SECTOR SIMULATION ANALYSIS OF GEORGIA COTTON PRODUCTION

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Abstract

Stochastic simulation analysis of Georgia cotton production shows the relationships among key variables that impact the financial returns to cotton farming. A model is developed with aggregated state level data to represent the cotton farming sector. Data are for average costs and returns at the farm level. Random generation of correlated prices and yields accounts for variability of net returns that include government payments. Graphical presentations show changes in each component of government payments as market price changes. A negative relationship between government payments and market revenue indicates that commodity income support programs provide a safety net for farmers during periods of low prices.

Introduction

Cotton leads all Georgia crops in acreage planted. Georgia farms producing cotton generally utilize proper agronomic rotation practices with peanuts and corn that make cotton production an essential component of a diversified state agricultural economy. Simulation models include relevant variables to depict crop production. Combining rotation crops for simultaneous simulation creates a whole farm model. The objective of this report is to apply simulation analysis to examine the financial situation of the Georgia cotton production sector.

Data

A simulation model of the Georgia cotton production sector analyzes costs and returns for production of cotton and typical rotation crops. Prices received and yields applied for sector simulation are presented in Table 1. Expected U.S. prices are projections for the 2008 production year from the Agricultural and Food Policy Center (AFPC) at Texas A&M University (Outlaw et al, 2007). Historical differences between annual U.S. prices determine expected Georgia price. Expected 2008 yields are average state yields for 2003-2007 adjusted by the trend in the moving 5-year averages (USDA-NASS, 2007). Yields for direct payments (DP) and counter cyclical payments (CCP) are state averages published by the Farm Services Agency (USDA-FSA, 2003). Recent acreage shifts in Georgia lead to whole farm simulation acreage with a 100 acreage reduction in cotton that shifts to corn.

Table 1. Prices[1] and Yields[2], and Acreage

	Peanuts	Cotton	Corn
GA Price	474	0.634	3.42
US Price	483	0.630	3.28
Expected Yield	3,046	805	127
DP Yield	3,152	688	62
CCP Yield	3,152	717	68
Harvested Acreage	350	600	200
Base Acreage	350	700	100

[1]Peanuts: $/ton, Cotton: cents/lb., Corn: $/bu.

[2]Peanuts: lbs./acre, Cotton: lbs./acre, Corn: bu./acre

Average 2008 production costs for cotton are based on University of Georgia (UGA) crop enterprise budgets for 2008 (Shurley and Ziehl, 2007). Similarly, average production costs for corn and peanuts are based on UGA budgets (Smith and Ziehl, 2007a; Smith and Ziehl, 2007b). Provisions for commodity programs in the *2002 Farm Act* are applied in this analysis (Westcott, Young, and Price, 2002). The adjusted world price (AWP) for calculating loan deficiency payments (LDP) is determined by the average difference between Georgia price and annual AWP (USDA-FAS, 2007).

Prices and yields have historical relationships that can be accounted for with stochastic analysis. CCP varies with price while LDP varies with price and yield. Thus, total revenue, as well as baseline expenses for harvesting, ginning, marketing, and warehousing are variable. Generation of random prices and yields leads to results that account for stochastic relationships existing in production. An alternative to typical normality assumptions in simulating stochastic commodity prices and yields is application of a multivariate empirical (MVE) distribution. 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). This simulation applies the MVE function of Simetar (Richardson, Schumann, and Feldman, 2006). Simetar generates random variables with means of prices and yields in Table 1 and covariance structures determined by 1997-2006 historical prices and yields (USDA-NASS, 2007). This report includes two simulations each with 500 iterative solutions. One simulation is with 700 acres of cotton, and the second simulation is for a whole farm with 1,150 total acres.

Cotton Simulation

Average simulated revenue and costs for cotton on a per acre basis are presented in Table 2. Cotton budgets include an expected 2008 price received for cottonseed sold of $125/ton. Total market revenue from lint and cottonseed is $577. Government payments from DP, CCP, and LDP are $75. Total operating costs of production are $572. Resulting net returns to land and unpaid labor are $80.

