INTER-SECTORAL RELATIONSHIPS IN THE TEXAS COTTON INDUSTRY

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Abstract

A multi-sectoral econometric model was developed to analyze economic interrelationships among various sectors of the cotton industry. Results of the study indicate that the production sector and the agribusiness sectors of the Texas cotton industry are intricately dependant on each other. More importantly, results indicated that a one bale increase in production generated $673 in revenues for the industry. Further, textile mill level price variability affected the production and ginning sectors, but not the merchant/shipper sector.

Introduction

Cotton is the single most important textile fiber in the world, accounting for about 50 percent of the total world fiber production. In 1995, the United States ranked second in the world in cotton production by producing 17.9 million bales of cotton for an estimated value of $6.5 billion (USDA, 1997). Cotton production in the United States is scattered across the Cotton Belt stretching from Virginia to California. The state of Texas has the largest area devoted to cotton of any single state. Texas cotton farmers produced approximately 4.46 million bales of cotton, representing 25 percent of the total production in the United States, for a value of about $1.6 billion in 1995 (USDA, 1997).

The cotton industry in Texas brings together many agribusinesses such as the production input, ginning, cottonseed oil mill, and shipping and warehousing sectors. However, there is currently a lack of understanding as to the extent of the economic interdependence among the various sectors of the Texas cotton industry. Furthermore, the available empirical tools are not adequate to accurately assess the economic effects of changes in the production sector on the agribusiness sectors. The general objective of this study was to identify and quantify the economic interrelationships and interdependence between the production and agribusiness sectors of the Texas cotton industry. A clear understanding of the inter-sectoral relationships in the Texas cotton industry and the development of empirical tools to measure the economic effects of changes in one sector on others should be beneficial to the Texas cotton industry. The study should also be beneficial to policy makers in maintaining the competitive position of the industry in domestic and foreign markets.

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Methods and Procedures

Several assumptions were made for the purposes of this analysis. Specific assumptions with regard to the various sectors of this study are presented below. The merchant, warehouse and shipper sectors of the Texas cotton industry were combined to represent the merchandising sector because of a lack of disaggregated data concerning the three sectors. Furthermore, because data were not available showing the percentage of cotton being sold via the merchant sector versus the percentage being sold from producers directly to domestic mills, it was assumed that ownership of all cotton passes from the production sector, to the merchant/shipper sector, and finally to the textile mill sector. If cotton is sold directly from producers to textile mills, thus bypassing the merchant/broker sector, the merchant/shipper sector was hypothesized to have either been vertically integrated into the production or textile mill sector. Finally it was assumed that the price domestic textile mills pay for Texas cotton is equal to the price ports and/or Canada pay for Texas cotton.

Model Specification

In order to accomplish the objective of this study, four different regions of the state were identified and separated (Figure 1). Areas chosen for these regions were based on similar growing conditions of cotton and cotton production practices employed within these areas. These regions are: Region 1 which, included the Texas High Plains and Rolling Plains; Region 2, which included the Cross Timbers, Blacklands, East Texas, South Central Texas, and South Texas; Region 3 included the Upper Coast and Coastal Bend; and Region 4 included the Edwards Plateau and Trans-Pecos regions of Texas.

Identifying the factors that affect the production of cotton in the four defined regions of Texas was addressed through the specification of an acreage response function for each region. The regional acreage response functions were then multiplied by the reported cotton yield per acre to determine the total cotton production in the state. The cottonseed sector was modeled simply by expressing the production of cottonseed as a function of the total production of cotton lint. The cottonseed oil mill sector was analyzed by first estimating the supply of cottonseed to oil mills and then by specifying the total production of cottonseed oil as a function of the supply of cottonseed to oil mills and other exogenous variables.

