ABSTRACT

Arkansas cotton acreage has followed declining trends in U.S. acreage during the latter years of the previous decade. In Arkansas, the primary crops competing for cotton acreage are corn, soybeans, and rice. Farm managers and land owners are interested in optimizing long-term financial returns while capitalizing on short-term opportunities in acreage allocations. Long-term acreage allocations are mostly due to soil characteristics and crop rotation considerations that determine suitability for crops. Short-term acreage allocations are responses to economic considerations related to commodity prices and production costs. Results indicate consistent long-term acreage responses with a shift in response magnitude between cotton and rotation crops. The shift in magnitude is attributable to relative relationships among commodity prices that were less favorable to cotton for the period beginning in 2007.

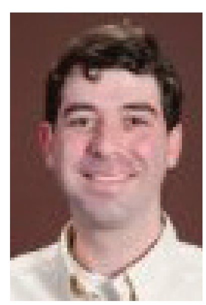
Change in Arkansas Cotton Acreage during 2002-2010

By Archie Flanders, Bobby Coats, and Carter Dunn

Introduction

Arkansas cotton acreage has followed declining trends in U.S. acreage during the latter years of the previous decade. Potential acreage shifts to competing crops varies by state and is dependent on localized agronomic conditions. Responsiveness of acreage reallocations to changes in economic considerations entail fundamental agronomic characteristics that vary by geographical production area. The objective of this research is to quantify Arkansas cotton acreage responses with rotation crops for two distinct economic periods. Economic conditions that determine acreage allocations include relative commodity prices for all crops that are potentially included in a desirable crop rotation program for maintaining agronomic viability. Relative commodity prices are often influenced by domestic and global public policies. Background information for understanding Arkansas acreage shifts includes both state agronomic circumstances and prevailing public policies.





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In Arkansas, the primary crops competing for cotton acreage are corn, soybeans, and rice. Cotton and corn production are most suitable on soil types that make these crops almost completely interchangeable. Soybean and rice production are optimal on soil types that limit the interchangeability of cotton acreage with these crops.

The 1990's was a period of high expectations for global growth and export demand for U.S. rice, cotton, soybeans, wheat, and corn. For the first time since World War II the world's progressive developing and developed economies were embracing globalization and moving toward a global economy with increasingly open markets and free trade. Optimism about future sustainable global growth through the 1990's and beyond would, it was widely believed by analysts, provide U.S. row-crop producers with a reasonable return on their investment. Thus, the 1996 Farm Bill was written to transition the U.S. program row-crop agriculture away from traditional farm government program support (Coats, 2012; Coats, 2011).

The 1996 Farm Bill was enacted into law in June 1996, and by July 1997 the Asian Financial Crisis emerged. The financial crisis spread and continued inflicting economic damage throughout the world with an economic global low being reached in 2002. This crisis was extraordinarily problematic and deflationary for many commodity prices. This led to uncertainty about future global growth, which caused countries to heighten their agricultural and food and energy security position.

In 2002, the rice farm market price was 43 percent of the U.S. farm government program target price and cotton was 63 percent, but a year earlier in 2001 cotton's farm market price was 42 percent of cotton's target price. The farm market price as a percent of target price for rice had not been this low in relative terms since 1960. The cotton farm market price as a percent of target price had not been below the 2001 level since 1972.

In 2002, corn's farm market price was 64 percent of its target price with a previous four-year average (1988 to 2001) of 52 percent. Wheat's 2002 farm market price as a percent of target price was 85 percent with a previous four-year average of 63 percent. The 2002 farm market price for soybeans as a percent of target price was 92 percent with a previous four-year average of 77 percent. Rice's previous four-year average was 59 percent while cotton's previous four-year average was 65 percent.

The fundamental global economic weakness; heightened agricultural, food, and energy security concerns; and the future economic global uncertainty caused the U.S. to return to traditional farm policy mechanisms for rice, cotton, soybeans, wheat, and corn in the 2002 farm bill. Building energy security concerns in the first decade of 2000 caused the U.S. government to accelerate the growth of the U.S. biofuels sector. USDA in 2001 instituted a bioenergy program with the goal to encourage greater purchases of eligible farm commodities used in the production of biofuels. The emphasis was on corn for ethanol and soybean oil for biodiesel. Ongoing government involvement through farm and energy policy to date has insured a continued balance of farm-grown food and energy feed stocks. Corn has been the biggest price benefactor of the renewed biofuels policy with other row-crop prices benefiting from their relationship with corn.