Table 2. Cotton Revenue and Costs, per Acre

	-dollars-
Lint Revenue	512
Seed Revenue[1]	65
Government Payments	75
Variable Costs	462
Fixed Costs	110
Net Returns	80

[1]Cottonseed Price = $125/ton

Charts 1-5 show the relationship between Georgia price, government payments (GP), and net returns for 700 acres of cotton. Chart 1 indicates that LDP decreases as price increases, and there are no payments when price approaches $0.57/lb. Chart 2 shows that CCP approaches $0 as cotton price approaches $0.67/lb. CCP increases as price decreases, but becomes constant at $54,948 when price is below $0.54/lb. Chart 3 shows that GP consists only of DP which equals $27,304 when price is greater than $0.67/lb. Chart 4 shows the relationship between NR and cotton price. NR is within a constant range when price is less than $0.67/lb. NR enters an increasing trend only when price is greater than $0.67/lb. Thus, increased average NR occurs only when GP is at its minimum. Chart 5 shows increasing market receipts are associated with decreasing GP. A summary of Charts 1-5 is that market receipts and GP are substitutes, and average NR increases occur only as market revenues increase.

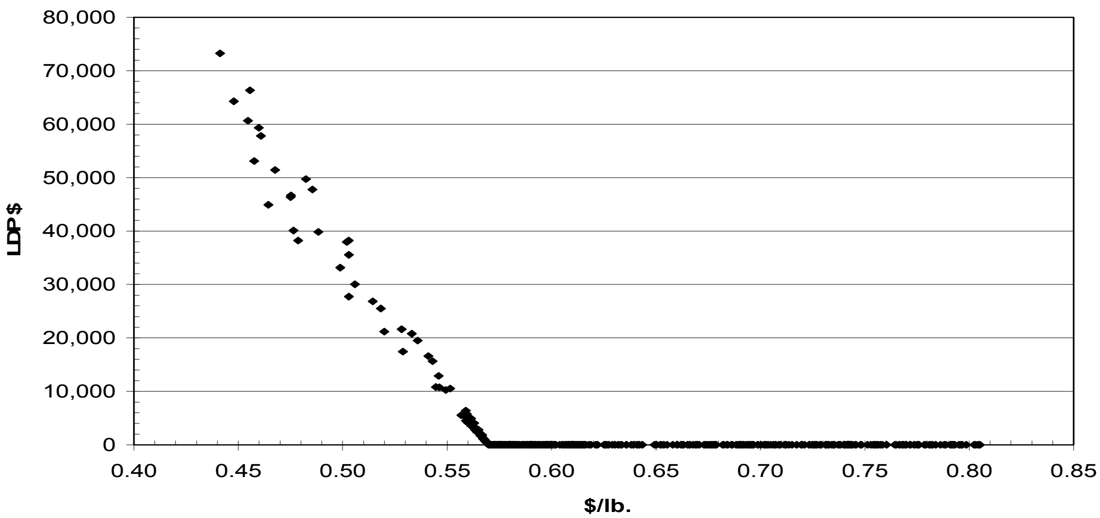

Chart 1. Scatter Plot of Cotton Price and LDP

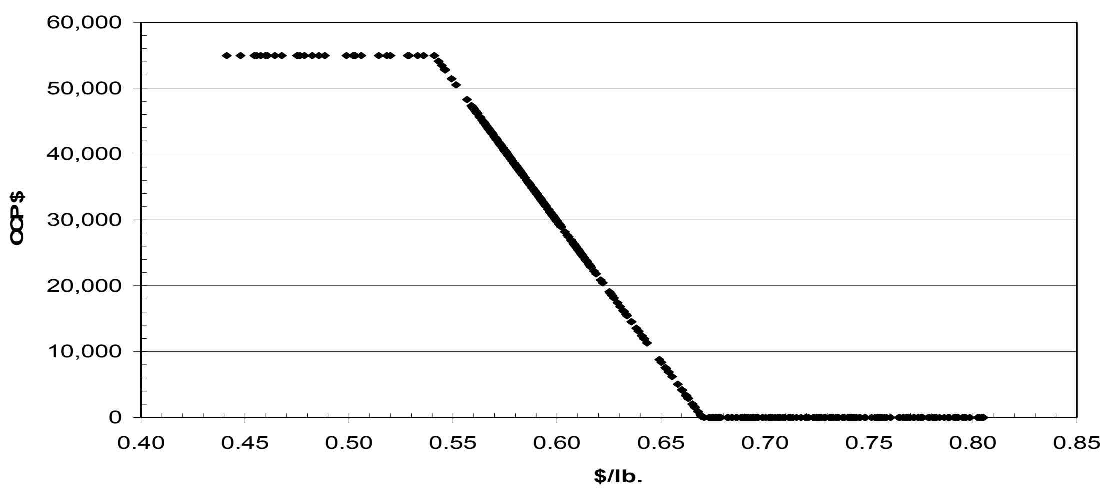

Chart 2. Scatter Plot of Cotton Price and CCP

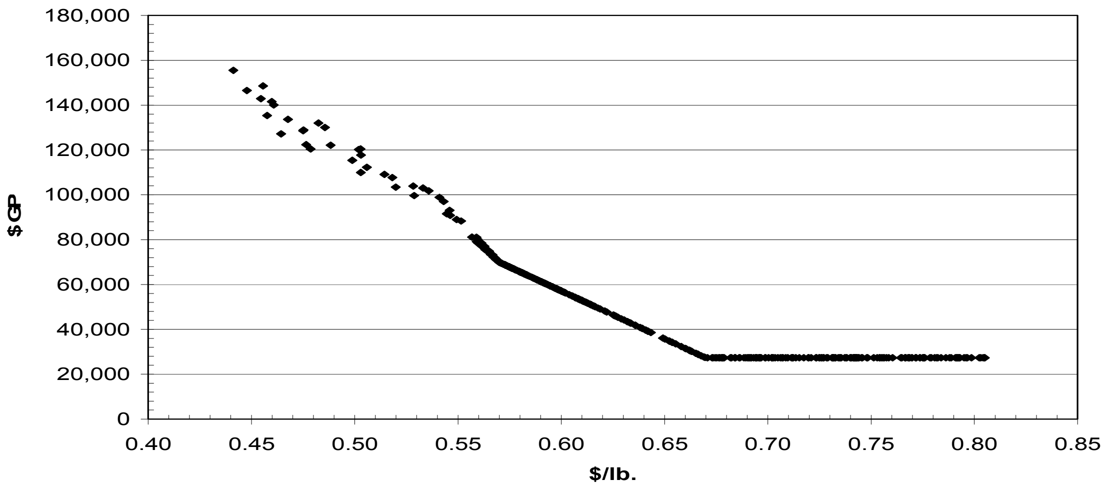

Chart 3. Scatter Plot of Price and GP

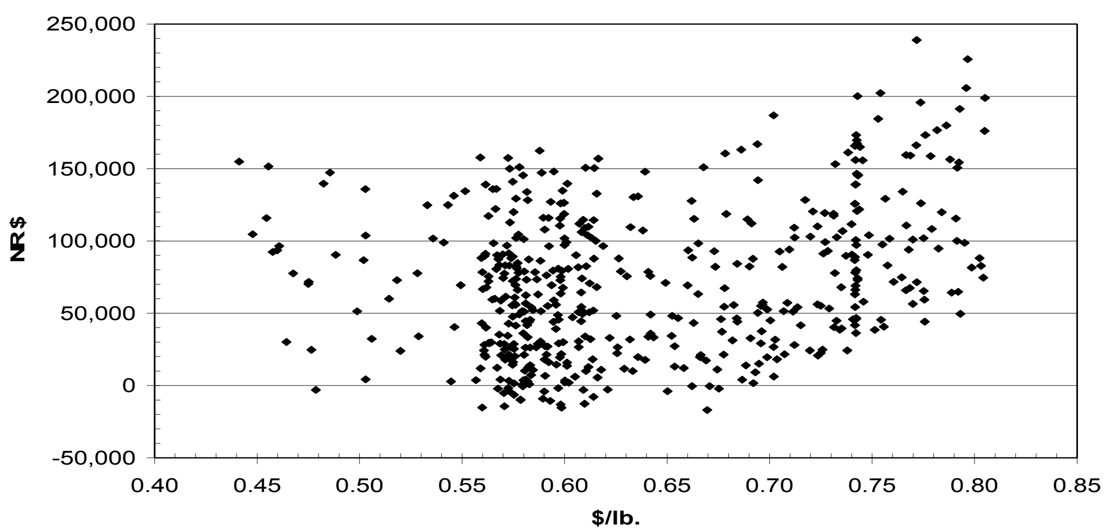

Chart 4. Scatter Plot of Cotton Price and Net Returns

