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U.S. COTTON ACREAGE RESPONSE TO SUBSIDIZED CROP INSURANCE, 1995 to 2011

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Abstract

Using simultaneous insurance participation and acreage response equations, this study models the acreage response of U.S. cotton at the county level to subsidized crop insurance. Results of panel data analyses suggest that counties with relatively low yields are more likely to respond positively to insurance participation with a greater percentage of cotton acreage in their county than high-yielding counties. Empirical evidence indicates that crop insurance policies are shifting cotton production from counties with lower production risks, higher yields and highly desired cotton to counties with higher production risks, lower yields and poorer quality cotton.

Key words: simultaneous, panel, fixed effects, subsidy per pound, rate of return

JEL Codes: Q11, Q18.

Introduction

Technology, fixed production assets, market conditions, and government programs are a few of the many factors that affect cotton plantings and production. Congress formed the Federal Crop Insurance Corporation (FCIC) in 1938 with the objective to protect farm incomes from crop failures and low prices plus protect consumers from food and fiber shortages and high prices. Crop insurance was further expanded through the Federal Crop Insurance Reform Act of 1994 which brought major changes in government subsidy levels, producer affordability and expected returns. For example, the entire insurance premium for CAT is paid for by the government and producers pay just a modest sign-up fee for each crop. Upland cotton acreage insured increased from 1994 to 1995 from 5.8 million acres to 15.8 million acres.¹ The increase in participation is not surprising because Congress initially required farmers to purchase crop insurance to be eligible for any disaster payments. Congress eliminated this requirement in 1996 and CAT enrollment acreage declined.

To encourage enrollment at higher coverage or buy-up levels, Congress provided additional premium subsidies for the 1999 and 2000 crop years. From 1998 to 1999, premium subsidies increased by 44.2 and 47.6 percent for cotton and other commodity crops. Passage of the 2000 Agricultural Risk Protection Act (ARPA) resulted in moving from a subsidy that was a fixed-dollar-per-acre amount to a percentage subsidy, causing farmers to shift from lower cost yield insurance to more expensive revenue policies (Babcock 2011). Premium subsidies for crops other than cotton increased by 33.1 percent or \$426 million from 2000 to 2001, when ARPA was first enacted. A 23.8 percent increase in premium subsidies or

an additional \$51 million in premium subsidies occurred for cotton producers in 2001. In effect, about 14.68 million acres of cotton were insured in 2001, the largest net acreage ever insured for cotton.

The effect of subsidized crop insurance reform on farmers' cropping decisions has been an important debate for many years. Because the probability of yield falling below the 50 percent CAT yield established for a farm varies greatly by region and crop, the impact of crop insurance reform is not expected to be equal across the Cotton Belt. That is, the expected return on CAT premiums paid by the government to the producer for each acre planted varies greatly across the Belt. To the extent that crop insurance affects farmers' cropping decisions, it is also important to quantify how changes in crop insurance policies cause farmers to alter their participation and planting decisions.

Variation in production regimes across the Cotton Belt make this a good crop to evaluate the extent that an acreage response may occur from subsidized crop insurance. To illustrate these regional differences, figure 1 shows the ratio of premium subsidies for cotton received divided by gross sales for the states of California and Texas. This ratio averages 0.76% for California and 11.67% for Texas, over a fifteen-fold difference for the 1995 to 2013 time period. Virtually all of California's acreage is grown under irrigation while much of Texas's acreage comes from dryland production on the High Plains that exhibits greater yield variability.

The Federal Agricultural Improvement and Reform (FAIR) Act or Freedom to Farm Act of 1996 also allowed for complete planting flexibility for the first time, with exceptions to fruits and vegetables. However, other factors have also influenced acreage

decisions for cotton since crop insurance premium subsidies became more generous in 1995 and subsequent years. Transgenic Bt cotton became commercially available for use in 1996 and the profitability and risk implications of this technology are not uniform across the Cotton Belt (Frisvold et al. 2000; and Fernandez-Cornejo and McBride 2002).

Acreage response due to farm programs, particularly farm subsidized crop insurance has been an important topic among researchers (Barnett et al. 2002; Deal 2004; Duffy et al. 1987; Goodwin et al. 2004; Keeton and Skees 1999; Vandever and Young 2001; Wu 1999; Wu and Adams 2001). Most of these studies focus on corn, soybeans, wheat, or a crop mix of these. Only a few address the impacts of subsidized crop insurance for cotton and the ability for cotton producers to respond to crop insurance subsidies was rather limited until the 1996 FAIR Act.

Crop insurance has received a fair bit of attention not only by politicians but also by agricultural economists. Babcock (2011) argues that returning to the subsidy structure for crop premiums prior to ARPA would save upwards of \$2 billion. The crop insurance program has been relatively expensive given that federal disaster assistance remains strong, and it has potentially distorting effects on production and input use (Glauber 2007). Knight and Coble (1997) outlined econometric studies examining issues related to the Multiple Peril Crop Insurance (MPCI) program since the 1980s. They considered studies on acreage effects of MPCI and other insurance programs as important areas for future research. Another area of future research suggested is insurance inducing farmers to grow more risky crops, possibly to the detriment of the environment. Shifting production from one region to another can increase the level of production risk associated

for a crop and it is also quite possible that production under more marginal and risky land could have undesirable environmental consequences.

Some studies provide contradicting results about the size of the effect of crop insurance. Keeton and Skees (1999) studied acreage shifts for six major U.S. crops from 1978 to 1982 and 1988 to 1992. Their findings show that crop insurance has created incentives for farmers to plant more acres, especially in more risky areas. Estimates show that crop insurance subsidies in the 1980s led to about 50 million additional cropland acres.