The stimulus-driven global growth that emerged in 2003 along with emerging biofuels industries' demand for corn and soybean feed stocks was the catalyst for the bull market in commodities that would follow with rice, soybeans, wheat, and corn prices reaching new record highs in 2008. The trending cotton price spike was significant, but not of the magnitude seen in rice, corn, soybeans, and wheat.

U.S. corn prices received increased relative to cotton prices after 2006 (NASS, 2012). Production characteristics of corn and soybeans create price relationships that result in a discernible price ratio among the two crops that can be expressed as $R_{SB,C}=Price_{Soybean}/Price_{Corn}$ (O'Brian, 2010; Ubilava, 2008; Zulauf & Specht, 2005). Thus, there has been upward pressure on soybean prices received as corn prices have increased.

Factors that lead to changes in U.S. field crop prices have impacts on trends for Arkansas prices. Figure 1 presents indexes of Arkansas crop prices for 2002-2010. The 2002-2006 period has similar trends for cotton, corn, and soybeans. Rice price increases greatly outpaced prices for all other field crops throughout 2002-2010. After 2006, price increases for corn and soybeans were greater than cotton price increases. In 2010, the price indexes for rice, soybeans, and corn were 2.72, 1.93, and 1.87, respectively (2002 = 1.00). This compares to a price index of 1.65 for cotton. While agronomic conditions are constant throughout the study period, Figure 1 indicates two distinct economic environments and a relative change in economic conditions that is not favorable to cotton.

Data and Methodology

Arkansas Field Crop Acreage. The major field crops in Arkansas consist of cotton, corn, soybeans, and rice. Soil characteristics that vary by geographical region influence long-term crop acreage decisions for Arkansas producers. Yield increases for corn, cotton, soybeans, and rice that production technologies are increasing similarly for all field crops (NASS, 2012). Producers make short-term marginal adjustments in acreage determined by annual economic considerations while maintaining a long-term acreage base.

Typically, 3.5 million acres of soybeans are planted with approximately 100,000 acres devoted to seed production (Coats & Ashlock, 2011). Soybeans are most commonly produced in the eastern part of Arkansas, with some production in the Arkansas River valley and the southwestern corner of the state. Over 35 of the 75 Arkansas counties produced soybeans in 2011 (NASS, 2012).

The Arkansas Delta region in the eastern part of the state leads in rice production. Some acreage is in the Arkansas River Valley, as well as in southwestern Arkansas. Rice and soybeans are typical rotation crops on irrigated acreage, and 68 percent of rice acreage follows soybeans. Approximately

28 percent of rice acreage follows rice, and the remaining four percent follow other crops such as corn, grain sorghum, cotton, wheat, oats, and fallow. The majority of rice is produced on silt loam soils (48% of total acreage), with an increasing amount produced on clay (27%) and clay loam (21%) soils. Arkansas primarily produces the long and medium grain varieties, but a small amount of short grain rice is also produced in the state (Wilson Jr. et al., 2010).

Arkansas corn and cotton production are focused in the eastern part of the state. Although producers have successfully cultivated corn on a wide range of soil types, corn performs best on deep, well-drained, medium to coarse textured soils. One of the most important considerations for land selection is drainage, and corn performs best on well drained soils. Characteristics of optimal soil types for cotton are similar to corn (Barber et al., 2012; Ross et al., 2011).

Figure 2 presents the state acreage planted to each crop for 1995-2010. In addition to recent trends, Figure 2 shows long-term acreages for each of the crops. Soybeans have a historical average of between 3.0 and 3.5 million acres during 1995-2010. Rice has a historical average of 1.5 million acres during 1995-2010. Until 2007, cotton had a historical average of 1.0 million acres, and corn had a historical average of less than 0.5 million acres during 1995-2010. There are approximately 6.0 million annual acres of cotton, corn, soybeans, and rice in Arkansas. Figure 3 indicates a relatively constant level of combined soybean and rice acreage.

Arkansas cotton acreage can be categorized with a period of stable or increasing cotton acreage during 2002-2006, followed by a period of declining acreage during 2007-2010 in Figure 3. These distinct periods of cotton acreage correspond to changes in relative prices received presented in Figure 1. All crop prices are increasing after 2006, but cotton price increases lag behind increases for other crops. Although the price index for rice is much greater than all other crops, rotation considerations with soybeans and compatibility of soil types with cotton is a limiting factor for the impacts that increased rice prices can have on cotton acreage. The objective of this empirical analysis is to quantify changes in acreage response among cotton and competing crops for the 2002-2006 and 2007-2010 time periods.

