton, eastern Arkansas.  
<sup>2</sup> Five-year (89-93) mean price received in Arkansas, 1993 dollars.  
<sup>3</sup> Five-year (89-93) mean of historical deficiency payments, 1993 dollars.  
<sup>4</sup> Root mean square error of a trend regression fitted through each data series.

Table 2. Estimated enterprise costs and returns for irrigated cotton production, Arkansas Delta.

Enterprise Item	Irrigated <sup>1</sup>
Yield (lbs lint/ac) <sup>2</sup>	826
Price (\$/lb lint) <sup>3</sup>	0.643
Gross Receipts (\$/ac)	\$531.12
Variable Costs (\$/ac)	\$358.31
Fixed Costs (\$/ac)	78.25
Total Specified Costs (\$/ac)	436.56
Returns above Total Specified Cost (\$/ac)	94.56
Returns above Total Specified Cost w/cotton program (\$/ac) <sup>4</sup>	173.71

Notes:<sup>1</sup> Cost estimates based on Bryant *et al.* (1993).  
<sup>2</sup> Ten-year (1984-93) mean yield for irrigated cotton.  
<sup>3</sup> Five-year (1989-93) mean price received.  
<sup>4</sup> Participation in farm program under 1990 Farm Bill provisions.

Table 3. Simulated net returns for tenants and landlords under a 75/25 straight share irrigated cotton rental arrangement, Arkansas Delta.

Simulated Net Returns <sup>2</sup>	Row Unit	Tenant		Landlord	
		With Program <sup>1</sup>	Without Program	With Program <sup>1</sup>	Without Program
Mean	\$/ac	38.45	-27.82	134.98	122.39
Std. Dev.	\$/ac	43.63	51.73	14.54	17.24
CV	%	113	NA	11	14
Min	\$/ac	-58.37	-140.80	102.71	84.75
Max	\$/ac	135.16	105.16	167.22	166.72
Prob [Net Ret ≤ 0]		0.20	0.68	0.00	0.00

<sup>1</sup>Participation in government program under 1990 Farm Bill provisions.  
<sup>2</sup>Returns to tenant overhead (overhead capital, overhead labor, risk, mgt) or returns to landlord overhead (land, overhead capital, overhead labor, risk, management). Excludes an opportunity charge for landlord land, but includes all share payments by tenants for use of the land.

Table 4. Probability that returns to landlord land will be equal to or less than a specified annual percentage return for a 75/25 straight share, Arkansas Delta.

Returns to Land (%/yr) <sup>1</sup>	With Government Program <sup>2</sup>	Without Government Program
	Probability	
0 %	0.00	0.00
6 %	0.00	0.00
7 %	0.00	0.00
8 %	0.00	0.00
10 %	0.00	0.03

<sup>1</sup>Assumes all residual returns above specified variable and fixed costs accrue to land as the sole residual claimant. 1991 average value of Arkansas irrigated cropland was \$886/acre (USDA-ERS, 1991).

<sup>2</sup>Participation in government commodity program under 1990 Farm Bill.