IMPACT OF ALTERNATIVE LAND RENTAL AGREEMENTS ON THE PROFITABILITY OF COTTON PRODUCERS ACROSS THE COTTON BELT

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Abstract

Across the Cotton Belt, cropland values increased, decreased, or remained constant, depending on the state, from 2007 to 2011. The average change in cropland values in the Cotton Belt from 2010 to 2011 was 3.6%, modest when compared to increases in the Corn Belt. However, even modest increases in land values translate into rising production costs for producers, either through increased ownership costs or increased rents. With approximately 40% of farmland being rented nationally, land values and methods of securing land are important to overall profitability of cotton operations. The objective of this research was to evaluate the impact of land values on cotton (*Gossypium* L.) producer profitability across the Cotton Belt considering alternative methods of securing land and production systems. A cotton production financial simulation model was constructed to evaluate the impact of alternative methods of securing land, considering variable prices and yield, on grower net returns above variable costs considering conventional tillage and conservation tillage systems. Data were gathered from cotton enterprise budgets and historic prices, yields, land values, and rents for Arkansas, Georgia, and Texas. The preliminary results suggest that, in general, the cash rent and flexible cash rent scenarios provide the highest net returns over variable costs and the lowest net return variability; however, every farming operation is different and each producer must make an informed decision for their operation.

Introduction

Across the United States (U.S.), agricultural producers are faced with rising production costs. While land rent is just one part of production costs, increases in rent can have a negative impact on profitability. Increases in land values and rents differ by region and state, and by whether or not the land is irrigated. Land values have increased at an accelerated rate over the last five years, with the exception of 2009, in the Corn Belt (Illinois, Indiana, Iowa, Missouri, and Ohio), Lake States (Michigan, Minnesota, and Wisconsin), and Northern Plains (Kansas, Nebraska, North Dakota, and South Dakota) (USDA-NASS, 2012). While producers in the Cotton Belt (Alabama, Arizona, Arkansas, California, Florida, Georgia, Kansas, Louisiana, Mississippi, Missouri, New Mexico, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia) have not seen the large double digit increases in land values over the last two years, land values have increased in many of these states, while staying stable and even decreasing in others. Furthermore, the farmland rent-to-value ratio has been decreasing over the last 45 years. This means that it takes longer for an asset to pay for itself today than it did 45 years ago (Nickerson et al., 2012). Cotton (*Gossypium* L.) is an important commodity to these states, and maintaining profitability is important to these producers in the face of increasing land values and rent.

In 2011, cotton producers in the U.S. harvested approximately 9.46 million acres of cotton (0.3049 million acres of pima cotton (*Gossypium* L.) and 9.156 million acres of upland cotton). The average pima cotton yield was 1,340 lb ac^{-1} and the average upland cotton yield was 722 lb ac^{-1}. Producers received on average 1.64 \$ lb^{-1} for pima cotton and 0.913 \$ lb^{-1} for upland cotton. In 2011, producers in Arkansas, Georgia, Mississippi, North Carolina, and Texas planted the most acres and were the largest producers, in terms of production of upland cotton, while producers in California and Texas planted the most acres and were the largest producers of pima cotton. Nationally, cotton was harvested on 18605 operations (551 operations harvested pima cotton and 18286 operations harvested upland cotton), based on the 2007 U.S. Census of Agriculture. The North American Industry Classification System (NAICS) identifies cotton farming by NAICS code 11192. In 2007, approximately 10000 operations were classified as cotton farms, totaling over 13 million acres and over 4.3 billion dollars in total commodity sales. It is important to note that these operations may have produced other crops besides cotton. According to the U.S. Census Bureau, only one NAICS code is assigned to a business establishment, based on the primary business activity. The primary business activity is based on activity that generates the most revenue for the business establishment. Arkansas, Georgia, Mississippi, North Carolina, and Texas had the largest number of operations classified as cotton farms. Of the operations identified by NAICS code 11192, Arkansas, California, Georgia, Mississippi, and Texas had the highest production in terms of sales.

