Impact of the Cotton Crop Insurance Program on Cotton Planted Acreage

A report delivered in fulfillment of the task order for Federal Crop Insurance Corporation (FCIC) Board of Directors Exhibit Number 2066.

by

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Executive Summary

In recent years, U.S. cotton producers have experienced significant changes in available production technologies, market conditions, federal commodity programs, and the federal crop insurance program. Among the technological factors affecting cotton production are genetically modified seeds and the geographic expansion of the boll weevil eradication program. Market prices for cotton have trended steadily downward since 1996. The Federal Agricultural Improvement and Reform Act of 1996 (FAIR Act) made tremendous changes to federal commodity program provisions that impacted cotton and other program crops. FAIR Act payments have been supplemented by federal *ad hoc* disaster assistance in every year since 1998. The Agricultural Risk Protection Act of 2000 (ARPA) increased premium subsidies and made other important changes in the federal crop insurance program. Recently, changes in cotton crop insurance rate-making procedures have also been implemented.

These changes have no doubt affected a number of farmer decisions, including which crops to produce and the allocation of acreage across those crops. Nationally, cotton acreage has increased every year since 1999. The mid-south experienced a dramatic increase in planted acreage in 2001. Current estimates are that cotton acreage will decrease in 2002. Yet many have questioned why cotton acreage increased in 1999, 2000, and 2001. In these years, expected market prices for cotton were approximately \$0.60 per pound, down from \$0.72 per pound in 1998.

Some have suggested that cotton crop insurance provisions may have contributed to the increase in cotton acreage during this period. While this report discusses technological changes, changes in market conditions, and commodity program changes, the primary emphasis is on the potential impact of crop insurance provisions on cotton planted acreage.

Mississippi is one of the states that experienced a large increase in cotton planted acreage over the period 1999-2001. A regression model was used to estimate the relationship between changes in Mississippi cotton planted acreage (measured at the county level) and the following explanatory variables: cotton expected net market returns, cotton expected returns from crop insurance, soybean expected net market returns, and soybean expected returns from crop insurance. The model was estimated using data from 1996-2000, a period when commodity program provisions were relatively stable and thus would not be expected to explain substantial acreage changes. The findings from this model indicate that expected net market returns for both cotton and soybeans have substantial effects on cotton acreage in Mississippi. However, changes in expected returns to insurance, or in per acre insurance premium rates, have very modest effects on acreage.

This report also presents an analysis of producer utilization of specific cotton crop insurance program provisions and whether or not those provisions impact actuarial performance. This is in response to assertions that various program provisions encouraged added cotton acreage. The analysis is conducted using unit-level crop insurance data. Five provisions were

examined: added land; new producer APH guarantees; the optional APH yield substitution created by ARPA; APH yield cups; and skip-row planting pattern options. The data indicate potential problems related to added land, new producer APH, and yield cup provisions. Policies utilizing these provisions generally had loss ratios much higher than those of other policies in the same county. Skip row cotton does not seem to affect actuarial performance in the region where it has been traditionally practiced (Texas). However, in Mississippi and Alabama it appears problematic. Finally, the ARPA yield adjustment provision appears to have no major effect on actuarial performance. Data for some of these provisions were available for only one year, so these findings should be considered preliminary. However, the findings do identify areas of concern were further analysis is recommended.

Our conclusions about the relatively modest impacts of crop insurance on cotton planted acreage appear to be supported by preseason predictions of significant cotton acreage reductions in 2002. While there have been only minor changes in crop insurance provisions since 2001, both the National Cotton Council and the USDA are predicting substantially lower cotton acreage in 2002.

Table of Contents

List of Tables

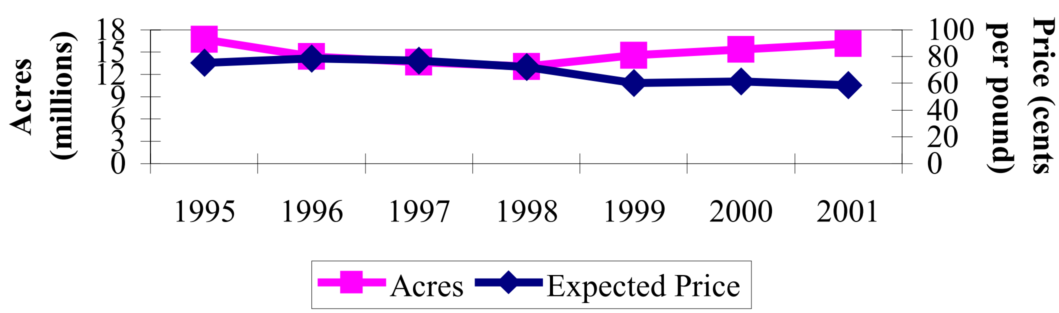
List of Figures

1.0 Introduction

Between 1998 and 2001, U.S. planted acreage of upland cotton increased by 23 percent from 13.1 million acres to 16.1 million acres. This increase in planted acreage occurred despite the fact that expected cotton prices were around $0.60 per pound in 1999, 2000, and 2001, down from $0.72 per pound in 1998.

Figure 1.1 compares national planted acreage of upland cotton to expected cotton prices for 1995-2001. Expected cotton prices are calculated as the average of February closing prices for the New York Board of Trade December cotton futures contract. From 1996 to 1998, planted acreage decreases along with expected price. But for 1999-2001 planted acreage increases every year while expected prices are relatively constant at around 60 cents per pound.

Figure 1.1: Upland Cotton Acreage (USA) and Expected Market Prices



This report investigates factors that may have contributed to the increase in cotton planted acreage since 1998. The report is organized as follows. The next section (section 2.0) provides background information on cotton acreage and cotton crop insurance participation. Section 3.0 reviews previous research on the relationship between crop insurance participation and planted acreage. Section 4.0 describes a simple conceptual framework of how crop producers make planting decisions. This simple framework will motivate much of the analysis that follows. Sections 5.0 - 8.0 each examine a general set of factors that may have influenced cotton planted acreage. These are, respectively, technological influences, market influences, federal commodity program influences, and crop insurance influences. Section 9.0 describes the findings from an empirical model used to analyze how expected net market returns and expected returns from crop insurance affect changes in Mississippi cotton acreage. Section 10.0 examines the extent to which insured farmers utilize various provisions of the cotton crop insurance program and whether or not those provisions seem to impact actuarial performance. Section 11.0 contains concluding remarks.

2.0 Background Information

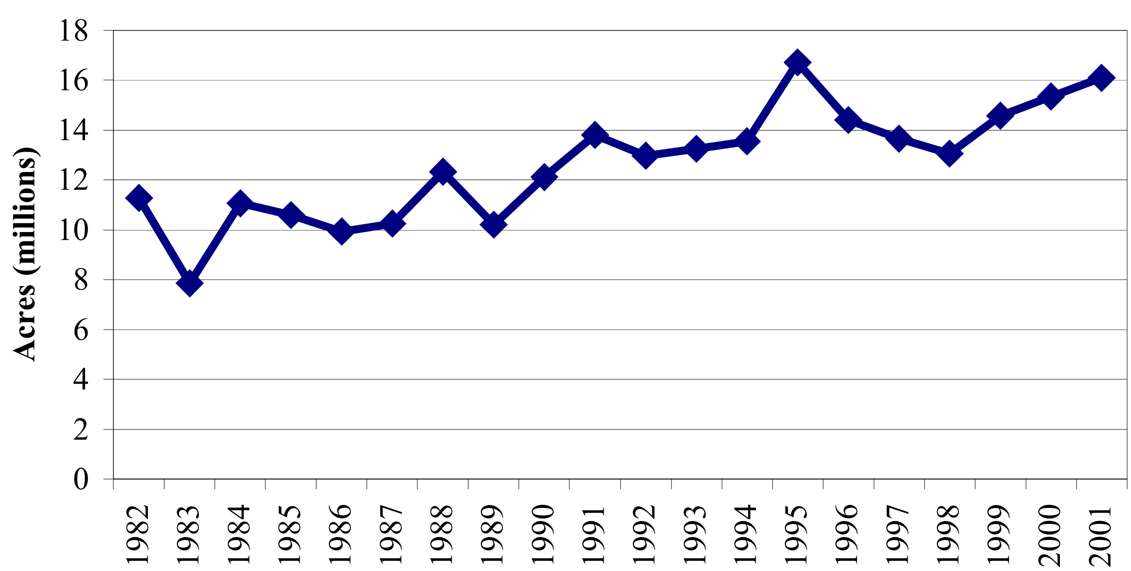
This section of the report provides important background information on acreage planted to cotton in the U.S. and federal crop insurance participation by cotton producers. Changes in cotton acreage are examined over time and across geographic regions. For selected states, cotton acreage is compared to acreage for competing crops over time. Changes in cotton crop insurance participation are examined, including changes in products purchased and coverage levels selected.

2.1 Cotton Acreage

U.S. planted acreage of upland cotton has varied widely over the past two decades from a low of 7.9 million acres in 1983 to a high of 16.7 million acres in 1995. The 1983 low was due to a government program that reduced surpluses by paying farmers not to plant crops. Throughout this period, various government policies have directly and indirectly influenced cotton acreage. Acreage Reduction Programs (ARP's), 0-50/92 programs, and the

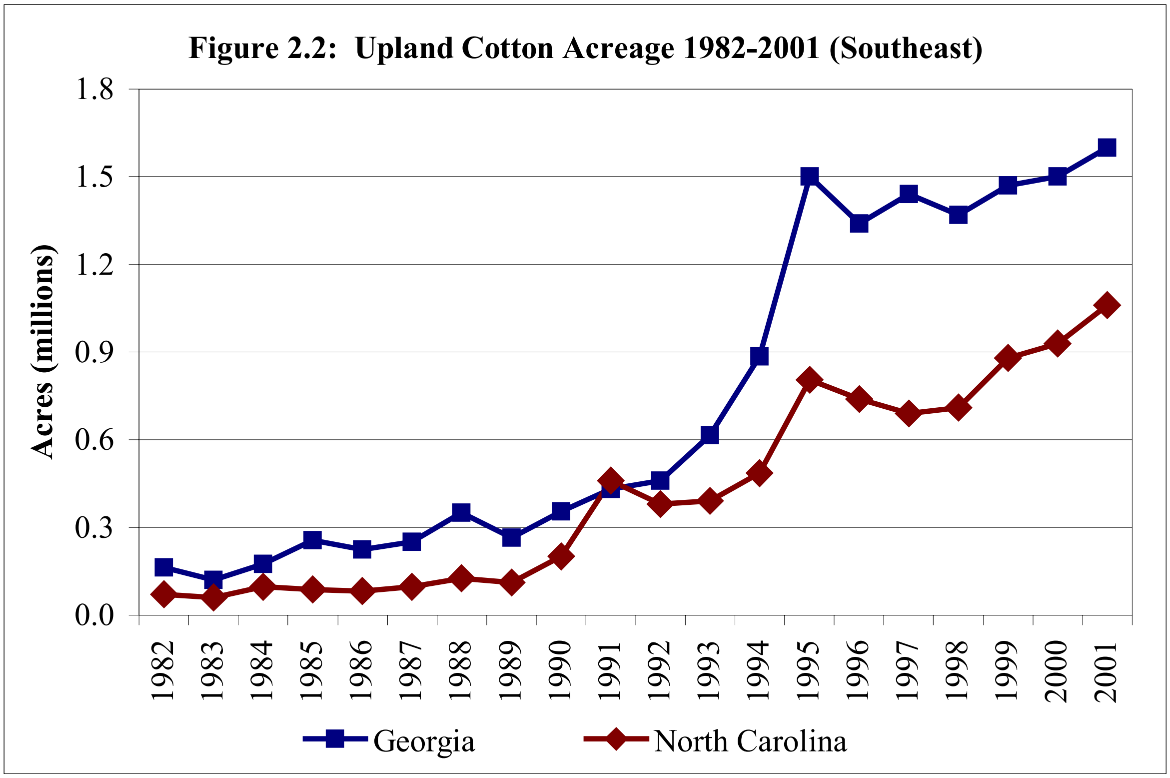
Conservation Reserve Program (CRP) are examples of programs that tended to reduce cotton acreage. For example, ARP's were set at 25% in 1986, 1988, and 1989. Figure 2.1 shows that from 1992 to 1995 upland cotton acreage increased every year. In 1996, on the heels of new farm legislation that de-coupled subsidy payments from crop planting decisions, upland cotton acreage began to decrease. Acreage decreased every year through 1998 and then increased every year from 1999 until 2001. The 16.1 million acres planted in 2001 was the second-highest planted acreage over the prior two decades.

Figure 2.1: Upland Cotton Acreage 1982-2001 (USA)



Figures 2.2, 2.3, and 2.4 present 1982-2001 planted acreage for states in different cotton producing regions of the U.S. Figure 2.2 presents planted acreage for the southeast states of Georgia and North Carolina. Figure 2.3 presents planted acreage for the mid-south states of Mississippi, Arkansas, and Louisiana. Figure 2.4 is for Texas, the state with the most cotton acreage. It is instructive to consider planted acreage by region, because different patterns occur in each region. Georgia and North Carolina have experienced a steady upward

trend in cotton acreage since the early 1980s. Dramatic increases in planted acreage occurred in the early 1990s. Planted acreage leveled off after 1995 before the upward trend reemerged in 1999.



A very different pattern occurred in the mid-south states of Mississippi, Arkansas, and Louisiana. Figure 2.3 shows much less of a long-term upward trend in acreage. In Mississippi and Louisiana, planted acreage in 1999 was approximately the same as in 1982. Arkansas more than doubled its planted acreage between 1982 and 1999. But even Arkansas's increase in planted acreage is smaller, in both absolute and percentage terms, than that experienced by Georgia and North Carolina over the same period. In the mid-south, planted acreage peaked in 1995 with all three states planting more than 1 million acres. Mississippi planted more than 1.4 million acres in 1995. Acreage then declined from 1995 until 1998 with particularly dramatic declines occurring in Mississippi and Louisiana. In 1998 Louisiana planted less than half as much cotton acreage as had been planted in 1995.

Mississippi's cotton acreage fell by more than one-third over the same period. Since 1998, cotton acreage has increased steadily in these three states with the largest increase occurring in 2001.

Figure 2.3: Upland Cotton Acreage 1982-2001 (Mid-south)

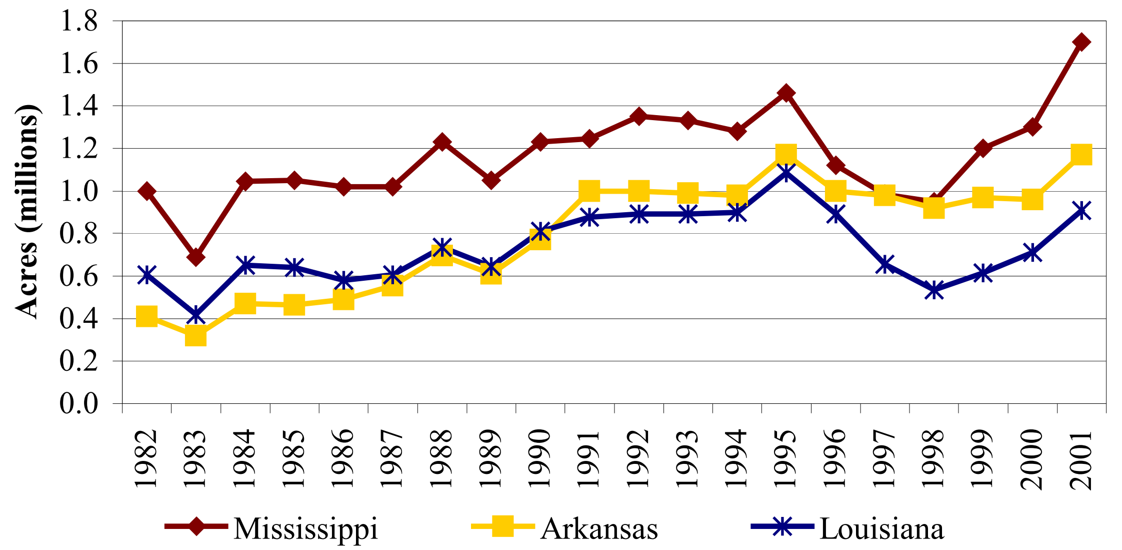


Figure 2.4 presents cotton acreage for Texas. While there has been some variation in planted acreage through time, there is no evidence of a pronounced upward trend. In fact, Texas cotton acreage in 2001 was about the same as in 1982.

Figure 2.4: Upland Cotton Acreage 1982-2001 (Texas)

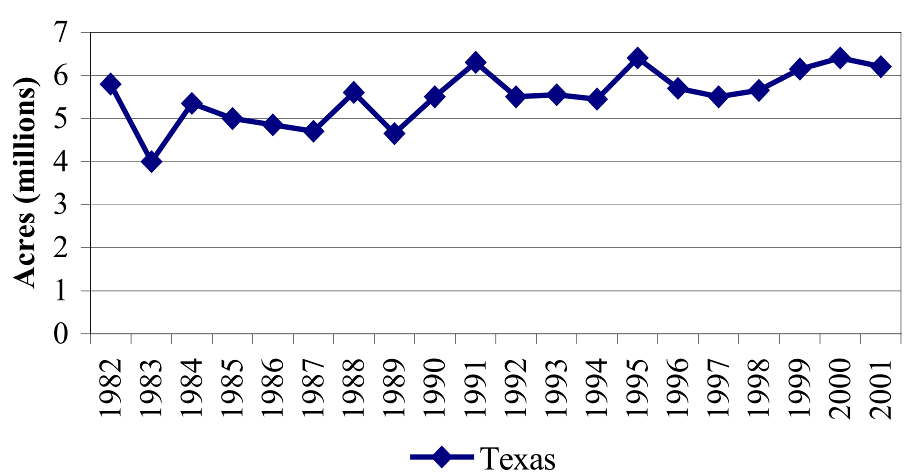


Figure 2.5 shows geographic changes in cotton planted acreage between the periods 1985-89 and 1995-99. For each of these periods, we construct a ratio of the average acreage planted to cotton in the county divided by the national average planted acreage. The index mapped in the figure is the simple difference in this ratio between 1985-89 and 1995-99. If the index is positive, the county's proportion of national acreage was higher in 1995-99 than in 1985-89. These counties are colored orange and red. If the index is negative, the county's proportion of national acreage was lower in 1995-99 than in 1985-89. These counties are colored green.

Figure 2.5: Changes in Counties' Percentage of National Cotton Planted Acreage Between 1985-89 and 1995-99

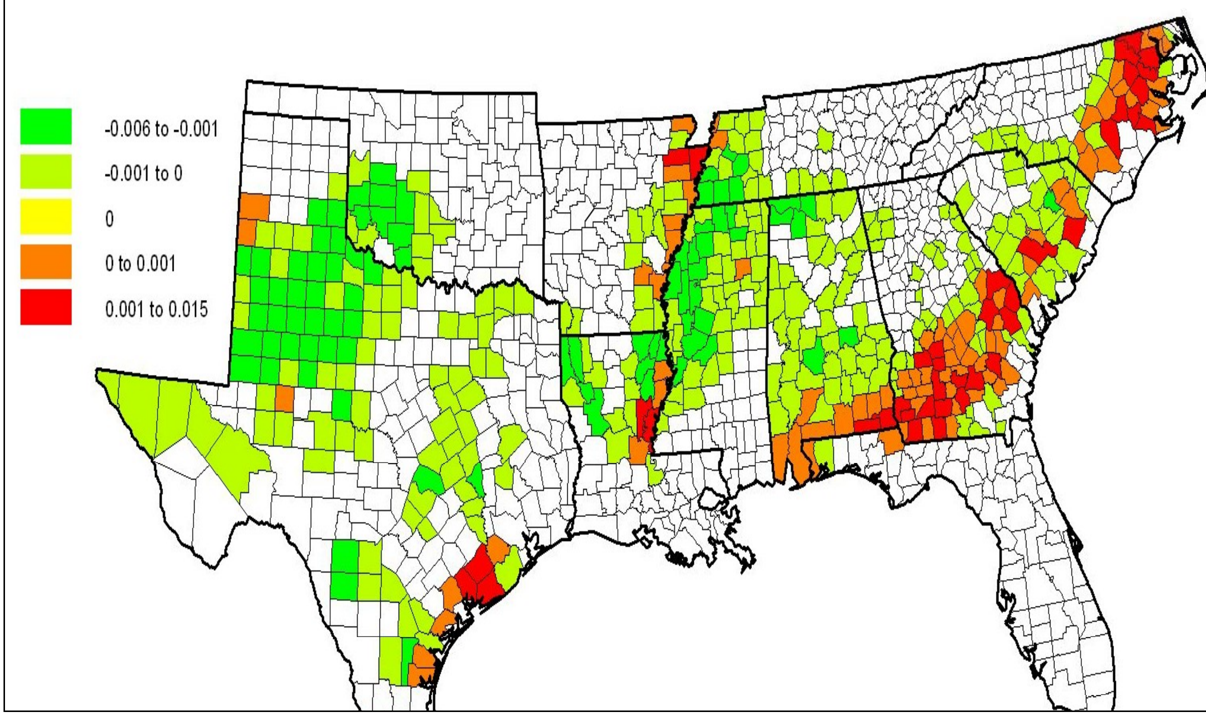
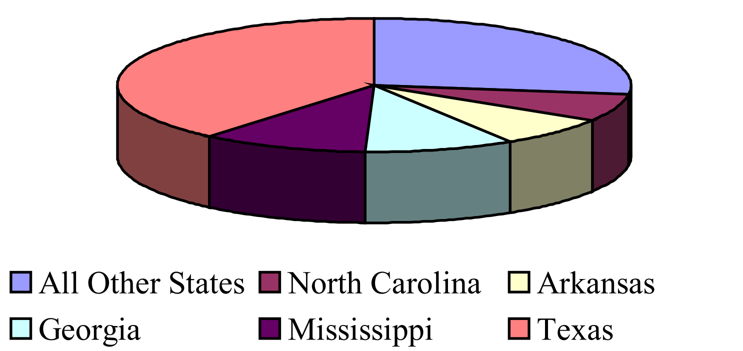


Figure 2.6 compares cotton planted acreage across states for 2001. Only states with at least 1 million planted acres are shown individually. Texas has, by far, the most planted acreage followed, in order, by Mississippi, Georgia, Arkansas and North Carolina.