Using the national policy simulation model of POLYSYS-ERS, Young et al. (2001) showed market impacts across seven regions for the eight largest commodities in the U.S. Their simulation results suggest that an additional 960,000 acres has been added from crop insurance subsidies with wheat and cotton accounting for about 75 percent of the total increase.

Goodwin et al. (2004) found that the expansion of crop insurance programs has not induced large acreage increases. Acreage response, insurance participation, input usage and CRP participation were jointly evaluated in the Heartland region for corn and soybeans and in the Northern Great Plains for wheat and barley from 1985 to 1993, using a pooled cross-sectional time series model. The elasticity of acreage response to changes in insurance participation for corn, soybeans and barley were 0.014, 0.0025, and 0.19 respectively. Results of policy simulations suggest that large premium decreases (30%) caused planted acreage to increase by about 1.1% for barley and only about 0.28% to 0.49% for corn.

Most of these acreage response studies have focused on crops other than cotton except for Barnett et al. (2002). They examined the impacts of crop insurance on cotton planted in Mississippi from 1996 to 2000 using a single equation model. Cotton acreage was modeled as a function of expected net returns per acre for cotton and soybeans, a major competing crop in Mississippi. Their results showed that on average, a 1% increase in expected net returns from crop insurance increases cotton acreage by 0.036% while the effect of a 1% increase in the expected net market return for cotton would increase acreage by 0.222%. This indicates that the relatively larger return in dollars per acre from market factors has more influence on cotton plantings than the expected return to insurance.

Deal (2004) examines the relationship between subsidized crop insurance and soil erosion. He models the impact of crop insurance on cotton acreage and input usage in the Southern Seaboard, Mississippi Portal and Prairie Gateway regions for the two time periods of 1990 to 1995 and 1996 to 2000. Similar to Goodwin et al. (2004), he used the instrumental variable technique in the context of generalized method of moments to jointly estimate the proposed five structural equations. Regression results implied a negative and significant relationship between crop insurance participation and cotton acreage in 1990 to 1995 in the Mississippi Portal but a positive and significant relationship in the two regions for the 1996 to 2000 period. Elasticity estimates of cotton acreage response to changes in insurance participation were mostly inelastic, ranging from -0.104 to 0.099. Based on policy simulations, he found that significant premium rate

reductions substantially impact insurance participation but these reductions do not translate to large changes in cotton acreage.

This study aims to quantify the percent of cropland acreage in a county planted to cotton as a result of subsidized crop insurance using the years of 1995 to 2011. A simultaneous model of insurance participation and the percent of cotton planted in counties across the U.S. Cotton Belt. County level data is utilized for a time period when producers had variation in premium subsidies and planting flexibility. In addition, factors like Bt cotton, support prices, competing crop prices, and other factors are considered so that more defensible policy conclusions can be drawn.

Empirical Model

An unbalanced panel data set of 564 cotton-producing counties from 1995 to 2011 resulted in 9024 pooled observations. Data are unbalanced in the sense that the number of counties varies over time. Creating a complete panel from unbalanced panel data for the purpose of computational simplification is not recommended since it may cause a large loss in efficiency (Baltagi and Chang, 2000). Insurance contract data were collected from the Risk Management Agency (RMA) summary of business report while acres planted, state level prices, and county yield data were collected from the National Agricultural Statistics Service (NASS). To avoid disclosure of individual operations, NASS does not publish acreage values for all counties.

Total acres planted as reported by NASS are less than the insured acres reported by RMA for a few counties. This discrepancy may be due to sampling errors since NASS uses sample surveys to collect information from farm cooperators to establish county-

level acreage data. RMA can also report acreage values even if a county has only one producer due to the Freedom of Information Act. Finally, the prevented planting provision in insurance policies may contribute to this gap. Prevented planting can occur from a shortage in irrigation water due to drought, excess moisture, or other natural causes that may prevent planting for a county. The producer may opt not to plant the insured crop and file for a prevented planting payment. Land under prevented planting is counted under insured acreage but not as planted acreage by NASS.

Several benefits and limitations of using panel data are enumerated by Hsiao (2003) and Baltagi (2005). Increased variability in panel data can yield more insights among variables. In addition, panel data increases the degrees of freedom and exhibits less collinearity among explanatory variables, thereby improving the efficiency of estimates. Most importantly, panel data controls for individual heterogeneity and allows better analysis of dynamic adjustments, unlike time-series data and cross sectional data.

To estimate the effect of crop insurance participation on the percent of cotton planted in the county, a simultaneous two-equation system approach is estimated. This takes into consideration the simultaneous nature of the decision process on how much land to insure and allocate to cotton production, an approach suggested by Goodwin et al. (2004). Marginal effects of the chosen interaction terms were calculated from the simultaneous two-equation fixed effects model. STATA was used to estimate the model.

Data

Data on Bt adoption rates were obtained from the Mississippi State University archive of Beltwide Cotton Insect Loss (CIL, Williams 1995 to 2011) data. Counties are

matched to their state or region, as specified in the CIL data. Other data such as futures prices, average world price for cotton and deficiency payments were obtained from Agricultural Marketing Service (AMS), USDA. Prices were deflated using the CPI for all goods and are in 2011 dollars.

