

**Acreage Response of Southeastern Upland Cotton to Federal Policy  
in the Freedom to Farm Era**

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## ABSTRACT

Cotton has been a staple crop of the United States since the invention of the cotton gin. Upland cotton, in particular, has been so prominent throughout the history of the southeastern United States, that it has often sustained the region's economy. Due to the historical nature of the Southeast's reliance on cotton production, the United States government has implemented several policies over multiple generations to ensure its economic viability. These policies attempt to assist upland cotton producers in multiple capacities, including price support tactics, entitlement programs, and loan assistance. Since the 1996 Farm Bill (The Freedom to Farm Act), American farm operators have had the ability to explore new crop production.

This study examined upland cotton acreage from 1996 to 2010 within the southeastern United States. Annual planted acreage and production data were modeled using lagged cotton production, price of cotton per pound, loan rates, entitlement program returns, and alternative cropland use and production. Two multiple regression models were used: one in which each acre of cotton planted received a full subsidy payment for total yield, and one in which the yields and acreage for calculating subsidy payments was reduced. Both models analyzed the Southeast as a whole, as well as individual states within the region. Multiple regression analysis indicated that there was no significant ( $P < 0.05$ ) relationship between federal policy and upland cotton growth on a regional level. However, for each of Arkansas and South Carolina there were two significant ( $P < 0.05$ ) parameters: marketing assistance loans and corn production for Arkansas, and soybean and lagged cotton production for South Carolina. These findings

indicate that, within individual states, the amount of acreage devoted to upland cotton was responsive to some federal programs, as well as alternative crop production.

## DEDICATION

I dedicate this paper to my whole family, both living and deceased, and to those people in my life that have given their own time and effort to see me succeed.

I should first thank God, both for the opportunities in my life as well as the ability to accomplish what duties have been placed in front of me.

I thank Dr. Charles Beauchamp, who allowed me to work on this degree on his time. He has had to put up with a lot from me, always handling my problems as if they were his own. I appreciate that.

I thank the memory of my grandparents, John O. and Frances Barnes, and Garnett and Elaine Wood. Were they alive today, I only hope that I have made them proud. The core of my character I attribute to both of my grandfathers, Granddaddy John O. and Granddaddy Garnett. They provided lessons in education, hard work, agriculture, and family that I will never forget.

My parents, Bill and Alice: I owe far too much to encompass in a few simple sentences. Thank you for your encouragement, support, and love, as well as your limitless funding of my further education. I hope that I have made you proud, as I have always been proud to be your son.

For my wife, Lea, thank you for putting up with me over the last six years. I know that for a relatively young man I can be cantankerous. I admit these shortcomings, and love you too.

Finally, and with most importance, I dedicate this work to my two daughters, Katelyn Olivia and Roxanne Jane. They are the reason I could not walk away from school until finishing. They are the reason that I get out of bed in the morning. I love you both.

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## **CHAPTER 1: INTRODUCTION**

### **Cotton: Production and Profit**

The American farming community has seen significant changes in agricultural land since the founding of the country. Whether voluntarily, or by force, the purpose of agricultural production acreage has adapted to multiple factors. From the dawn of the 20<sup>th</sup> century, agricultural acreage has responded to the industrialization of not only the country, but also of the labor force. In turn, agricultural industrialization increased farm mechanization, which changed the landscape of the American farm. Factors such as the urbanization of rural areas and decreasing farm profitability have reduced farmed acreage in the past one hundred years. The United States Department of Agriculture (USDA), in an effort to preserve a balance between agricultural needs, environmental needs, and economic needs, has implemented multiple farm programs that have induced changes in land use. While attempting to help individual producers measure and reduce production risks, constant policy changes have affected row crop acreage in the United States, including the acreage of upland cotton grown.

Although cotton is a staple crop in the southeastern United States, cotton producers have adjusted to many federal policy changes such as the elimination of cropland production limitations in the 1996 Farm Bill. Cotton acreage has also been affected by environmental policy, aimed at conserving soil and water resources. Consequently, crops grown specifically for alternative or biofuel production (primarily corn, soybean, and switchgrass) may be a viable option for cotton producers searching for more profitability per acre, especially with competitive crop incentive programs promoted by the government.

The profitability of upland cotton in downturn years is dependent upon federal policy that supports individual producers. To this extent, the USDA has developed entitlement programs to aid planting and harvesting, price support programs to counteract economic risks, and marketing programs that attempt to maximize producers' sales price. Cotton farm operators, in turn, may continue to produce cotton or change production to alternative crops as a response to these programs. This acreage response is a measure of an individual's profitability and production status, and their ability to continue operating in the future. This paper will investigate the economic production of upland cotton within the Southeastern United States between 1996 and 2009.

## **CHAPTER 2: LITERATURE REVIEW**

### **A Brief History of Recent Federal Farm Policy**

Federal agricultural policy, as directed by the USDA, has been prominent since the New Deal of the 1930s. The federal government initiated most policies and programs in an effort to keep American farmers producing their individual crops. Upland cotton was no exception, with policy being developed to support price nationally. Unfortunately, the price of upland cotton within the United States, specifically the southeast region, was not fully and statistically documented until 1964. The price of upland cotton in this era averaged between \$0.27 and \$0.32 per pound; by 1970 it had dropped to between \$0.20 and \$0.25 a pound. However, the time period between 1972 and 1995 saw the average southeastern state price of upland cotton increase steadily to around \$0.75 per pound. Unstable fluctuation between highs (\$0.80/lb) and lows (\$0.25/lb) began in 1996 and has continued until the present (USDA-NASS, 2010; USDA-ERS, 2010). Future prices (and most recent trends) have often dictated the quantity of cotton grown, as illustrated by an associated press article released in April, 2010, in which Alabama farmers have increased cotton plantings by more than 100,000 acres due to the increase in price (A.P., 2010). Nationwide, all cotton plantings were up 19% in 2010 as well (USDA-NASS, 2010).

The Federal Agriculture Improvement and Reform (FAIR) Act of 1996, otherwise known as the 1996 Farm Bill or Freedom to Farm Act, released farms from growing only what had been grown there before (Anderson et al., 2001). Under the quota and allotment systems predating 1996, farm operators were harnessed to the historical production of the land. Although they could theoretically grow whatever they wanted, agricultural producers could receive no benefits from the government if they chose to work against their cotton

allotment. The quota and allotment systems of the 1970s and 1980s presented payments to producers based on physical production of the cotton crop. This policy was developed in response to worldwide low prices combined with relatively high American stocks of cotton (Houston et al., 1999). A cotton producer intending to participate in these programs was paid to grow a specific amount of upland cotton, set in pounds. Noncompliance in these programs simply meant nonpayment of subsidies.

With the introduction of decoupled base acreage in 1996, farm program payments could be made tied to base, not to production. Base acres on a farm were built by historical production of a crop, and multiplied by yield to create a payment to the producer (Anderson et al., 2001). Upland cotton farm operators could increase their cotton bases by increasing either acreage or yield (or both), but would still receive an annual payment based upon the historical production of the farm. Consequently, these cotton producers now had the ability to receive the cotton base payment and switch production to alternative crops (Anderson et al., 2001).