The ginning and the merchant/shipper sector relationships were modeled by estimating equations for the ginning sector marketing margin and the merchant/shipper sector marketing margin, respectively. It was hypothesized that the price Texas producers receive for cotton is directly proportional to the U.S. producer price, thus the price Texas producers receive for cotton was simply regressed against the price U.S. producers receive for cotton.

The effects of changes in the production sector on the agribusiness sectors were examined by analyzing the responsiveness of the agribusiness sectors and their total revenues to changes in the production of cotton and cottonseed. These responsiveness estimates were determined by analyzing how a one percent change in the production of cotton and/or cottonseed affected the agribusiness sectors' marketing margins and total revenues. Finally, the effects of changes in the agribusiness sectors on the production sector was accomplished through the responsiveness of the production sector and its total revenues due to changes in the agribusiness sectors. These responsiveness estimates were determined by analyzing how a one percent change in the ginning and merchant/shipper sectors' marketing margins, price paid by domestic textile mills and/or ports and Canada pay for cotton, and price paid to producers for cottonseed affect the production sector's total revenues.

Model Estimation

The parameters of the model were initially estimated using ordinary least squares (OLS). The models were evaluated using the signs and magnitudes of the coefficients, F-tests, t-tests, R^2 values, White's Test for heteroscedasticity, and the Durbin-Watson test for autocorrelation. The maximum likelihood procedure was used in cases where autocorrelation was present.

Determination of the functional form for each equation in this model consisted of analysis of error term models for individual variables, a procedure discussed in detail in Brown and Ethridge (1995). Residual analysis consisted of regressing the error terms of the regression equations against each of the individual independent variables and the squared term of the variable under consideration. Statistically significant parameter estimates indicated problems with the functional form of the variable under consideration. Quadratic, cubic, reciprocal, and logarithmic transformations of the regressors were employed in a trial and error approach to adjust the functional form as the residual analysis indicated was necessary.

Results

The results and findings presented below are the outcome of the methods and procedures used to accomplish the objectives of this study and is separated into three sections. The first section presents the estimated equations along with the *t*-values in parenthesis below the respective estimated parameters in each equation and the R^2 for each estimated equation. The second section includes interpretations and explanations of the estimated system of equations. Finally, the third section presents the findings regarding the responsiveness of each sector of the cotton industry due to changes in the price domestic textile mills and/or ports and Canada pay for cotton, the price cottonseed oil mills pay for cottonseed, the price of cottonseed oil, and the production of cotton lint.

System of Equations

The system of estimated equations used in this analysis are (1) acreage response equations; (2) production of cottonseed; (3) supply of cottonseed to oil mills; (4) production of cottonseed oil; (5) price producers receive for Texas cotton; (6) ginning marketing margin; and (7) merchant/shipper marketing margin. Definitions of individual variables are presented in Table 1.

Acreage Response Equations

$$PLAR1_t = -8.11 + 8.75\ CTP_{t-1} - 4.28\ AVOCR1_{t-1} + 81490.00\ MG_{t-1}^{-1}$$
(-0.004) (2.001) (-2.340) (0.981)
$$+ 0.11\ USBASE_t - 42.75\ MAR_t + 8.36\ LIMIT_t \quad (1)$$
(1.336) (-3.637) (2.444)
$R^2 = 0.7720$

$$PLAR2_t = -54.03 + 5.95\ CTP_{t-1} - 1.51\ AVOCR2_{t-1} - 5183.78\ MG_{t-1}^{-1}$$
(-0.101) (6.691) (-2.946) (-0.299)
$$+ 0.03\ USBASE_t - 8.60\ MAR_t + 1.60\ LIMIT_t \quad (2)$$
(1.770) (-3.997) (2.264)
$R^2 = 0.9412$

$$PLAR3_t = -913.20 + 3.03\ CTP_{t-1} - 1.10\ AVOCR3_{t-1} - 35232.00\ MG_{t-1}^{-1}$$
(-1.702) (1.974) (-2.230) (2.324)
$$+ 0.06\ USBASE_t - 10.16\ MAR_t + 1.84\ LIMIT_t \quad (3)$$
(2.551) (-3.161) (1.907)
$R^2 = 0.6947$