The two-equation system proposed is

$$PINSUR_{it} = \alpha + \beta_1 PCOTACRES_{it} + \beta_2 SUBSIDYPERLB_{it-1} + \beta_3 PROR_{it-1} + \beta_4 E[P_{cot,it}] + \beta_5 YLD_{it-1} + \beta_6 E[P_{cot,it}] YLD_{it-1} + \beta_7 YLDVAR_{it} + \beta_8 PBT_{it} + \beta_9 D1_t + \beta_{10} D2_t + \mu_{1it} \quad (1)$$

$$PCOTACRES_{it} = \gamma + \delta_1 PINSUR_{it} + \delta_2 E[P_{cot,it}] + \delta_3 YLD_{it-1} + \delta_4 E[P_{cot,it}] YLD_{it-1} + \delta_5 YLDVAR_{it} + \delta_6 PBT_{it} + \delta_7 PICC_{it} + \delta_8 D1_t + \delta_9 D2_t + \mu_{2it} \quad (2)$$

where $PINSUR_{it}$ is the total insurance liability for county i divided by the total possible liability of each county as a percentage and $PCOTACRES_{it}$ is the percent of tillable acreage planted to cotton in county i , all for year t . The numerator of $PINSUR_{it}$ changes with different policies producers select and the denominator is the maximum coverage possible for each county or $(Planted\ Acres_{it})(maximum\ coverage\ level)(county\ yield\ average\ for\ years\ t-1\ through\ t-5)(100\%\ price\ election)$. $E[P_{cot,it}]$ is the expected cotton price for the state that county i resides in determined by December Futures prices, lagged state basis and expected Loan Deficiency Payments (LDPs). YLD_{it-1} is average yield (lbs./acre) for county i in year $t-1$ and the expected per acre revenue or interaction term between lagged county yield and price is $E[P_{cot,it}] YLD_{it-1}$. $YLDVAR_{it}$ represents yield variability using an average moving coefficient of variation for years $t-1$ through $t-10$, PBT_{it} is the percentage adoption rate for Bt cotton in county i given the regions defined by the Cotton Insect Loss Estimates, and $SUBSIDYPERLB_{it-1}$ (cents/lb.) is the expected

premium subsidy per pound of production (i.e., per acre premium subsidy in $t-1$ divided by the prior 5-year yield average for $t-1$ through $t-5$). $PROR_{it-1}$ is the percentage rate of return or ratio between total indemnity and producer premium costs in $t-1$ as a percentage, $PICC_{it}$ is a price index of competing crops for spring wheat, corn, and soybeans based on Crop Revenue Coverage (CRC) planting prices and loan rates for county i as a percentage, and dummies of $D1$ and $D2$ for the periods of 2000 to 2001 and 2002 to 2011 reflect different premium subsidy regimes relative to the base period of 1995 to 1999. Error terms of μ_{1t} and μ_{2t} correspond to the fixed effects standard linear simultaneous equation model (Cornwell et al., 1992) for the results presented.

Variables included to capture influences of market and government incentives and technology on farmer's decision making include $E[P_{cot}]$, YLD , and the interaction term between these two variables. $E[P_{cot,it}]$ is calculated using RMA's Crop Revenue Coverage price (generally determined by nearby December futures prices in February) plus the 'November state basis' to incorporate state level supply and demand conditions. The expected Loan Deficiency Payment is incorporated into the basis value to capture the effect of government price support programs on the price the producer expects to obtain at planting. The December futures price in February is chosen because the sales closing date for cotton insurance is in February and this is about the latest date that producers can significantly alter their planting decisions for the upcoming cropping year. Basis is the difference between the lagged state price a county resides in and the average of the lagged Friday December futures prices during the last quarter the contract is traded. This is the most recent basis information available and December corresponds to when a large

percentage of the new crop cotton is marketed. If the Adjusted World Price (AWP) is below 52 cents per lb. when producers sell their cotton they are eligible to receive this difference on their sales. Thus, the expected Loan Deficiency Payment (LDP) or “market gain” is constructed as:

$$E[LDP_t] = \frac{\sum_{i=1}^{100} \max[(52 - G(E[AWP_{it}])), 0]}{100} \quad (3)$$

$$E[AWP_t] = DecFutFeb_t + E[BasisLDP_t] \quad (4)$$

$$E[BasisLDP_t] = AWPlq_{t-1} - DecFutlq_{t-1} \quad (5)$$

where $AWPlq_{t-1}$ and $DecFutlq_{t-1}$ are averages of the weekly Adjusted World Price and New York Cotton Exchange December Futures (AMS/USDA) during the last quarter of the calendar year in $t-1$ and $G(\cdot)$ is a random draw from a lognormal distribution that is based on differences between $E[BasisLDP_t]$ and $BasisLDP_t$. $AWPlq_{t-1}$ minus $DecFutlq_{t-1}$ provides an expectation for what the upcoming “basis” for the Loan Deficiency Payment will be for year t . $DecFutFeb_t$ is the December Futures prices in February for the last four Fridays prior to the February sales closing date for cotton.

The effect of competing crops of wheat, corn, and soybeans on cotton acreage are also considered. To compare relative prices and competition for acreage, a Laspeyres Price Index of Competing Crops ($PICC$) with 1996 as the base year was constructed as

$$PICC_{it} = \sum_{k=1}^3 \left(\frac{E[P_{k,it}]}{P_{k,i1996}} \right) \left(\frac{acres_{k,it}}{acres_{1,it} + acres_{2,it} + acres_{3,it}} \right) \quad (6)$$

$$E[P_{k,it}] = \text{Max} \begin{cases} RMAPlantP_{kt} + E[Basis_{k,it}] \\ CLR_{k,it} \end{cases} \quad (7)$$

$$E[Basis_{k,it}] = P_{k,state,t-1} - RMAPlantP_{k,t-1} \quad (8)$$

where the expected price for each competing crop of spring wheat, corn, and soybeans ($k=1,2,3$) or $E[P_{k,it}]$ is constructed using RMA's CRC Planting Price ($RMAPlantP$). This planting price is constructed using futures prices for the upcoming crop prior to the crop's sales closing date. If this planting price plus the expected basis (annual state price minus RMA's planting price for the prior year) is less than the County Loan Rate ($CLR_{k,it}$) level, then the CLR is used as the expected price. Note that prices used in the computation are primarily determined at the state-level while all acreage values are measured at the county-level. Using this measure, more weight is given to the relatively larger competing crops in a county. $PICC$ has a mean of 109.99. A high $PICC$ is expected to decrease the acreage planted to cotton. This variable is also used as an instrument for the percent of cotton planted equation.