### **Price Support and Entitlement Programs**

Between 1996 and 2002, all participating farms in the United States could adjust and increase base acreage. Payments were made according to base acreage in these years, but increases in base acreage were dictated by the Production Flexibility Contract (PFC) (Anderson et al., 2001). The PFC required farmers to report cropland data in order to expand or change base, and the set-aside system of farming where farmers could not produce cotton on 100% of cropland was still in effect (USDA-FSA, 2001). However, in 2002, base acreage across the country was locked by the USDA. The historical yields of all cotton farms were set, and associated base payments became locked as well. This base lock has introduced the

current environment in farm program entitlement payments, where base cannot be increased and payments to operators are truly decoupled (Qiu et al., 2009).

The Direct Payment program was initiated by the 2002 Farm Bill as an associated payment to base acreage on a farm. Direct payments are based on a farm's yield per acre per crop, and paid on a percentage (85% through 2008 payments; 83.3% from 2009 up) of the base acres that exist on the farm (USDA-FSA, 2008b). These payments are made interdependently of actual production on the farm, or national or state market price of the associated crop. Therefore, current direct payments should theoretically have no effect on whether a crop such as cotton is grown, as these payments will be made as long as the farm retains cropland status and base acreage (Qiu et al., 2009). Cotton producers stand to make some income off of direct payments because of previous cotton acreage plantings that defined the base of the farm.

Direct Payments are associated with Counter-Cyclical Payments, and are combined to form the Direct and Counter-Cyclical Payment Program (DCP). Counter-cyclical payments, unlike their direct counterparts, are based on annual market crop returns. The USDA, and specifically the Farm Service Agency (FSA), set a price for each commodity every fiscal year, and use this price as a trigger. When, at the end of the year, the average price of the commodity (in this case upland cotton) is below that of the federal trigger level, a counter-cyclical payment is made on bases for that specific crop (USDA-FSA, 2008b).

Like direct payments, counter-cyclical payments are made to owners or operators of base acres, and are not dependent upon whether the crop is actually grown. Counter-cyclical payments will also be made without respect to an individual's actual market value (Qiu et al., 2009). For example, an upland cotton producer may grow out 500 acres (all base acres) and

sell his cotton for \$0.60/pound. However, the average market price for upland cotton is only \$0.52/pound. If the federal trigger level is set anywhere above the national average, perhaps \$0.55/pound, then the counter-cyclical payment is made on cotton bases because the national price has fallen below the trigger level. Consequently, upland cotton producers have enjoyed a five-year run between 2003 and 2008 of counter-cyclical payments on cotton bases due to low market prices (USDA-NASS, 2010; USDA-ERS, 2010).

Introduced by the 2008 Farm Bill, the Average Crop Revenue Election (ACRE) program is an entitlement program built upon DCP, with an added incentive based on both farm and state yields. ACRE reduces direct payments to 80% of base acreage, and eliminates the possibility of a counter-cyclical payment. ACRE also reduces all federal loan rates to a producer by 30%. However, the benefits of the ACRE program are similar to that of a low-cost insurance policy, with payments triggered from state annual production (state average yield X state average price) as well as historical individual farm production (individual yield X national average market price) (USDA-FSA, 2008a). Due to the loss of counter-cyclical payments, the ACRE program may not be particularly popular with cotton producers. The limited amount of annual enrollment statistics associated with the ACRE program make the effects of it difficult to study. However, no ACRE payments have been made on cotton base acres since the program's inception.

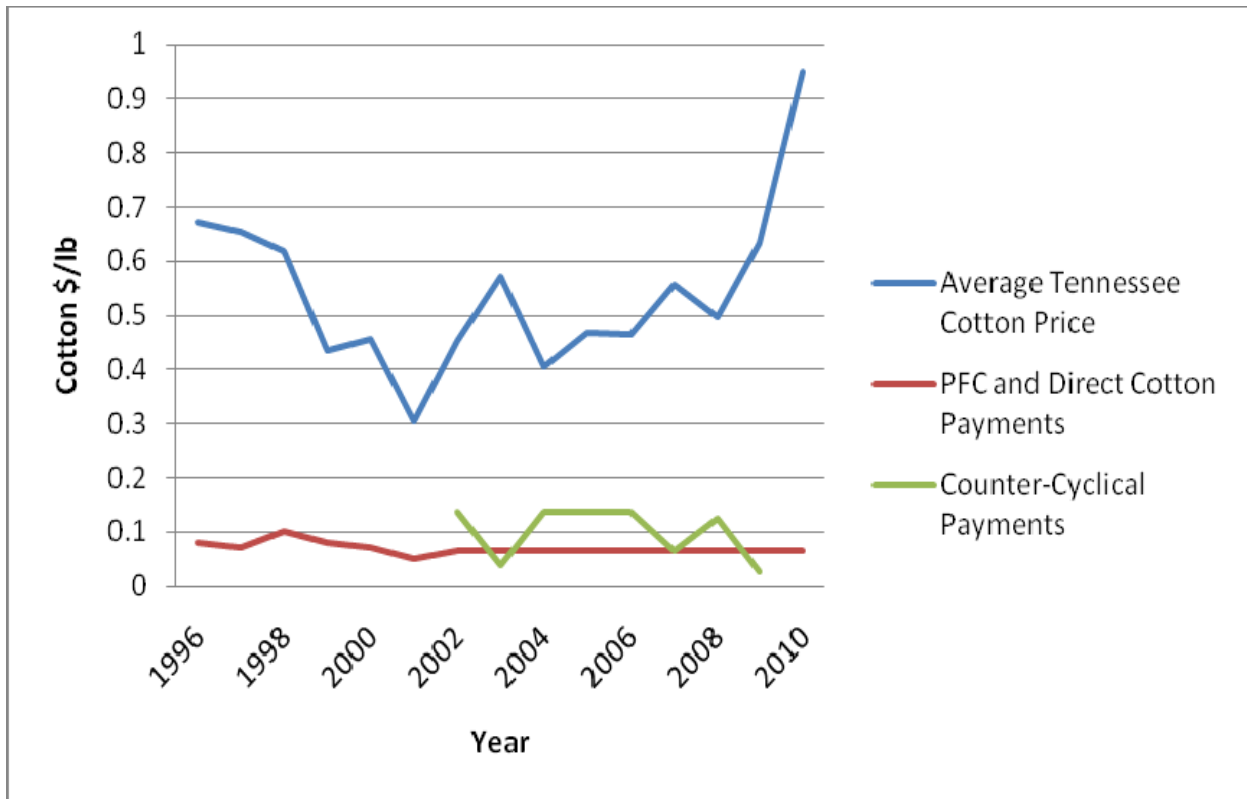
Table 1 provides all federal payments (PFC, DCP) and marketing assistance loans (MAL) made since 1996. Figure 1 illustrates average Tennessee cotton payments as well as PFC and DCP payments.