Empirical Model. County level acreage data is applied to investigate acreage response among cotton and competing crops during 2002-2010 (NASS, 2012). Data is collected for 18 counties producing the major field crops for a total of 162 observations. The panel data structure allows for repeated annual observations on counties producing cotton and competing crops. A fixed effects model for panel data captures all unobserved, time constant factors that affect a dependent variable. Changes in cotton acreage among competing crops can be represented by a first-differenced equation as:

(1) $\Delta Cotton_{it}=\beta_0+\beta_1\Delta Corn_{it}+B_2\Delta Soybean_{it}+B_3 \Delta Rice_{it}+\Delta\mu_{it}$,

where *i* represents a county as a cross-sectional unit and t presents an annual observation of the change in crop acreage from the previous year. β_0, β_1, B_2, and B_3 are parameters to be estimated, and $\Delta\mu_{it}$ is an error term for the first-differenced equation. Assuming that the explanatory variables are strictly exogenous and not correlated with the error term, the first-difference method gives unbiased parameter estimates.

Potential change due to higher commodity prices for competing crops after 2006 can be quantified by restating Equations (1) as

$$(2) \quad \Delta Cotton_{it}=\beta_0+\beta_1\Delta Corn0306_{it}+\beta_2\Delta Corn0710_{it}+B_3\Delta Soybean0306_{it}+B_4\Delta Soybean0710_{it}+B_5\Delta Rice0306_{it}+B_6\Delta Rice0710_{it}+\Delta\mu_{it},$$

where each explanatory variable in Equation (1) is dichotomized to represent acreage changes for 2003-2006 and for 2007-2010.While Equation (2) is not a price response model, the empirical model will investigate acreage responses for a period of constant agronomic conditions with increasing production technologies for all crops over two distinct periods of economic environments.

Results

Table 1 presents the parameter estimates for Equation (2). Negative signs indicate that corn soybeans and rice acres are substitutes for cotton acres during both the 2003-2006 and 2007-2010 time periods. Producers continued similar rotation practices in both time periods, but cotton acreage declined relative to other crops in rotation programs. A coefficient greater than 1.0 for corn during 2007-2010 indicates that higher corn prices induced new corn acreage in addition to acreage that was exiting cotton for corn. Comparing estimates between the 2003-2006 and 2007-2010 time periods indicates that substitution increased for all competing crops after 2006. Increases in relative coefficient values for the later time period are 146 percent for corn, 151 percent for soybeans, and 131 percent for rice. Soybeans and rice are expected to substitute for cotton as rotation crops. The average coefficient change in the later period for soybeans and rice is 141 percent.

Results in Table 1 indicate shifts in acreage allocations among cotton and rotation crops. The shifts are attributable to relative relationships among commodity prices that were less favorable to cotton for the period beginning in 2007. Comparing returns per acre for the two periods is a means to estimate increases in cotton prices that are required to increase the profitability to relative levels that existed during the 2003-2006 period.

Figure 4 presents indexes for ratios of prices received to total production costs for 2006-2011. Costs are from baseline budgets for 2011 and input prices changes applied to respective inputs to derive costs for 2006-2010. Aggregated 2011 production functions are developed for field crops as weighted averages of crop enterprise budgets (Flanders, 2011). With significant price increase in 2011, corn has the greatest ratio of 1.53 for the final year. Ratios for corn and soybeans are greater than for cotton throughout the period. Ratios for rice are greater for cotton in all but the final two years. Comparisons of crop relationships for prices and costs are explanations for acreage shifts demonstrated in Table 1.

Discussion

Public policies and global economic conditions related to agriculture have a potential to cause shifts in acreage allocations. Producers may maintain fundamental relationships in crop rotation practices, but shift acreage concentrations in order to capture increased profits. There are approximately six million annual acres of cotton, corn, soybeans, and rice in Arkansas.

Arkansas cotton acreage can be categorized with a period of stable or increasing cotton acreage during 2002-2006, followed by a period of declining acreage during 2007-2010. These distinct periods of cotton acreage correspond to changes in relative prices received that favor alternative crops over cotton. Results of this analysis indicate shifts in acreage allocations among cotton and rotation crops. Producers continued similar rotation practices in both time periods, but cotton acreage declined relative to other crops in rotation programs. With increasing production technologies for all crops, the shifts are attributable to relative relationships among commodity prices that were less favorable to cotton for the period beginning in 2007.