$YLDVAR$ is included to capture yield variability among counties. $YLDVAR$ is calculated as the ratio of the $t-1$ to $t-10$ trailing standard deviation to the corresponding trailing mean. To avoid losing a large number of observations, counties with at least two years of historical yield over the ten-year period are considered. Counties facing high yield risks are expected to increase participation.

In order for the system of equations to be identified, instruments are used for the insurance participation and percent of cotton planted equation. $SUBSIDYPERLB$ and $PROR$ are used as instruments for the insurance participation equation while $PICC$ is used as an instrument in the percent cotton planted equation. These instruments are valid in the sense that $SUBSIDYPERLB$ and $PROR$ should not directly influence acreage

planted to cotton and *PICC* should not directly influence insurance participation.

Descriptive statistics of the variables are summarized in table 1.

The literature measures crop insurance participation in different ways. The conventional way of measuring crop insurance participation is simply the ratio of insured to total acres planted or in a binary model participation has a value of 1 when insurance is purchased and 0 otherwise. Goodwin (1993) proposes an alternative approach to measuring participation by considering changes in buy-up coverage levels. Goodwin et al. (2004) argue that one can increase insurance participation without increasing acres insured by merely increasing the coverage level, which is reflected in total liability. Similarly, the denominator for *PINSUR* equals the total possible liability or maximum liability by multiplying the 5-year historical average yield for a county by the price election for a given year times the maximum price election coverage of 75% for years before 2000 and 85% for years after 2002.

The introduction of Bt cotton has shifted the competitive advantage of production for many regions, particularly those susceptible to bollworms. Higher Bt adoption rates would appear to be associated with increased plantings for these regions. On the other hand, the effect of Bt adoption on insurance participation may be negative since Bt cotton reduces production risk. Table 1 shows how Bt cotton adoption varies by region.

The counties can be grouped into 4 distinct production regionsⁱⁱ namely Southeast, Delta, Southwest and West regions. Crops yields, prices and hydrological conditions differ across production regions. Among the four regions, insurance participation is highest in the Southeast region (64.96%) over the sample period. The Southwest region is

not far behind at 62.47% and this region is characterized by having many counties with low cotton yields, low cotton prices, and high production risk on the High Plains. Conversely, insurance participation is lowest in the West region (44.75%) where cotton yields and prices are highest and production risk is lowest. Examining the subsidy per unit of production across different production regions, rates are highest for the Southwest (3.7 cents/lb.) and lowest for the West (1.2 cents/lb.). Do counties in riskier areas benefit more from the subsidized crop insurance?

Results

Based on figure 2, total cotton acreage decreased from 1995 to 1998, slowly increased from 1998 to 2001, and then declined in 2002. In 1995, the year with the highest percent of acreage insured, about 57% of the insured acreage was under CAT while only 43% under Buy UP (BUP) coverage. High CAT participation is associated with 1994 crop insurance legislation which mandated participation in at least CAT to be eligible for farm commodity programs. But this requirement was rescinded in the 1996 Farm Bill. A series of subsidy increases followed to encourage insurance participation and in effect, insured acreage increased, especially for BUP levels. In 2001, about 76% of the insured acreage was under BUP while CAT only comprised 24% of the total acreage insured. From 2000 to 2002, about 56% of the insured acreage was at the 65% coverage level or greater.

Fixed Effects Model

Following Goodwin et al. (2004) a simultaneous framework is employed to estimate the effect of subsidized crop insurance program on the percentage of cropland

planted to cotton for counties across the Cotton Belt. The equations are simultaneous because acreage decisions and crop insurance program participation decisions are made at the same time. Unlike Goodwin et al. (2004), a panel data structure and fixed effects specification was applied. It can be argued that μ is correlated with the explanatory variables. For example, the location of the county, size of county, and land quality can be correlated with the regressors. Therefore, correlation between μ and the explanatory variables are assumed. Another reason for choosing the fixed effects model is that the counties observed are not randomly sampled but more or less exhaust the population. Parameter estimates for equations 1 and 2 are given in table 2.

Insurance Participation

Instruments used for the insurance equation are *SUBSIDYPERLB* and *ROR*. The estimate of *ROR* in the insurance equation shows a strong and positive association between *ROR* and crop insurance participation (*INSURANCE*). Similarly, *SUBSIDYPERLB* is highly significant and positive. If subsidy per lb. of production increases then *INSURANCE* also increases. Generally, counties that receive higher subsidy per lb. of production are counties where production risks are high and yields are relatively low. Because subsidy rates are structured as a percentage of total premiums, it favors high risk and or low yielding counties. Keeton and Skees (1999) suggest targeting a per unit of production subsidy so that subsidies will no longer favor high-risk regions at a cost to low-risk regions.

The correlation of yield variability and insurance participation is also noticeable in comparing the different regions. High insurance participation among counties having

relatively higher yield variability or unstable yield is not surprising due to high risks in production that these counties face. This is supported by table 1 which shows that the Southeast and Southwest have the highest yield variability and levels of insurance participation while the West has the lowest yield variability and level of insurance participation.