Table 1. Annual federal price support among cotton, corn, and soybeans (from USDA-NASS, 2010; USDA-FSA, 2001; USDA-FSA, 2008b; USDA-FSA, 2009)

Year	Commodity (Paid as Yield per Acre)						Marketing Assistance Loan
	Upland Cotton (\$/lb)		Corn (\$/bu)		Soybean (\$/bu)		Upland Cotton (\$/lb)
	PFC Payment		PFC Payment		PFC Payment		MAL Rate
1996	0.08		0.24		---		0.59
1997	0.07		0.46		---		0.56
1998	0.10		0.36		---		0.522
1999	0.08		0.35		---		0.384
2000	0.07		0.32		0.26*		0.45
2001	0.05		0.26		---		0.519
	Direct	Counter Cyclical	Direct	Counter Cyclical	Direct	Counter Cyclical	MAL Rate
2002	0.0667	0.1373	0.28	---	0.44	---	0.52
2003	0.0667	0.0393#	0.28	---	0.44	---	0.52
2004	0.0667	0.1373	0.28	0.29	0.44	0.182	0.52
2005	0.0667	0.1373	0.28	0.35	0.44	---	0.52
2006	0.0667	0.1373	0.28	---	0.44	---	0.52
2007	0.0667	0.0643#	0.28	---	0.44	---	0.52
2008	0.0667	0.1258	0.28	---	0.44	---	0.52
2009	0.0667	0.0258#	0.28	---	0.44	---	0.52
2010	0.0667	---	0.28	---	0.44	---	0.52

\*Oilseeds received no price support between 1996 and 2001. Yr 2000 ad hoc disaster payment.

# Partial counter-cyclical payment based on low percentage price support.



**Figure 1. Comparison of Tennessee Average Cotton Prices and Price Support (\$)**

(USDA-NASS, 2010)

## **Price Support Loan Programs**

Although modern farming techniques and implementation can drastically improve individual per acre yield of a commodity, many producers and operators require operating loans to harvest and store cotton until they can get an acceptable price. The FSA provides Marketing Assistance Loans (MALs) for such a situation. Federal MALs provide a certain amount of risk management to cotton producers, providing these producers the funds to wait further into the marketing year to sell their product, and possibly increase sales price.

Multiple incentives exist for upland cotton producers when dealing with MALs. The first is cotton's eligibility for MALs, which has not been available for every row crop between 1996 and 2010. Secondly, private cotton exchanges have been set up in the Southeast to receive a producer's loan, thereby accepting some of the financial risk. In return, the producer agrees to sell only to that exchange for a percentage of the profit, and the exchange pays off the loan. Finally, when the sales price of cotton drops below that of the loan rate, a producer receives a market loan gain: the difference between the loan rate and the sales rate, thereby avoiding total financial loss (USDA-FSA, 2009).

If a producer chooses to forgo the utility of an MAL, they may benefit from a Loan Deficiency Payment (LDP). LDPs occur when producers choose to sell their cotton at a market price below that of the federal loan price. The LDP is, in fact, the difference between the two rates realized in a dividend check to the producer (USDA-FSA, 2002). Although uncommon in all crops, the likelihood of an LDP occurrence is slightly higher in upland cotton due to the 20 year volatility in its price.

## **Conservation Programs**

Beginning in 1986, the Conservation Reserve Program (CRP) was set up in an attempt to economically stabilize the supply line of multiple American row crops by taking cropland out of production. CRP is divided into two separate signups: general and continuous. For practical purposes, data concerning a continuous signup is of little value to cropland analysis, as continuous CRP deals almost entirely with field margins, buffer and filter strips, and marginal pastureland (USDA-FSA, 2010). General signup into this program, however, may enroll entire fields and require a cropping history. In other words, possible cotton land could be statistically affected by a CRP general signup.

Although the most recent (2010) signup of cropland into CRP is attempting to lock up 32,000,000 acres nationwide, most cotton producers will leave their land out. Upland cotton, and land dedicated solely to cotton, is widely considered to be more valuable than CRP contracts. Simply put, upland cotton landowners stand to lose both income and future profitability by enrolling their land into CRP. The actual cash rental value of cotton land is higher than a CRP rental payment (USDA-NASS, 2010; USDA-FSA, 2010). Enrollment into the Conservation Reserve Program may also require costly rehabilitation (clearing of land, chemical or conventional burn downs, etc.) in preparation for post contract cropping.

### **What is Acreage Response?**

The relationship between crop production and crop prices has been reviewed and documented with great frequency. Variables have included raw planted acreage, harvested acreage, volume or weight production of an individual crop, price per planted unit, and price per production unit (Houston et al., 1999). The planted acreage of any specific crop may

increase or decrease in response to the price per unit the crop is expected to bring in. This relationship is the primary principle behind acreage or supply response.

The theory of supply response is part of the supply chain of any production industry where the demand for a particular good is inelastic. In the case of cotton, supply is typically dictated by local or world demand and price point (Lee and Kennedy, 2008). However, federal policy developed for both cotton and other crops may be stimulating a response from American cotton producers. For example, a shift in the acreage allotment of cotton may be based upon the increased revenues of both soybean and corn, which command both feedstock and biofuel markets. The price increases of corn and soybeans have been dramatically higher than the increase in price of cotton during the decade spanning 2000-2009 (Lee and Kennedy, 2008). Meanwhile, the acreage of corn planted has been on the rise while both soybean and cotton have declined.

In 1976, Danin published “A Simple Analysis of Acreage Response to Some Agricultural Programs” in an effort to verify that agricultural producers were not attempting to simply “maximize” profits by their own growing potential. This work identified several aspects in the decisions required by farmers in both planting and profitability. Unlinked price support, linked price support, and diversion payments were included in this analysis (Danin, 1976). Although simplistic in model, the analysis used in this study explored the parameters of expected production and profit versus alternative growth and federal support pricing within a quota and allotment system. Danin found that the crop allotment system that dominated federal policy at the time could not stimulate a response from producers when concerned with crop alternatives, but that this policy is significant when not linking multiple row crops together (1976). Producers during the 1960s and 1970s could respond to policy not

by converting acreage to alternative crops, but by continuing to produce their initial crop (Danin, 1976). This acreage response is reasonable considering the restriction of crop flexibility at that time.

Since the 1996 Farm Bill, planting flexibility has changed from previous decades. The decoupling of farm bases has increased both own-price and cross-price elasticity (Lin et al., 2000). In this environment, when both elasticities increase, the net result tends to increase all crop acreages. However, with planting flexibility, this environment promotes an ability to change production with a reasonable assumption of profits. Cotton acreage specifically rose 7.9% between 1997 and 1999 (Lin et al., 2000). This finding shows that acreage response between row crop prices has a greater chance of occurrence in the Freedom to Farm era.

Shogren et al. (2003) studied the response of producers to counter-cyclical payments only. This study hypothesized that risk-averse individuals are more likely to plant base crops when given their set of price expectations. However, while determining risk aversion in association with acreage response, Shogren et al. (2003) appears to have neglected the chief proposition of the direct and counter-cyclical program (that these payments are decoupled, and will be made without respect to actual plantings and yields). This study does attribute less acreage response during times of price uncertainty. Many producers, including cotton operators, are more likely to “grow what they know” during widespread low prices between multiple row crops. Under circumstances of price uncertainty, acreage response to federal policy would be expected to decrease.

### **Alternative Crop Options**

Although nationwide studies are important to the study of acreage response, in the case of cotton, the primary production area is the southeastern portion of the country

(specifically Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Oklahoma, South Carolina, Tennessee, and Texas). Cotton tends to be a soil specific crop, one that grows more readily in sand or clay than corn. Soybeans, however, can grow in nearly identical soil and climate conditions as upland cotton (Parrott and McIntosh 1996). Soybeans would therefore be a better competitor than corn for cotton base land. With the price of upland cotton fluctuating between 40 and 90 cents from 2002 to present, soybean price has experienced much less volatility (generally averaging in the \$8 to \$9 range), and is a viable option for cotton producers in search of greater profit margins.