$$PLAR4_t = -324.45 + 1.05\ CTP_{t-1} + 0.10\ AVOCR4_{t-1} + 4677.84\ MG_{t-1}^{-1}$$
(-2.950) (2.476) (0.358) (1.695)
$$+ 0.02\ USBASE_t - 1.85\ MAR_t + 0.49\ LIMIT_t \quad (4)$$
(4.569) (-2.977) (2.566)
$R^2 = 0.6000$

Production of Cottonseed

$$PROSLB_t = 1.70\ PROTXLB_t \quad (5)$$
(132.606)

$R^2 = 0.9985$

Supply of Cottonseed to Cottonseed Oil Mills

$$SSEED_t = 55.91E8 - 7.28E18\ PROSLB_{t-1} - 28.84E6\ SDPLB_{t-1} \quad (6)$$
$$(28.761) \qquad (-19.810) \qquad (-3.888)$$
$R^2 = 0.9448$

Production of Cottonseed Oil

$$PROSOLB_t = -24.21E6 + 0.14\ SSEED_t - 97.33E7\ POIL_{t-1}$$
$$(-1.115) \qquad (25.717) \qquad (-3.295)$$
$$+ 40.69E5\ NOM_t \quad (7)$$
$$(6.484)$$
$R^2 = 0.9667$

Price Producers Receive for Texas Cotton

$$LCTP_t = -0.09 + 1.02\ LCTPUS_t \quad (8)$$
$$(-9.168) \qquad (30.030)$$
$R^2 = 0.9730$

Ginning Marketing Margin

$$MGLB_t = -5.75 - 4.42E\text{-}10\ PROTXLB_t + 0.03\ TXCP_t - 0.01\ SDP_t$$
$$(-2.186) \qquad (-0.913) \qquad (2.388) \qquad (-1.869)$$
$$+0.05\ NGIN_t - 3.05E\text{-}5\ NGIN_t^2 + 3.01E\text{-}4\ CHBMOD_t \quad (9)$$
$$(6.708) \qquad (-6.153) \qquad (0.920)$$
$R^2 = 0.8966$

Merchant/Shipper Marketing Margin

$$MERCHM_t = 0.619 - 6.27E\text{-}10\ PROTXLB_t + 1.43E\text{-}19\ PROTXLB_t^2$$
$$(1.725) \qquad (-2.015) \qquad (1.883)$$
$$+ 0.06\ PRCM_t + 0.96\ PCHPRAY_t + 6.20E\text{-}10\ BBSTT_t \quad (10)$$
$$(0.454) \qquad (5.902) \qquad (1.631)$$
$$- 4.53E\text{-}19\ BBSTT_t^2$$
$$(0.068)$$
$R^2 = 0.7111$

Interpretation and Explanation of the System of Equations

Acreage Response Equations. Results indicated that Regions 1 and 3 were less responsive to changes in the price of cotton in the previous year than Regions 2 and 4. A potential reason for this difference is the large concentration of acreage devoted to cotton in regions 1 and 3 relative to the two more responsive regions (2 and 4). Acreage that was suitable for cotton production may already be planted in cotton in Regions 1 and 3. Regions 2 and 4 were more responsive to changes in the price of cotton lint in the previous year because of the availability of suitable land in these Regions for cotton production.

It was also found that Region 2 was more responsive to changes in the price needed to make cotton as profitable as grain sorghum followed by Regions 1 and 3. A possible explanation for the difference in the responsiveness to the profitability of an alternative crop is that, Region 2 has had a higher concentration of land that was suitable for growing either cotton or grain sorghum relative to Regions 1 and 3. Thus, producers in Region 2 react more to changes in the relative profitability of grain sorghum to cotton than other regions of Texas. The price needed to make cotton as profitable as grain sorghum was not statistically significant in explaining the variation in cotton planted acreage in Region 4, and this may be because the relative profitability of grain sorghum to cotton in Region 4 has not varied over the data range. In fact, Region 4 currently has the lowest concentration of land producing grain sorghum, indicating that grain sorghum is probably not a profitable alternative to cotton in that region.