The effects of $E[P_{cot,it}]$ and YLD_{it-1} plus their interaction term, $E[P_{cot,it}]YLD_{it-1}$, on insurance participation are also included in the model. Based on the marginal effect of own expected price as described in figure 3, an increase (decrease) in price expectation causes a decrease (increase) in insurance participation for counties with relatively high yield expectations. On the other hand, the correlation between expected price and insurance participation is positive for counties with very low yield but not significant for a 95% confidence interval. This finding is very interesting and has important policy implications.

Lastly, a positive correlation between Bt cotton adoption rates and insurance participation suggests that areas with a high rate of adoption insure more. Although Bt may be viewed as a substitute for reducing yield risk, Bt cotton is also relatively more expensive than non-transgenic varieties and the producer may be insuring to protect the repayment of their investment. This is particularly relevant when one considers that many producers are also insuring for price.

Acreage Response

For the *ACRES* equation, the instrument is the Price Index of Competing Crops (*PICC*). The estimate for *PICC* is significant and negative. An increase in the expected

price of these competing crops causes a decrease in cotton plantings. The effect of *YLDVAR* on cotton acreage is positive and significant for the Delta and Southeast. For counties with very low yields, the marginal effect of the price expectation on cotton acreage is positive, whereas it is negative for high yielding counties.

The effect of Bt cotton adoption on cotton plantings is negative for the Delta. While higher adoption is generally associated with a technology shift and competitive advantage for a region like the Delta with the highest percentage of Bt adoption, the need for resistance management may shift to alternative crops.

Unexpectedly, we found a negative and significant correlation between insurance participation and the percentage of cotton acres planted in a county. Given the latter part of the time frame considered where corn and soybeans were priced relatively high to cotton, particularly after the Energy Policy Act of 2005. This is believed to account for a decline in the percentage of cropland acres planted to cotton while insurance participation rates increased.

Marginal Effects of Expected Price and Yield

Generally, counties that exhibit the highest cotton yields are those that are irrigated or have the lowest production risk. Prices are also relatively higher for irrigated counties due to better overall quality. Average prices for the West are 84.38 cents/lb. while they are 73.63 for the Southwest. On the other hand, dryland production or counties with limited rainfall can be characterized with relatively low yields and high production risks. Prices are also generally lower, due in large part to lower quality, as evidenced by lower average state prices.

Based on the parameter estimates and standard errors of the reduced form, the marginal effects of $E[P_{cot,it}]$ on insurance participation (figure 3) suggest that an increase in the price expectation causes a decline in insurance participation among counties with relatively higher yields. In counties where yields are relatively high, crop insurance participation will decline with a high expected price because the probability of receiving indemnity payments in these counties is low. However, a lower price expectation may cause counties with very high yields to insure more. On the other hand, counties with very low yields behave differently. The association between expected price and insurance participation is positive which is likely due to higher production risks in counties with very low yields.

The marginal effect of $E[P_{cot,it}]$ on cotton acreage is given in figure 4. The direction of the effect is similar to figure 3 where in the marginal impact of price is decreasing in yield. That is, an increase in the expected price has a smaller impact on acreage when yield is very high and there is more acreage response from counties with extremely low yields. This may indicate that counties with extremely high yields are those that are irrigated. Because of limited irrigation water, these counties are not able to respond as much as counties with dry land agriculture. Another intuition is that since yield is very high in these counties, it can be argued that the current land quality being used is also high. An increase in acreage response due to changes in price expectation may suggest bringing less productive land into cotton production. Therefore, when yields are very high, an increase in price results in a smaller impact on acreage because the options for putting more land into production are limited.

Conclusions and Implications

Insurance participation for cotton and its effect on the percent of cropland planted to cotton is examined for the entire U.S. cotton belt, and not just one or two regions. Planting restrictions were removed in 1996 for the first time in decades, allowing producers to respond to market and crop insurance incentives more than previously. Using simultaneous equations for crop insurance participation and the percentage of cropland planted to cotton, results show that counties with extremely low yields, usually those in rainfed or dryland regions, have more response to insurance participation compared to those with very high yields as the price expectation goes up. Moreover, counties with extremely low yields respond more to changes in expected price than counties with relatively high yields. An important policy implication of this result is that price supports are likely to benefit counties more that have relatively greater production risks. Furthermore, higher insurance subsidies lead to greater insurance participation and cotton production in relatively riskier counties.

The estimated acreage response from insurance participation is insignificant for the West and negatively significant for the Delta, Southeast, and Southwest. The insignificance of all variables for the West suggest that the cropping decisions in the irrigated region have not been affected much by crop insurance, as also indicated by the relatively low subsidy received per pound of production. The negative and significant correlation between insurance participation and the percentage of cotton acres planted in the Delta, Southeast, and Southwest was not expected. However, the Energy Policy Act of 2005 is believed to have contributed to the decline in the percentage of cropland

planted to cotton for these regions, particularly given the run-up in corn prices that occurred before other commodities. While a Laspeyres Price Index of competing crops was considered for spring wheat, corn, and soybeans, further research is needed to develop a more precise and quicker reaction to competing commodity crops and subsidized crop insurance. In addition, crop insurance subsidies have been increasing for all program commodities and not just cotton over the 1995 to 2011 time period considered.