The exponential growth of ethanol and biodiesel has been seeded by American fuel standards that will require fuel producers to use at least 15 billion gallons of ethanol by 2015 (Susanto et al., 2008). With these additional fuel requirements, land once used to produce cotton could change to corn and especially soybean production. The base acreage system that once dominated American agriculture has changed as a result of the past three Farm Bills (1996, 2002, and 2008). Agricultural producers have experienced a great deal of planting freedom compared to the previous five decades, where production was essentially tied to the base acreage in which the farm was located or an allotment specified by a locality quota (Duffy et al., 1987).

Cotton production has experienced no less change than any other crop in the last fourteen years. Once a dominant cotton producing country, the United States has decreased the net tonnage produced over the last several decades, even before alternative crops began to affect acreage and production (Duffy et al., 1987; Susanto et al., 2008). Although cotton yield per acre has increased, many farms formerly growing cotton have either switched crops or been eliminated from business altogether.

Upland cotton is an expensive commodity to harvest, according to Mutuc et al. (2010). There is no fast or easy entrance or exit into cotton production, due to the high costs of specialized equipment involved (cotton pickers rather than combines, cotton wagons or buggies rather than grain haulers). A cotton producer can expect to spend between \$450 and \$500 an acre on requisite multiple treatments of herbicides and pesticides, as well as several possible fertilizer applications and chemical harvesting aids for defoliation. These costs are necessary to increase yields to a profitable level. The added field work increases per acre fuel consumption in cotton production.

The peak crude oil prices of 2008 (~\$128/ barrel) made cotton production too costly for many cotton producers and states in which cotton is produced (Mutuc et al., 2010). These “price shocks” in the oil sector affected cotton growers on multiple levels, as motivation to switch to alternative crops to increase profits, and as motivation to switch from cotton to decrease losses. It should be noted that cotton does partially benefit from high crude oil prices, in that production of polysynthetic material (clothing, etc.) decreases and therefore world cotton prices increase, benefiting the cotton producer. Mutuc et al. (2010) attributed 3% of cotton price variation to oil price “shocks”. Although a 3% increase in cotton production prices seems fairly insignificant, an increase in production price coupled with a decrease in cotton price could be devastating to producers.

With all input prices increasing, one might expect that cotton acreage would respond to federal policy on biofuels. Both the 2005 Energy Policy Act and the 2007 Energy Independence and Security Act have served as an incentive for cotton farmers to withdraw and enter into an alternative crop market, especially in the wake of the newer nonbinding (or

less binding) farm contracts. In a study conducted by Khanna (2008), production costs for specific crops were thoroughly analyzed. The study took into account the current landscape of production, where fuel and fertilizer costs may dictate the planting decision of the producer. Estimates of average per acre costs of crop production in a sample conducted in Arkansas in 2007 indicated that upland cotton tends to be more costly to produce than alternative row crops (Table 2; Khanna, 2008).

### **System Modeling**

Modeling cotton supply response or acreage response requires multiple factors. The factors must include measures of per acre payment for cotton, alternative crops (specifically soybean and corn), and federal direct or counter cyclical payments for these crops. Parrott and McIntosh (1996) effectively estimated both cash price values for cotton and competitive crops while separately weighing support prices of each respective crop in 1996. The objective of their study was to analyze growth without a futures market affecting a farmer's decisions on what to plant (Parrott and McIntosh, 1996). The regression model included cotton, soybean, and supplementary payments and indicated that the support price for cotton was not as important (at the 0.10 level) as one might believe. However, the support price for cotton was more important during agricultural program years as opposed to years without specific cotton program support (Parrott and McIntosh, 1996). They concluded that the permanent effects of farm programs and policies over time may contribute to a farmer's crop choice.

Table 2. Average row crop expenses for corn, upland cotton and soybeans in Arkansas, 2007 (from Khanna, 2008).

DESCRIPTION	UNIT	CORN	UPLAND COTTON		SOYBEAN		
		IRR.*	IRR.	NON-IRR	IRR.	DBL. CROP**	NON-IRR.
<b>Fertilizer</b>							
Urea	Lb	215	218	174			
Liquid Nitrogen	Lb	405					
Phosphate	Lb	163	130	130	80	70	80
Potash	Lb	125	200	200	120	75	120
Sulfur	Lb		11	11			
Boron	Lb		7	7			
Irrigation	inch	12	10		12	10	
<b>Labor</b>							
Operator	hrs	0.72	1.11	1.58	0.54	0.49	0.39
Hired	hrs	0.39	0.68	0.66	0.31	0.26	0.11
Fuel (incl. Custom Hire)	gal	22.08	28.3	18.96	21.94	19.09	6.3
<b>Cost of Production</b>							
Seed	\$	60.72	99.71	72.67	22.95	32.16	22.95
Chemicals	\$	16.19	96.54	80.84	41.59	38.77	41.59
Custom Hire	\$	10.52	55.56	51.01	24.91	26.09	24.91
Repair & Main.	\$	14.23	25.71	23.22	11.78	11.25	6.25
Ownership Charges	\$	71.48	133.1	104.6	70.15	70.91	26.79
Operating Interest	\$	11.46	19.17	13.6	6.98	6.9	5.23
<b>Total Specified Expenses</b>							
<b>Average</b>	<b>\$</b>	<b>410.5</b>	<b>623.2</b>	<b>506.8</b>	<b>276.7</b>	<b>275.1</b>	<b>181.3</b>
<b>Range (Max-Min)</b>	<b>\$</b>	<b>80.35</b>	<b>135.3</b>	<b>9.33</b>	<b>68.33</b>	<b>93.2</b>	<b>12.62</b>
# of Production Methods		7	28	3	8	10	2
Land Charge	\$	69.23	92.31	64.17	92.31	40.83	52.5

\* IRR. = Irrigated

\*\* DBL CROP = double crop

Kleiber (2009) conducted studies on crop choice concerning ethanol driven corn demand. With the United States and the rest of the world implementing biofuel policy as part of standard fuel consumption practices, the demand for corn, soybean, and possibly switchgrass has driven up their prices enough to make some farmers question their historical planting decisions. The question of opportunity cost inherently exists in such situations. Kleiber's work reflected more upon universal American farms (that may produce corn, soybean, wheat, or livestock), and concentrated upon the environmental effects of biofuel growth as well as ethanol plant location in conjunction with planting decisions. However, Kleiber estimated that ethanol (especially corn based ethanol) has already increased the amount of land devoted to corn and soybean, and subsequently reduced planting allotments of other crops.

Smith et al. (2009) published an overview of the supply response of all southeastern crops that identifies crop programs and policies, as well as individual farm risk. It provides some insight into acreage response over the last ten years, building upon previous work by Duffy et al. (1987; 1994). The expected utility function, or von Neumann- Morgenstern function, for farm operators was analyzed as it applied to row crop acreage, and took into account previous wealth as well as farm returns (Smith et al., 2009). The objective of the study was to maximize utility as it applies to net farm income from growth and program payments. The inherent risks taken by agricultural producer are assumed to decline when government programs or interventions are added into the utility function. With decreasing risk, it could be assumed that a farmer (in this case, a cotton producer) would not be averse to switching his primary cash crop, or at least reducing the growth of his base acreage, if he believed that the move would result in greater profits. The model indicated that, in a perfect

growing climate with standard field output for any individual crop, wealth and its effects were pivotal in choosing acreage allotments (Smith et al., 2009).