As cotton acreage declines can be attributed to decreasing relative price levels, cotton acreage increases would follow any increases in relative cotton prices. However, another consideration for producers shifting acreage out of cotton is the extensive management requirements when compared to alternative crops. Crop enterprise budgets include total labor hours required for production of each crop with surface irrigation (Dunn et al., 2011). Total labor requirements for cotton are 1.68 hours per acre. This compares to 0.66 hours for soybeans, 0.79 hours for corn, and 0.98 hours for hybrid rice.

As relative prices increase for alternative crops, the greater management requirements further reduce incentives for planting cotton. Another consideration is infrastructure specific to cotton production. Declining cotton production leads to contraction in the cotton ginning industry. When ginning capacity is diminished below a critical regional threshold, it is a negative factor for expanded cotton production in that region.

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Table 1. Regression Coefficients[y] for Acreage Change, Cotton and Major Field Crops, Arkansas, 2002-2010

Variable	Coefficient[z]	Std. Error	t Statistic	Prob. > |t|
Intercept	481.997	528.100	0.910	0.3630
Corn0306	-0.804*	0.172	-4.680	<0.0001
Corn0710	-1.172*	0.126	-9.300	<0.0001
Soybean0306	-0.464*	0.075	-6.210	<0.0001
Soybean0710	-0.702*	0.076	-9.270	<0.0001
Rice0306	-0.448*	0.088	-5.090	<0.0001
Rice0710	-0.587*	0.177	-3.320	0.0012
R-Square	0.6997			

[y]Data are pooled, and OLS is applied for heteroscedasticity-consistent covariance matrix estimation of the model.

[z]Values followed by * are significant at P<0.01.

Figure 1. Index of Arkansas Price Received, 2002-2010 (Source: NASS, 2012).

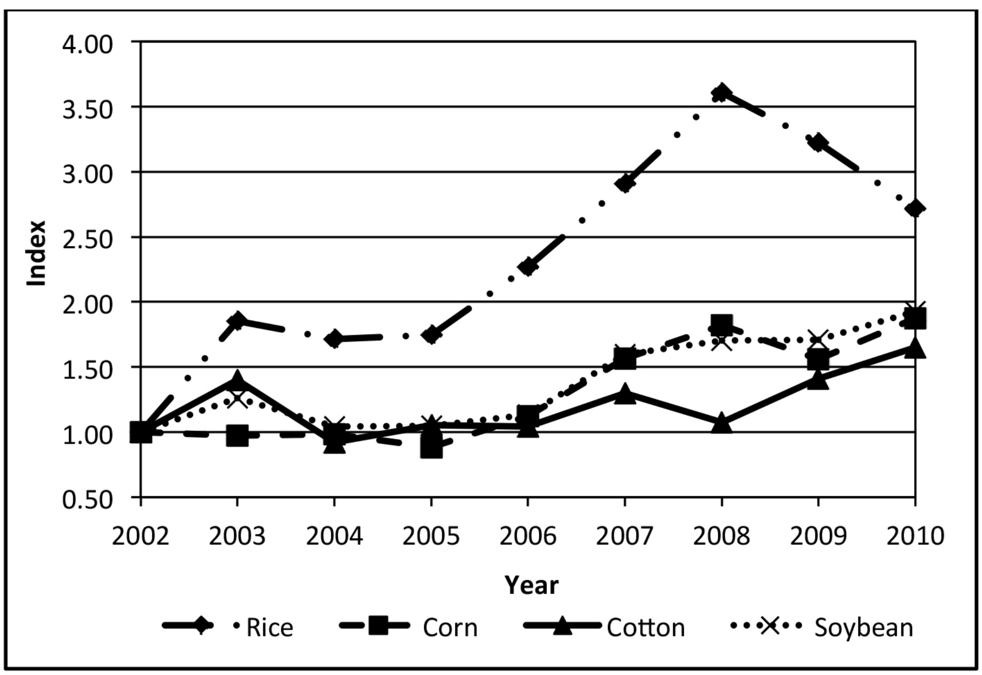

Figure 2. Arkansas Acreage for Major Field Crops, 1995-2010 (Source: NASS, 2012).