Furthermore producers in Region 3 responded more to changes in the margin associated with ginning in the previous year than producers in Region 4, but the ginning charge was not a factor in planting decisions of producers in Regions 1 and 2. One potential reason why the cotton planted acreage in Regions 1 and 2 were not responsive to changes in the ginning marketing margin is that the cost of producing cotton in Regions 1 and 2 has been relatively lower than the cost of producing cotton in Regions 3 and 4 (Texas A&M University, 1975-1995). Thus, any change in the cost of production, including the ginning charge, had a stronger effect on Regions 3 and 4 relative to Regions 1 and 2.

The announced governmental cotton base acreage allotment for planting was found to affect planted cotton acreage in Region 2 the most followed by Region 4 and Region 3. Because Regions 1 and 3 have had considerably higher concentrations of acres devoted to cotton, compared to the other two regions (2 and 4), inferences can be drawn that Regions 1 and 3 only had marginal cotton land available to bring into cotton production. Any new cotton acreage brought into production would have produced lower returns than current acreage. Therefore, producers in Regions 1 and 3 did not respond to changes in the level of cotton base acreage as much as the producers in Regions 2 and 4.

Region 4 was found to be the most responsive to governmental programs mandating acreage reduction followed by about the same responsiveness for Regions 3, 2, and 1. A potential reason why producers' planting decisions in Region 4 was so much influenced by an increase in mandatory acreage reduction to comply with governmental programs could be that the cost of producing cotton was higher and the relative profitability was lower in Region 4 compared to the other regions of the State (Texas A&M University, 1975-1995). Thus, any incentive provided by governmental programs to reduce cotton acreage in Region 4 by a per acre payment was probably viewed by producers as a less risky proposition.

Finally, it was found that producers in all regions of the study responded similarly to changes in the governmental payment limitation per person. In absolute terms, however, producers in Regions 4 and 3 were slightly more responsive to changes in the governmental payment limitation per person than producers in Regions 2 and 1. This again suggests that Region 4 had the highest governmental cotton program participation rates relative to Regions 3, 2, and 1. This might imply that cotton producers in Region 4 required the assistance of governmental programs more relative to producers in other three regions of Texas.

Production of Cottonseed. The production of cottonseed was found to increase by about 1.70 pounds when the production of cotton lint increased by one pound (equation 5). The relationship between the production of cotton lint and cottonseed, as expected, was positive because cottonseed and cotton lint are joint products. It is thus obvious that cottonseed can not be produced independently of cotton lint, justifying the lack of an intercept term in the estimated equation. Further, it should be noted that the magnitude of the relationship (1.70 pounds of cottonseed to every one pound of cotton lint) is consistent with what is generally believed to be true by industry participants.

Cottonseed Oil Mill Sector

Supply of Cottonseed to Cottonseed Oil Mills. The relationship between the production of cottonseed and supply of cottonseed to oil mills (equation 6) indicated that as the production of cottonseed increased by one percent from its historical mean value, the supply of cottonseed to Texas cottonseed oil mills increased by about 0.86 percent from its historical mean value. One potential reason why a one-to-one ratio was not observed is that a certain amount of cottonseed is used by the production sector for personal reasons such as replanting and for cattle feed. Once this demand has been met, the production sector supplies the remaining cottonseed to industries such as the cottonseed oil mills and/or dairies.