Cropland land values and cash rents vary widely across the Cotton Belt, and differ by whether the cropland is irrigated or dryland. Across all cropland, Arizona had the highest average land values (8749 \$ acre^{-1}) between 2000 and 2011. Oklahoma had the lowest average land values (974 \$ acre^{-1}). Ten states (Alabama, Arizona, California, Florida, Georgia, New Mexico, North Carolina, South Carolina, Tennessee, and Virginia) saw cropland values peak in 2007, 2008, or 2009. The remaining states (Arkansas, Kansas, Louisiana, Mississippi, Missouri, Oklahoma, and Texas) have seen land values continue to rise over the period 2000 to 2011. Irrigated cropland values were the highest in states growing high-value crops (i.e. fruits and vegetables, tree crops) that require irrigation: Arizona, California, Florida, and New Mexico. All cropland values were adjusted to 2011 using the Producer Price Index (Bureau of Labor Statistics, 2012). Over the period 2008 to 2011, average cropland rent ranged from 53 \$ acre^{-1} for irrigated cropland in South Carolina to 356 \$ acre^{-1} for irrigated cropland in California. Non-irrigated cropland rent ranged from 18 \$ acre^{-1} in New Mexico to 93 \$ acre^{-1} in Missouri. As with cropland land values, states where high-value crops were grown had the highest cash rents, especially for irrigated cropland. Understanding the influence of rent on profitability is important since almost 40 percent of agricultural land is rented by producers (Nickerson et al., 2012).

Aside from land ownership and cash rent, producers have other land tenure options, such as flexible cash rent and share rent arrangements. Due to the number of land tenure options, it is difficult to determine the best land tenure option given production costs. Previous literature has focused primarily on specific states and specific types of land tenure arrangements, such as share rent. Gueck et al. (2009) concluded that in the Texas High Plains, in regards to share rent arrangements, the producer and the landlord did not necessarily have the same preferred alternative, and that risk aversion of both the producer and landlord must be considered when finalizing share rent arrangements. For Louisiana rice producers, Deliberto and Salassi (2010) concluded that producers who cash rent increase their net return risk as compared to a share rent arrangement. The objective of this research is to evaluate the impact of agricultural land values and land rent on cotton producer profitability in Arkansas, Georgia, and Texas considering alternative methods of securing land and different production systems.

Materials and Methods

A cotton production financial simulation model was constructed to evaluate the impact of alternative methods of securing land, considering variable prices and yield, on grower net returns above variable costs considering different production methods. Data were gathered from cotton enterprise budgets and historic cotton lint and cottonseed prices, cotton lint yields, cropland land values, and cropland rents for Arkansas, Georgia, and Texas. Cotton lint and cottonseed prices, cotton lint yields were obtained from USDA - NASS for 1980 to 2011 (USDA-NASS, 2012). Cropland land values (2000 to 2011) and cropland rents (2008 to 2011) were also obtained from USDA-NASS (USDA-NASS, 2012). All prices, cropland land values, and cropland rents were adjusted to 2011 dollars using the Producer Price Index (Bureau of Labor Statistics, 2012). Table 1 displays the average cropland rent, cropland land values, and rent-to-value ratios for irrigated and dryland cropland.

Table 1. Average cropland rent (2008 – 2011), average cropland land values (2000 – 2011) and rent-to-value ratio by state for irrigated and dryland cropland.

State	Irrigated			Dryland		
	Cropland Rent ($ ac^{-1})	Cropland Land Values ($ ac^{-1})	Rent-to-Value Ratio	Cropland Rent ($ ac^{-1})	Cropland Land Values ($ ac^{-1})	Rent-to-Value Ratio
Arkansas	104.94	1889	0.056	53.61	1508	0.036
Georgia	142.31	2978	0.048	52.21	3372	0.015
Texas	79.17	1427	0.055	26.36	1274	0.021

Crop enterprise budgets were collected from Arkansas (University of Arkansas, 2012), Georgia (Smith et al., 2012), and Texas (Texas AgriLife Extension, 2012). Input costs that were yield based, such as ginning and warehousing, varied with stochastic yields. For Texas, enterprise budgets were used from District 2 for upland cotton, as this was the District in Texas with the largest upland cotton acreage based on data from 2000 to 2011. Table 2 displays variable costs of production by state and production alternative based on average cotton lint yields using data from 1980 to 2011. Arkansas had the highest average upland irrigated yields and the highest variable costs for irrigated production. Georgia had the highest average upland dryland yields and the highest variable costs for dryland production.