Smith et al. (2009) go on to integrate futures prices, an important aspect of a cotton planter's decision, as well as regional production costs, which may outweigh profitability in states with minimal cotton growth. The results indicate that cotton (among cotton, soybean, and corn) had several insignificant parameters, chief of which was that cotton did not respond well to future prices (Smith et al., 2009). Cotton producers would respond better to lagging market prices, especially since these farmers tend to observe and plant according to these prices (Smith et al., 2009).

Accurate analysis of acreage response to any policy can be difficult considering the multiple variables that affect planted acreage. Studies are often conducted with less than 50 observations due to the high amount of variability involved in a model (Ramirez et al., 2004). According to Ramirez et al. (2004), modeling for acreage response should first focus on acreage, prices, and yields before integrating additional policy statistics. That cotton study did not observe any specific policy, opting instead to create a "dummy" policy that may result in acreage response. Even when conducting such a study, cotton analysts should use caution when determining results, as a chance of error is relatively high (Ramirez et al., 2010).

## **Objectives**

This study will examine the current Farm Programs (Price Support and Loans) administered by the Federal government. The objective is to evaluate planted upland cotton acreage as compared with annual cotton production, annual cotton price received, federal price support payments, and competing crop statistics within each Southeastern

State. The study was designed to identify federal programs and policies that stimulate a response in planted upland cotton acreage, and to compare the effects of price support programs as well as alternative crop production.

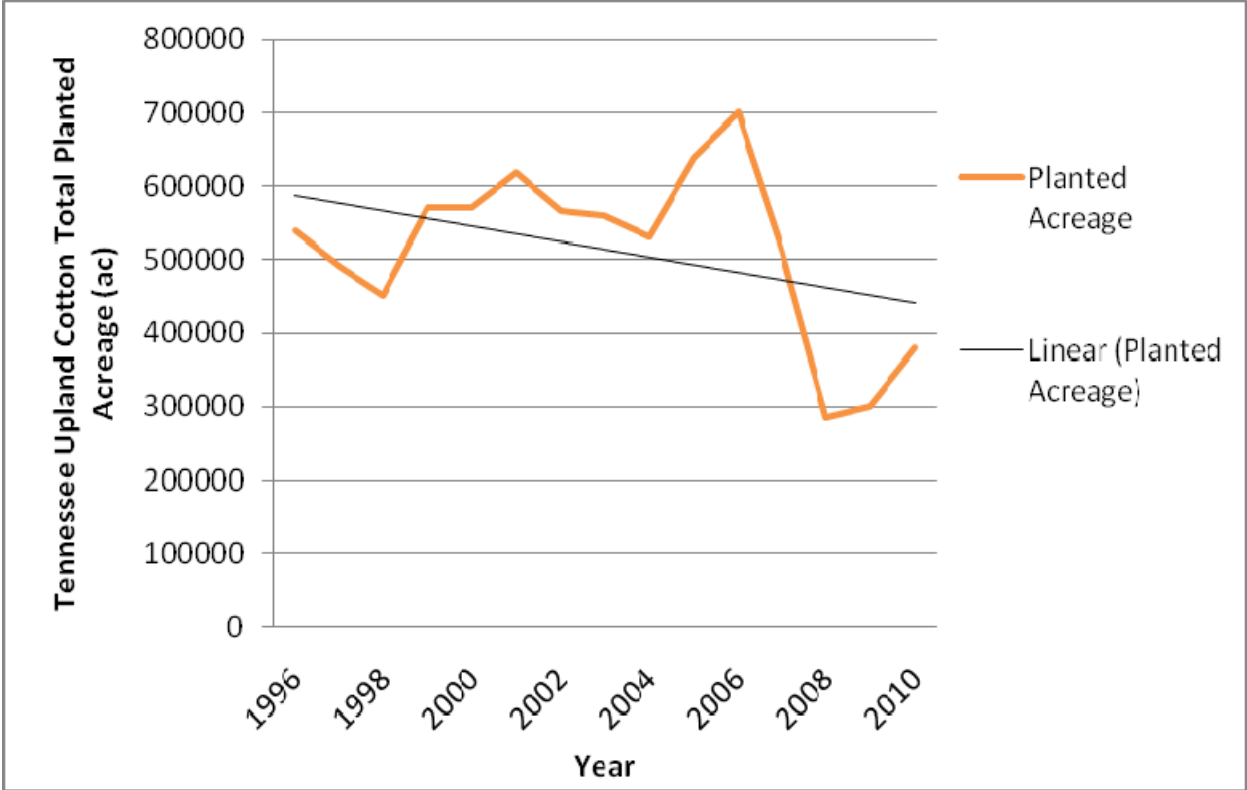
## **CHAPTER 3: MATERIALS AND METHODS**

### **Data Source and Material**

National Agricultural Statistical Service (NASS) data was compiled using the NASS ad hoc query tool ([www.nass.usda.gov](http://www.nass.usda.gov)) for 1996 to 2010. Only states located within the southeast region of the United States, i.e. Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, and Virginia, were analyzed for upland cotton production.

Planted acreage per state was compared to upland cotton planted acreage, cotton total production, and average annual state cotton price, as well as entitlement program payments, federal loan rates, and alternative crop planting options. Figure 2 illustrates Tennessee planted cotton acreage over the reference range as an example. Six variables related to upland cotton price and production outputs were included in the study (Table 3). Without definitive federal payouts for alternative crop (traditional biofuel crop) growth as a factor, alternative and competing crop acreage (soybean and corn) was added to investigate whether these crop acreages increased while cotton acreage decreased. In addition to corn and soybean acreage, price and production output of each were included in the models (Table 3).

All independent variables used in the study, including price, production output, acreage, and subsidy payments were lagged one year before the dependent variable of annual planted cotton acreage. The purpose of lagging this data was to simulate a cotton producer's planting decisions. The theory behind lagging inputs is that cotton farmers will use previous years' production outputs as an estimate to what their farms are capable of producing in the current growing season.



**Figure 2. Average Tennessee Planted Cotton Acreage**

(USDA-NASS, 2010)

**Table 3. Upland cotton price and production variables and alternative price and production variables used in the models.**

Upland Cotton Price/Production Inputs		Alternative Crop Price/Production Inputs	
Variable	Abbreviation	Variable	Abbreviation
Current Cotton Acreage (ac)	$Ct_{ac}$	Previous Year Soybean Acreage (ac)	$Sb_{pr}$
Previous Year Cotton Acreage (ac)	$Ct_{pr}$	Previous Year Soybean Production (bu)	$Sb_y$
Previous Year Total Cotton Production (lbs)	$Ct_y$	Previous Year Soybean Price (\$)	$Sb_p$
Previous Year Average Cotton Price (\$)	$Ct_p$	Previous Year Corn Acreage (ac)	$Cr_{pr}$
Previous Year Cotton Subsidy Payment (\$)	$Ct_s$	Previous Year Corn Production (bu)	$Cr_y$
Previous Year Cotton Loan Rate (MAL) (\$)	$Ct_l$	Previous Year Corn Price(\$)	$Cr_p$

### Data Model and Statistical Analysis

Multiple regression statistical analysis was used to determine whether a linear relationship exists between planted cotton acreage and the other variables and the strength of any such relationship. Among all acreage response studies performed since 1996, the most logical to use as an example was Houston et al. (1999), which employed planted cotton acreage in a linear regression model. Houston et al. (1999), as well as Parrott and McIntosh (1996), observed that cotton acreage could be modeled as a function of multiple inputs. A linear regression model was used in the present study, as in previous studies. However, data was separated by state, in an effort to see the effects of policy within each state. Regional data was also analyzed using the same models as the

individual states, for a comparative study between the Southeast region and member states within it. To accurately assess cotton production, both cotton price and bulk production were lagged with prior cotton acreage. In addition, DCP and PFC payments were lagged along with annual MAL rates.