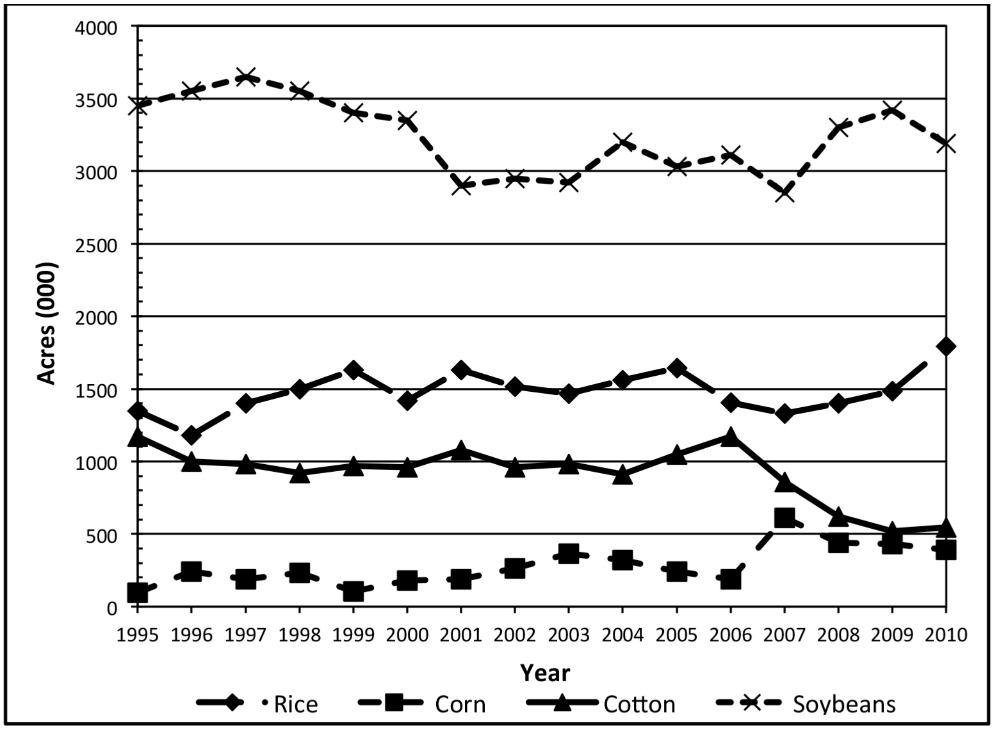

Figure 3. Index of Arkansas Acreage Planted, 2002-2010 (Source: NASS, 2012).

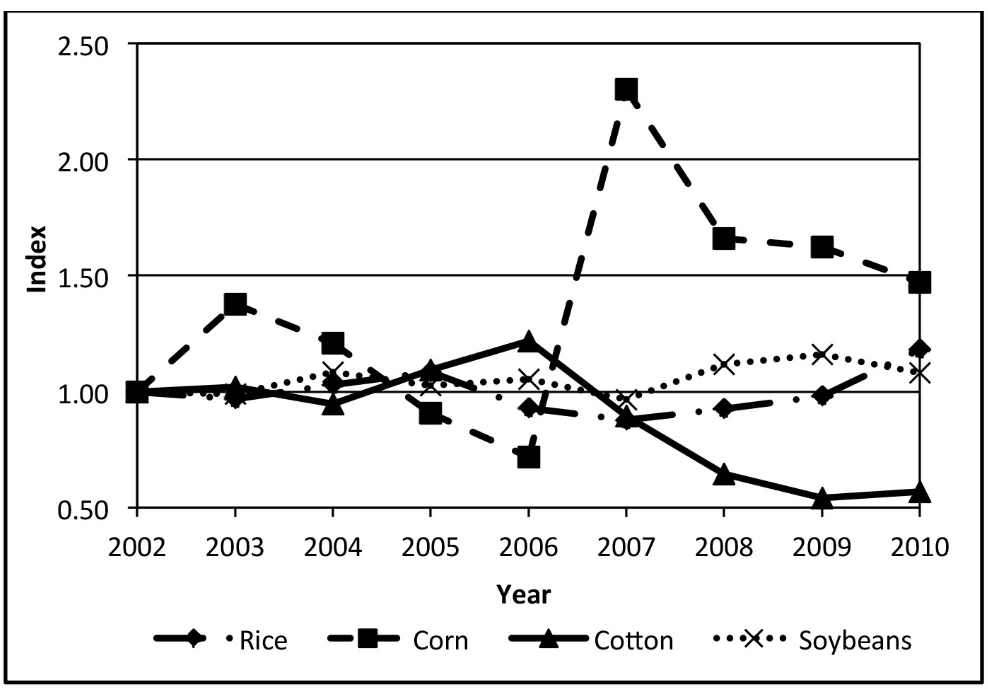

Figure 4. Indexes for Ratio of Price Received to Total Production Costs, Major Arkansas Field Crops, 2006-2011, 2006=1.0 (Source: Flanders, 2011; NASS, 2012).