Figure 2.6: Acres of Cotton Planted by State, 2001



Current estimates are that cotton acreage will decrease in 2002. The Prospective Plantings report issued by the National Agricultural Statistical Service on March 29, 2002 indicates that farmers intend to plant approximately 14.8 million acres to upland cotton in 2002, a decrease of about 6 percent from 2001 planted acreage. Most of the decrease is projected to occur in the mid-south. Acreage in Arkansas, Louisiana, and Mississippi is projected to decrease by around 15 percent.

2.2 Comparison Of Cotton And Competing Crop Acreages

Figures 2.7, 2.8, and 2.9 present cotton acreage in three different states, along with acreage of major competing crops, for the years 1990 through 2001. The primary intent in providing these three figures is to allow a comparison of how crop acreages for cotton and major competing crops have varied through time.

Figure 2.7 shows that in 1990 over 1.2 million acres were planted to cotton and soybeans in Georgia. Over 70 percent of that acreage was in soybeans. By 2001, the pattern was completely reversed. Georgia had almost 1.7 million acres planted to cotton and soybeans, with approximately 90 percent of that acreage in cotton.

Figure 2.7: Acres Planted to Cotton and Soybeans 1990-2001 (Georgia)

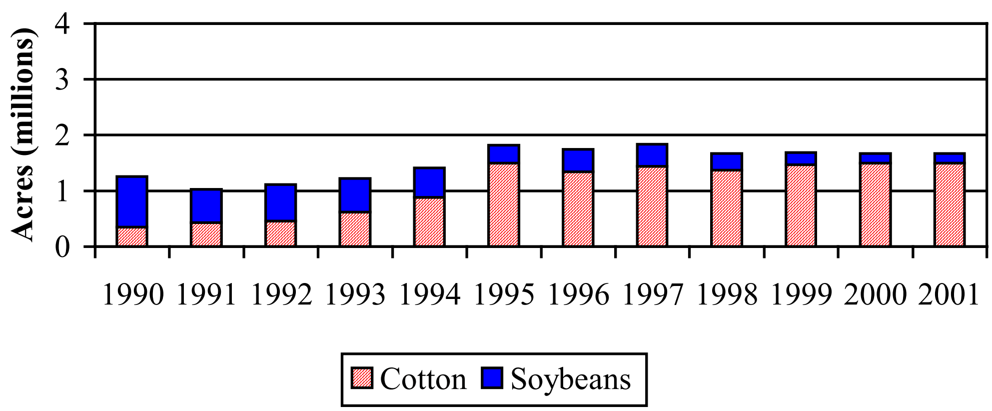


Figure 2.8: Acres Planted to Cotton and Soybeans 1990-2001 (Mississippi)

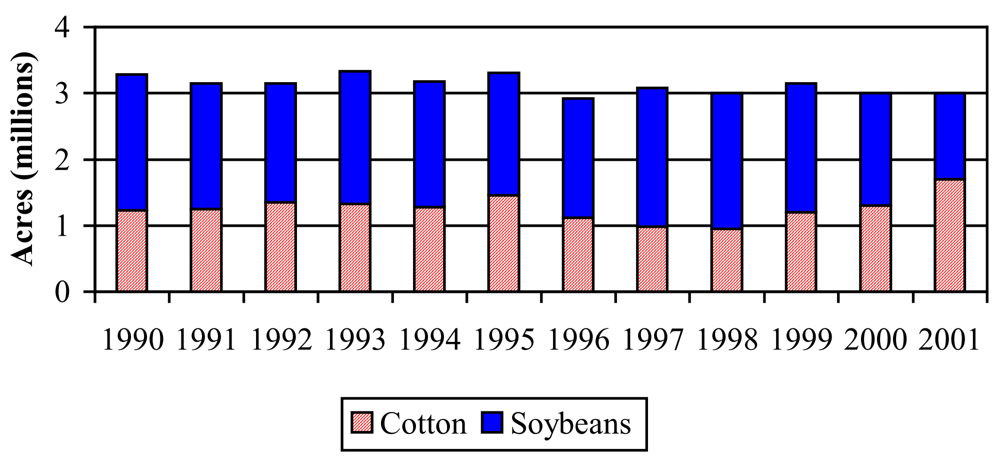
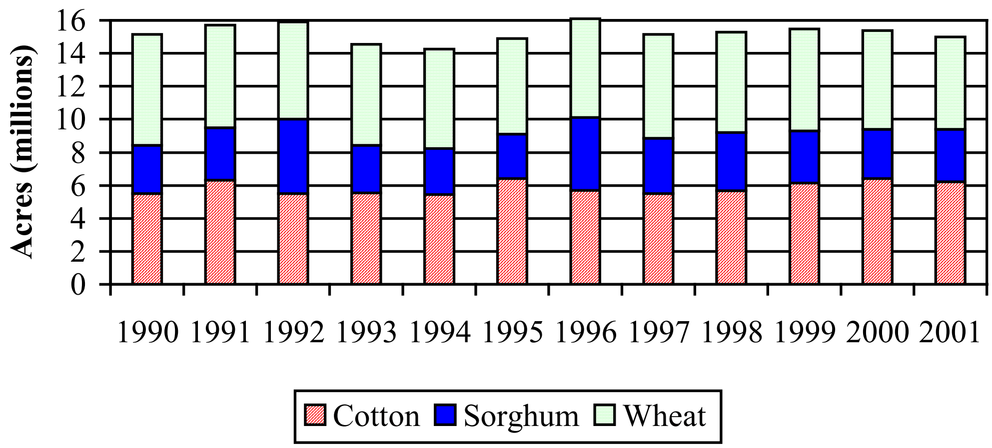


Figure 2.8 reports the same information for Mississippi. Total acreage of the two crops has been very stable, at around 3 million acres, throughout the period. While cotton

acreage has increased every year since 1998, cotton acreage did not exceed soybean acreage until 2001. The trend toward cotton acreage replacing soybean acreage is not nearly as pronounced as in Georgia.

Figure 2.9, which presents acreage for the major crops in Texas, includes cotton and two alternative crops, sorghum and wheat. Since 1990, there have not been major changes in the total acreage planted to these three crops in Texas. The lowest total acreage was a little more than 14 million acres in 1994. The highest total acreage was 16 million acres in 1996. Cotton has represented a fairly stable portion of overall Texas acreage throughout the time period. It has exceeded 5 million acres in every year since 1990, and the proportions of cotton, sorghum, and wheat have remained fairly constant.

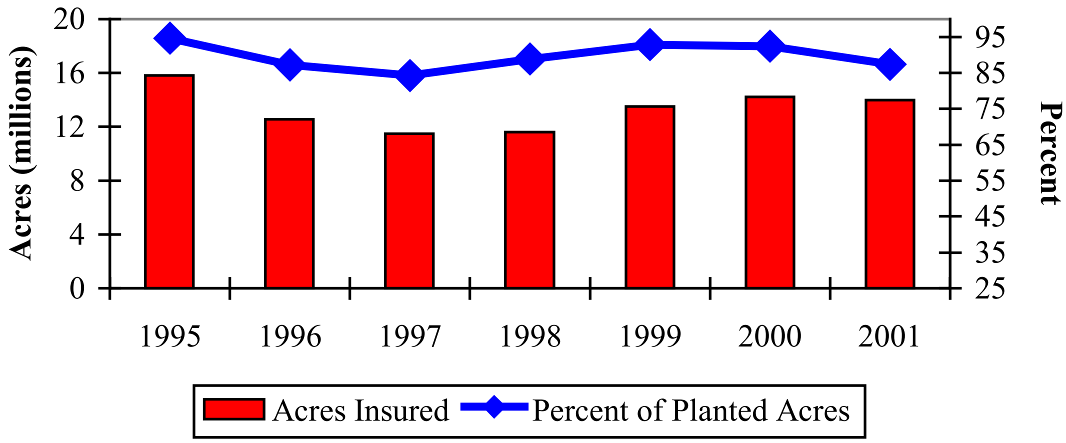
Figure 2.9: Acres Planted to Cotton, Sorghum, and Wheat 1990-2001 (Texas)



2.3 Cotton Crop Insurance Participation

Figure 2.10 shows U.S. cotton crop and revenue insurance participation for the years 1995 through 2001. Both catastrophic and buy-up coverage are included. The bars indicate actual acres insured while the line shows insured acres as a percentage of total planted acres. In 1995, almost 16 million acres of cotton were insured. Recall that U.S. cotton acreage peaked in 1995. It is also important to note that for 1995 only, farmers were required to

Figure 2.10: Cotton Acreage Insured, All Plans, All Coverages

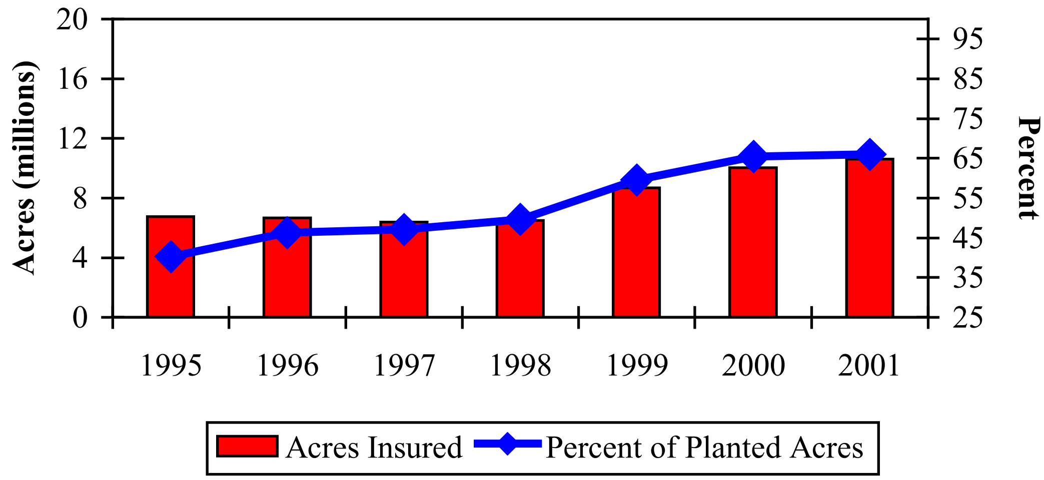


participate in crop insurance to maintain eligibility for commodity program benefits. In 1996 and 1997, cotton insurance participation declined both in absolute terms, due to the decrease in cotton planted acres, and as a percentage of planted acres. Some of those who purchased crop insurance in 1995 to maintain commodity program eligibility quit purchasing insurance when the requirement was lifted. Insured cotton acreage increased each year from 1998 until 2000 and held steady in 2001. Between 1998 and 2001 cotton crop insurance participation varied between 87 and 93 percent of planted acres.

Figure 2.11 reports information similar to that in figure 2.10. However in Figure 2.11, only cotton acreage insured at the buy-up level is reported. Acreage insured at the buy-up level increased dramatically in 1999 and has continued to increase in subsequent years. Additional premium subsidies for buy-up coverage were offered on an *ad hoc* basis in 1999 and 2000. New crop insurance authorizing legislation made the additional subsidies permanent beginning in 2001. As a percentage of planted acres, buy-up coverage has increased steadily since 1995. In 2001, approximately 65 percent of all cotton planted acres were insured at some level of buy-up coverage (a breakout of coverage levels, including limited buy-up, is provided later).

Figure 2.12 disaggregates the percentage of cotton acreage insured at the buy-up level for six of the largest upland cotton producing states. Percentage participation in buy-up coverage for Texas, the largest cotton producing state, has remained fairly stable since 1996, generally exceeding 75 percent. After rising to 92 percent in 1999, participation in buy-up coverage dropped back to 82 percent in 2001.

Figure 2.11: Cotton Acreage Insured at the Buy-up Level



The other five states examined in Figure 2.12 all show a significant increase in buy-up coverage since 1995. Georgia had the second highest percentage of acreage insured at the buy-up level in 1995. This was still the case in 2001. However, the percentage of acreage insured at the buy-up level had increased from 45 percent to slightly over 75 percent – a level similar to that of Texas. North Carolina's percentage of acreage insured at the buy-up level has been consistently lower than that of Georgia, but has followed a similar growth pattern. In 1995, the mid-south states of Mississippi, Arkansas, and Louisiana all had less than 20 percent of their cotton acreage insured at buy-up levels. By 2001, buy-up participation had increased to 53 percent in Louisiana and 68 percent in Mississippi, while buy-up participation in Arkansas remained low at approximately 19 percent.

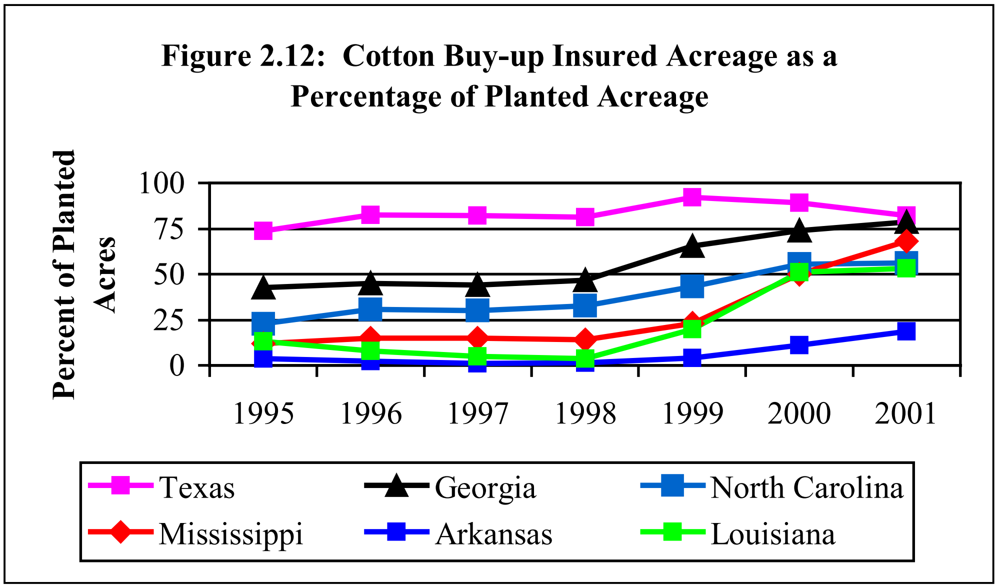
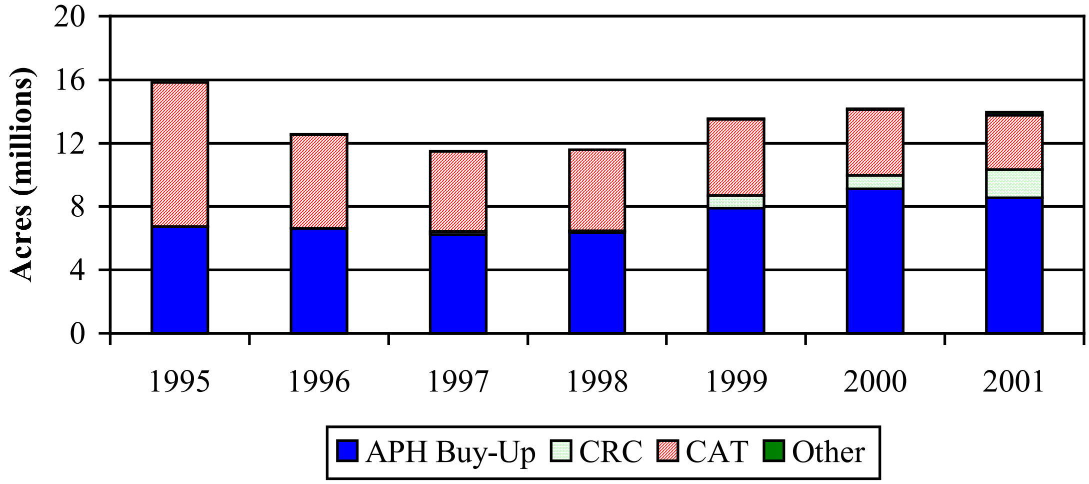


Figure 2.13 reveals information about the type of insurance policies being purchased by cotton producers. The catastrophic crop insurance product was introduced in 1995. This was also the year when producers were required to have at least catastrophic crop insurance protection to be eligible for commodity program benefits. In that year, approximately nine million acres of cotton were insured under catastrophic policies while 6.7 million acres were insured under buy-up APH policies. Cotton planted acreage decreased in 1996 and the link to commodity program benefits was removed. This led to substantially less cotton acreage being insured with almost all of the reduction occurring in catastrophic coverage. With increased premium subsidies beginning in 1999, cotton acreage insured at the buy-up level has increased relative to that insured at the catastrophic level. The year 1999 also marked the first time that significant acreages of cotton were insured under Crop Revenue Coverage (CRC) revenue insurance with slightly less than 800,000 acres insured. The CRC share of

buy-up cotton crop insurance increased in 2000 and again in 2001. By 2001, 1.8 million acres of cotton were insured under CRC. Compared to other major crops, revenue insurance still accounts for a relatively small proportion of cotton buy-up insurance.

Figure 2.13: Aggregate Cotton Acreage by Insurance Type



For the years 1998-2001, Figure 2.14 breaks down buy-up participation in crop and revenue insurance into alternative coverage levels. It is important to note that the 80 and 85 percent coverage levels were not available until 2000. Recall that additional premium subsidies on buy-up coverage were offered on an *ad hoc* basis in 1999 and 2000. The Agricultural Risk Protection Act of 2000 (ARPA) made additional subsidies permanent beginning in 2001, and it altered the subsidy structure from that offered in 1999 and 2000. In 1998, policies at the 50 percent coverage level accounted for 20 percent of the buy-up business. By 2001, that had declined by almost half. Prior to ARPA, the maximum dollar amount of premium subsidy per acre was offered at the 65, 70, and 75 percent coverage levels. From a farmer's perspective, the least expensive method for capturing the maximum dollar amount of premium subsidy was to purchase at the 65 percent coverage level. Therefore, there was a significant "piling up" of participation at the 65 percent coverage level. From 1998 through 2000, participation at the 65 percent coverage level increased significantly each year. At the same time participation at the 50 percent coverage level decreased significantly. In 2001, participation at the 65 percent coverage level decreased sharply while participation at higher coverage levels increased.