Corn and soybean production, acreage, and price was likewise lagged by one year, as lagging represents a cotton producer’s state of mind as well as the most current data available when making planting decisions. In addition to lagged prices, prices were deflated across years 1997-2010 to 1996 values according to the PPI index (Table 4). The deflation of prices was necessary to reduce the standard error, as well as increase the accuracy in analysis among all years.

Table 4. Percentage change in the dollar, deflated annually since 1996 (Source: Bureau of Labor Stats. PPI Calculator).

<i>Year</i>	<i>Deflated Value</i>
1996	1.00
1997	0.98
1998	0.96
1999	0.94
2000	0.91
2001	0.89
2002	0.87
2003	0.85
2004	0.83
2005	0.80
2006	0.78
2007	0.76
2008	0.73
2009	0.73
2010	---

Soybean and corn subsidies (specifically PFC and DCP payments) were not included in the models because these payments are not made on cotton base acres. Conservation and disaster federal payments were not included in the model for multiple reasons. Conservation payments are not recorded by type of cropland. There is no accurate way to assess the percentage of upland cotton cropland that has been enrolled in a federal conservation program; only assumptions can be made by the region that cropland occupies. Disaster payments have only recently (since 2008) been administered on a guaranteed basis. Prior to 2008, disaster programs and payments were directed under ad hoc (annually as needed) programs. There was no guarantee that disaster payments would be made during any given growing season. Loan Deficiency Payments were not included in the model because of the significant decline in both use and payment since 2006, as well as payment records occurring within states on individual bales of cotton as opposed to cotton acreage. Future prices were not included in the study as they tend to take into account upland cotton price within the entire country, not the Southeast region.

Two linear regression models were built to evaluate the acreage and production data. The first is the full base subsidy model:

$$Ct_{ac} = \frac{(Ct_p \times Cc_p)}{Ct_{pr}} + \frac{(Ct_p \times Cc_p)}{Ct_{pr}} + \frac{(Ct_p \times Cc_p)}{Ct_{pr}} + \frac{(Sb_p \times Sb_p)}{Sb_{pr}} + \frac{(Cm_p \times Cm_p)}{Cm_{pr}} \quad (\text{Equation 1})$$

And the second is the reduced base subsidy model:

$$Ct_{ac} = \frac{(Ct_p \times Cc_p)}{Ct_{pr}} + \frac{0.50(Ct_p \times Cc_p)}{0.75Ct_{pr}} + \frac{(Ct_p \times Cc_p)}{Ct_{pr}} + \frac{(Sb_p \times Sb_p)}{Sb_{pr}} + \frac{(Cm_p \times Cm_p)}{Cm_{pr}} \quad (\text{Equation 2})$$

The full base model (Equation 1) operates as a “dummy” model, and assumes that each acre of cotton grown within the southeastern United States is a cotton base acre.

Therefore, each acre planted in the full base model receives a subsidy payment.

Consequently, cotton production (\$/acre) in the full base model must be impacted by the amount of cotton produced (lbs) in each state. The full base model assumes that a subsidy payment is made on each pound of cotton produced in the Southeast.

The second regression model (Equation 2) represents a real world, and therefore, reduced base scenario. All cotton is not grown on program (or subsidized) cropland, and not all base yields represent the full capacity of the cropland. In this model, the assumption of real world base acres creates a reduction of subsidy payment acreage. Thus, subsidy yield (on average equaling half of actual production yield) was reduced 50%, and base acres (on which the subsidies are paid) were reduced to 75% of actual planted acreage. Upland cotton base acres tend to represent about 75% of planted cotton cropland.

The justification behind these models revolves around the profitability of government payments. These models were developed to see if increased PFC/DCP payments would have a greater effect on annual planted upland cotton acreage. Consequently, the marketing assistance loan variable was not increased or otherwise reduced, as MALs can be agreed upon between producers and the USDA without participation in either the current DCP program or previous PFC program.

Both multiple regression models (for individual states as well as regional models) were analyzed using Statistical Analysis Systems (SAS 9.2, SAS Institute Inc., Cary, NC). SAS was used because it could process multiple variables within both models efficiently. Both models were evaluated for F values ( $P < 0.05$ ) as well as R-square values as a test for how well the data fit the model. Partial regression coefficients within the regression models were evaluated for significance ( $P < 0.05$ ) using a standard t-test.

Significant parameter estimates from the model output were analyzed for elasticity using the formula:

$$\text{Elasticity} = \text{p.e.} * \frac{\text{avg}(x)}{\text{avg}(y)} \quad (\text{Equation 3})$$

Where p.e. was a significant parameter estimate, avg(x) was the average value of the specific independent variable that correlates to the significant parameter estimate, and avg(y) was the average value of the dependent variable (in this case, planted upland cotton acreage).

The elasticities of all significant variables within the model were important in observing the relationship between planted upland cotton acreage (dependent variable) and the parameter affecting this acreage (independent variable). The amount of change in planted cotton acreage as dictated by the independent variable was categorized as elastic or inelastic depending upon whether the ratio was less than or greater than one. When the relationship between dependent and independent variables is less than 1.0 (as defined by Equation 3), it was characterized as inelastic, indicating that the average change in the dependent variable would be less than the average change in the independent variable. When this ratio was greater than 1.0, an elastic relationship was found where the average change in the dependent variable was greater than the average change in the independent variable. Any relationship where Equation 3 found the ratio to be 1.0 would be defined as unit elastic.

## CHAPTER 4: RESULTS

The results of the multiple linear regression analyses revealed both significant and insignificant parameters. When modeling the response of annual cotton acreage, each state was analyzed separately, in an effort to separate high production areas (Texas) from low production areas (Virginia), and as a member of the Southeast region. Tables 5 and 6 summarize the regression analyses for both the full base “dummy” model and the reduced base model.

The results show that the full base and reduced base models produced nearly identical results, with the exception of the subsidy \$/acre parameter estimate in Georgia (Tables 5 and 6). All parameters proved to be significant at least once in either the full base or reduced base model, but parameter estimates for almost all significant independent variables required elasticity analysis due to exceptionally high values. MAL, soybean, and corn parameters were significant within the region, but the relative weakness of the model ( $R^2 = 27.5\%$ ) indicates that the both the full base and reduced base models are not reliable.

Regression models for Alabama, Florida, Mississippi, North Carolina, and Virginia had no significant parameters in either the full base or reduced base model (Tables 5 and 6). The data for these states did not fit the model well, either with non-significant ( $P > 0.05$ ) R-squares or moderately low but significant ( $P < 0.05$ ) R-squares. In the specific cases of North Carolina, Mississippi, and Virginia the models are technically valid ( $P < 0.05$ ), but indicate no significant parameters. On the other hand, the results for both Alabama and Florida indicate that the models are a poor fit for the data ( $R^2 < 0.50$ ), and required very little interpretation for these states.

Table 5. Statistical results from the multiple regression analysis for the full base and subsidy model, and significant model parameter estimates associated with each state and the southeast region.