Table 2. Variable costs of production by state and production alternative based on average cotton lint yields from 1980 to 2011.

State/Scenario	Average Upland Cotton Yield (lb ac^{-1})	Average Total Variable Costs ($ ac^{-1})
Arkansas		
Furrow Irrigation	872	637.78
Pivot Irrigation		671.56
Dryland	662	495.10
Georgia		
Conventional Tillage, Dryland	674	514.95
Strip Tillage, Dryland		522.85
Texas		
Herbicide-tolerant, insect-resistant, Dryland	330	261.76
Herbicide-tolerant, insect-resistant, Pivot	637	579.13

While there are many different methods for securing land, the following methods were considered in this study: cash rent, flexible cash rent, share rent, and land purchase. Cash rent per acre was based on average cash rent for each state for dryland cropland and irrigated cropland, if applicable, in cotton producing counties. Georgia had the highest per acre irrigated cropland rent, and Arkansas and Georgia had similar (within two $ ac^{-1}) dryland cropland rent. Flexible cash rent typically are based on gross revenue, base rent plus a bonus, yield only, price only, or profit (Edwards, 2008; Fleming and Breece, 2001; Langemeier, 1997). For the purposes of this study, flexible cash rents were based on gross revenue using the following equation:

$$(1)\quad fcr = br + \left(\frac{ay}{by}\right) + \left(\frac{ap}{bp}\right).$$

In this equation *fcr* is flexible cash rent in $ ac^{-1}; *br* is base rent or the average cropland rent for dryland or irrigated cropland; *ay* is actual yield based on the stochastic yield; *by* is the base yield or average yield over the given time period; *ap* is actual price based on the stochastic price; and *bp* is the base price or average price over the given time period. The minimum rent was set as the base rent and the maximum rent was two times the base rent.

Under share rents arrangements, the producer and landlord share the income and expenses for producing a given crop. In this study, the landlord was assumed to receive 25% of gross revenue and cover 25% of a subset of variable costs, such as fertilizer, seed, and insecticides, as well as providing the land. Share rent agreements can vary in the share amounts and it is important to calculate the most equitable sharing arrangement; however, this was not calculated as part of this study (Boehlje and Eidman, 1984). For the land purchase scenario, the assumptions were a down payment of 25% of the average per acre cropland land value, an interest rate of 5.5%, and a 25 year loan. Georgia had the highest irrigated and dryland cropland land values of the three states. Taxes were not included in this study.

Net return distributions were simulated using multivariate empirical distributions (MVEs) of cotton lint yield, cotton lint price, and cottonseed price. SIMETAR (Richardson et al., 2008) was chosen to simulate the MVEs. The MVEs were estimated using 1980 to 2011 average yield and price values at the state level for Arkansas, Georgia, and Texas. The benefit of utilizing the MVE distribution is that a specific distribution is not imposed on the variables. Estimated MVEs include estimated means with deviations calculated relative to the trends for cotton lint yield and cotton lint price and relative to means for cottonseed price. The average cotton lint yield, cotton lint price, and cottonseed price over the given time period were assumed to be the expected yield and price in the risk analysis. The simulation included 1000 iterations of cotton lint yield, cotton lint price, and cottonseed price samples drawn from the estimated MVEs. Net returns over variable costs did not include any government or crop insurance payments; however, crop insurance premiums were included as a variable expense. The probability of net returns above variable costs less than 0 $ ac^{-1} or greater than 200 $ ac^{-1} were also estimated using SIMETAR.

Results and Discussion

Net return simulation summary statistics are shown in Table 3. Across all states and production alternatives, the scenario excluding land rent/ownership had the highest mean net return over variable costs and the lowest net return variability, as expected. The following discussion focuses on the remaining scenarios: cash rent, flexible cash rent, share rent, and land ownership.