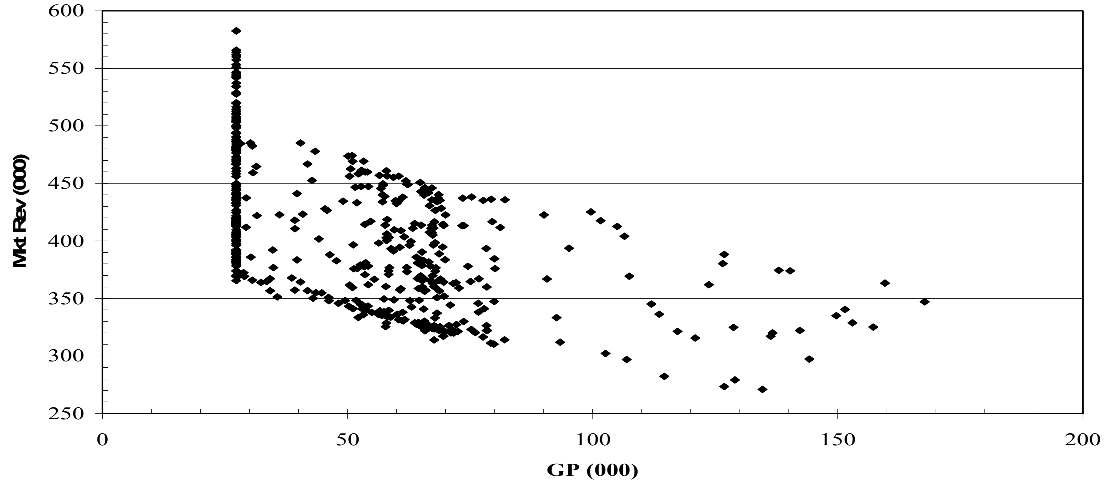

Chart 5. Scatter Plot of Market Receipts and Government Payments, 700 Acres of Cotton

Chart 6 shows the cumulative distribution function (CDF) of NR with GP, as well as NR with market receipts only. CDF indicates the probability of NR occurring at points equal to or less than points on the horizontal axis. All CDF points for NR including GP are to the right of CDF points with only market receipts, indicating GP increases NR at all probability levels. The CDF with GP is to the right of $0, indicating a CDF having no points with negative NR. The $0 point intersects the CDF with only market receipts at the 50% probability level. This indicates that NR with only market receipts are less than $0 in 50% of the simulated outcomes.