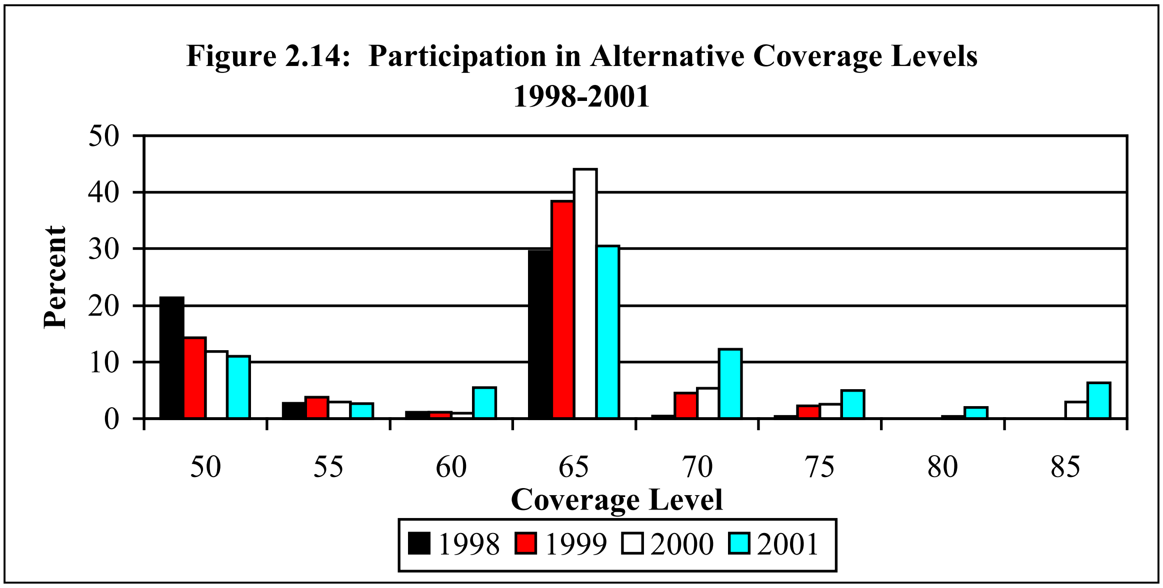


Figure 2.15 shows the percentage of 2001 cotton buy-up insurance at various coverage levels for selected states and the entire U.S. With the exception of Mississippi, most cotton buy-up insurance was still purchased at the 65 percent coverage level. Mississippi is a notable outlier with over 44 percent of buy-up acres insured at the 85 percent coverage level. In contrast, for the entire U.S., only about 6 percent of cotton buy-up acres were insured at the 85 percent coverage level.

In general, participation at the 65 percent coverage level was significantly higher than at the 50 percent coverage level. However, Texas still had 20 percent of its buy-up cotton acres insured at the 50 percent coverage level.

Figure 2.15: Proportion of Buy-up Insured Acres at Various Coverage Levels 2001

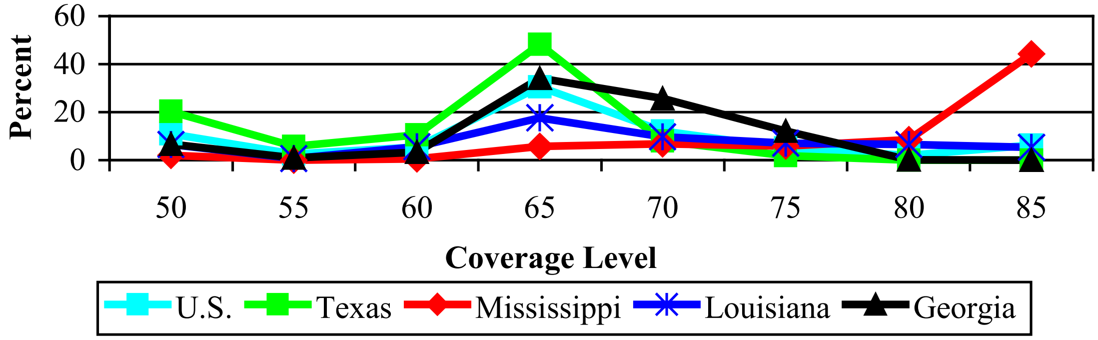
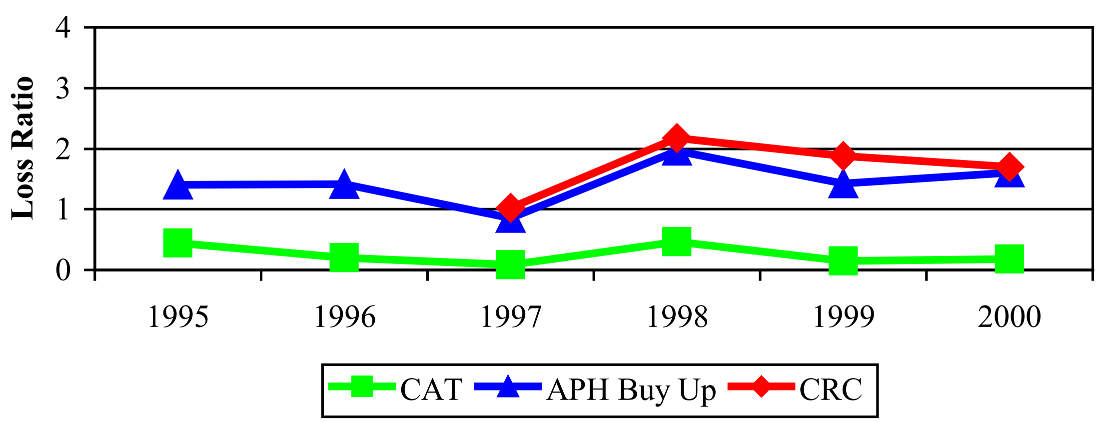


Figure 2.16 presents cotton crop insurance actuarial performance by type of insurance from 1995 through 2000. The loss ratio, measured as total indemnities divided by total premiums, is a standard measure of insurance actuarial performance. National aggregate loss ratios (total indemnities/total premiums) are presented here for catastrophic coverage, APH buy-up coverage, and CRC. Loss ratios for 2001 are not included because final indemnity totals for 2001 are not yet available. CRC did not become available until 1997.

Figure 2.16: Cotton Loss Ratios by Type of Insurance



The loss ratio for catastrophic coverage has been well below the breakeven level of 1.0 since its inception in 1995. In fact, since 1995 the highest loss ratio for cotton catastrophic coverage occurred in 1998, but was only 0.47. Loss ratios for APH buy-up coverage generally track those of catastrophic coverage, though at a much higher level. The cotton APH buy-up loss ratio was above 1.0 in every year except 1997. Over this period, the highest loss ratio for cotton APH buy-up coverage was 1.96 in 1998. This loss ratio implies that on average in 1998, cotton APH buy-up policies paid out approximately $2 of indemnity for every dollar of total premium (farmer paid premium plus government premium subsidies) received. In general, the loss ratio for CRC cotton has been slightly higher than the comparable APH loss ratio in every year since its inception in 1997. The difference has never been very large, except in 1999 when the CRC loss ratio was 1.88 while the APH buy-up loss ratio was 1.43.

3.0 Previous Research

To date, only limited research has been conducted on the relationship between crop insurance participation and planted acreage, and that research has generated inconsistent findings. Wu found that Nebraska corn farmers who purchased crop insurance shifted land out of hay and pasture and into crop production. However, he does not quantify the extent to which crop insurance participation may have increased crop acreage. Keeton, Skees, and Long examined changes in crop acreage between the periods 1978-1982 and 1988-1992, and estimated relatively large increases for six major field crops. In contrast, Young, Vandeveer, and Schnepf estimated that crop insurance participation increased planted acreage for eight major field crops by slightly less than 1 million acres. However, cotton accounted for approximately 25 percent of the estimated increase in planted acreage. Goodwin and Vandeveer examined the relationship between insurance participation and planted acreage for corn-belt corn and soybeans, wheat, and barley production in the northern great plains. The initial analysis was for the period 1985-1993. They also examined the relationship between insurance participation and planted acreage for corn and soybeans in the heartland region for the period 1997-1998. Except for heartland soybeans and northern great plains barley over the period 1985-1993, a statistically significant positive relationship was found between insurance participation and planted acreage. However, the magnitude of this relationship was quite small. A 100 percent increase in crop insurance participation was found to increase planted acreage between 2 and 6 percent.

All of these studies found that crop insurance participation was directly related to increased planted acreage. However, the estimated effect of crop insurance on crop acreage has generally been small. The exception is the study by Keeton, et al. It is important to note that all of these studies have serious limitations. First, these studies likely have limited generalizability across crops or regions. Secondly, a lack of appropriate data appears to have lead to misspecification and omitted variable bias in some cases. These are serious concerns and may severely bias results. Finally, Wu's is the only study based on farm-level data. Aggregate data can mask many of the important factors that affect farm-level decision-making.

4.0 Conceptual Framework

When farmers plant crops they are making financial investments in enterprises that they hope will generate positive rates of return. In this sense, farmers are no different than those who invest in stocks, bonds, or other financial assets.

Two characteristics, expected return and risk, are commonly used to evaluate investment opportunities. Crop farmers invest in a portfolio of crops. The portfolio may include only one crop or it may be diversified across several crops. The expected return for the portfolio of crops is the weighted average of the expected returns for each of the crops in the portfolio.

Risk is a measure of the variability in returns from a portfolio relative to the expected return of the portfolio. The higher the variability in returns relative to the expected return, the higher the risk. For a portfolio of crops, risk is often caused by variability in prices and /or yields. Appendix A describes statistical methods for measuring expected return and risk.

Economists commonly assume that investors are rational business people who desire higher expected returns, but dislike risk. It seems reasonable to assume that the same is true of farmers. Unfortunately, expected return and risk are often directly related. Higher expected returns generally imply more exposure to risk, and vice versa.

Throughout this report we will assume that farmers make investment decisions, including crop-mix planting decisions, by weighing expected returns against risk. Expected returns and/or risk can be affected by changes in factors such as technology, market conditions, and federal programs. When changes occur, the farmer may change the crop-mix of the portfolio or the allocation of acreage across crops so as to reestablish a desired risk-return balance.

For example, consider a farm that produces a portfolio of crops consisting of cotton, soybeans, and forage. Assume that the expected returns from cotton are higher than those from soybeans, while the expected returns from soybeans are higher than those from forage. The variability in returns relative to the expected return (risk) is also higher for cotton than for soybeans and higher for soybeans than for forage. The returns to these crops may also be correlated. If so, this will influence the variability of the overall portfolio.

Suppose that a new federal program greatly reduces the farmer's exposure to risk from cotton and soybean production with little or no reduction in expected return. Further, assume that no such benefits are provided for forage production. If, following introduction of the new federal program, the farmer maintains the same crop mix as before, he/she will be exposed to less risk. However, by shifting forage acreage into cotton and soybean production the farmer can restore the original level of risk exposure, but at a higher expected return.

What if the federal government implements a program that does not reduce risk exposure, but rather increases the expected returns from producing cotton and soybeans? Again, assume no such benefits are provided for forage production. By shifting land out of forage production and putting it into cotton and soybean production, the farmer can capture more benefits from the federal program. Of course, this will increase the risk in the farmer's crop portfolio, but the increased risk will be compensated by much higher expected returns.

5.0 Technological Influences

Changes in production technology can affect both the risk and the expected returns from cotton production. In recent years, two technological changes have had tremendous impacts on cotton producers. Those changes are boll weevil eradication programs and genetically modified varieties of cotton.

5.1 Boll Weevil Eradication

The initial U.S. boll weevil eradication program was begun in 1978 and included Virginia, North Carolina, South Carolina, Georgia, Florida, and the southern part of Alabama (table 5.1). Eradication efforts for the remainder of Alabama and middle Tennessee were begun in 1993. The boll weevil has now been largely eradicated from the southeastern U.S.

Table 5.1: Chronology of Boll Weevil Eradication through Fall 2001

Region	Start Date	Current Status	1,000 Acres
VA – NC - SC - GA - FL - S.AL	Fall '78 thru '87	Post-Eradication	3,925
CA – AZ – NW N.Mexico	Fall '83 thru '87	Post-Eradication	1,000
C.AL – N.AL - M.TN	Fall '93 thru '94	Eradication Confirmation	225
TX - Southern Rolling Plains	Fall '94	Post-Eradication	350
Sub Total	**---**	**---**	***5,500***
TX - South Texas/Winter Garden	Fall '96	Year 6	400
TX - Central Rolling Plains	Fall '96	Year 6	700
Mississippi - East & Central	Fall '97	Year 5	440
Louisiana - Red River & SW Arkansas	Fall '97	Year 5	138
Mississippi - South Delta	Fall '98	Year 4	190
Tennessee – Southwest	Fall '98	Year 4	200
Oklahoma	Fall '98	Year 4	380
New Mexico - Luna Co./Mesilla Valley	Fall '98	Year 4	35
Arkansas – Southeastern	Fall '99	Year 3	325
Louisiana – East	Fall '99	Year 3	735
Mississippi - North Delta	Fall '99	Year 3	530
TX - Western High Plains	Fall '99	Year 3	850
TX - Northwest Plains	Fall '99	Year 3	600
TX - Permian Basin	Fall '99	Year 3	800
TX - El Paso/Trans Pecos	Fall '99	Year 3	60
TX - Northern Rolling Plains	Fall '99	Year 3	400
Arkansas – Central	Fall '00	Year 2	217
Tennessee – Northwest	Fall '00	Year 2	400
New Mexico – Pecos Valley	Fall '00	Year 2	20
Missouri	Fall '01	Year 1	450
Arkansas - Northeast Ridge	Fall '01	Year 1	125
TX - Southern Blacklands	Fall '01	Year 1	200
TX - Southern High Plains/Caprock	Fall '01	Year 1	1,114
TX - Northern High Plains	Fall '01	Year 1	600
New Mexico - (Roosevelt & Curry Co.)	Fall '01	Year 1	25
Sub Total	**---**	**---**	***9,934***
TX - 7 Co. Upper Gulf Coast	Not Established	Not Established	270
TX - Northern Blacklands	Not Established	Not Established	100
Arkansas - NE Delta	Not Established	Not Established	360
TX – St. Lawrence	Not Established	Not Established	130
TX - Lower Rio Grande Valley	Not Established	Not Established	185
Sub Total	**---**	**---**	***1,045***
Total	**---**	**---**	***16,479***

Source: National Cotton Council

Eradication efforts are currently ongoing in the delta region of Mississippi, Arkansas, Louisiana, and west Tennessee (with the exception of the northeastern delta of Arkansas). Eradication is complete in the southern plains of Texas, but is ongoing in other regions of Texas, Oklahoma, and Missouri. Most ELS cotton regions have also completed boll weevil eradication programs.

While farmer paid assessments for boll-weevil eradication can be quite expensive, the post-eradication reduction in production costs is impressive. Planning budgets obtained from Mississippi State University and the University of Georgia indicate that a representative Mississippi delta farm has an expected cotton yield that is 175 pounds per acre higher than a representative Georgia farm. However, the Georgia farm has an expected net market return above direct expenses that is about $10 per acre higher than the Mississippi farm. This is because the Mississippi farm has significantly higher direct expenses than the Georgia farm. Much of this difference in direct expenses is due to the fact that Georgia has completed a boll weevil eradication program. The Mississippi farm spends over $60 per acre more on insecticides than does the Georgia farm. Also, the Mississippi farm spends $22 per acre on boll weevil eradication assessments. The Georgia farm spends $4.50 per acre for a post-eradication maintenance assessment. It has also been suggested that boll weevil eradication may reduce yield risk. A recent RMA study on boll weevil eradication confirms the cost reduction just discussed. However, it also finds that the effect on overall yield variability is small.

5.2 Genetically Modified Cotton

Genetically modified cotton varieties became commercially available on a limited basis in 1996 with the introduction of insect-resistant (Bt) cotton. Bt cotton contains a gene that triggers production in the plant tissue of a protein that is toxic to many larvae of the lepidoptera order, including tobacco budworm and cotton bollworm. Thus, Bt cotton reduces the need for spray applications of synthetic insecticides. The technology does not control all cotton pests and thus does not eliminate the need for all insecticide applications. Crop monitoring is still critical. Further, farmers must pay a technology fee when they purchase Bt cottonseed. However, the extent to which farmers have adopted Bt cotton varieties would indicate that the benefits are perceived as outweighing the costs.

In 1997, varieties containing herbicide-tolerant traits were introduced commercially as well as limited quantities of varieties that combined this trait along with the Bt trait (so called "stacked gene" varieties). During the 1997 crop year, industry estimates were that approximately 25 percent (3.4 million acres) of U.S. upland cotton acreage was planted to genetically modified varieties.

Since then producers have rapidly adopted genetically modified varieties. In 2000, an estimated 61 percent (9.4 million acres) of U.S. upland cotton acreage was planted to a genetically modified variety — insect-resistant, herbicide-tolerant, or stacked-gene. The percentage of acreage planted to these crops continues to expand. NASS prospective plantings indicate that 71 percent of 2002 planting will be genetically modified cotton varieties.

On a percentage basis, producers seem to have adopted genetically modified varieties of cotton more rapidly than genetically modified varieties of other field crops. The exception to this is genetically modified soybeans that were estimated to have reached 68 percent of planted acreage in 2001.

Presumably, farmers have adopted genetically modified cotton varieties because, relative to conventional varieties, they are perceived to increase expected net returns, reduce the variability in net returns (i.e., reduce risk), or both.

6.0 Market Influences

World cotton consumption increased throughout much of the 1980's. During the 1990's, however, several factors combined to limit further increases in consumption. These factors included slow global economic growth during the early 1990's, the collapse of the textile industry in the former Soviet Union, polyester consumption gains, and the Asian financial crisis that sent a shock wave through the Asian-dominated textile industry.

During the first half of the decade, world cotton consumption averaged only 85.6 million bales annually. This amount was similar to annual average consumption in the late 1980's. By the second half of the 1990's, average consumption increased somewhat to 87.7 million bales. From the 1998 low of 85.4 million bales, brought about by the Asian financial crisis, world cotton consumption rose to a record 91.9 million bales during the 1999 season and has remained near the 92 million bale mark over the past two seasons. China and Pakistan, both stagnant cotton consumers during the 1990's, have helped lead the rebound in world consumption, as has Russia's recovering textile industry.

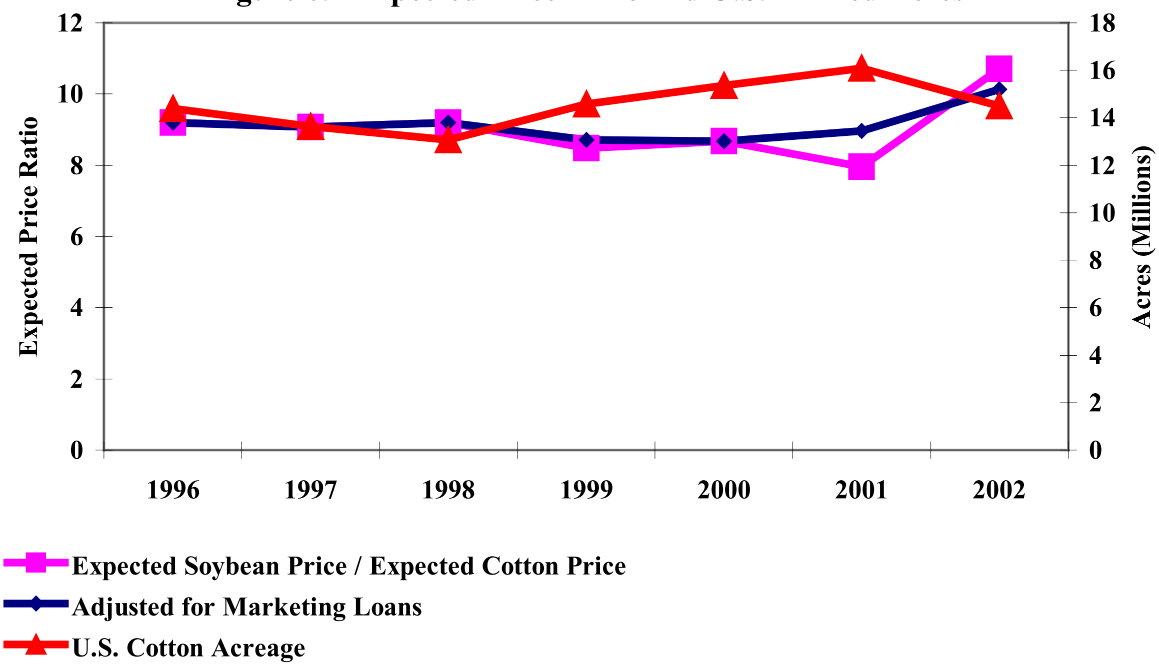
During the early 1990's, the annual average of world cotton production was approximately equal to the annual average of consumption. However, world cotton production fluctuated from a record of 95.8 million bales in 1991 to only 77.1 million two years later. This, in turn, caused significant variability in stocks and world prices. Stocks-to-use ratios ranged from approximately 44 percent following the record crop of 1991 to only 31 percent in 1993, while world cotton prices lagged these events, rising from about 58 cents per pound in 1992 to 92 cents in 1994. Subsequently, this price rebound encouraged a 12 percent increase in world cotton acreage in 1995 that resulted in production exceeding 93 million bales once again.