For the B2RF Furrow alternative in Arkansas, the cash rent and land ownership scenarios had similar and highest mean net returns over variable costs; however, the share rent scenario had the lowest net return variability with a CV of 70.89. For the B2RF Pivot alternative, the cash rent and land ownership scenarios had similar and highest mean net returns over variable costs; however, the share rent alternative had the lowest net return variability with a CV of 77.25. For the B2RF Dryland alternative, the cash rent scenario had the highest net return over variable costs and the flexible cash rent scenario had the lowest net return variability with a CV of 83.16. Under the irrigated scenarios, for cash rent, flexible cash rent, and land ownership scenarios, the probability that net returns would fall below zero was 8% and the probability net returns would be greater than 200 $ ac^{-1} was 61%. These results were similar because of the base rent, yield, and price set for the flexible cash rent, as well as the lower land values in Arkansas allowing for per acre ownership costs to almost equal per acre cash rent. It is important to remember that land taxes were not included so the probability of net returns being less than zero would increase for the land ownership scenario. In the dryland alternative, the share rent scenario had the highest probability of net returns less than zero (15%), and the cash rent and flexible cash rent scenarios had the highest probability of net returns greater than 200 $ ac^{-1} (49%).

For Georgia, the cash rent scenario had the highest net returns over variable costs and the lowest net return variability with a CV of 86.28 for the conventional tillage dryland alternative. For the strip tillage dryland alternative, the cash rent scenario had the highest net return over variable costs and the flexible cash rent scenario had the lowest net return variability with a CV of 100.22. There was very little difference between the cash rent and flexible cash rent scenarios under either alternative. The difference between the mean net returns over variable costs of the cash rent and flexible cash rent scenarios was 3.22 $ ac^{-1} for the conventional tillage and strip tillage alternatives. The probability of net returns less than zero was the highest for land ownership under both alternatives, while the probability of net returns greater than 200 $ ac^{-1} was highest for cash rent and flexible cash rent under both alternatives. The land ownership scenario in Georgia was less profitable than cash rent and flexible cash rent scenarios due to higher average land values. An increase in average cash rent or changes in the flexible cash rent assumptions, holding average land values constant, would change the relationship.

Net returns over variable costs were the highest and net return variability was the lowest in the cash rent scenario in the Texas dryland scenario. The probability of net returns less than zero was lowest for the cash rent and flexible cash rent scenarios. These same scenarios also had the highest probability of net returns greater than 200 $ ac^{-1}$. For the pivot irrigation scenario, the share rent scenario had the highest net returns above variable costs and the lowest net return variability; however, the net return variability was high for all of the scenarios in both alternatives. The share rent scenario had the lowest probability of net returns less than zero and the cash rent scenario had the highest probability of net returns greater than 200 $ ac^{-1}$ for the pivot irrigation scenario in Texas.

For the irrigated scenarios in both Arkansas and Texas, the share rent scenario had the lowest probability of net returns less than zero. Across all states and scenarios, the cash rent and flexible cash rent scenarios had the highest probability of net returns greater than 200 $ ac^{-1}$. The results were dependent on the average cash rent, the design of the flexible cash rent arrangement, the share rent percentage, and the average cropland land values. A sensitivity analysis will be conducted as part of future research, as well as expanding the study to additional states, land tenure scenarios, and production alternatives.

Summary

On average for the U.S., cropland land values have steadily increased over the last ten years, with the exception of 2008 to 2010. Large increases in land values occurred between 2010 and 2012; however, land values have not increased in all states. Agricultural producers are faced with a number of land tenure options aside from land ownership: cash rent, flexible cash rent, and share rent. Across the Cotton Belt, producers are deciding the amount they can afford to pay for rent, or if purchasing land is the best option. Focusing on Arkansas, Georgia, and Texas, the preliminary results from this study suggest that, in general, the cash rent and flexible cash rent scenarios provide the highest net returns over variable costs and the lowest net return variability based on CV given the assumptions made in this study. Particularly in Georgia and Texas, which had higher land values than Arkansas, land ownership was the least profitable in the dryland scenarios. Overall, the main conclusion was that every farming operation is different and each producer must make an informed decision for their operation. These preliminary results could be the starting point for producers, but farm specific information should be analyzed before making a decision regarding land tenure.