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Table 1. Summary Statistics of Variables

Region (# of observations)	Delta (940)	Southeast (2,197)	Southwest (1,728)	West (221)	U.S. (5,086)
<i>Dependent variables</i>					
$PINSUR_{it}$	47.916 (0.693)	64.960 (0.474)	62.470 (0.584)	44.748 (1.293)	60.084 (0.333)
$PCOTACRES_{it}$	22.195 (0.444)	26.742 (0.356)	19.169 (0.449)	12.915 (0.902)	22.730 (0.241)
<i>Independent variables</i>					
$SUBSIDYPERLB_{it-1}$	1.702 (0.038)	2.834 (0.043)	3.690 (0.068)	1.223 (0.094)	2.846 (0.324)
$PROR_{it-1}$	455.81 (52.070)	273.32 (11.820)	281.40 (10.059)	261.88 (25.034)	309.30 (11.507)
$E[P_{icot,it}]$	75.496 (0.406)	78.241 (0.288)	73.633 (0.290)	84.378 (1.159)	76.435 (0.186)
YLD_{it-1}	791.94 (5.925)	665.58 (3.902)	544.41 (6.066)	1,094.99 (21.235)	666.42 (3.502)
$E[P_{icot,it}] YLD_{it-1}$	58,927.2 (436.52)	51,350.2 (304.68)	39,213 (422.67)	91,276 (1,920.74)	50,361.9 (277.00)
$YLDVAR_{it}$	18.295 (0.156)	23.737 (0.155)	27.869 (0.219)	17.341 (0.573)	23.857 (0.119)
PBT_{it}	69.922 (0.881)	65.764 (0.547)	31.792 (0.744)	25.962 (1.903)	53.261 (0.462)
$PICC_{it}$	87.930 (2.715)	133.61 (1.944)	87.128 (2.683)	147.671 (8.741)	109.987 (1.430)
$D1_t$	0.140 (0.113)	0.154 (0.0077)	0.156 (0.0088)	0.181 (0.0259)	0.154 (0.0051)
$D2_t$	0.574 (0.016)	0.540 (0.011)	0.534 (0.012)	0.507 (0.033)	0.542 (0.0070)
<i>Other descriptors</i>					
Planted acres	41,620 (1,321.1)	18,256 (316.21)	47,983 (1,631.5)	45,265 (3,814.9)	33,847 (670.8)
Insured acres	37,093 (1,174.8)	17,042 (302.3)	45,917 (1,602.8)	37,320 (3,171.0)	31,440 (642.3)

Mean values are above the sample standard errors in parentheses.

Table 2. Fixed effects results of simultaneous percent insured and percent cotton planted equations

Dependent Variable	Equation for $PINSUR_{it}$ (insured/max insurance•100)					Equation for $PCOTACRES_{it}$ (cotton planted /cropland acres • 100)				
	Delta	SE	SW	West	U.S.	Delta	SE	SW	West	U.S.
Intercept	10.053** (1.755)	3.684* (1.581)	-5.264** (1.908)	-1.236 (9.965)	2.875** (0.837)	5.307* (2.354)	6.167** (1.022)	0.1684 (0.5155)	-2.269 (1.223)	2.222** (0.4627)
$E[P_{icot,it}]$	-0.4626** (0.1761)	0.3336** (0.1281)	0.0398 (0.1270)	-2.828 (0.3516)	0.2326** (0.0653)	-0.4128 (0.1765)	-.0329 (0.074)	0.1142** (0.0387)	-.0773 (0.0633)	0.0311 (0.0335)
YLD_{it-1}	-.0755** (0.0142)	0.0390** (0.0106)	0.0120 (0.0145)	-0.0415 (0.0345)	0.0273** (0.0057)	-0.2540 (0.0165)	0.0135* (0.0068)	0.2374** (0.0043)	-.0103 (0.0058)	0.0107** (0.0030)
$E[P_{icot,it}] YLD_{it-1}$	0.0005** (0.00019)	-.0007** (0.0014)	-.0004* (0.0002)	0.0003 (0.00035)	-0.0006** (0.00007)	0.000005 (0.00016)	0.0002** (0.00009)	-.00039** (0.00006)	0.00008 (0.00006)	-0.0002** (0.00004)
$YLDVAR_{it}$	0.7368** (0.1444)	0.1249 (0.0818)	0.0579 (0.0862)	-.2634 (0.5756)	0.0306 (0.0508)	0.315** (0.1656)	0.1598** (0.0541)	-.0192 (0.0000)	-.1339 (0.0899)	0.0015 (0.0264)
PBT_{it}	0.1876** (0.0376)	0.2248** (0.0433)	0.0960** (0.0330)	0.1154 (0.0889)	0.1507** (0.0190)	-.08358** (0.0281)	-.0223 (0.0143)	-.0099 (0.0075)	0.0168 (0.2653)	-0.0135 (0.0072)
$SUBSIDYPERLB_{it-1}$	3.891** (0.5887)	5.474** (0.8147)	2.763** (0.4533)	2.875 (1.795)	3.536 (0.2851)					
$PROR_{it-1}$	0.0006** (0.00023)	0.0006 (0.00064)	0.0033** (0.0012)	0.0014 (0.0050)	0.00063* (0.00025)					
$PICC_{it}$						-.08352** (0.0109)	-.0244** (0.0036)	-.0179** (0.0026)	-.0036 (0.0049)	-.0251** (0.0021)
$D1_t$	-18.099** (2.091)	-7.786** (2.730)	2.527 (3.056)	-13.057** (4.863)	-7.173 (1.366)	-18.410** (4.263)	-14.414** (1.352)	-3.557** (0.7148)	-1.666 (1.7567)	-8.602** (0.676)
$D2_t$	-12.958** (2.534)	-6.264** (2.036)	6.591** (2.341)	1.846 (13.381)	-4.219 (1.154)	-3.822 (2.953)	-6.678** (1.415)	1.597* (0.7189)	3.1674 (1.6317)	-1.119** (0.629)
$PCOTACRES_{it}$	1.051** (0.1679)	1.645** (0.4500)	2.491** (0.7621)	-2.778 (3.228)	1.379 (0.243)					
$PINSUR_{it}$						-.6800** (0.1821)	-.6191** (0.0581)	-.2927** (0.0445)	-.07433 (0.1032)	-.4302** (0.0341)

Note: Asterisks indicate statistical significance at the 5%(*) and 1%(**) levels. Standard errors are in parentheses.