Aided by the large 1995 crop, world production averaged 89.4 million bales per year during the last half of the 1990's, nearly 2 million bales per year higher than average annual consumption. As a result, world cotton stocks increased, with stocks-to-use ratios exceeding 50 percent in both 1997 and 1998. Prices responded, declining from the 1994 peak to approximately 53 cents per pound for the 1999 season. With record world consumption (that exceeded production) in both 1999 and 2000, stocks were reduced. In 2001 world cotton acreage increased for the first time in 6 years (although U.S. acreage had been increasing since 1998). Official estimates of 2001 world cotton production are not yet available. However, due to generally favorable growing conditions around the globe, 2001 world cotton production is forecast to reach a new record, forcing stocks higher once again. As a result, world cotton prices have decreased. This is expected to lead to a reduction in cotton acreage in 2002 and increases in cotton consumption.

Market conditions affect expected commodity prices and hence, expected returns. Figure 6.1 shows the ratio of soybean price expectations to cotton price expectations for 1996 through 2002. Soybean price expectations are calculated as the February average closing price of the Chicago Board of Trade November soybean futures contract. Cotton price expectations are calculated as the February average closing price of the New York Board of Trade December cotton futures contract. In Figure 6.1 the ratio of price expectations is plotted along with planted acreage of cotton in the U.S.

During the period 1996-1998, the ratio of expected soybean prices to expected cotton prices was fairly steady. There was a slight increase in expected soybean prices relative to expected cotton prices in 1998. During this period cotton acreage decreased as farmers took advantage of the planting flexibility created by the 1996 FAIR Act. During the period 1999-2001, the ratio of expected soybean prices to expected cotton prices was lower than it had been over the previous three years. In other words, compared to the previous three years, expected cotton prices were higher relative to expected soybean prices over the period 1999-2001. This increase in expected cotton prices relative to expected soybean prices corresponds to increases in cotton acreage over the same period.

Figure 6.1 Expected Price Ratio and U.S. Planted Acres



In 2002, the ratio of expected soybean price to expected cotton price increased dramatically due to extremely low expected cotton prices. This corresponds to an expected sharp decrease in cotton planted acreage. The figure also shows the expected price ratio when the loan rate is taken into account. That is when market price falls below the loan rate, the loan is substituted for the market price. Including the loan rate affects the ratio in 2001 and 2002. In 2001 the ratio is slightly increased and in 2002 is slightly lowered.

In many cotton-producing regions, soybeans are the principal alternative crop to cotton. Figure 6.1 provides evidence that U.S. cotton planted acreage has varied inversely with the ratio of expected soybean prices to expected cotton prices.

7.0 Federal Commodity Programs

Since the New Deal era, the U.S. federal government has provided crop farmers with a variety of federal programs that reduce risk exposure and/or increase expected returns. Program benefits differ across crops. For example, federal programs have generally been targeted to row crop and small grains production. If, as hypothesized in section 4.0, farmers are in fact rational decision-makers who desire higher expected returns but dislike risk, relative differences in federal program benefits across crops undoubtedly affect farm-level crop-mix decisions. Historically, there have been instances where policy-makers deliberately structured federal farm programs so as to create incentives for farmers to produce more of one crop and less of others. Perhaps more common, however, are situations when federal programs have caused unintended effects on farm-level crop-mix decisions.

This section of the report examines the potential for federal farm programs to influence farmers' planting decisions. The discussion focuses on changes brought about by the 1996 farm bill, the marketing loan program, and *ad hoc* disaster assistance provided since 1998.

7.1 FAIR Act of 1996

Prior to 1996, farmers' eligibility for federal price and income support programs was contingent upon compliance with established acreage limitations. Federal regulations governed how crop-specific acreage bases were established for farms with established histories of producing program crops. Each year, the U.S. Department of Agriculture (USDA) would determine for each program crop what percentage of the acreage base could be planted. In some years farmers were allowed to plant their entire acreage base. In other years acreage reduction programs required farmers to idle some percentage of their base acreage to remain eligible for program benefits. Farmers were not allowed to plant another program crop on those set-aside acres. In this way, the USDA attempted to control market supplies and keep federal outlays for price and income support programs within budget constraints. Under the 1990 Farm Act flex acres provisions, farmers could plant up to 15 percent of their base to another program crop.

The FAIR Act of 1996 removed most base acreage restrictions. Counter-cyclical price and income support programs were replaced with Agricultural Market Transition Act (AMTA) payments that did not vary with market conditions. Instead they were pre-specified for each year of the 7-year farm bill. With only a limited number of exceptions (to protect fruit and vegetable growers from a sudden increase in supply), all remaining federal restrictions, that limited the production of program crops to designated base acres, were removed. Eligibility for federal benefits, and the magnitude of those benefits, became essentially independent of farmers' decisions regarding how many acres to plant and what crops to produce on those acres.

Farmers were now free to make planting decisions based on economic incentives. Planting flexibility greatly reduced federal intrusion into farm business decision-making. Farmers were also able to implement beneficial crop rotations. Planting flexibility allows farmers the flexibility to respond to market price signals and thus, improves market efficiency. However, planting flexibility complicates the process of predicting crop acreage.

Farmers can alter planting decisions in response to market incentives. They can also alter planting decisions in response to incentives inherent in federal farm programs. For example, loan rates above market clearing levels for some crops will create incentives that favor the production of those crops. These shifts would not be an efficient response to market signals but rather an unintended side effect of federal farm programs. To the extent that these changes in U.S. planted acreage shift market supply, notable impacts on relative prices could occur across commodities.

7.2 Marketing Loan Program

The FAIR Act of 1996 maintained the existing nonrecourse marketing assistance loan program. Under this program, the government provides producers with interest-bearing loans of 10 months' duration. The harvested crop serves as collateral. For each commodity, the dollar amount of the loan is the product of the quantity of commodity put under loan and a government established loan rate denominated in dollars per unit of production. If the loan is not repaid by the established expiration date, the commodity is forfeited to the government in lieu of cash repayment. To minimize commodity forfeitures when market prices are below the loan rate, the government allows the loans to be repaid at per unit rates that are approximately equal to local market prices. When this occurs, farmers receive a marketing loan gain of the difference between the loan rate and the repayment rate for each unit of production put under loan. Farmers, except for extra-long staple (ELS) cotton producers, may also opt to receive loan deficiency payments in exchange for agreeing not to take out marketing loans. Loan deficiency payments are equal to the difference between the loan rate and the established repayment rate.

Oilseeds and ELS cotton producers are eligible to participate in the marketing loan program, even though those commodities are not eligible for AMTA payments. Wheat, feed grains, upland cotton, and rice farms must be receiving AMTA payments to be eligible for the marketing loan program. If the farm is receiving AMTA payments, then the total production on that farm is eligible for marketing loans, not just production from the base acres.

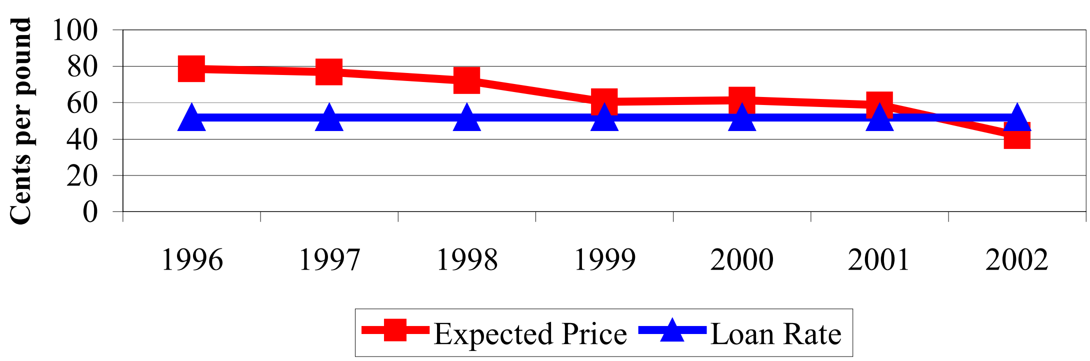
Under authorizing legislation, the sum of marketing loan gains and loan deficiency payments across all crops is limited to $75,000 per person (or $150,000 per person under the three-entity rule). However, in every year since 1999 *ad hoc* disaster legislation has increased the limitation to $150,000 per person (or $300,000 per person under the three-entity rule).

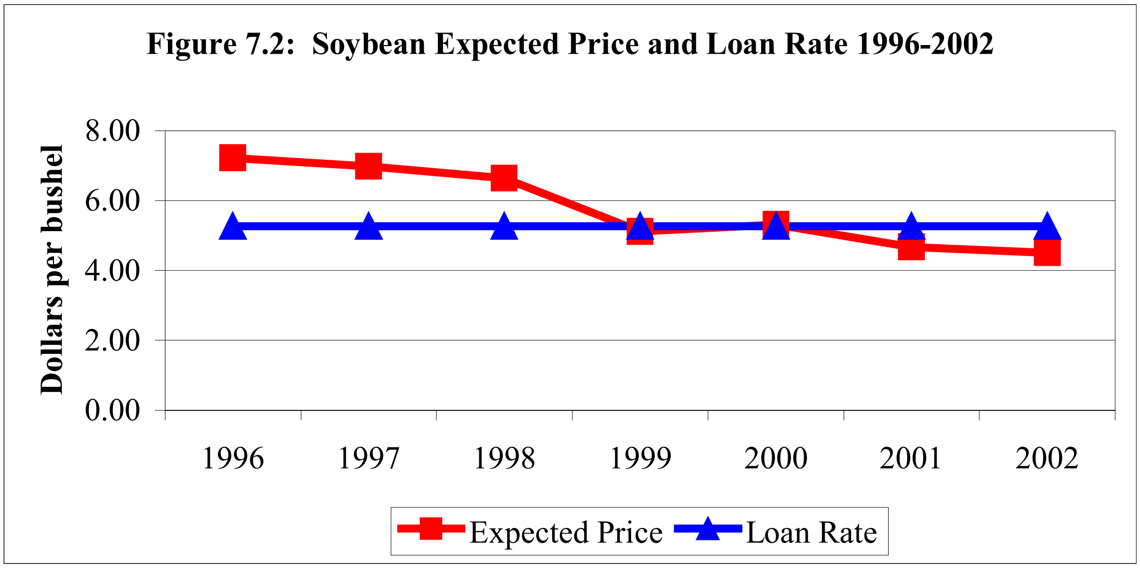
Actual loan rates vary by county. The 1996 FAIR Act set minimum and maximum national average loan rates for all eligible commodities. The Act also prescribed formulas for establishing the actual national average loan rate within these parameters. The national average minimum loan rate for cotton is $0.50 per pound and the maximum is $0.5192. Under the 1996 FAIR Act, the national average cotton loan rate has always been set at the maximum of $0.5192 per pound. By comparison, soybean loan rates are bounded between $4.92 per bushel and $5.26 per bushel. Under the 1996 FAIR Act, national average soybean loan rates have been set at the maximum in every year except 1996 when they were set at $4.97 per bushel.

In most cases farmers can sell the commodity at a price that approximates the repayment rate. So, for every unit of production put under loan, the marketing loan program effectively ensures that revenue per unit will be at least as high as the loan rate. Thus, the program functions as a sort of price insurance for producers of eligible crops. In years when market prices are consistently higher than the loan rate, farmers receive no marketing loan benefits (either marketing loan gains or loan deficiency payments). But when market prices are below the loan rate, farmers can expect to receive, on all production put under loan, per unit revenues that are approximately equal to the loan rate. Part of this revenue will derive from sale of the commodity and part will derive from marketing loan benefits. Thus, in effect, the marketing loan program provides producers a free put option on all production with the strike set at the loan rate.

To see how marketing loan rates might affect farmers' planting decisions, Figures 7.1 and 7.2 show expected prices and national average loan rates for cotton and soybeans since 1996. As before, the expected price for cotton is calculated as the February average closing price on the December New York Board of Trade cotton futures contract. The expected price for soybeans is calculated as the February average closing price on the November Chicago Board of Trade soybean futures contract.

Figure 7.1: Cotton Expected Price and Loan Rate 1996-2002





From 1996 to 1998 expected market prices were well above the loan rate for both cotton and soybeans. This does not mean, however, that the put option implicit in the marketing loan program was of no value. Even put options with strikes well "out of the money" have some value. There is always some probability that the price could fall below the strike.

In 1999 and 2000 expected market prices for cotton were slightly above the loan rate, while expected soybean prices were approximately equal to the loan rate. Soybean expected prices dropped below the loan rate in 2001. In this situation, the marketing loan clearly had significant value for soybean producers. The implicit put option was now "in the money." Cotton expected prices did not fall below the loan rate until 2002.

Periods of relatively low prices signals producers that the market currently desires less of that particular commodity. However, the free price insurance provided by the marketing loan program shields farmers from these price signals. In theory, if during periods of relatively low market prices farmers did not have this price protection, they would be more likely to reduce planted acreage or shift acreage into production of other commodities. To the extent that this theory is valid, the marketing loan program causes excess market supplies and low prices to be maintained for longer periods than would otherwise be the case. In addition, if relative loan rates across commodities are not consistent with relative market prices, there is potential for the marketing loan program to affect farmers' choices of which commodities to plant.

Westcott and Price empirically estimated the impact of the marketing loan program on planted acreage and prices for the major program crops. For the year 2000, they estimate an aggregate effect across all commodities of approximately 4 million additional planted acres due to the marketing loan program. Just less than 1.5 million of these additional planted acres were in upland cotton production, an increase of approximately 10.5 percent relative to cotton acreage that would have been planted without the marketing loan program. They estimate that this additional cotton acreage caused upland cotton prices to be approximately $0.05 per pound less than they would have been without a marketing loan program.

7.3 Ad Hoc Disaster Relief

Ad hoc disaster relief payments were made to U.S. crop producers in every year between 1998 and 2001. While some of these payments were designated as compensation for yield losses due to natural disasters, the largest share by far was designated as compensation for low market prices. The FY 1999 Omnibus Consolidated and Emergency Appropriations Act (P.L. 105-277) authorized nearly $2.9 billion in "market loss payments" as compensation for low market prices. Most of these payments were made in late 1998. These payments were disbursed as supplemental AMTA payments, and thus benefited only those already receiving AMTA payments under the provisions of the 1996 FAIR Act.

Another $1.9 billion was allocated for crop producers who experienced disaster-related yield losses in 1998 or in prior years. The FY 2000 Agriculture Appropriations Act (P.L. 106-78) provided more than $5.5 billion in supplemental AMTA market loss payments. These payments were made in late 1999. Soybean producers were eligible for $475 million in market loss payments. Another $1.2 billion was authorized for 1999 disaster-related yield losses. The Agricultural Risk Protection Act of 2000 (P.L. 106-224) authorized another $5.5 billion in supplemental AMTA market loss payments (paid in September 2000) and $500 million in soybean market loss payments. The FY 2001 Agriculture Appropriations Act (P.L. 106-387) contained more than $1.6 billion for disaster-related yield and quality losses in 2000. The 2001 Agricultural Economic Assistance Act (P.L. 107-25) authorized yet another $5.5 billion in supplemental AMTA market loss payments (paid in 2001) and another $500 million in soybean market loss payments. Additional payments are expected in 2002 if a new farm bill is not enacted.

Has this *ad hoc* disaster relief increased planted acreage of cotton, and if so, to what extent? In answering this question, an important consideration is to what extent farmers made planting decisions based on the expectation of future federal disaster payments. All of the disaster payments described above were *ad hoc*. None of the authorizing legislation created standing disaster payment programs that farmers could depend on in subsequent years. However, it is probably fair to say that after the first few years of supplemental AMTA payments farmers came to expect that those payments would be provided as long as market prices remained low.

Over 75 percent of the *ad hoc* disaster relief funds disbursed between 1998 and 2001 were in the form of supplemental AMTA payments. Those receiving AMTA payments are free to produce whatever crop they wish (with the exception of certain fruits and vegetables).

Thus, it seems improbable that supplemental AMTA payments would have increased incentives for planting cotton relative to other crops. In fact, one might argue that the structure of the *ad hoc* assistance created incentives for planting soybeans relative to cotton. Those receiving AMTA payments, but producing soybeans, were eligible for supplemental AMTA market loss payments, as well as soybean market loss payments.

If supplemental AMTA payments did not cause increased planting of cotton, did they forestall a reduction in cotton planted acreage that would have occurred otherwise? Would financially strapped cotton producers have been forced out of business without the supplemental AMTA payments, thus reducing cotton planted acreage? While the supplemental AMTA payments made since 1998 no doubt allowed many financially marginal cotton producers to remain in business, this does not necessarily imply that cotton acreage would have been reduced otherwise. As some farmers were forced out of business, the land would likely have been acquired by more financially secure farmers and kept in production. This is what has occurred during prior periods of financial difficulties in U.S. agriculture.

What about supplemental payments related to yield losses? Could these payments have increased incentives for producing cotton relative to other crops? Again, it seems unlikely. Less than 20 percent of the *ad hoc* payments made since 1998 were for yield losses. The *ad hoc* nature of these payments and the fact that only farms in designated disaster areas were eligible for yield loss payments makes it unlikely that, in any given year, farmers could have anticipated receiving disaster assistance tied to yield losses. Even if farmers did have expectations of yield loss disaster assistance, it is not clear how that would affect crop planting-decisions.

8.0 Crop Insurance Influences

Some have suggested that the crop insurance program may be at least partially responsible for recent increases in U.S. cotton planted acreage. Specific concerns have been raised about the large increase in planted acreage experienced in 2001. This section of the report addresses potential crop insurance influences on cotton planted acreage.

In 1999 and 2000 additional crop insurance premium subsidies were made available on an *ad hoc* basis. However, they were offered ex ante, so producers were aware of the additional subsidies at crop insurance sign up. Since the additional subsidies were not written into permanent authorizing legislation, farmers could not be certain that they would be available in future years. The Agricultural Risk Protection Act of 2000 (ARPA) altered permanent authorizing legislation to increase premium subsidies and change the distribution of subsidies across coverage levels. The impact of these changes is the first item discussed in this section.

Next is an analysis of cotton premium rate changes initiated with the 2000 crop year. This is followed by a discussion of crop insurance price elections. The section concludes by considering several other crop insurance issues that, at least anecdotally, have been linked to increased cotton acreage, particularly in the mid-south in 2001.

8.1 Premium Subsidies

The second and third columns of Table 8.1 show pre-ARPA statutory premium subsidy percentages for Crop Revenue Coverage (CRC), revenue insurance, and actual production history (APH), yield insurance products, respectively (*ad hoc* subsidies are not included). The highest coverage levels received the lowest premium subsidy percentages and vice versa. For example, a crop producer who purchased a CRC policy at the 85 percent coverage level would receive a federal premium subsidy equal to 10 percent of the total premium cost. The producer would pay the remaining 90 percent of the total premium cost. A crop producer who purchased a CRC policy at the 50 percent coverage level would receive a federal premium subsidy equal to 42 percent of the total premium cost. The producer would pay the remaining 58 percent of the total premium cost.

Table 8.1: Premium Subsidy Percentages Before and After ARPA

Coverage Level	Revenue Insurance Premium Subsidy Percentage Prior to ARPA	APH Premium Subsidy Percentage Prior to ARPA	APH and Revenue Insurance Premium Subsidy Percentage after ARPA	Increase in APH Premium Subsidy Due to ARPA
50% (buy-up)	42%	55%	67%	21.82%
55%	35%	46%	64%	39.13%
65%	32%	42%	59%	40.48%
70%	25%	32%	59%	84.38%
75%	18%	24%	55%	129.17%
85%	10%	13%	38%	192.31%

Prior to ARPA, the premium subsidy on CRC policies was set equal to the same dollar amount per acre as the premium subsidy on APH policies. Since premium rates for CRC policies are higher than those for corresponding APH policies, and since the dollar amount of premium subsidy per acre was being held constant across the two products, the premium subsidy percentage for CRC policies was lower than for APH policies. The premium subsidy percentage for CRC policies ranged from 10 percent to 42 percent while the premium subsidy percentage for APH policies was higher, ranging from 13 percent to 55 percent. ARPA stipulated that the federal premium subsidy percentage would be equalized across yield and revenue insurance products.