State	Analysis of Variance		Significant* Model Parameter Estimates		
	Pr > F	Adj. R-Square	Variable	Estimate	Pr > [t]
Alabama	0.0554	0.4938	NONE	--	--
Arkansas	0.0003	0.871	MAL Corn \$/Ac	1180 -1439	0.0355 0.0138
Florida	0.3257	0.1277	NONE	--	--
Georgia	0.0058	0.7267	Cotton Sub \$/Ac	-2195	0.036
Louisiana	0.0639	0.4725	Soybean \$/Ac	-4653	0.0452
Mississippi	0.0259	0.5908	NONE	--	--
North Carolina	0.0064	0.7191	NONE	--	--
South Carolina	< 0.0001	0.9233	Cotton \$/Ac Soybean \$/Ac	419 -1681	0.0094 < 0.0001
Tennessee	0.0062	0.7216	Corn \$/Ac	-2547	0.0021
Texas	0.1307	0.349	Corn \$/Ac	-7246	0.0363
Virginia	0.0400	0.5384	NONE	--	--
Entire Southeast	< 0.0001	0.2719	MAL Soybean \$/Ac Corn \$/Ac	-6577 -11829 9713	0.011 0.0001 < 0.0001

\* Significant at  $P \leq 0.05$ .

Table 6. Statistical results from the multiple regression analysis for the reduced base and subsidy model, and significant model parameter estimates associated with each state and the southeast region.

State	Analysis of Variance		Significant* Model Parameter Estimates		
	Pr > F	Adj. R-Square	Variable	Estimate	Pr > [t]
Alabama	0.0554	0.4938	NONE	--	--
Arkansas	0.0003	0.871	MAL Corn \$/Ac	1180 -1439	0.0355 0.0138
Florida	0.3257	0.1277	NONE	--	--
Georgia	0.0058	0.7267	Cotton Sub \$/Ac	-3293	0.036
Louisiana	0.0639	0.4726	Soybean \$/Ac	-4653	0.0452
Mississippi	0.0259	0.5908	NONE	--	--
North Carolina	0.0064	0.7191	NONE	--	--
South Carolina	< 0.0001	0.9233	Cotton \$/Ac Soybean \$/Ac	419 -1681	0.0094 < 0.0001
Tennessee	0.0062	0.7216	Corn \$/Ac	-2547	0.0021
Texas	0.1307	0.349	Corn \$/Ac	-7247	0.0363
Virginia	0.0400	0.5384	NONE	--	--
Entire Southeast	< 0.0001	0.2719	MAL Soybean \$/Ac Corn \$/Ac	-6577 -11829 9714	0.011 0.0001 < 0.0001

\* Significant at  $P \leq 0.05$ .

Models for Texas and Louisiana had significant parameters with corn and soybean production, respectively. However, models for these states were not significant ( $P > 0.05$ ), so the parameter estimates have little validity.

Arkansas and South Carolina presented the most accurate models according to their associated R-squares (0.871 and 0.9233, respectively). Marketing assistance loan \$/ac and corn \$/ac were both significant parameter estimates in Arkansas, with respective values (1179.86 and -1438.65) that required elasticity testing. South Carolina's significant parameter estimates, cotton \$/ac (418.86) and soybean \$/ac (-1681.45) also required further elasticity testing.

All significant parameters were found to be inelastic when compared to planted cotton acreage, with the exception of corn production in Tennessee (Table 7). This relationship between dependent cotton acreage and independent corn production is elastic, indicating that the average increase in corn production is greater than the average unit (acre) decrease of cotton planted.

Although the cotton subsidy \$/ac parameter estimates in Georgia differed from model to model, the inelasticity of the variables' relationship to planted cotton acreage was found to be equal, indicating little difference between the models (Table 7). The significant parameter estimates in South Carolina and Arkansas were all found to be inelastic when analyzing the relationships that exist between cotton acreage and these parameters.

Table 7. Analysis of parameter estimate elasticities in relation to planted cotton acreage.

State	Independent variable			Mean cotton Acreage	Parameter elasticity	
	Parameter	Estimate	Mean		Means ratio*	Elastic value**
<b>Full and Reduced Base Model</b>						
Arkansas	MAL \$/AC	1180	383.96	892857	0.000430	0.5074
	CORN \$/AC	-1439	293.02		0.000328	-0.4721
South Carolina	COTTON \$/AC	419	303.28	243285	0.001247	0.5221
	SOYBEAN \$/AC	-1681	129.38		0.000532	-0.8942
<i>Tennessee†</i>	<i>CORN \$/AC</i>	<i>-2547</i>	<i>241.53</i>	<i>512500</i>	<i>0.000471</i>	<i>-1.2004</i>
Southeast Region	MAL \$/AC	-6577	306.13	11515714	0.000027	-0.1748
	SOYBEAN \$/AC	-11829	158.42		0.000014	-0.1627
	CORN \$/AC	9714	229.11		0.000020	0.1933
<b>Full Base Model</b>						
Georgia	COTTON SUB \$/AC	-2195	74.76	1289285	0.000058	-0.1273
<b>Reduced Base Model</b>						
Georgia	COTTON SUB \$/AC	-3293	49.84	1289285	0.000039	-0.1273

\*Means ratio = Mean of independent variable mean/Mean cotton acreage

\*\*Elastic value = Parameter estimate x Means ratio

†Italicized parameters were those found to be elastic when compared with planted cotton acreage. All other parameters were inelastic when compared with planted cotton acreage.

The negative parameter estimate value of cotton subsidy \$/ac in Georgia for the full base and reduced base models would indicate that for every unit decrease of cotton acreage, subsidy payments increase (and by a large amount). The opposite would be expected, but subsidy payments are decoupled and not made with respect to actual planted cotton acreage or production.

Finally, the Southeast region, when analyzed as a whole, was found to have three significant parameter estimates: MALs, soybean \$/ac, and corn \$/ac (Tables 5 and 6). The parameter estimates themselves ( $> 6500$  for MALs,  $> 11800$  for soybean \$/ac, and  $> 9700$  for corn \$/ac) were decidedly inelastic (Table 7).

## CHAPTER 5: DISCUSSION

The expectation of this study was that federal policy may to some extent promote upland cotton planting in the Southeast, possibly encouraging an increase in acreage. This would appear to be most notable in the year 2010, where planted cotton acreage has dramatically increased. However, a greater expectation of this study was to confirm or reject the proposal that federal policy has helped simply to maintain cotton production within the included states. This expectation was based upon the general downturn of price for upland cotton between 2001 and 2008. Theoretically, these consistent low prices should have forced more cotton operations into alternative planting choices or out of business entirely.

Due to the very large changes in almost all independent variables, the measure of many of the parameter estimates would appear to be inaccurate. The parameter estimates in all states, with the exception of South Carolina, simply appear to be too high. For example, most cotton growers in Tennessee would not expect an increase in corn production of \$2500/ac for every acre of cotton they do not plant. This number is not realistic, although it is established as elastic (Table 7).

Within the region as a whole, considering the low value of R-square indicating a weak model, the parameter estimates would also appear to be much too high. This is especially true in the case of soybean production, where the model identifies an increase of \$11000/acre for every acre of cotton not planted. If this number were truly accurate, the relationship between cotton acreage and soybean production should be highly elastic. However, soybean production, as well as the other significant variables within the regional model, was found to be inelastic (Table 7).