Results also indicated that as the price cottonseed oil mills pay for cottonseed increased by one percent from its historical mean value, the supply of cottonseed increased by about 0.13 percent from its mean value. The positive relationship between the price and the quantity supplied of cottonseed is consistent with economic theory. However, the quantity supplied of cottonseed to oil mills was not very responsive to the price of cottonseed. This could be because the production, and thus the supply of cottonseed to oil mills, is dependent on the production of cotton lint not the price of cottonseed.

Production of Cottonseed Oil. The relationship between the supply of cottonseed to oil mills in Texas and the production of cottonseed oil suggested that as the supply of cottonseed to oil mills increased by one pound, the production of cottonseed oil increased by about 0.14 pounds. Over the range of data used in this study, on an average, about 0.15 pounds of cottonseed oil was historically produced per one pound of cottonseed (Texas Agricultural Statistics Service, various issues; USDA, various issues). This supports the finding of this study regarding the relationship between the supply of cottonseed to cottonseed oil mills and production of cottonseed oil.

Results also indicated that a one percent increase in the price of cottonseed oil from its historical mean level increased the production of cottonseed oil by about 0.10 percent. An explanation for such an inelastic supply of cottonseed oil may lie in the fact that the price of oil does not influence cotton production, thus, the supply of cottonseed to cottonseed oil mills was not more responsive to changes in cottonseed oil prices.

Finally, results suggested that as the number of cottonseed oil mills in Texas increased by one, the production of cottonseed oil increased by about 4.07 million pounds. It should be noted that over the study period, the number of cottonseed oil mills in Texas has continuously decreased from 40 cottonseed oil mills in 1969 to 12 mills in 1995. However, the average production of cottonseed oil per cottonseed oil mill has increased from about 9.28 million pounds in 1969 to about 33.27 million pounds in 1995. This estimate suggests that as the number of cottonseed oil mills in Texas decreased some oil production was lost, however the remaining cottonseed oil mills in Texas increased their capacity.

Price of Texas Cotton Lint

The relationship between the price paid to U.S. producers and the price paid to Texas producers for cotton lint suggested that as the price paid to U.S. producers for cotton lint increased by one percent, the price paid to Texas producers for cotton lint, as expected, increased by about one percent. Because the price paid to U.S. producers for cotton lint is a weighted average of the prices paid to producers of each state in the U.S., it was expected that the estimated coefficient would be close to one.

Texas Ginning Sector

The estimated coefficient for the production of cotton lint was not statistically significant in explaining the variation in the marketing margin associated with ginning in Texas. An explanation for this could be that the nature of the competition in the ginning industry that forces cotton gins to compete for cotton from producers based on its ginning charge. If the margin associated with individual gins frequently fluctuates based on the level of cotton production, customers may choose to use another gin. Thus, ginners are likely opting for price stability and putting more emphasis on customer retention than short-term profitability.

Results indicated that as the price Texas producers received for cotton lint increased by one cent per pound, the marketing margin associated with ginning increased by about 0.03 cents per pound. This suggests that when the price of cotton increased, the demand for ginning services also increased, which resulted in an increase in the ginning charge, ceteris paribus.

Furthermore, as the price paid by oil mills in Texas for cottonseed increased by $1.00 per ton of seed, the ginning margin decreased by about 0.009 cents per pound. This is contradictory to results of previous studies that suggested that cotton gins attempt to adjust ginning charges directly with cottonseed prices so the sale of cottonseed would pay for these charges. This could indicate that the ginning industry in Texas no longer "gins for seed." Cotton gins in Texas may have been competing on ginning charges alone rather than on the level of seed rebates it could obtain for its producers.