The fourth column of the table shows that ARPA also increased federal premium subsidies. While premium subsidies were increased for all coverage levels, the largest increases in premium subsidies were at the highest coverage levels. The fifth column of the table shows that ARPA increased premium subsidies at the lowest coverage level by approximately 22 percent , while subsidies at the highest coverage level were increased by over 192 percent.

Since premium subsidies are designated as a percentage of total premium, the higher the total premium, the higher the dollar value of the premium subsidy. This has some important implications. First, riskier crops and riskier production regions have higher premium rates. Thus, the dollar value of premium subsidies is higher for riskier crops and regions. Table 8.2 presents premium subsidies for non-irrigated cotton in Washington County, Mississippi; Dooley County, Georgia; and Lubbock County, Texas. For each county, the assumed APH yield is between 15 and 20 percent higher than the RMA reference yield for the county, and 75 percent coverage is assumed. The premium subsidy per $100 of liability in Dooley County, Georgia is more than double that in Washington County, Mississippi. The premium subsidy per $100 of liability in Lubbock County, Texas is more than four times higher than in Washington County, Mississippi. The premium rate reflects RMA's estimate of the relative yield risk in each of the counties. As is evident in Table 8.2, the riskier production regions receive the most dollars of premium subsidy per $100 of liability.

Table 8.2: Non-Irrigated Cotton Premium Subsidies

	Washington County, Mississippi	Dooley County, Georgia	Lubbock County, Texas
APH yield	825 lbs./ac.	650 lbs./ac.	300 lbs./ac.
Premium Rate	10%	27%	41%
Total premium per	$10.00	$27.00	$41.00

$100 of liability			
Producer premium per $100 of liability	$4.50	$12.15	$18.45
Dollars of premium subsidy per $100 of liability	$5.50	$14.85	$22.55

Designating premium subsidies as a percentage of total premium also favors high value crops over low value crops. Table 8.3 demonstrates this point using an example from Washington County, Mississippi. In this county, soybean premium rates are significantly higher than cotton premium rates. However, for this example, 75 percent coverage premium rates have been set to 0.15 for both crops. Normalizing the coverage level and premium rate allows the dollars of subsidy to vary only by the expected value of the crop. Crop insurance liability per acre is calculated using 75 percent coverage and the maximum price elections in place for 2001. Since the crop insurance liability per acre is significantly higher for cotton than for soybeans, the dollar amount of premium subsidy per acre is much higher for cotton than for soybeans. This is due strictly to the difference in the expected value of production per acre between the two crops.

Table 8.3: Premium Subsidies Per Acre for Washington County, Mississippi.
(For comparison purposes, 75% coverage premium rates for both crops have been set at 0.15).

	Soybeans	**Cotton**
APH yield	25 bu./ac.	825 lbs./ac.
2001 Maximum price election	$5.26/bu.	$0.63/lb.
Crop insurance liability per acre	$98.63	$389.81
Total premium per acre	$14.79	$58.47
Producer premium per acre	$6.66	$26.31
Dollars of premium subsidy per acre	$8.13	$32.16

Designating premium subsidies as a percentage of total premium favors both higher-risk producers and higher valued crops. In many regions of the South, soybeans are the principle alternative crop to cotton. Cotton is a higher valued crop than soybeans. In many regions it is also a riskier crop than soybeans. Thus, farmers can receive higher premium subsidies from producing cotton rather than soybeans.

8.2 Cotton Premium Rate Changes

The Senate report language to the 1999 Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Bill stated the following:

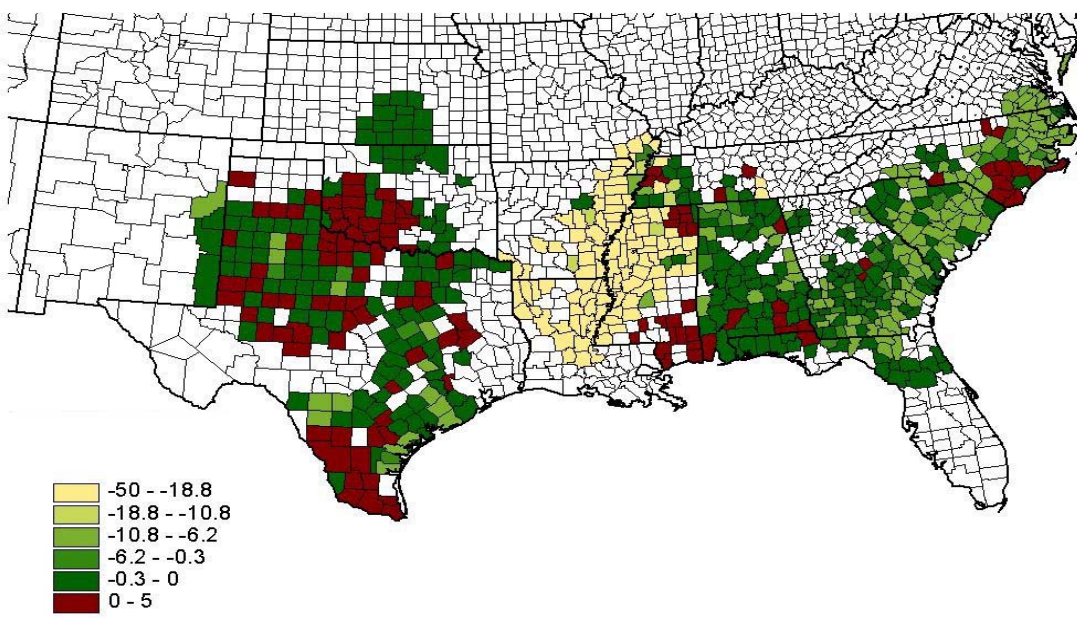
> Cotton producers participating in the Federal Crop Insurance Program pay significantly higher premiums and receive a lower indemnity per dollar of coverage when compared to other major commodities. In addition, cotton insurance premiums vary greatly among otherwise similar regions with little explanation. Within available funds, the Committee directs the agency to carry out a study to review current crop insurance rates, rating practices, and compare current rates to other major commodities. The Committee urges the agency to use independent experts representing all geographic cotton-growing areas.

In response, RMA contracted for an independent study addressing these issues. The requested study compared traditional RMA rate-making procedures, based on historical loss-cost, to simulation-based procedures as used for the Income Protection revenue insurance product. Traditional loss-cost procedures establish premium rates based on prior loss experience for a particular crop, county, and production practice. This rate-making procedure is commonly used in the insurance industry when previous loss experience is considered to provide a reasonable expectation of future losses. However, if for some reason future losses are expected to be different than previous loss experience, loss-cost rate-making is no longer appropriate.

Prior to 2000, some suggested that the cotton crop insurance loss experience was much higher than reasonable expectations. Among the reasons offered were that the cotton crop insurance program was plagued by moral hazard and adverse selection, and had experienced various design flaws (Barnett, Coble, and Spurlock). All of these problems would have contributed to high loss costs. Over time, RMA addressed these problems through program modifications. Thus, it was argued historical loss experience overstated future expected losses, and premium rates based on historical loss-cost were excessive.

The cotton rating study used NASS county-yield data, combined with RMA APH data, to simulate estimated loss costs for each cotton-producing county (Risk Management Agency). Since only yield data were used to conduct the simulation, the effects of past moral hazard, adverse selection, and policy design problems were less likely to impact estimated loss costs. The results from this study were used to adjust cotton premium rates for the 2000 crop year. Figure 8.1 shows the percentage change in non-irrigated cotton premium rates.

Figure 8.1: Crop Year 2000 Percentage Change in Non-Irrigated Cotton Premium Rates



The most drastic reductions in cotton premium rates occurred in the delta states of Arkansas, Louisiana, and Mississippi. Non-irrigated cotton premium rates decreased by up to 50 percent for many counties in these states. In contrast, premium rates actually increased slightly in other areas, particularly parts of Texas and Oklahoma.

The change in cotton premium rates, combined with the increased premium subsidies mandated by ARPA, resulted in a dramatic decrease in the premium paid by farmers for cotton crop insurance in many regions. Consider the example in Table 8.4 for a cotton farm in Washington County, Mississippi. The farm has an actual production history of 750 pounds per acre. To maintain consistency across time, a price election of $0.63 per pound is assumed for all years.

Table 8.4: Washington County, Mississippi Farm with 750 Pound per Acre APH Yield and Price Election of $0.63 per Pound.

Coverage Level	Dollars of Coverage per Acre	Farmer Premium per Acre 1998	Farmer Premium per Acre 2001	Change in Farmer Premium from 1998 to 2001
50%	$236	$10.74	$4.00	-63%
55%	$260	$15.43	$5.22	-66%
60%	$284	$21.69	$6.35	-71%
65%	$307	$25.09	$8.95	-64%
70%	$331	$38.29	$11.70	-69%
75%	$355	$58.34	$17.43	-70%
80%	$378	N/A	$27.26	N/A
85%	$402	N/A	$43.54	N/A

After the premium rate adjustments and the ARPA additional premium subsidies, farmer premiums per acre for 2001 were between 63 and 71 percent less than in 1998, depending on the coverage level. The 80 and 85 percent coverage levels were not available in 1998.

Table 8.5 presents another example, this time for a cotton farm in Limestone County, Alabama. This farm has an actual production history yield of 650 pounds per acre. Again, to allow for comparison, the price election is set at $0.63 per pound for all years.

Table 8.5: Limestone County, Alabama Farm with 650 Pound per Acre APH Yield and Price Election of $0.63 per Pound				
Coverage Level	Dollars of Coverage per Acre	Farmer Premium per Acre 1998	Farmer Premium per Acre 2001	Change in Farmer Premium from 1998 to 2001
50%	$205	$3.95	$2.90	-27%
55%	$225	$5.70	$3.80	-33%
60%	$246	$8.09	$4.60	-43%
65%	$266	$9.47	$6.54	-31%
70%	$287	$14.25	$8.58	-40%
75%	$307	$21.86	$12.72	-42%
80%	$328	N/A	$19.95	N/A
85%	$348	N/A	$31.89	N/A

The percentage change in farmer premium between 1998 and 2001 is not as dramatic as for the Washington County, Mississippi farm. There are two reasons for this. First, premium rates for the Washington County, Mississippi farm are higher than for the Limestone County, Alabama farm. Thus, the higher premium subsidy percentages introduced by ARPA benefit the Washington County, Mississippi farm more than the Limestone County, Alabama farm. Second, as seen in Figure 8.1, when cotton premium rates were adjusted in 2000, Alabama premium rates were not reduced as much as Mississippi premium rates.

8.3 Price Elections

Some have suggested that crop insurance price elections have occasionally created incentive for increases in cotton acreage. The 2001 crop year is often used as an example. In late 2000, RMA established a maximum price election for 2001 APH insured cotton of $0.63 per pound. After this announcement cotton futures market prices decreased. The February 2001 average closing price for the December cotton futures contract was $0.59 per pound, or approximately 7 percent less than the established maximum cotton price election. By harvest, prices had decreased to approximately $0.35 per pound.

Also in 2001, the APH price election for soybeans was set at the national average loan rate of $5.26 per bushel. The February expectation of price at harvest was $4.67 per bushel, or approximately 13 percent less than the established maximum soybean price election.

Figures 8.2 and 8.3 show expected prices (February average of harvest futures contract), loan rates, and APH maximum price elections for cotton and soybeans, respectively, for 1996-2002. It is interesting to note that the difference between the APH price election and the expected price for cotton was actually greater in 1999 than in 2001. In 1999, the APH price election was $0.66 per pound, or 10 percent higher than the expected price of $0.60 per pound.

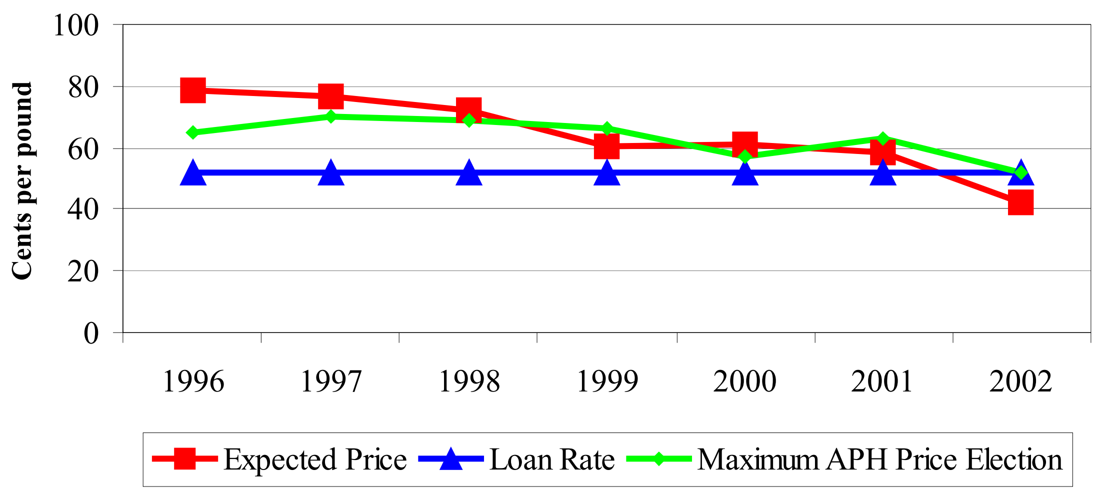
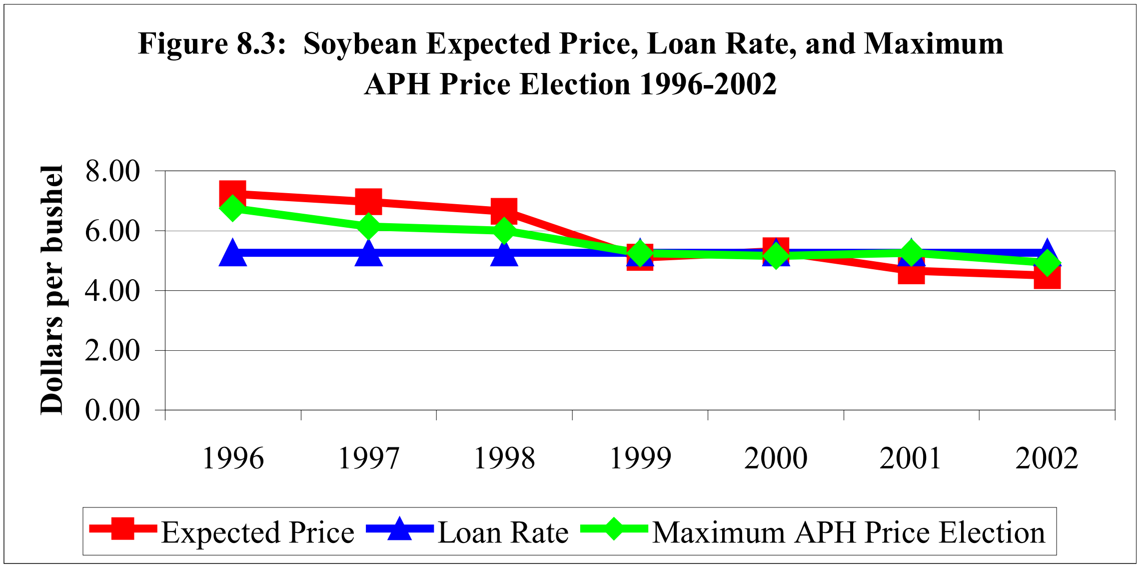


Figure 8.2: Cotton Expected Price, Loan Rate, and Maximum APH Price Election 1996-2002

Moral hazard may occur if the APH price election is well above market prices. In the extreme, an insured farmer may be tempted to deliberately lose the crop. However, in some cases, the marketing loan program creates an important counterbalance *against moral hazard.* While the APH price election for soybeans in 2001 was 13 percent higher than the market price expectation, it was equal to the loan rate. Thus, the APH price election created no incentive to lose the crop because causing a bushel to be lost would result in an equal



reduction in marketing loan benefits. By comparison, the cotton APH price election was only 7 percent higher than the market price expectation. However, it was more than 17 percent higher than the national average loan rate of $0.52 per pound. Thus, in 2001, the cotton marketing loan program provided much less of a disincentive for moral hazard behavior than did the marketing loan program for soybeans.

Despite this, it is important to remember that when farmers were making planting decisions in 2001, the expected price for cotton (based on the futures market) was $0.59 per pound, just slightly below the APH price election of $0.63 per pound. It seems very unlikely that many farmers made premeditated decisions to plant and lose a cotton crop simply to capture what was then an expected difference of $0.04 per pound. Even at the highest coverage level of 85 percent, the lost deductible would far exceed $0.04 per pound. With 85 percent coverage and an expected market price of $0.59 per pound, the value of the lost deductible would be almost $0.09 per pound, far more than the $0.04 per pound difference between the maximum price election and the expected market price. The value of the lost deductible is even higher for lower coverage levels. Thus, considered in isolation, it seems that the 2001 APH price election for cotton would not have created incentives for increased cotton acreage.

8.4 The Potential for Over-Insurance

As argued above, it is hard to see how recent cotton APH price elections by themselves could affect planted acreage. However, if effective deductibles are significantly lower than stated deductibles, APH price elections could impact acreage planting decisions. This situation could occur if farmers were offered an approved APH cotton yield that greatly exceeded their actual expected yield – a situation that we will call being "over-insured."

There are a number of methods by which farmers can become over-insured. Most of these methods require that the farmer be producing on land of heterogeneous quality within the same county. For example, a farmer can transfer a high proven yield from a "reference unit" to an insured unit on lower quality added land within the same county. Anecdotal information suggests that in recent years this method has been used by several mid-south cotton producers. In response, the RMA has made numerous changes to reference unit added land procedures since 2000.

Another method used to become over-insured is to claim new producer status for a particular crop. Again, anecdotal evidence suggests that this method has been widely used in the mid-south in recent years. Standard RMA procedures require that for purposes of calculating an approved APH yield, policyholders provide at least 4 years of proven yield records on insured units. If policyholders cannot provide 4 years of proven yield records, the missing years are replaced with a T-yield, which is essentially a percentage of the National Agricultural Statistical Service (NASS) county average yield for that crop in that county. The percentages are set so as to provide severe penalties to those who cannot provide at least 4 years of yield records for the insured unit. However, new producers, who have at least 4 years of yield records on one insured unit, are not subject to these penalties on other insured units. So, if new producers provide 4 years of yield records on at least one unit, then for all other insured units 100 percent of the NASS county average yield can be used in place of any missing proven yields.

While designed to keep from penalizing new farmers, the new producer provisions can be manipulated in counties with heterogeneous soil quality. For example, in the delta region of Mississippi, cotton is typically produced on high quality silt loam soils. NASS county average yields can exceed 800 pounds per acre. But there are also heavy clay soils in these same counties that, if planted at all, are typically planted to rice or soybeans. If planted to cotton, these heavy clay soils might be expected to yield only between 200–300 pounds per acre. A cotton farmer, who is classified as a new producer and can provide 4 years of yield records on one unit of insured cotton, can effectively take an 800 pound per acre APH yield and apply it to soils that are capable of producing less than 300 pounds per acre. If the farmer purchased a policy with 75 percent coverage, the units with an excepted yield of 300 pounds per acre would effectively be 100 percent over-insured. It is almost certain that these over-insured units will receive an indemnity. Even farmers who are not really new producers can play this game by having another family member insure the crop as a new producer.

Yet another method for becoming over-insured involves establishing high proven yields on good quality land. Then for one year only, the farmer combines the good quality land with poorer quality land from a number of locations that are potentially insurable as optional units. However, the farmer insures both the high quality land and the low quality land as one aggregate basic unit. In the next year, the basic unit is disaggregated into a number of optional units. Each of the optional units will inherit the yield history of the aggregate basic unit – most of which was established on the high quality land.