The regression analyses presented other surprising outcomes. One such surprise was that cotton acreage in Texas did not respond to price, subsidies, and previous planting. The high probability of error within the F test, as well as the weak R-square, indicated that the model was not a good fit for Texas cotton production. Perhaps, the volume of production created too much variability within the model to accurately assess which variables may be significant. Texas had, by far, the most cotton and soybean acreage during all 14 years, which may eliminate a relationship between cotton and soybeans.

Cotton acreage showed little response to cotton price outside of South Carolina, which was unusual. Perhaps this was due to the relatively low number of observations. Cotton acreage may respond to cotton price if 60 or 70 years of lagged production, lagged acreage, and lagged price observations were studied instead of the 14 years used in this study. Theoretically, and almost certainly in real world practice, cotton price should be one of the greatest factors in cotton production. The lack of significance of the price coefficient outside of South Carolina may indicate that cotton producers are not willing to switch crops at all (which may apply to all states across the Southeast).

The moisture in the environment of South Carolina makes that state a prime candidate for frequent crop rotation. This creates an environment where cotton may be planted several years in a row, then abandoned for more adaptable corn or soybeans. South Carolina producers may also be more averse to government programs and may have fewer outlets to sell cotton, given the reduction of the textile industry in the region in the last 20 years.

The significance of marketing assistance loans in Arkansas may be unusual. However, MALs are firm in their annual price, with very little variability. Planted cotton acreage in Arkansas has been fairly constant since 1996, which may create unknown error

within the model, but does mirror the constant rate of MALs. The significance of corn production makes much more sense as a responsive parameter for cotton acreage in Arkansas. Geographically, Arkansas is in a natural corn production area, and closer to the Corn Belt than the rest of the Southeast. This close proximity to large corn markets (feed lots, granaries, and mills) may persuade Arkansas cotton producers to switch crops during poor cotton market years.

In comparison to previous studies, this analysis provided some similar results. Several insignificant parameters were identified as in Smith et al. (2009), including cotton subsidy payments in nearly all states as well as competing crops in several of the states. Kleiber (2009) had estimated that ethanol crops already affected acreage of competitive crops within the entire United States. This study cannot agree or disagree with that statement. However, because corn and soybean production was found to be significant within the region, as well as several independent states, the present study has shown that these competing crops have increased while cotton acreage has decreased. When comparing this analysis to studies performed by Houston et al. (1999) and Parrott and McIntosh (1996), results were not compatible due to the range of years studied. Whereas Parrott and McIntosh (1996) found that cotton acreage was more responsive during program years, this study modeled only program years. Without non-program year data included in this study, a comparison is difficult to make.

## **CHAPTER 6 CONCLUSION**

This study provided some insight to upland cotton acreage response. The null hypotheses proved accurate, in that upland cotton acreage was not responsive to direct federal assistance, and that the majority of cotton acreage was not responsive to the alternative crop growth being promoted by federal biofuel incentives. Although federal policy through entitlement programs and loans appears to have some effect on planted cotton acreage within individual states, they show no reliable significance in the planting decisions upland cotton producers must face annually.

The lack of response to cotton price or previous cotton acreage (outside of South Carolina) is a concern, and may be addressed with a more developed model with more observations. However, it should be noted that hybrid corn and soybean varieties are very popular within the southeast region at this time. Many cotton producers switched to corn or soybeans during the early 1980s, at a time when the regional cotton market was exceptionally poor (including loan rates). Consequently, a major factor in planting decisions and acreage response may be input costs, which were not included in these models. The addition of input costs into the regression model may very well strengthen it.

This study analyzed only cotton acreage, not producers of upland cotton. There is a distinct difference between the two. Cotton farmers tend to grow cotton, as their fathers did, and their grandfathers did. Many do not simply exit cotton production, and if they do, they may not return to growing cotton. More likely, the fluctuation of cotton acreage over the past 14 years has been caused (especially the large increase in planted cotton acreage in 2010) by cotton producers changing the amount of cropland they rent. As previous reports (A.P., 2010; USDA-ERS, 2010) have stated throughout early 2010, the estimated sales price of upland

cotton has increased significantly. These estimations became reality during the harvest of 2010, with record profits being recorded. Cotton producers with an eye on the market may attempt to rent more land than usual in an attempt to take advantage of such a promising cotton market. Consequently, land owners may be willing to accept the premium price for rent that cotton farmers are willing to pay. Between land owners and custom cotton operators, an increase in cropland devoted to cotton production has been obvious in 2010, as was the decrease in cotton acreage in years past.

Within specific programs, Georgia cotton subsidy payments appear to be inaccurate despite significance according to both models. The negative value of both models' parameter estimates indicates that subsidy dollars are increasing while cotton acreage decreases. This may be attributed to the lagging effect of each model. Typically, DCP payments are received in October following a growing season, and the value may not be expected by a producer until it is made. However, because payments are decoupled from actual production, they do not reflect actual cotton acreage at the present time. In fact, these payments represent acreage according to 1996 statistics (and are paid on base acres established in that year). As Georgia cotton acreage has decreased, these payments were continued, and have increased between 2002 and 2009 from counter-cyclical payments. This may explain the negative value of the parameter estimates. The strength of both the full base and reduced base models, and high parameter estimates coupled with inelasticity create questionable results. Although subsidy payments have clearly had some effect on cotton acreage in Georgia, it does not appear to be the primary reason cotton farmers continue or discontinue growing cotton. Further modeling is required to determine the full extent.

Marketing Assistance Loans were found to be of significance in both Arkansas and the entire region as a whole. For the region, the R-square values were low. In Arkansas, the significance of MALs can be attributed to the lack of variability in this government loan program. The constant production of cotton in Arkansas mirrors the constant and regular availability of the loan. However, because of the exceptionally high values associated with MAL parameter estimates, the accuracy of this variable is in question. Additionally, the models did not take into account the repayment of the loan, only the value of the loan/acre to the cotton producer. MALs do not guarantee profit, as the model would suggest, only hedge against total economic loss. Because of this factor, as well as the unreliability of the model and inaccuracy of parameter estimate values, MALs must not be considered significant variables in dictating acreage response of upland cotton.

Finally, the study, if evaluated only on a state basis, does show sub regional response effects, especially in alternative crop acreage. The most notable examples are Arkansas and South Carolina, where cotton acreage responded well to planted corn acreage (\$1438 per acre of corn for every decreased acre of cotton) and soybean acreage (\$1681 increase per acre of soybeans for every decreased acre of cotton), respectively. The reasonable value of these parameter estimates, as well as the moderate inelasticity, indicate that these variables may be accurate. Consequently, the strongest of all variables in relation to cotton acreage was cotton production itself (in South Carolina) where the value of the parameter estimate was \$418/acre for each acre increase of cotton planted. This relationship was also approaching unit elasticity, further indicating the accuracy. Perhaps a linear regression test should be run to analyze only lagged cotton, corn, and soybean acreage in these states while emphasizing the maximization of R-square values to ensure model accuracy.

In conclusion, the models indicate that there are many differences across the Southeast region of the United States. These differences may be based upon climatic, geographic, geologic, or political differences, but it appears that they are enough to affect why producers continue to grow upland cotton. With an increase in cotton acreage across all studied states during 2010, further analysis could provide more insight once cotton market prices for 2010 are finalized. This evaluation may be more effective with 2011 planting decisions, as well as planting and production statistics predating 1996. However, within South Carolina, this study does recognize that both cotton production per acre and soybean production per acre are significant factors in predicting cotton acreage response in that state.

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