The marketing margin associated with ginning was found to increase at a decreasing rate with an increase in the number of gins, reach a maximum at about 862 gins and then decrease within the range of data. Results indicated that as the number of active cotton gins in Texas increased by one percent from its historical mean value, the marketing margin associated with ginning increased by about 0.44 percent. This suggests that as the number of active gins in Texas decreased (and increased capacity) over the relevant data range for this study, gins were able to process cotton at a lower cost thus reducing the ginning margin. The increasing capacity is also a potential reason why the marketing margin associated with ginning actually decreased within the data range. From 1969 to 1975, the number of active gins in Texas decreased from 1106 to 838 (USDA-ERS, 1969-1975), however, during this same time period, the total production of cotton in Texas ranged from about 2.38 million bales to about 4.67 million bales (Texas Agricultural Statistics Service, 1990). Increases in the ginning margin due to increased production of cotton may have occurred during this time period because the total number of active gins may not have been able to adjust capacity enough to keep up with cotton production.

The relationship between the change in the number of bales hauled by modules and the marketing margin associated with ginning in Texas was not statistically significant. Even though the introduction of modules into cotton transportation from the cotton field to gin plant actually increased the efficiency of the ginning industry, it also had additional associated costs not present with transportation of cotton by trailer. These additional costs to the ginning industry included the purchase or lease of trucks to transport the modules to the gin plant, maintenance on these trucks, drivers for the trucks, etc. The benefits gained from increases in efficiency may have been offset by increases in the cost to the gin plant, thus not having any considerable impact on the marketing margin associated with ginning.

Merchant/Shipper Sector

Results indicated that as the production of cotton lint increased by one percent from its historical mean value, the merchant/shipper sector's marketing margin decreased by about 0.72 percent at the mean. However it was also found that the marketing margin associated with the merchant/shipper sector actually increased at high levels of cotton production. An explanation for this behavior could be that with high levels of cotton production, the amount of time cotton is placed in storage before a suitable buyer is found may be longer. With increased storage time, costs associated with storing cotton also increases, thus, the merchant/shipper sector probably found it necessary to increase its marketing margin to account for this increased cost.

The estimated coefficient for the price textile mills and/or ports and Canada pay for Texas cotton was not statistically significant even at the 0.15 significance level. This suggests that changes in the price domestic textile mills and/or ports and Canada pay for cotton did not affect the merchant/shipper marketing margin. A potential explanation for this could be that the merchant/shipper sector considers itself to be a service sector to the production sector with a predetermined level of service charge. Since the amount of service provided by the merchant/shipper sector is not dependent on the price textile mills and/or ports and Canada pay for cotton, the merchant/shipper margin has been non-responsive to the market conditions of cotton lint. Thus, any change in the price domestic textile mills and/or ports and Canada pay for cotton did not affect this margin.

Furthermore, results indicated that as the percentage change in the price of rayon increased by one percent, the margin associated with the merchant/shipper sector increased by about 0.96 dollars per pound. Since rayon is viewed as a substitute for cotton by domestic mills and/or ports and Canada in some cases, any increase in the price of rayon could have resulted in an increase in the demand for cotton. If the domestic mills and/or ports and Canada substitute cotton for rayon, then the merchant/shipper sector would take advantage of the price increase of rayon and increase their margin for merchandising/shipping cotton.

Finally, as the beginning stocks of Texas cotton increased by one percent from its historical mean level, the marketing margin associated with the merchant/shipper sector increased by about 0.88 percent. Since the merchant/shipper marketing margin is a service charge for all activities (including cotton storage) between the sale of cotton by the producer and the purchase of that cotton by domestic textile mills and/or ports and Canada, any increase in the beginning stocks of Texas cotton would suggest that more cotton remains in storage from the previous year, leading to increased storage cost. Thus, in years with high levels of beginning stocks, the merchant/shipper sector probably increased the service charge to offset the additional storage cost.

Inter-Sectoral Relationships

The effects of changes in one sector on other sectors of the Texas cotton industry is presented in this section. It should be noted that all effects were calculated at the historical mean levels of the variables under consideration.

Results of this study indicated that as the price paid by domestic textile mills and/or ports and Canada for cotton increased by one percent, the total revenues associated with the production sector increased by about 1.30 percent. Furthermore, the marketing margin and total revenues associated with ginning increased by about 0.002 percent in response to a one percent increase in the price of cotton. The merchant/shipper marketing margin and total revenues were, however, not affected by a change in the price paid by domestic textile mills and/or ports and Canada.