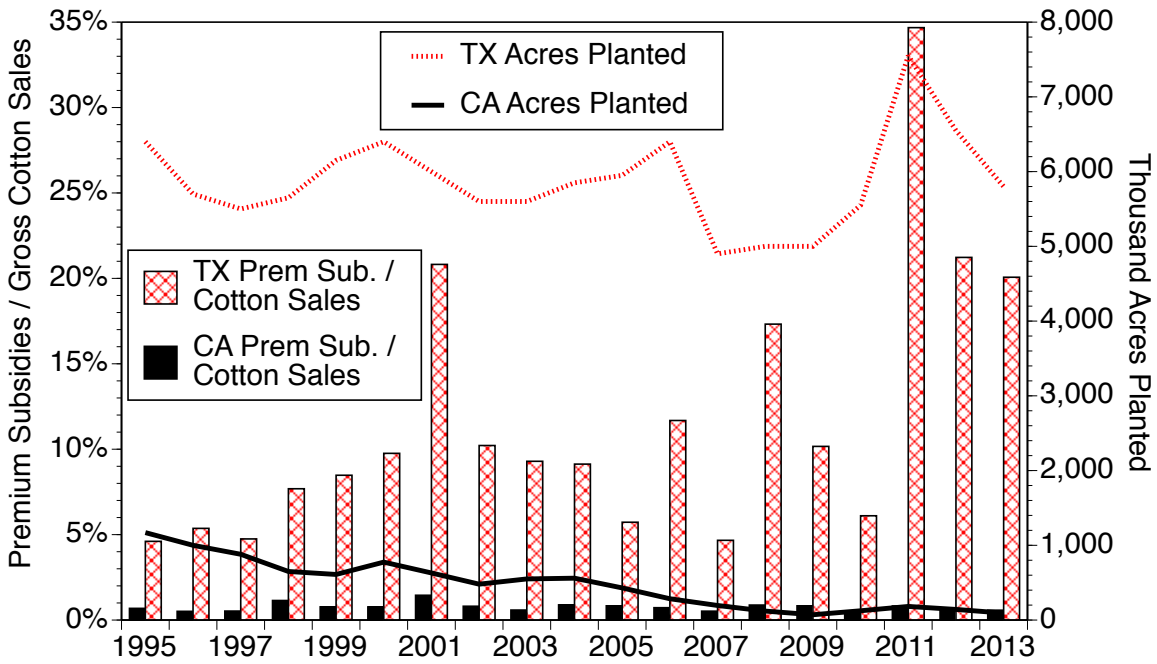


Figure 1. Relative Premium Subsidy Levels and Acres of Upland Cotton Planted for California and Texas, 1995-13