Finally, prior to the 2001 crop year, several farmers in the mid-south became convinced that crop insurance provisions did not accurately adjust cotton approved APH yields for skip-row planting patterns. During that time, two of the authors heard many stories about farmers who were convinced that they could become over-insured by using skip-row planting patterns. When the issue was raised with RMA officials at the Jackson, Mississippi regional office, they replied that a number of farmers and/or their insurance agents seemed to be misinformed about crop insurance skip-row provisions.

The opportunity to over-insure can create incentives for additional cotton planted acreage. Anecdotal information suggests that, particularly in the mid-south, farmers have recognized and taken advantage of these opportunities. The incentive for producers to become over-insured using one of these methods is only amplified by situations such as 2001 when cotton price elections were higher than expected market prices.

Table 8.6 presents a hypothetical example of expected net returns from purchasing crop insurance in Marshall County, Mississippi. Since the soils are of moderate quality, the expected cotton yield is only 600 pounds per acre. Two scenarios are presented. One scenario has the approved APH yield equal to the true expected yield of 600 pounds per acre. The other scenario demonstrates a case of over-insurance since the approved APH yield is 700 pounds per acre. Both insurance scenarios utilize the 2001 cotton price election of $0.63 per pound and assume 75 percent coverage. However, note that in the over-insurance scenario, the effective coverage level is 87.5 percent (.75 x (700 / 600)).

Table 8.6: 2001 Expected Net Returns from Crop Insurance

	APH = 600 lbs./ac.	APH = 700 lbs./ac.
75% Coverage Crop Insurance Producer Premium Per Acre	$18.06	$17.73
75% Coverage Crop Insurance Expected Indemnity Per Acre	$40.14	$46.83
Expected Net Return Per Acre From Crop Insurance	$22.08	$29.10

In both scenarios, crop insurance purchasing significantly increases the expected net return per acre. However, the combined expected net return per acre in the over-insurance scenario is $7.02 per acre higher than in scenario without over-insurance. There are two reasons for this. First, in the over-insurance scenario premiums are reduced because the premium calculation formula assigns lower premium rates to producers with higher approved APH yields. Second, with over-insurance, expected indemnities are higher because the effective coverage is higher.

9.0 Empirical Estimates of Acreage Response

A regression model was estimated to examine how cotton acreage responds to changes in expected net returns to cotton and competing crops. The analysis focused on Mississippi, where the most dramatic shifts in cotton acreage occurred during the past five years. Soybeans are the predominant crop that competes with cotton for acreage in Mississippi, so only cotton and soybean net returns were incorporated into the model. The time period modeled was 1996 through 2000, one in which other commodity program parameters were relatively stable and thus would not be expected to explain substantial acreage changes.

Data used in our analysis were obtained from three primary sources:

a) The unit-level crop insurance records for individual insured producers;
b) Crop cost of production information obtained from Mississippi State University (MSU); and,
c) County crop acreage information obtained from National Agricultural Statistical Service (NASS) databases.

Given the large Mississippi cotton acreage change that occurred in 2001, it would have been desirable to include that year in the analysis. However, NASS acreage estimates for the 2001 crop year are currently available only at the state level. Therefore, we were precluded from incorporating 2001 crop year information into our model, which was formulated to estimate acreage at the county level.

The model was specified as a complete panel, which means that only counties with adequate data to provide the necessary crop insurance and other information for the full five-year period were included. The dependent variable to be explained by the model was county level cotton acreage in crop years from 1996-2000. The explanatory variables included:

a) *County Identifiers* for each county, to account for differences in total crop acreage, land quality, and other unique production characteristics of the county;
b) *Cotton Expected Net Return Per Acre*, and
c) *Soybean Expected Net Return Per Acre.*

Cotton and soybean net returns per acre were constructed to include both *Expected Net Market Return* and *the Expected Net Return to Insurance*. Per acre values of *Expected Net Market Return* and *Expected Net Return to Insurance* for each crop, in each county and year were calculated as follows:

Expected Net Market Return = (Expected Price * Expected Yield) - Cost, and

Expected Net Return to Insurance = Expected Indemnity - Producer Premium.

The expected price for each crop in each year was the February average of daily settlement prices for the harvest month futures contract.[1] Thus, it was the harvest-period price being forecasted by the futures market at the time planting decisions were being made. The futures contract used in calculating expected cotton price was the December New York Board of Trade Cotton contract. The contract used in calculating the expected soybean price was the November soybean contract traded on the Chicago Board of Trade. Costs for each county and crop year were based on Mississippi State University planning budgets and data from an

[1] It is commonly assumed that producers assume the commodity loan rate represents a minimum expected price when market price expectations are below the loan rate. However, during the time period examined here, market price expectations for cotton and soybeans remained above the loan rate in each year.

annual survey of crop producers, also conducted by MSU. Expected insurance indemnities were based on non-subsidized crop insurance premium rates for the 1996 crop year, which were intended to be actuarially fair and to represent expected losses for producers in each county. Per acre producer insurance premiums were calculated by multiplying per acre liability times the subsidized premium rate for the county and year.

Our model results are fully reported in Appendix B. Here we focus on interpreting and analyzing the implications of results relating to the effects of *Cotton Expected Net Market Return*, *Soybean Expected Net Market Return*, *Cotton Expected Return to Insurance* and *Soybean Expected Return to Insurance* on Mississippi cotton acreage during the study period. Those results indicate that a one-dollar increase in *Cotton Expected Net Market Return* or *Cotton Expected Return to Insurance* increased cotton acreage in an average Mississippi county included in the analysis by 71 acres. The estimated effect of a one-dollar per acre increase in *Soybean Expected Net Market Return* or *Soybean Expected Return to Insurance* was a decrease of 197 cotton acres for an average county.

Economists find it useful to translate estimated effects like those from our models into elasticities, which express the effects in terms of percentage changes. The estimated elasticities depend on the mean values of the relevant variables. Since for both crops the mean of *Expected Net Market Returns* is much larger than the mean of *Expected Returns to Insurance*, the elasticities for *Expected Net Market Returns* are much larger than the elasticities of *Expected Returns to Insurance*. We focus first on elasticities based on 1998 *Expected Net Market Returns* and *Expected Returns to Insurance* for each crop, in order to set the stage for an analysis of the dramatic increase in cotton acreage that occurred between the 1998 and 1999 crop years. Our results, based on 1998 values, indicate that a 1 percent increase in the *Cotton Expected Net Market Return* would result in a 0.222 percent increase in average county cotton acreage, while the estimated effect of a 1 percent increase in *Soybean Expected Net Market Return is a* 0.255 percent decrease in county cotton acreage. The estimated effect of a 1 percent increase in the *Cotton Expected Return to Insurance* is a 0.036 percent increase in average county cotton acreage, and the effect of a 1 percent increase in *Soybean Expected Return to Insurance* is a 0.042 percent reduction in average county cotton acreage. An important attribute of these results is that the estimated effects of percentage changes in *Expected Net Market Returns* for both cotton and soybeans are much larger than the effects of similar percentage changes in cotton or soybeans *Expected Returns to Insurance*. We will elaborate on this issue further after the example results for the 1998 to 1999 crop years are presented.

Average cotton acreage in the Mississippi counties included in our analysis was 35,465 in 1998 and increased by 28.6 percent to a level of 45,621 acres in 1999. The predicted change from our model is a slightly lower 25.5 percent. This predicted change can be decomposed as shown in table 9.1. Between 1998 and 1999 *Cotton Expected Net Market Return* increased modestly, by 11.1 percent, while *Soybean Expected Net Market Return* plummeted by 92.6 percent. *Expected Net Returns to Insurance* for both commodities increased substantially. The decomposition of the predicted percent change in cotton acreage clearly shows that the preponderance of that change resulted from the decline in soybean returns. A 38.5 percent increase in *Cotton Expected Return to Insurance* resulted in a modest 1.4 percent increase in cotton acreage, which was slightly dominated by a predicted 2.0 percent decrease in cotton acreage arising from a 48.2 percent increase in *Soybean Expected Return to Insurance*. Consistent with the magnitudes of the elasticities reported earlier, *Expected Net Market Return* had a much stronger influence on the estimated cotton acreage change than did the changes in *Expected Return to Insurance*. For example, an 11.1 percent increase in *Cotton Expected Net Market Return* increased cotton acreage by an estimated 2.4 percent, while a much larger 38.4 percent change in *Cotton Expected Return to Insurance* resulted in only a 1.4 percent estimated acreage increase.

In the analysis above, it is clear that large changes in *Expected Returns to Insurance* for both cotton and soybeans had minimal estimated effects on the cotton acreage change in the study counties between 1998 and 1999. Although this result was in part due to offsetting effects of increases in premium rates for both crops, it is also apparent that the individual effects of the changes for each crop were small. This can be further illustrated by examining the data for crop years 1999 and 2000, when cotton premium rates were dramatically reduced in the study counties and most other Mississippi counties, while soybean premium rates remained fairly constant. The elasticities from our models, based on 1999 values of all variables, indicate that a 1 percent increase in the per acre cotton premium would have resulted in a 0.021 percent decrease in cotton acreage. Soybean elasticities indicate that a 1 percent increase in the per acre soybean premium would have given rise to an estimated 0.022 percent increase in cotton acreage. Between 1999 and 2000, the average per acre cotton premium decreased by 44 percent, from $13.70 in 1999 to $7.73 in 2000. Based on our estimated elasticity, this would have given rise to a 0.92 percent increase in expected cotton acreage in an average study county. The change in per acre soybean premium between the two years was 3.7 percent, from $5.17 in 1999 to $5.36 in 2000. Our results indicate that this small increase in the per acre soybean premium would have resulted in a 0.08 percent increase in cotton acreage. Thus, this large change in relative per acre premiums for the two crops resulted in an estimated change in cotton acreage of only 1 percent.

What the results presented here demonstrate is that *Expected Net Market Returns* for both cotton and soybeans have substantial effects on cotton acreage in Mississippi. However, changes in *Expected Returns to Insurance* or in per acre insurance premium rates have very modest effects on acreage.

Table 9.1: Decomposition of Estimated 1998 to 1999 Average Change in Cotton Acreage for Mississippi Study Counties.		
Factor Influencing Acreage Change	Change in Factor Between the 1998 & 1999 Crop Years	Predicted Cotton Acreage Change Between 1998 & 1999
Cotton Net Market Return	+11.1%	+2.4%
Soybean Net Market Return	-92.6%	+23.7%
Cotton Expected Return to Insurance	+38.5%	+1.4%
Soybean Expected Return to Insurance	+48.2%	-2.0%
	Estimated Percent Change In Acreage	+25.5%

Having estimated a model of Mississippi cotton acreage, we then investigated changes in cotton acreage in 2001 and 2002, given pre-season USDA surveys. The model predicts aggregate state level acreages conditioned on economic expectation in the spring. Using preseason futures prices for both 2001 and 2002, expected revenue for cotton and soybeans is calculated. The expected return to insurance for both years is updated using RMA price elections for each year, and ARPA subsidy rate changes made in 2001are also included. The change in expected net market returns and expected net returns to insurance are then combined with point elasticities from 2000 data to estimate cotton acreage changes.

Table 9.2 Out of Sample Prediction of Mississippi Cotton Acreage Changes

Time Period	Cotton elasticity	Percent change in expected cotton net returns (net market returns + net crop insurance)	Soybean elasticity	Percent change in expected soybean net returns (net market returns + net crop insurance)	Predicted cotton acreage change	Planting Intentions Change From Previous Year*
2000 to 2001	+0.225	+15.7	-0.12	-44.8%	+9.0%	+15%
2001 to 2002	+0.225	-87.2%	-0.12	-27.6	-16.3%	-14%

* March USDA planting intention estimate of Mississippi cotton acres relative to actual plantings in previous year. Actual planting in 2001 exceeded reported intentions.

Table 9.2 shows values used in the out-of-sample predictions. In 2001, modest increase in expected net returns to cotton was coupled with a larger decrease in the expected net returns to soybeans. The results of this analysis show that while the model does predict an increase in cotton acres in 2001, the prediction of a 9% increase is below the observed 15% increase. For 2002, there is a strong decline in cotton expected net returns coupled with further decline in expected soybean net returns. Here the model predicts a 16% decline in cotton acreage, which is very close to the most recent USDA planting intention reports.

It is not clear why the model predicts one year closely while underestimating the change in the other year. One factor may be that weather conditions influenced planting in 2001. Generally, cotton can be planted earlier than soybeans in Mississippi. Good cotton planting conditions in 2001 may have contributed to the increase in 2001 cotton acreage. Another issue that should be noted is that the net returns to insurance used in these calculations assumes actuarially sound crop insurance rates. To the extent that some aspect of crop insurance adds incentives to plant cotton, then these estimates would not capture that effect. To the extent these effects exist, they are inherently difficult to measure because they are not uniform across producers. We attempt to address these issues in the next section where individual policy data is examined.

10.0 Empirical Examination of Unit-Level Crop Insurance Data

In this section, we report an examination of producer-level crop insurance policies. In particular, we analyze attributes of the policies that producers have chosen to purchase. The data used in this analysis are at the unit (basic or optional) level of aggregation. To conduct the analysis three different datasets were merged: 1) the enrollment records that producers provide when signing up for crop insurance; 2) the APH yield histories establishing the approved yields for insured units; and, 3) the loss records if losses occur.

The analysis focuses on five attributes that can be identified in the unit-level data. These are: 1) whether the unit is classified as "added land"; 2) whether the unit is for a new producer; 3) whether there has been a yield adjustment for at least one of the years used to calculate the APH yield; 4) whether the APH yield has been constrained from decreasing more than 10 percent relative to the previous year (the yield cup); and, 5) whether skip-row production practices were used. For each of these attributes, we first examine the percentage of cotton crop insurance liability in each state that has the attribute. We next present maps showing geographic differences in the percentage of liability that has the attribute. We then compare the actuarial performance on units with that particular attribute to the actuarial performance of all other cotton policies in the same county.

10.1 Added Land Provisions

Figure 10.1 shows, by state, the percentage of 2001 cotton liability identified as "added land". For Mississippi, almost 10 percent of cotton liability in 2001 was for added land. By contrast, in Texas slightly over 2 percent of cotton liability was for added land.

Figure 10.1: Percentage of 2001 Cotton Liability that is Identified as Added Land

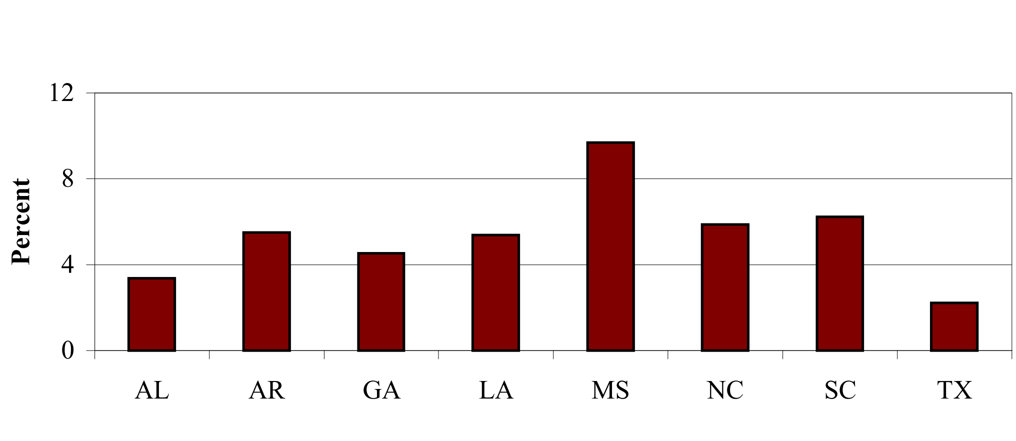
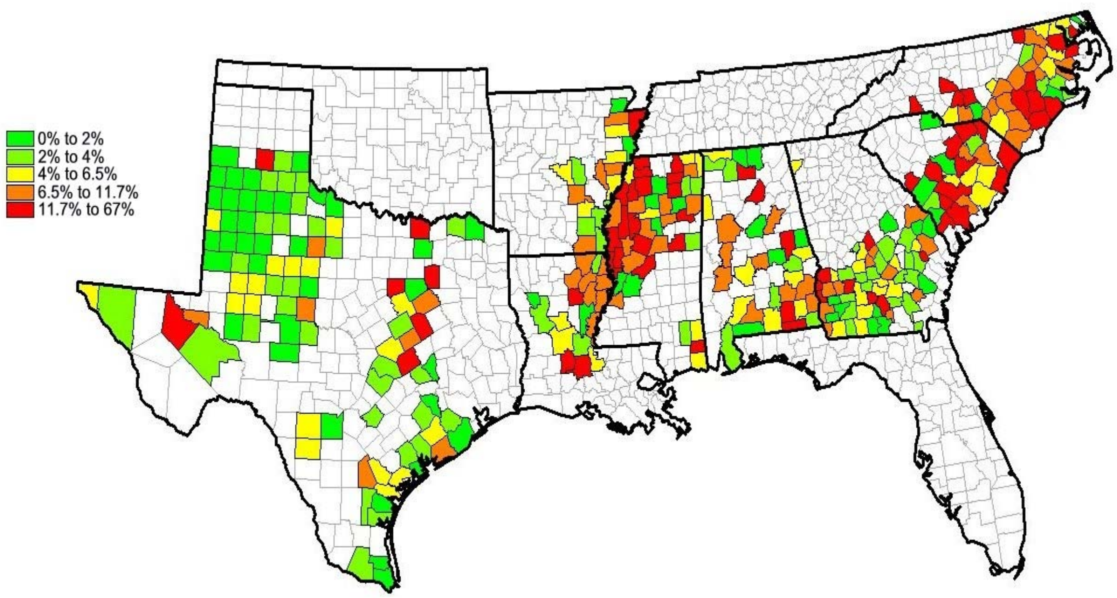


Figure 10.2 shows geographic differences in the percentage of 2001 cotton liability that was for added land. Counties colored red have relatively more of the attribute while counties colored green have relatively less.

Figure 10.2: Geographic Differences in the Percentage of 2001 Cotton Liability Identified as Added Land



A loss ratio, measured as indemnities divided by premiums, is frequently used to measure the actuarial performance of an insurance product. To examine actuarial performance associated with a particular attribute, we divide the loss ratio on policies with the attribute by the loss ratio on policies in the same county that do not have the attribute. For this "relative loss ratio", a value of 1.0 would mean that on average the actuarial performance of policies with the attribute was no different than that of policies without the attribute in the same county. A value higher than 1.0 indicates that the average actuarial performance of policies with the attribute was worse than the actuarial performance of policies without the attribute. A value lower than 1.0 implies that the average actuarial performance of policies with the attribute was better than that of policies without the attribute. The results are reported on a state-by-state basis with aggregate state measures being weighted by the liability associated with each policy. Note also that we only examined counties with at least 1,000 acres of the specific attribute in the county. This ensures that we make comparisons of actuarial performance only in counties with a significant amount of insured acreage identified with the specific attribute.

Figure 10.3 shows the 2001 relative loss ratio for cotton policies identified as having added land. The results are fairly uniform across all eight states. South Carolina is the only state in which added land policies actually had a lower loss ratio than those that were not identified as added land. For the other seven states the relative loss ratio ranges from 1.10 to 1.66. This suggests that, on average, policies associated with added land had worse actuarial performance than policies that were not. To the extent that producers expect added land policies will incur greater losses, this might influence the decision to plant and insure additional acreage.