With respect to a change in the price cottonseed oil mills pay for cottonseed, results indicated that as the cottonseed price increased by one percent, the supply of cottonseed to cottonseed oil mills increased by about 0.13 percent. A one percent increase in the price of cottonseed also resulted in about a 0.17 percent increase in the total revenues of the production sector. Further, a one percent increase in the price of cottonseed marginally decreased the marketing margin associated with ginning and the total revenue of the ginning sector.

Estimated effects of a change in the price of cottonseed oil on the cottonseed oil mill sector suggested that as the price of cottonseed oil increased by one percent, cottonseed oil mills increased the production of cottonseed oil by about 0.10 percent. Further, this one percent increase in the price of cottonseed oil resulted in about a 1.17 percent increase in the revenue generated by the cottonseed oil mill sector.

In regard to the effects of a change in the production of cotton lint, results suggested that a one percent increase in the production of cotton lint increased the production of cottonseed, supply of cottonseed to cottonseed oil mills, and the total revenue generated by the production sector by about 1.0, 0.86, and 1.15 percent, respectively. A one percent increase in the production of cotton lint did not, however, affect the ginning marketing margin but did increase the total revenue of the ginning sector by one percent. Further, a one percent increase in the production of cotton lint decreased the merchant/shipper marketing margin by about 0.73 percent but increased the total revenues of the merchant/shipper sector by 0.27 percent. Finally, a one percent increase in the production of cotton lint increased the production of cottonseed oil by about 0.81 percent and increased the total revenue generated by the cottonseed oil mill sector by about 0.81 percent.

It is thus obvious that cotton production variability has had direct implications for all sectors of the Texas cotton industry. It could be further extrapolated from the research that for every bale increase in production, about $673 of additional revenue was generated by the Texas cotton industry (excluding the input sectors and the textile mill sector), of which the production sector received about $547; the ginning sector received about $66; the merchant/shipper sector received about $39; and the cottonseed oil mill sector received about $22.

Estimated effects of a change in the ginning margin on the production sector suggested that as the ginning margin increased by one percent, the total revenues of the production sector decreased by about 0.002 percent. Results also indicated that as the marketing margin associated with the merchant/shipper sector increased by one percent, the total revenue associated with the production sector decreased by about 0.29 percent.

Summary and Conclusions

Texas cotton industry is composed of producers, gins, merchants, warehouses, cottonseed oil mills, textile mills, and a host of other agribusinesses that supply these sectors with inputs. Although these individual sectors provide different services, they are linked together because they all depend on cotton (in one form or another) for their existence. Cotton production uncertainties, stemming from production variability and the changing structure of farm programs, raise the question of identifying the effects of changes in the production sector on agribusinesses and also analyzing how changes in these agribusinesses may affect the cotton production sector of Texas. The general objective of this study was to identify and quantify the economic interrelationships between the production and agribusiness sectors of the Texas cotton industry.

The analysis is based on a multi-sectoral econometric model, consisting of regional acreage response functions, supply relationships of cottonseed to cottonseed oil mills, production of cottonseed oil, ginning and merchant/shipper margin relationships, and producer price function. Total revenues generated by each of the sectors were then determined, and the economic interdependence of each sector due to changes within each individual sector along with changes in other sectors were estimated.

Results of this study indicated that a change in the production of cotton lint, as expected, affected the total revenue of production, ginning, merchant/shipper, and cottonseed oil mill sectors. While it was observed that a change in the production of cotton did not affect ginning charges, it did affect the charges of the merchant/shipper sector of the Texas cotton industry. It was further observed that approximately 90 percent of a change in the price domestic textile mills and/or ports and Canada pay for cotton lint is passed on to the production sector, the remainder being absorbed by the ginning sector. The merchant/shipper sector was unaffected by any change in the price domestic textile mills and/or ports and Canada pay for cotton lint.