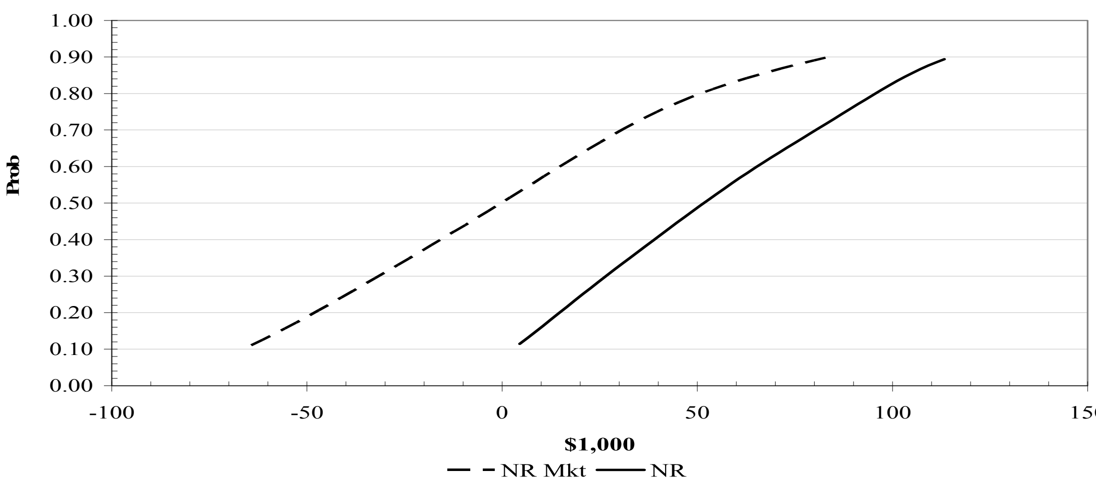

Chart 6. CDF of Net Returns and Net Returns with Market Receipts Only, 700 Acres of Cotton

Whole Farm Simulation

Whole farm simulation with 1,150 total acres includes 600 acres of cotton, 350 acres of peanuts, and 200 acres of corn. Total revenue of $755,718 in Table 3 consists of $684,376 in market receipts and $71,342 in GP. Total production costs are $674,080. Approximately 50% of Georgia cropland is rented. Applying a rental rate of $60/acre to 575 acres leads to land rent expenses of $34,500. Deducting land rent from NR results in farm income of $47,138. Without GP, farm income would be -$24,204.

Table 3. Whole Farm Revenue and Costs, 1,150 Acres

	-dollars-
Revenue	684,376
Government Payments	71,342
Variable Costs	537,723
Fixed Costs	136,357
Net Returns	81,638
Land Rent	34,500
Farm Income	47,138
Farm Income w/o GP	-24,204

Returns to variable costs (RVC) for each crop are presented in Table 4. Peanuts average $188/acre, cotton averages $120/acre, and corn averages $58/acre. Stochastic sensitivity analysis indicates that as cotton prices increases to $0.70/lb., average cotton RVC increases to $170/acre. Increasing corn price to $4.00/bu. leads to average corn RVC increasing to $120/acre.

Table 4. Returns to VC

Crop	$/acre
Peanuts	188
Cotton	120
Corn	58

Chart 7 shows for a whole farm that market receipts and GP are substitutes. Increases in market receipts lead to decreases in GP. Chart 8 shows the CDF plots for the whole farm simulation with GP and with market receipts only. The CDF with GP has all points to the right of $0. Without GP, the CDF intersects $0 at the 45% probability. This indicates the impact that GP has on reducing the likelihood of negative NR.