Figure 10.3: 2001 Added Land Cotton Loss Ratio Relative to Non-Added Land Cotton in the County (State Weighted Averages)

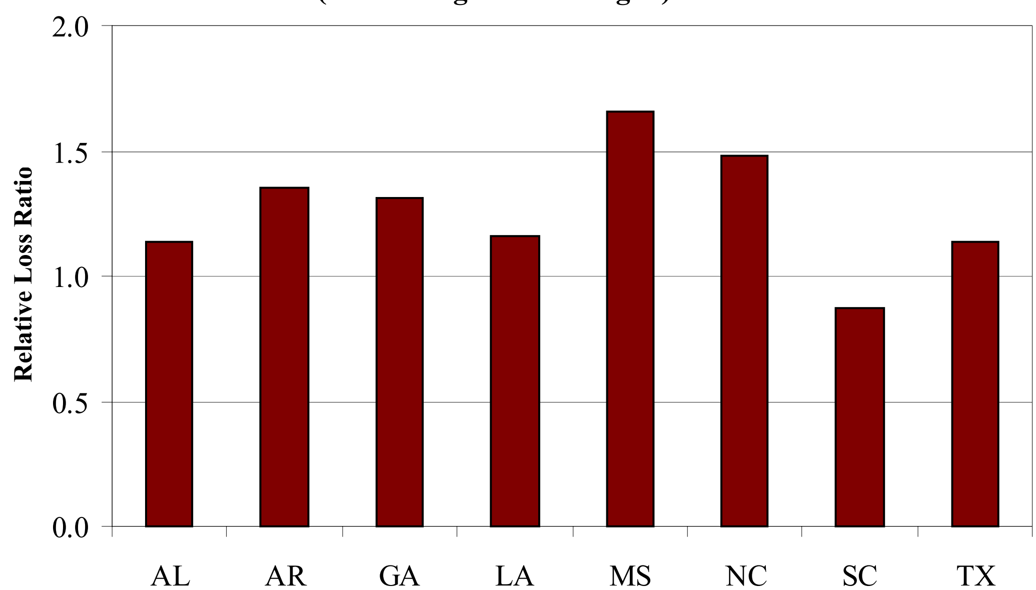
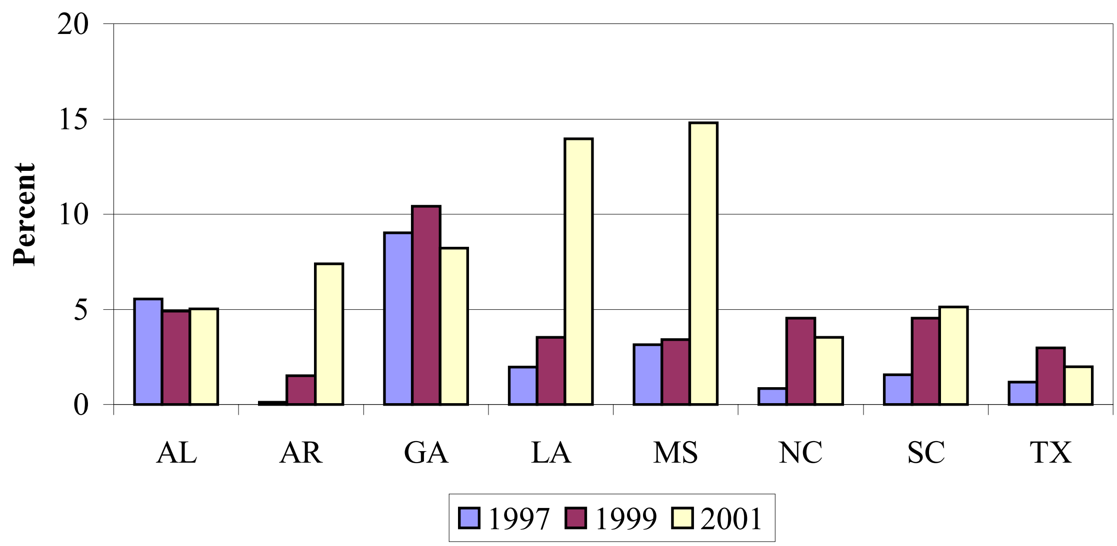


Figure 10.4: Percentage of 2001 Cotton Liability that is Identified as Receiving a Special T-Yield for a New Producer



10.2 New Producer Provisions

Figure 10.4 reports the percent of cotton liability identified as receiving a special T-yield for a new producer. As indicated earlier, RMA procedures allow a new producer of a crop in the county to avoid the penalties that are normally applied when less than four years of APH history are provided. In this instance, the producer is allowed to receive the county T-yield as an approved yield. This figure reports the results on a two-year interval beginning in 1997. The mid-south states have experienced the most dramatic changes. For the most part, these changes occurred between 1999 and 2001. For example, in 1999 approximately 4 percent of Louisiana cotton liability was identified as being for new producers. In the year 2001, new producers accounted for over 14 percent of Louisiana cotton liability. Similar results are shown for Mississippi and Arkansas. In each year examined, Georgia had between 8 percent and 10 percent of cotton liability associated with new producers. North Carolina, South Carolina, and Texas have, in general, experienced levels of new producer activity well below 5 percent in each year.

Figure 10.5: Geographic Differences in the Percentage of 2001 Cotton Liability Identified as Receiving a Special T-Yield for a New Producer

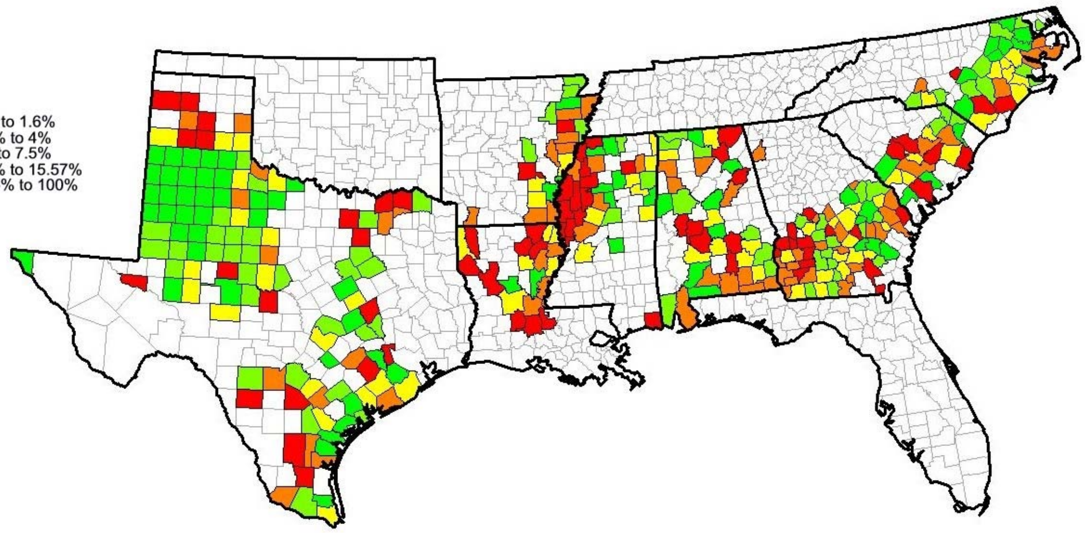
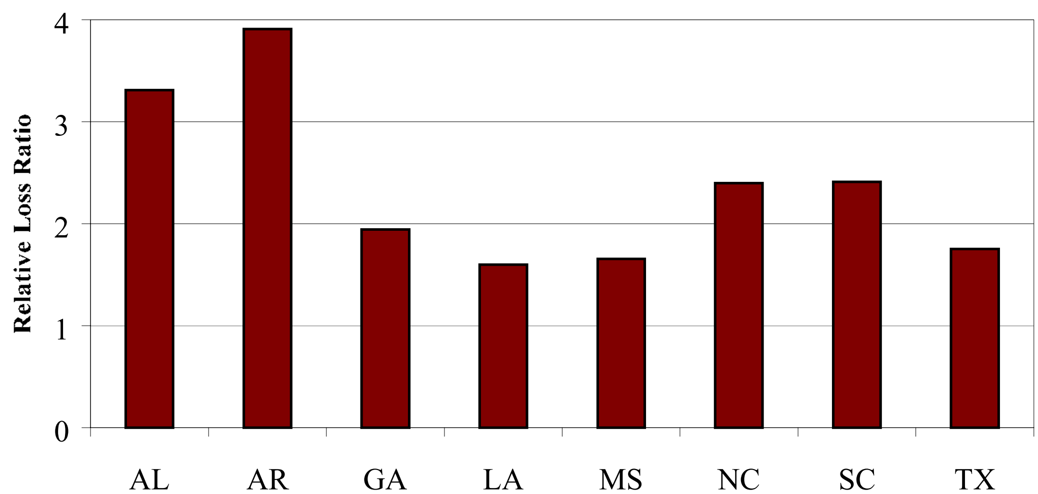


Figure 10.5 shows geographic differences in the percentage of 2001 cotton liability that was for new producers. Figure 10.6 shows that across all eight states analyzed, the average loss ratio for new producer policies was significantly higher than for policies without this attribute. In particular, Alabama and Arkansas have relative loss ratios in excess of 3.0, indicating that the average loss ratio on new producer policies was more than three times higher than the average loss

Figure 10.6: 2001 New Producer Cotton Loss Ratio Relative to Non-New Producer Cotton in the County (State Weighted Averages)

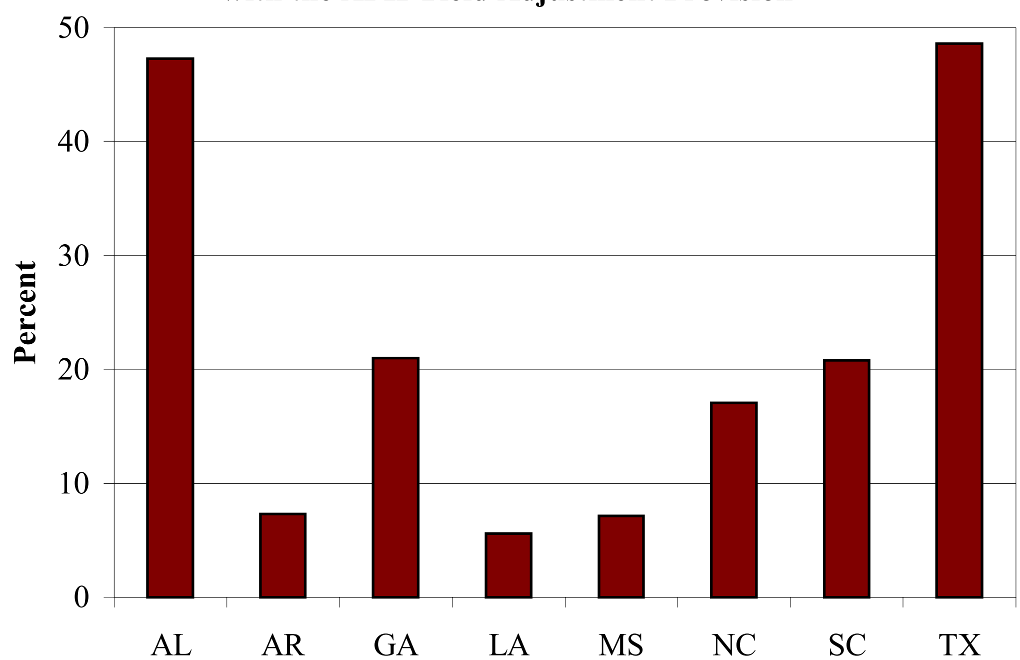


ratio of policies without this attribute. While the results were not as extreme in other states, the lowest relative loss ratio (for Louisiana) still indicates that the average loss ratio on new producer policies was 60 percent higher than for those not associated with new producers. These findings suggest that there is a significant difference in loss experience between new producers and other cotton crop insurance purchasers. If farmers recognize that by obtaining a new producer policy they can increase their expected returns, this might affect cotton crop insurance participation and planted acreage. However, it is not clear to what extent producers are able to know this in advance.

10.3 Yield Adjustment Provisions (60 percent of T-Yields)

As a result of a change contained in the 2000 ARPA legislation, insured farmers can now elect to have their approved APH yield calculated using 60 percent of the county T-yield in lieu of an actual yield that is lower than 60 percent of the T-yield. Thus, this provision tends to raise the approved APH yield for the unit. For 2001 we were able to identify policies that made use of this APH yield adjustment provision.

Figure 10.7: Percentage of 2001 Liability that is Identified with the APH Yield Adjustment Provision



Two states stand out in Figure 10.7. In both Alabama and Texas nearly 50 percent of the cotton crop insurance liability was in policies that made use of the yield adjustment provision. The other states in this analysis, Arkansas, Georgia, Louisiana, Mississippi, North Carolina, and South Carolina each had less than 22 percent of liability associated with the yield adjustment option. Figure 10.8 shows geographic differences in the percentage of 2001 cotton liability that made use of the yield adjustment option. It is important to note that producers who have not incurred a truly severe loss in recent years would not be able to utilize this provision.

Figure 10.8: Geographic Differences in the Percentage of 2001 Cotton Liability Identified with the APH Yield Adjustment Provision

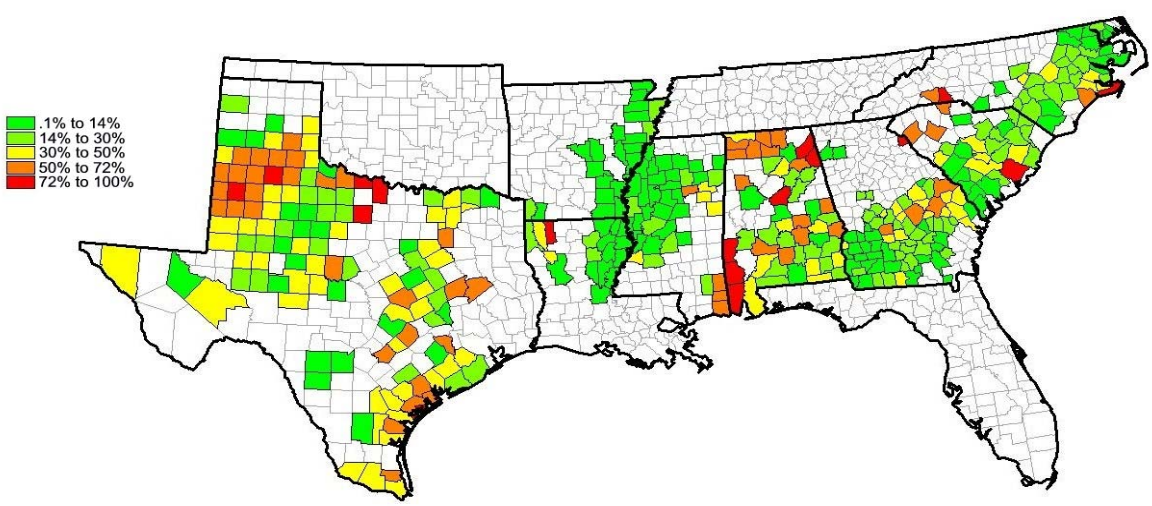
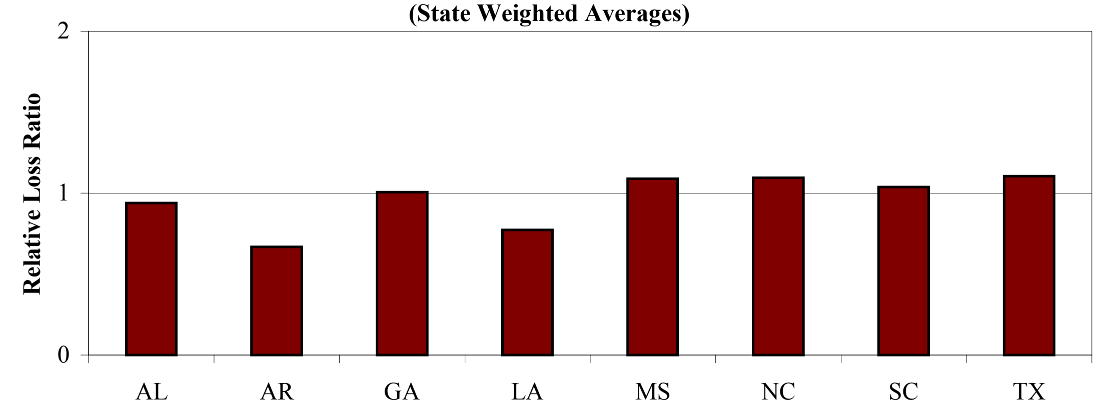


Figure 10.9 shows relative loss ratios for policies with the APH yield adjustment election. Results are fairly consistent across the eight states and suggest that in 2001, on average, the APH yield adjustment election did not result in significantly higher loss ratios. In fact, in Alabama, Arkansas, and Louisiana, the loss ratio for policies with APH yield adjustments was slightly lower for than for non-adjusted policies.

Figure 10.9: 2001 APH Yield Adustment Cotton Loss Ratio Relative to Non-Yield Adjustment Cotton in the County
(State Weighted Averages)



10.4 APH Yield Cup Provisions

Under normal circumstances, where a producer is adding one more year of proven yields to an existing APH yield history, approved APH yields are not allowed to decrease by more than 10 percent. This provision is often referred to as the APH yield cup. Figure 10.10 shows the percentage of 2001 cotton liability in each state that was associated with a cupped APH yield. The APH yield cup was used most often in Georgia, accounting for about 9 percent of cotton liability. In all other states, the yield cup was associated with between 5 and 7 percent of cotton liability.

Figure 10.10: Percentage of 2001 Liability that is Identified with the APH Yield Cup

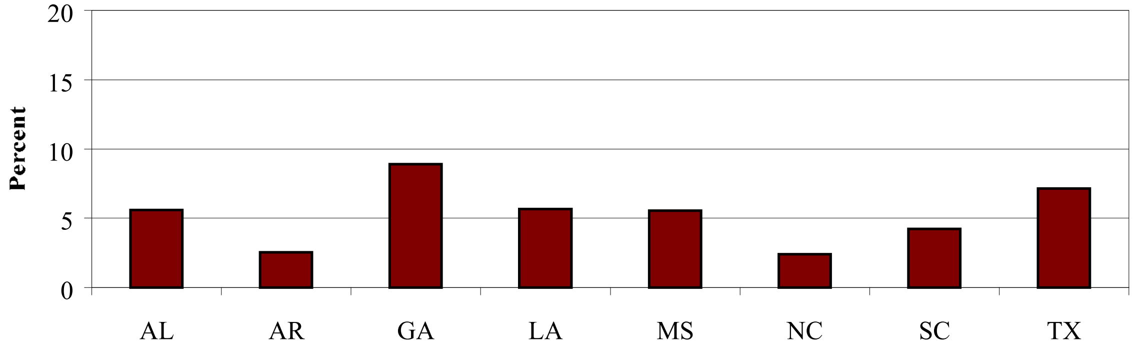


Figure 10.11 shows geographic differences in the percentage of cotton liability that was associated with a cupped APH yield.

Figure 10.11: Geographic Differences in the Percentage of 2001 Cotton Liability Identified with the APH Yield Cup

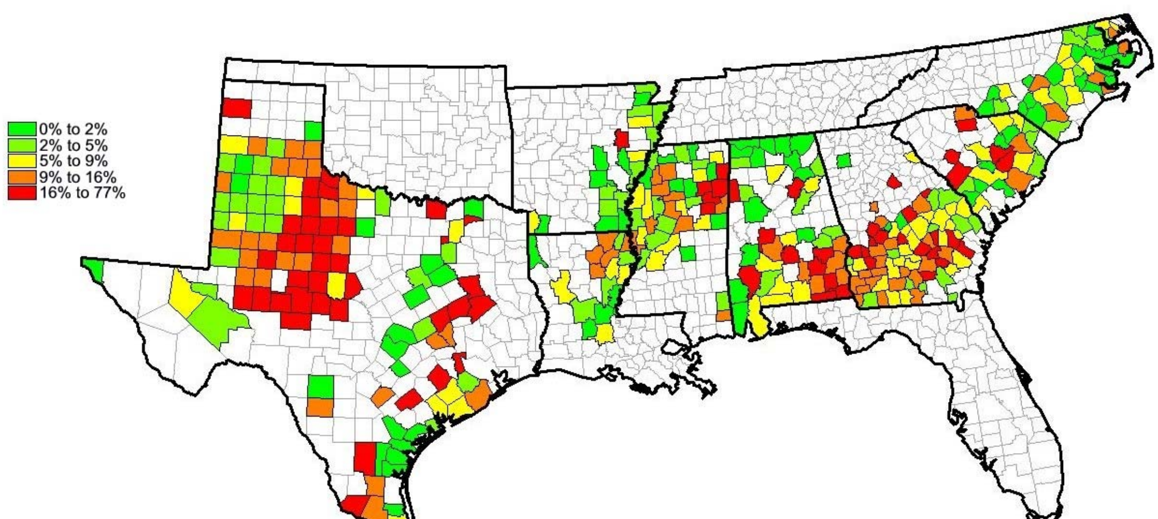
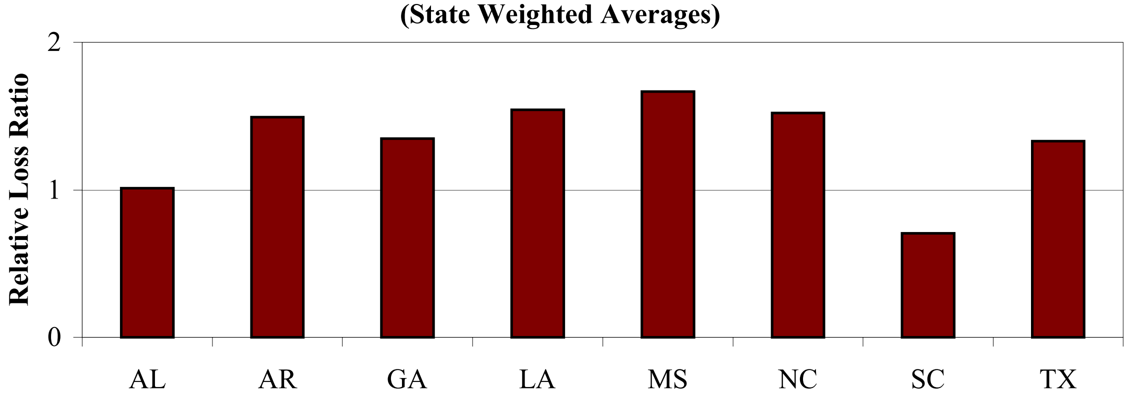


Figure 10.12 shows 2001 relative loss ratios for APH yield cup policies. Six of the eight states examined had higher loss ratios on yield cup policies than on those that were not cupped. The exceptions are South Carolina and Alabama. The highest relative loss ratio was 1.665 in Mississippi. The second highest was 1.52 in North Carolina. These findings provide some evidence that policies with cupped APH yields incur relatively higher loss ratios than those policies that do not have the cup applied.