Many previous research concerning agricultural commodities have typically taken the approach of addressing an individual sector independent of the other sectors of the industry. Results of this study clearly demonstrate the efficacy of a multi-sectoral approach in agricultural research. It further reinforces the importance of inter-sectoral impact assessments in evaluating and implementing governmental policies.

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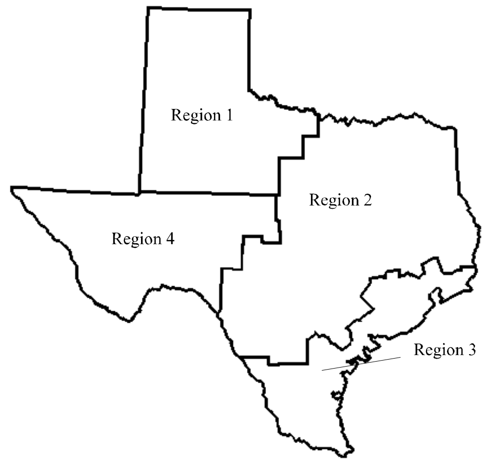

Figure 1. Four defined regions of the State of Texas for this study.

Table 1. Variable Definitions

Variable	Variable Definition
$PLARi_t$	Planted acres in Region i (1,000 acres) in time t
CTP_{t-1}	Price of cotton in cents/lbs. (1995 dollars) in time t-1
$AVOCRi_{t-1}$	Price needed to make cotton as profitable as grain sorghum in Region i (1995 dollars) in time t-1
MG_{t-1}	Ginning marketing margin in dollars/bale (1995 dollars) in time t-1
$USBASE_t$	Announced U.S. base acreage allotment for planting cotton (1,000 acres) in time t
MAR_t	Mandatory acreage reduction to comply with governmental programs in percent in time t
$LIMIT_t$	Governmental payment limitation per person in 1,000 dollars (1995 dollars) in time t
$PROSLB_t$	Production of cottonseed in Texas in pounds in time t
$SSEED_t$	Supply of cottonseed to Texas cottonseed oil mills in pounds in time t
$PROSLB_t$	Production of cottonseed in Texas in pounds in time t
$SDPLB_t$	Price cottonseed oil mills pay for cottonseed in dollars/lbs. (1995 dollars) in time t
$PROSOLB_t$	Total production of cottonseed oil in pounds in time t
$POIL_t$	Price cottonseed oil mills receive for cottonseed oil in cents/lbs. (1995 dollars) in time t
NOM_t	Number of cottonseed oil mills in Texas in time t
$LCTP_t$	Natural log of the price Texas producers receive for cotton in cents/lbs. (1995 dollars) in time t
$LCTPUS_t$	Natural log of the price U.S. producers receive for cotton in cents/lbs. (1995 dollars) in time t
$MGLB_t$	Texas ginning marketing margin in cents/lbs. (1995 dollars) in time t
$PROTXLB_t$	Production of cotton lint in Texas in pounds in time t
$TXCP_t$	Price received by producers for Texas cotton in cents/lbs. (1995 dollars) in time t
SDP_t	Price Texas cottonseed oil mills pay for Texas cottonseed in dollars/ton (1995 dollars) in time t
$NGIN_t$	Number of active cotton gins in Texas in time t
$CHBMOD_t$	Change in the number of Texas cotton bales hauled by modules in thousand bales in time t
$MERCHM_t$	Merchant/shipper marketing margin in dollars/lbs. (1995 dollars) in time t
$PRCM_t$	Price domestic textile mills and/or ports and Canada pay for Texas cotton in cents/lbs. (1995 dollars) in time t
$PCHPRAY_t$	Percentage change in the price of rayon in time t
$BBSTT_t$	Beginning stocks of Texas cotton in pounds in time t