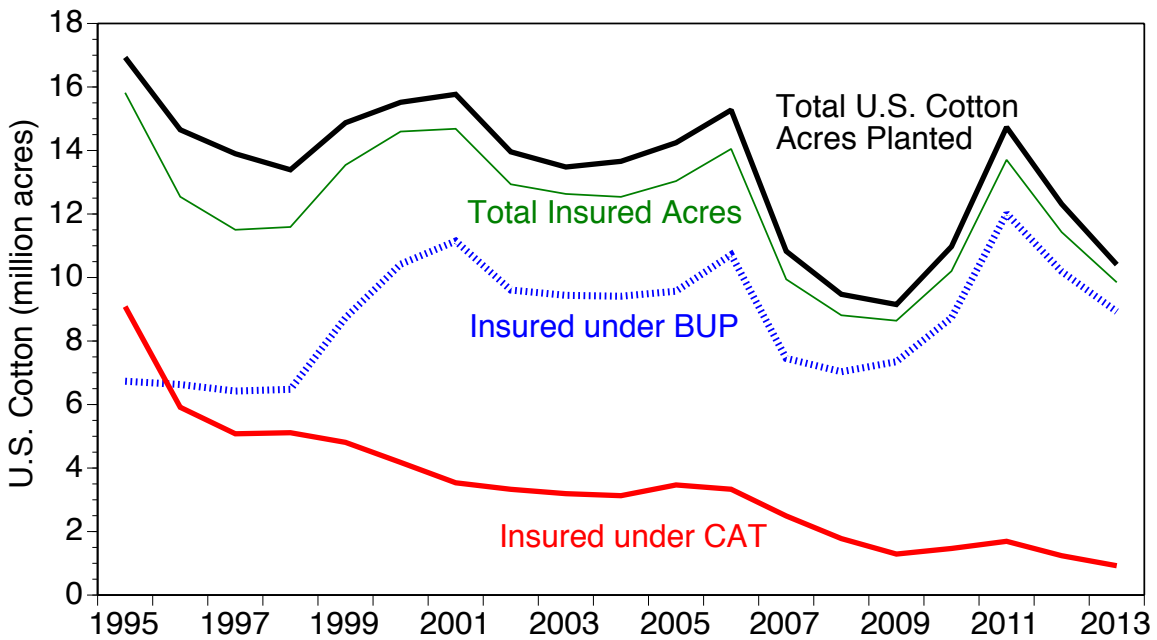


Figure 2. Insured U.S. cotton acreage by coverage levels, 1995-2013

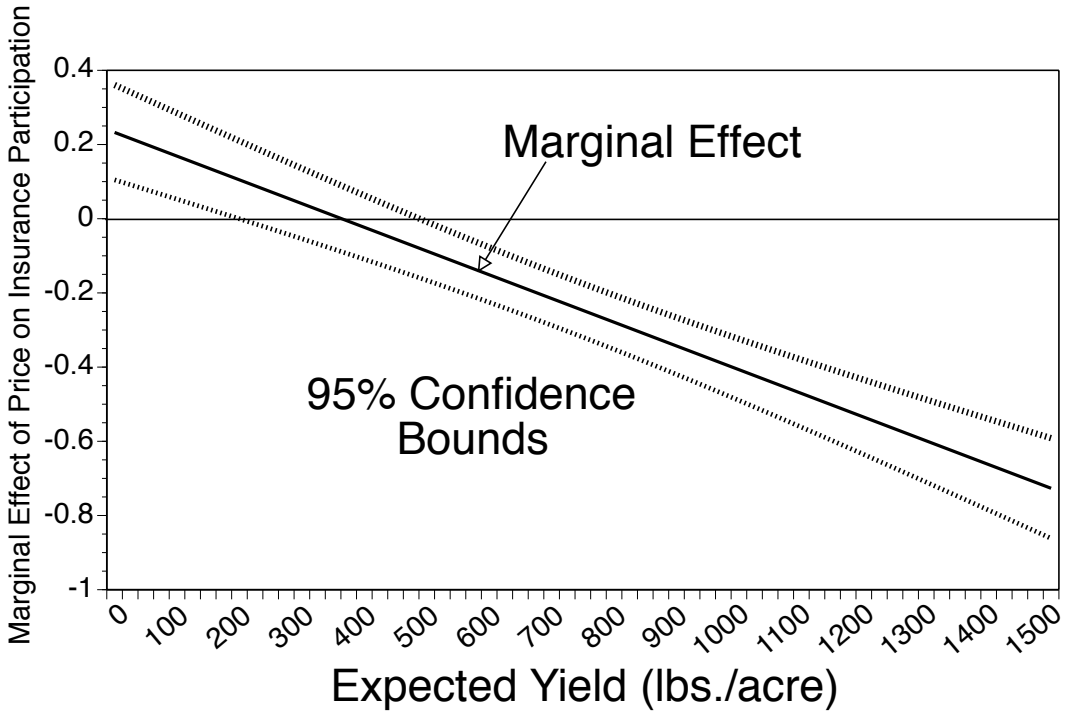


Figure 3. Marginal effects of expected price on insurance participation given yield expectation.

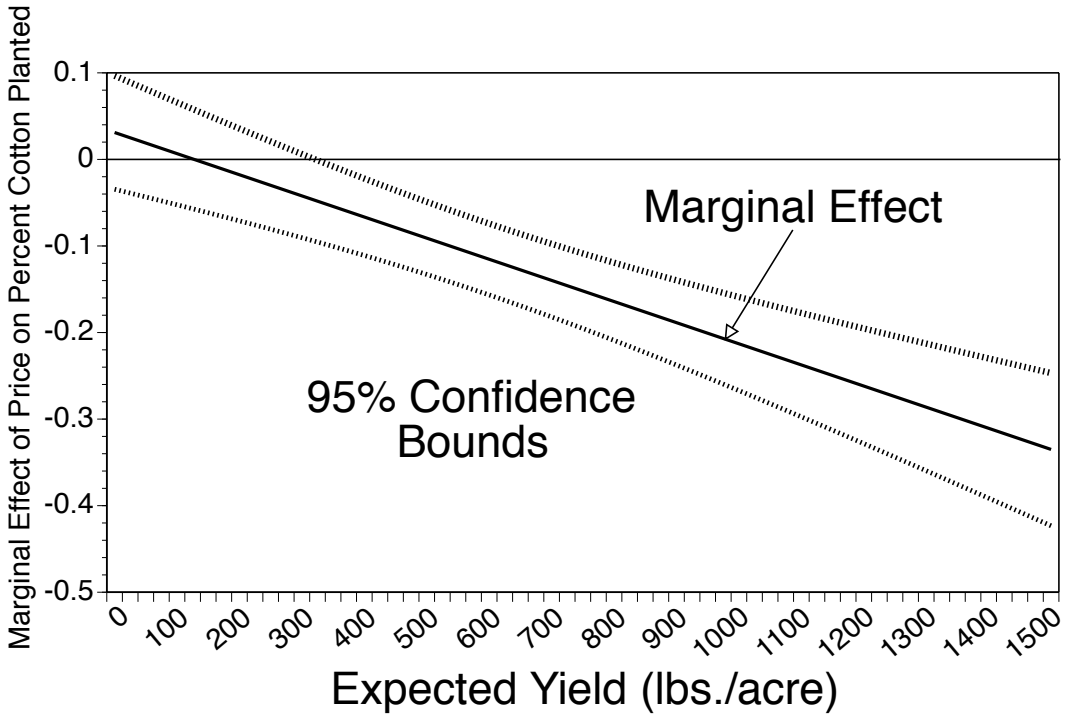


Figure 4. Marginal effects of expected price on percentage of cotton planted given yield expectation

Endnotes

ⁱ However, most of the insured acreage in 1995 was under CAT as around only 30% of the total acreage insured was at Buy UP (BUP) levels.

ⁱⁱ Southeast region includes Alabama, Florida, Georgia, North Carolina, South Carolina and Virginia; Delta region includes Arkansas, Louisiana, Mississippi, Missouri and

ⁱⁱ Southeast region includes Alabama, Florida, Georgia, North Carolina, South Carolina and Virginia; Delta region includes Arkansas, Louisiana, Mississippi, Missouri and Tennessee; Southwest region includes Kansas, Oklahoma and Texas; and West region includes Arizona, California and New Mexico.