Figure 10.12: 2001 Cupped Yield Cotton Loss Ratio Relative to Non-Cupped Yield Cotton in the County (State Weighted Averages)



10.5 Skip-Row Provisions

The final crop insurance policy attribute that we examine is skip-row cotton. When dryland cotton producers choose to plant in a skip-row pattern, their approved APH yields are adjusted to reflect the skip-row planting pattern. Anecdotal evidence from the mid-south suggests that in 2001, many cotton farmers thought that they could receive higher effective insurance coverage levels by planting skip-row cotton. Thus, skip-row provisions may have influenced producers' decisions to participate in crop insurance and possibly even to increase cotton acreage in 2001.

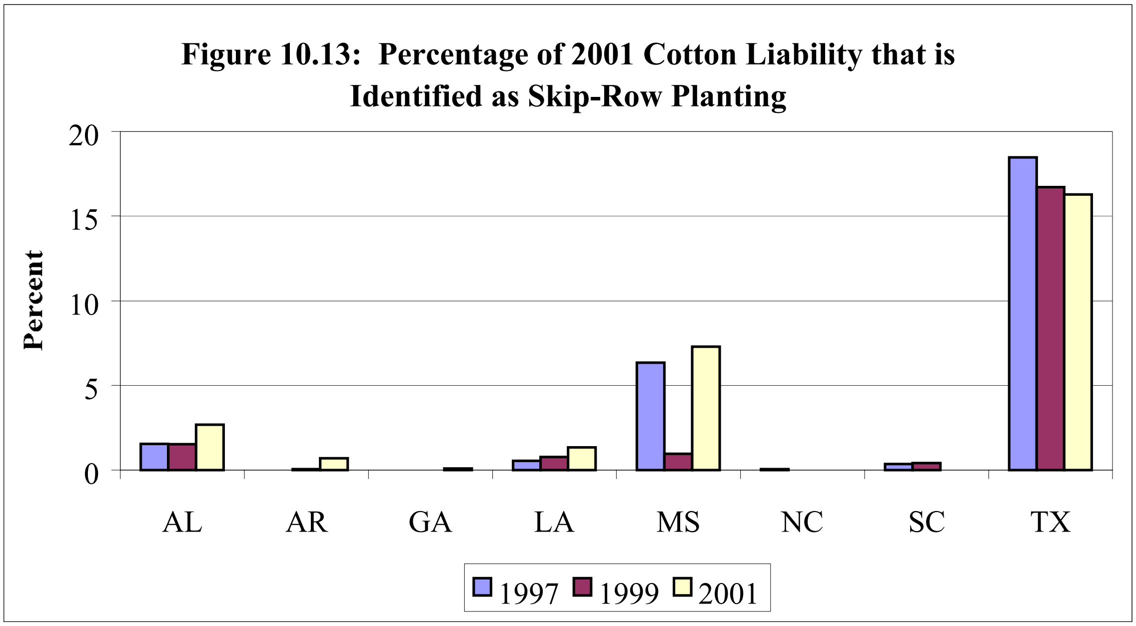


Figure 10.13 shows the percentage of cotton liability that was identified as skip-row planting in 1997, 1999, and 2001 for the eight study states. There is a very clear distinction between Texas and the other states in the study. In all three years, Texas had more than 15 percent of its cotton liability identified as skip-row planting. The only other state with a significant amount of skip-row planting was Mississippi. In Mississippi, the pattern has been somewhat erratic. In 1997 approximately 6 percent of cotton liability was in skip-row planting. In 1999 that figure decreased to 1 percent of liability. In 2001, skip-row planting jumped back to about 7 percent of cotton liability. In all the other states analyzed, there was very little skip-row planting. Figure 10.14 shows geographic differences in the percentage of cotton liability that is associated with skip-row production.

Figure 10.14: Geographic Differences in the Percentage of 2001 Cotton Liability Identified as Skip-Row Planting

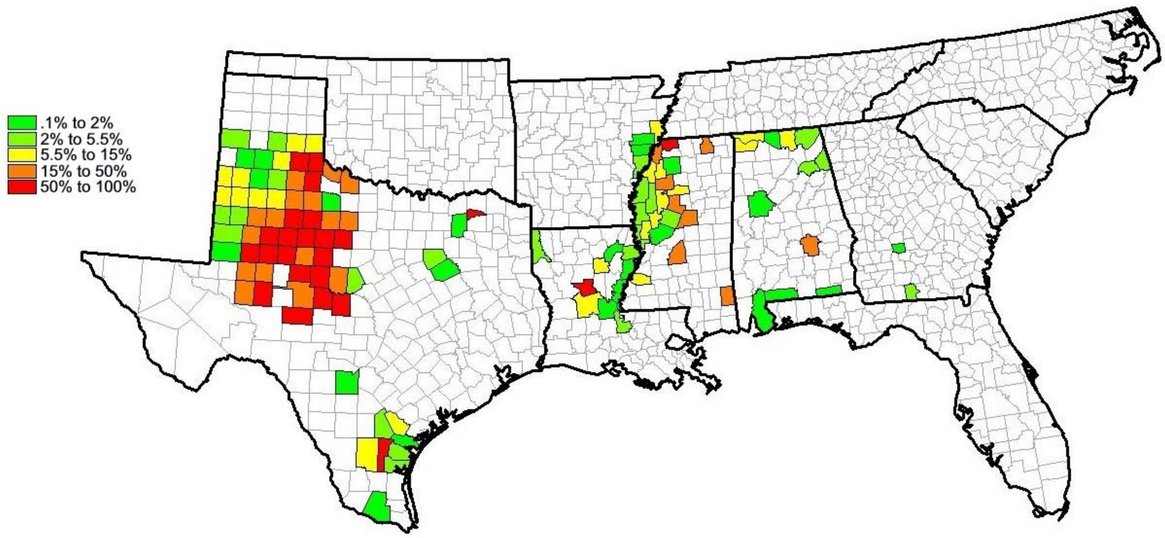
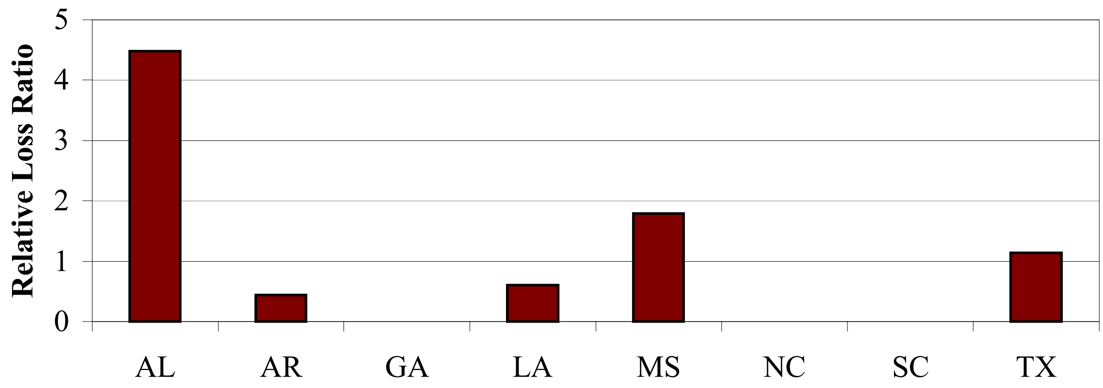


Figure 10.15 shows relative loss ratios for skip-row cotton in the eight states examined. In Georgia, North Carolina, and South Carolina, there was not enough skip-row planting to even calculate a loss ratio for this attribute. In Arkansas and Louisiana, there was only a small amount of skip-row cotton production and on average the actuarial performance of skip-row cotton was better than that of conventional solid-planted cotton. For Texas, where there is a large amount of skip-row cotton, our results indicate that skip-row actuarial performance was very similar to that for cotton that was not planted in skip-row patterns. In two states, there is some evidence of skip-row loss ratios exceeding loss ratios of solid-planted cotton. Those two states are Alabama and Mississippi. For Alabama, the relative loss ratio exceeds 4.0. For Mississippi, it is approximately 1.8.

Figure 10.15: 2001 Skip-Row Cotton Loss Ratio Relative to Solid-Planted Cotton in the County (State Weighted Averages)



11.0 Conclusion

The conceptual framework presented in section 4.0 clearly implies that producers make rational economic decisions by considering the tradeoff between expected return and risk. This framework suggests that recently observed cotton acreage shifts occurred as a result of producers making rational economic decisions, given the existing economic incentives. Understanding and measuring these economic incentives is crucial to correctly attributing the outcomes to the true causes.

Our background analysis indicates that recent cotton acreage changes have not occurred uniformly across the cotton belt. The most dramatic changes have occurred in the mid-south and to a lesser degree in the southeast. Simultaneously, significant changes have occurred in the crop insurance program. Most important among these changes are increases in premium subsidies and the cotton rate re-evaluation implemented in 2000. Not surprisingly, cotton crop insurance participation has increased, as have average coverage levels.

While cotton acreage has tended to increase in regions where crop insurance benefits and participation have increased, the magnitude of crop insurance effects must be considered in a broader context that includes the impacts of factors such as expected market revenue, cost of production, and marketing loan benefits. Failure to do so would cause one to incorrectly attribute all acreages changes to only one of many possible causes. To assess the effect of these factors, an econometric panel model was estimated for Mississippi counties over the years of 1996-2000. Strong statistical significance was found for the relationships between changes in cotton planted acreage and changes in the expected returns (including insurance) of cotton and soybeans. Consistent with the conceptual framework in section 4.0, cotton acreage tends to increase with higher expected cotton returns and decrease as expected soybean returns increase. In both instances the response tends to be inelastic. This means that a given percentage increase (decrease), in cotton expected returns, is associated with a smaller percentage increase (decrease) in cotton acreage. Similarly, a given percentage increase (decrease), in soybean expected returns, is associated with a smaller percentage decrease (increase) in cotton acreage.

It is important to consider the magnitude of the various components of expected returns. While actual crop insurance benefits vary due to growing conditions, the pre-season expected benefits to insurance for competing crops are fairly stable across time, unless there are significant program changes. The crop insurance subsidy structure does provide greater per acre subsidies to higher valued crops. The value of crop insurance expected benefits are also a function of price election levels. Over-insurance can occur if price elections were set at levels well above prices expected by producers. Our analysis of historical cotton and soybean price elections suggests that RMA price elections have been generally consistent with market expectations at the time the price elections are determined. In 2001, there was a downward trend in expected cotton prices after the November price election announcement. However, by the end of February, expected market prices were only about $0.04 per pound less than the price election.

In the cotton and soybean examples we have examined, the difference in expected crop insurance benefits across cotton and soybeans generally amounts to no more than $10-$20 per acre. This amount is not insignificant and certainly could affect planted acreage. However, relatively small cotton price changes can easily have much larger impacts on expected returns per acre. For example, if a farm has an expected cotton yield of 600 pounds per acre, a change in cotton market prices of $0.05 per pound implies a change in expected return of $30 per acre. Thus, the crop insurance influence on 2001 cotton acreage must be put into the context of soybean market price expectations being well below the loan rate, while February cotton price expectations were still at $0.07 above the cotton loan rate. This unique set of market conditions made cotton attractive relative to soybeans. In some areas, these market conditions appear to have created a situation where the expected returns from soybean production were approximately equal to the expected returns from planting cotton on land that was typically planted to soybeans. In this situation, expected returns from crop insurance may have been the "tie-breaker" that influenced producers to plant cotton on land that was typically planted to soybeans.

This study also provides an analysis of RMA producer-level data and seeks to find anomalous participation patterns indicative of producers taking advantage of some cotton program provision. To the extent that producers expect to gain inordinate benefits from utilizing these provisions, increased cotton planted (and insured) acreage could result. This analysis compared the loss ratio for policies with a given attribute to all other policies in the same county. This was done to make fair comparisons to an area with similar weather conditions. Because only one year of data was examined, we consider the results preliminary, but suggestive of needed further analysis. Five attributes were examined: added land, new producer APH guarantees, the ARPA instituted optional APH yield substitution, APH yield cups, and the skip-row planting pattern option. The data indicate potential problems related to added land, new producer APH, and yield cup provisions. For all three attributes, the loss ratio was generally much higher than for other policies in the same county. Skip row cotton appears to pose no threat in the region where it has been traditionally practiced (Texas). However, in Mississippi and Alabama it appears problematic. Finally, the ARPA yield adjustment provision appears to have no major effect on loss experience.

Our final comment is that our conclusions about the impact of crop insurance on 2001 cotton planted acreage appear to be supported by preseason predictions of significant cotton acreage reductions in 2002. The National Cotton Council and the USDA both predict substantial cotton acreage reductions. To our knowledge no major cotton crop insurance provisions have changed since 2001 except for reductions in some county T-yields.

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Appendix A: Expected Return and Risk

For a given crop, expected return is measured as:

(1) $$E\left(r_{crop}\right)=\sum_{j=1}^{k}\pi_j r_j$$

where $E\left(r_{crop}\right)$ is the expected return from producing the crop, r_j is a potential level of return, π_j is the probability that r_j will occur, and k is the number of unique levels of return that could potentially result from producing the crop.

Now, consider a crop portfolio consisting of cotton and soybeans. The expected return of the portfolio is calculated as:

(2) $$E\left(r_{portfolio}\right)=w_{cotton}E\left(r_{cotton}\right)+w_{soybeans}E\left(r_{soybeans}\right)$$

where w_{cotton} and $w_{soybeans}$ are the fractions of the total value of the portfolio which are invested in cotton and soybeans, respectively. Since there are only two crops in the portfolio, the sum of w_{cotton} and $w_{soybeans}$ must equal 1. Equation (2) can be generalized to allow for portfolios of more than two crops:

(3) $$E\left(r_{portfolio}\right)=\sum_{i=1}^{n}w_i E\left(r_i\right)$$

where n is the number of crops in the portfolio and $\sum_{i=1}^{n}w_i=1$.

Economists measure risk as the statistical variance in returns. For a single crop, the variance in returns is calculated as:

(4) $$\sigma_{crop}^2=\sum_{j=1}^{k}\pi_j\left[r_j-E(r)\right]^2$$

where σ_{crop}^2 is the variance in returns from the crop, $\left[r_j-E(r)\right]$ is the difference between the actual return and the expected return of the crop, and the other variables are as defined earlier. Equation (4) can be rewritten as:

(5) $$\sigma_{crop}^2=E\left[r_{crop}-E\left(r_{crop}\right)\right]^2$$

or

(6) $$\sigma_{crop}^2=E\left\{\left[r_{crop}-E\left(r_{crop}\right)\right]\left[r_{crop}-E\left(r_{crop}\right)\right]\right\}$$

which expresses variance as the expectation of the squared difference between the actual return and the expected return of the crop.

For our earlier two-crop portfolio of cotton and soybeans the variance would be measured as:

(7) $$\sigma^2_{portfolio} = w^2_{cotton}\sigma^2_{cotton} + w^2_{soybeans}\sigma^2_{soybeans} + 2w_{cotton}w_{soybeans}\sigma_{cotton,\,soybeans}$$

where $\sigma_{cotton,\,soybeans}$ is the covariance of returns between cotton and soybeans, and the weights, *w*, are as defined earlier. The covariance measures the extent to which returns from cotton and soybeans tend to move together. If returns from cotton are independent of returns from soybeans, the covariance will be zero. If returns from cotton tend to move directly (inversely) with returns from soybeans, the covariance will be positive (negative).

By changing the notation for variance from σ^2_{crop} to $\sigma_{crop,\,crop}$, equation (7) can be generalized to allow for portfolios of more than two crops:

(8) $$\sigma^2_{portfolio} = \sum_{g=1}^{n}\sum_{h=1}^{n} w_g w_h \sigma_{gh}$$

where *n* is the number of crops in the portfolio and $\sum_{i=1}^{n} w_i = 1$.

Appendix B: Results from Acreage Response Model

Summary statistics for regression data

Variable	N	Mean	Standard Deviation	Minimum	Maximum
Cotton Planted Acres	114	42,497.37	29,529.23	7,700	125,000
Cotton Gross Revenue Per Acre	114	507.9183	64.3765	383.3321	619.1862
Cotton Variable Cost Per Acre	114	358.9561	24.9453	289.0000	398.0000
Cotton Premium Per Acre	114	17.2336	6.8674	5.8062	37.2055
Cotton Crop Insurance Net Return Per Acre	114	21.4775	7.8826	10.7240	54.9754
Cotton Net Revenue Per Acre	114	170.4397	63.1076	38.9845	282.6531
Soybean Gross Revenue Per Acre	114	139.7699	20.4719	104.1872	175.6866
Soybean Variable Cost Per Acre	114	101.1628	11.4511	78.3000	116.5000
Soybean Premium Per Acre	114	7.60084	2.0933	4.0737	11.6943
Soybean Crop Insurance Net Return Per Acre	114	8.8890	2.2721	4.5747	14.4953
Soybean Net Revenue Per Acre	114	47.4962	26.4626	0.0665	102.8827

Regression of County Cotton Acreage (Mississippi)

Analysis of Variance

Source	Degrees of Freedom	Sum of Squares	Mean Square	F Value	Pr > F
Model	24	92537698613	3855737442	57.24	<.0001
Error	89	5995550598	67365737		
Corrected Total	113	98533249211			

Root MSE	8207.66331
Dependent Mean	42497
Coefficient of Variation	19.31334
R-Square	0.9392
Adj. R-Square	0.9227

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t value	Pr > |t|
Intercept	81913	6388.615	12.82	<.0001
ctnrev1	71.185	27.102	2.63	0.0102
sbnrev1	-196.558	38.581	-5.09	<.0001
cnty11	-17477	5582.611	-3.13	0.0024
cnty13	-59216	6056.703	-9.78	<.0001
cnty15	-73626	5265.230	-13.98	<.0001
cnty27	7033.299	5546.786	1.27	0.2081
cnty33	-71483	6039.640	-11.84	<.0001
cnty43	-73447	6040.135	-12.16	<.0001
cnty49	-73503	5198.864	-14.14	<.0001
cnty51	-35973	5348.702	-6.73	<.0001
cnty53	-19804	5191.954	-3.81	0.0003
cnty55	-64042	5193.116	-12.33	<.0001
cnty83	-6710.487	5191.168	-1.29	0.1995
cnty89	-61085	5261.907	-11.61	<.0001
cnty95	-67189	5848.452	-11.49	<.0001
cnty107	-54223	6143.634	-8.83	<.0001
cnty119	-53122	5608.394	-9.47	<.0001
cnty125	-41409	5192.839	-7.97	<.0001
cnty133	-19867	5191.024	-3.83	0.0002
cnty135	-12970	5603.080	-2.31	0.0229
cnty143	-36276	5625.657	-6.45	<.0001
cnty149	-79138	5216.882	-15.17	<.0001
cnty151	5198.428	5195.193	1.00	0.3197
cnty161	-67643	6478.111	-10.44	<.0001

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