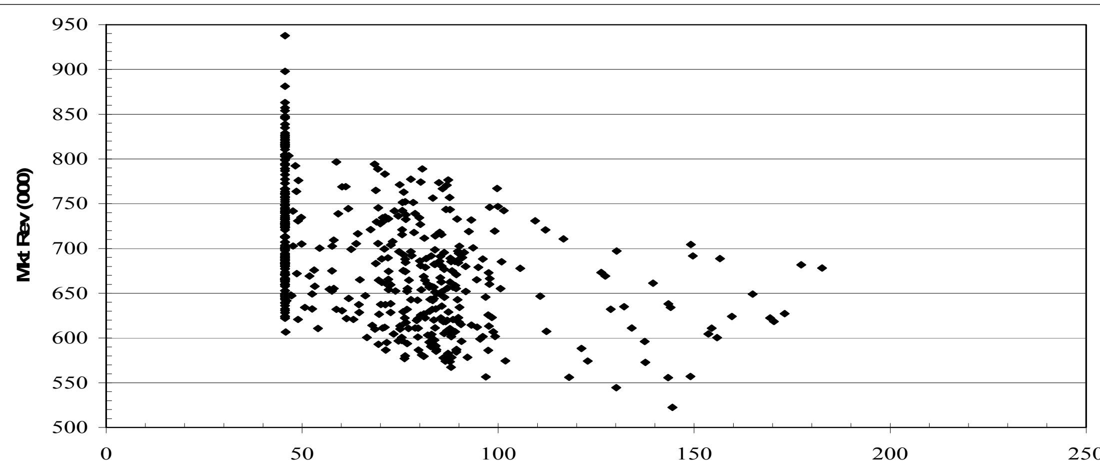

Chart 7. Scatter Plot of Market Receipts and Government Payments, Farm with 1,150 Acres of Cotton, Peanuts, and Corn

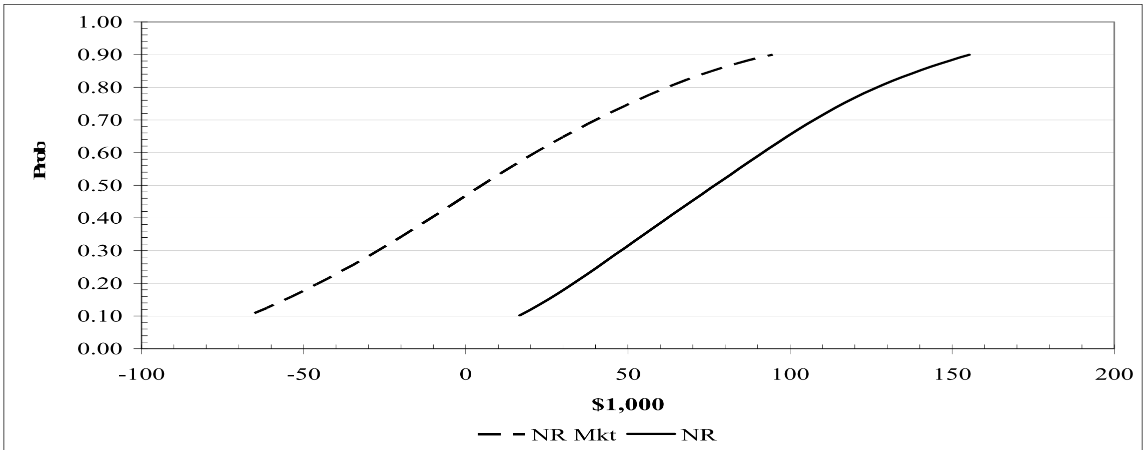

Chart 8. CDF of Net Returns and Net Returns with Market Receipts Only, Farm with 1,150 Acres of Cotton, Peanuts, and Corn

Summary

Simulation analysis is applied to investigate the financial situation of the Georgia cotton production sector. Analysis includes cotton production as a single crop and cotton as part of a whole farm in production with peanuts and corn. Government payments and market receipts are substitutes, and as market receipts increase, government payments decrease. Government payments decrease as prices received for cotton increase. Average net returns for cotton increase only when price is greater than $0.67/lb. At prices below $0.67/lb, government payments maintain average net returns within a constant range. Whole farm analysis indicates that without government payments, the average Georgia farm with cotton, peanuts, and corn has net returns of -$24,204.

References

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