The preliminary results of this study raise additional questions. First, what is the profit-maximizing flexible cash rent and share rent arrangement for each state and production alternative? Secondly, a sensitivity analysis needs to be conducted to determine how changes in cash rents and land values impact profitability. Third, there are a number of flexible cash rent arrangements used by producers. Additionally flexible cash rent arrangements need to be added to the study for comparison purposes.

Table 3. Average, minimum, and maximum simulated return over variable costs and probability of average returns over variable costs being less than 0 $ per acre or greater than 200 $ per acre for Arkansas, Georgia, and Texas.

State / Production Alternative / Land Tenure Alternative	Mean	Standard Deviation (SD)	Coefficient of Variation (CV)	Minimum	Maximum	Prob < 0 $ ac^{-1}	Prob > 200 $ ac^{-1}
	($ ac^{-1})			($ ac^{-1})			
Arkansas							
B2RF Furrow							
Excluding Land Rent	353.66	180.52	51.04	-206.03	839.66	3%	81%
Cash Rent	248.72	180.52	72.58	-310.97	734.72	8%	61%
Flexible Cash Rent	240.20	170.28	70.89	-310.97	681.26	8%	61%
Share Rent	205.50	135.39	65.88	-214.27	570.00	7%	51%
Land Ownership	248.04	180.52	72.78	-311.64	734.05	8%	61%
B2RF Pivot							
Excluding Land Rent	319.88	180.52	56.43	-239.80	805.89	5%	76%
Cash Rent	214.94	180.52	83.97	-344.75	700.94	11%	52%
Flexible Cash Rent	206.42	170.28	82.49	-344.75	647.49	11%	52%
Share Rent	175.26	135.39	77.25	-244.50	539.76	9%	42%
Land Ownership	214.27	180.52	84.25	-345.42	700.27	11%	52%
B2RF Dryland							
Excluding Land Rent	248.75	164.27	66.04	-170.50	684.23	7%	61%
Cash Rent	195.14	164.27	84.18	-224.12	630.61	14%	49%
Flexible Cash Rent	189.77	157.81	83.16	-224.12	598.91	14%	49%
Share Rent	141.81	123.20	86.87	-172.63	468.42	15%	34%
Land Ownership	164.41	164.27	99.91	-254.84	599.89	17%	42%

Georgia							
Conventional Tillage, Dryland							
Excluding Land Rent	213.55	155.35	72.75	-229.76	706.45	7%	52%
Cash Rent	161.35	155.35	86.28	-281.96	654.25	15%	38%
Flexible Cash Rent	158.13	150.55	95.21	-281.96	624.33	15%	38%
Share Rent	98.47	116.49	118.29	-233.91	468.07	21%	18%
Land Ownership	47.02	155.35	330.38	-396.29	539.92	39%	16%
Strip Tillage, Dryland							
Excluding Land Rent	205.65	155.35	75.54	-237.66	698.55	8%	50%
Cash Rent	153.44	155.35	101.25	-289.87	646.34	16%	36%
Flexible Cash Rent	150.22	150.55	100.22	-289.87	616.43	16%	36%
Share Rent	90.63	116.48	128.53	-241.76	460.23	23%	17%
Land Ownership	39.12	155.35	397.15	-404.19	532.02	41%	15%
Texas							
Herbicide-tolerant, insect-resistant, Dryland							
Excluding Land Rent	91.40	103.56	113.30	-110.32	460.26	20%	15%
Cash Rent	65.04	103.56	159.22	-136.68	433.90	30%	11%
Flexible Cash Rent	61.35	98.11	159.90	-136.68	407.54	30%	10%
Share Rent	27.40	77.67	283.44	-123.89	304.04	42%	3%
Land Ownership	20.19	103.56	512.90	-181.53	389.05	48%	7%
Herbicide-tolerant, insect-resistant, Pivot Irrigation							
Excluding Land Rent	103.56	136.99	132.29	-247.90	633.56	24%	23%
Cash Rent	24.39	136.99	561.66	-327.06	554.39	46%	11%
Flexible Cash Rent	16.80	126.51	753.04	-327.06	490.40	46%	8%
Share Rent	32.57	102.74	315.42	-231.02	430.07	41%	6%
Land Ownership	23.79	136.99	575.96	-327.67	553.78	47%	10%

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