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DECLINING COTTON ACREAGE IMPACTS ON U.S. COTTON GINNING INDUSTRY STRUCTURE AND COSTS

Maria Mutuc & Darren Hudson

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Department of Agricultural and Applied Economics
Texas Tech University | Box 42132 | Lubbock, Texas 79409-2132
P 806.742.2821 | F 806.742.1099

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U.S. COTTON GINNING INDUSTRY STRUCTURE AND COSTS

Maria Mutuc
Postdoctoral Research Associate
Darren Hudson
Professor and Larry Combest Chair of Agricultural Competitiveness
Department of Agricultural and Applied Economics
Texas Tech University
Lubbock, TX

Abstract

The United States cotton industry has seen sustained reductions in cotton acreage since 2006 that coincided with increased production of biofuels that afforded higher returns to crops such as corn, among others, from which biofuels are derived. With lower cotton production following reduced acreage, the average number of bales processed per gin in the U.S. declined from 26,920 bales in 2006 to 17,453 in 2008. As a result of this lower effective demand, higher-capacity gins are constrained to produce at lower volumes below their minimum efficient scale at higher costs. On the other hand, smaller capacity gins now operate closer to their minimum efficient scale which makes them more cost-effective in producing lower volumes. This paper evaluates how the recent declines in cotton acreage have affected the structure and costs faced by cotton gins in the U.S.

Introduction

Until recently, the United States cotton industry has not seen sustained acreage reductions since 1990. Unlike in the past where area harvested would contract in a year and immediately recover in the next, recent experience has been different. In 2006, area harvested declined by 7.8% followed by successive reductions of 17.6% and 27.8% in 2007 and 2008 (Table 1). In 2009, however, acreage expanded slightly by 2.2%. These reductions in acreage coincided with the developments in the oil-corn-ethanol complex.

With the surge in crude oil prices from US$60 per barrel in 2005 to US$128 per barrel in 2008, the demand for ethanol as a fuel alternative significantly strengthened. This, in turn, expanded the demand for materials such as corn, among others, from which ethanol and other similar biofuels are created. In the U.S., as the ethanol industry absorbed a significant share of the corn crop, corn prices rose in recent years. Higher corn prices have provided farmers the incentive to switch acreage from competing crops to corn. One of these competing crops is cotton, the acreage for which has declined by as much as 45% from 2005 to 2008 (from 5.6 to 3.1 million hectares), the period following the passage of the Energy Policy Act of 2005 that mandates a new Renewable Fuel Standard (RFS). The RFS ensures that gasoline marketed in the U.S. contains a specific amount of renewable fuel. As a result, it is expected that between 2006 and 2012, the RFS is slated to increase demand for renewable fuels from 4.0 to 7.5 billion gallons per year (Baker and Zahnister, 2006). These mandates were subsequently expanded in 2007. This paper evaluates how the contemporaneous, recent declines in cotton acreage have affected the structure and costs faced by cotton gins in the U.S.

Methods

Cotton Ginnings Annual Summary data from 1993 to 2008 was retrieved from the U.S. Department of Agriculture's National Agricultural Statistics Service (NASS). Specifically, we examined the number of gins and bales ginned according to four size groups measured in the number of bales ginned per season: (a) <15,000; (b) 15,000 – 19,000; (c) 20,000-39,000; and (d) >40,000 to determine the relative output size distribution of gins. With these estimates of gin numbers by size group, we used the average cost relationships developed by McPeek (1997) using a computerized cost simulation program called GINMODEL. GINMODEL calculates fixed and variable ginning costs for simulated gins at various processing utilization rates and gin capacities. Output from GINMODEL consists of total and per bale ginning costs separated into fixed and variable components. These costs are calculated for processing utilization levels ranging from one-hundred percent to ten percent.

Table 1. Cotton Area Harvested for the United States, 1990-2009

Marketing Year	Area Harvested (1000 hectares)	Growth Rate (%)
1990/91	4748	23.01
1991/92	5245	10.47
1992/93	4501	(14.18)
1993/94	5173	14.93
1994/95	5391	4.21
1995/96	6478	20.16
1996/97	5216	(19.48)
1997/98	5425	4.01
1998/99	4324	(20.29)
1999/00	5433	25.65
2000/01	5282	(2.78)
2001/02	5596	5.94
2002/03	5025	(10.20)
2003/04	4858	(3.32)
2004/05	5284	8.77
2005/06	5586	5.72
2006/07	5152	(7.77)
2007/08	4245	(17.60)
2008/09	3063	(27.84)
2009/10	3129	2.15
1990-2004		11.29
2005-2009		(43.98)

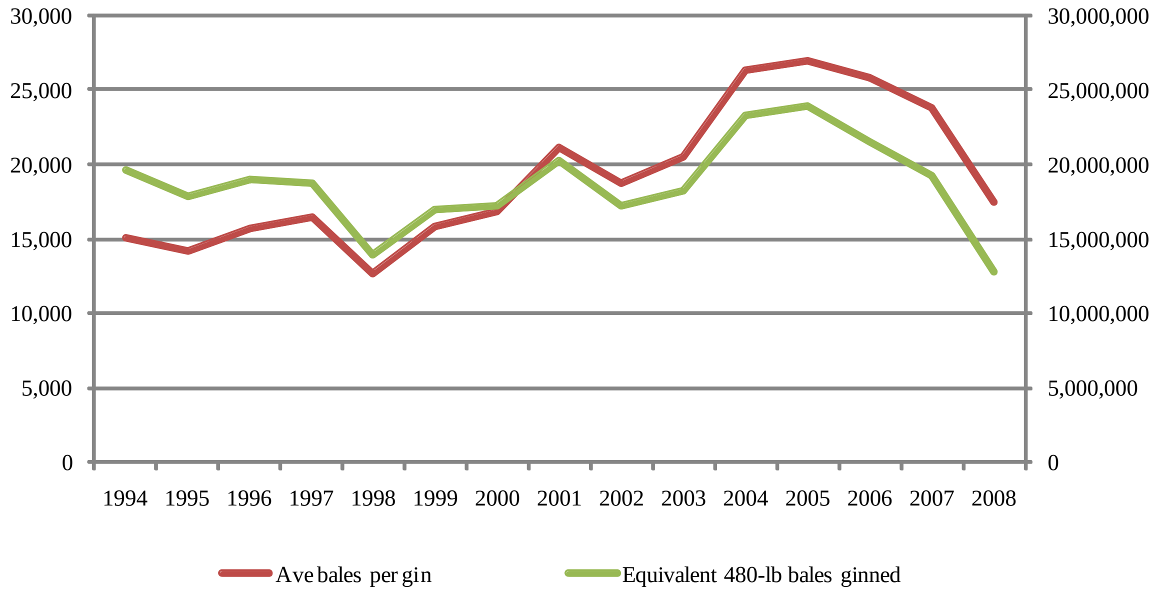
Source: United States Department of Agriculture

Results and Discussion

Cotton production has historically tracked acreage movements and, as such, a similar trend can be observed in output as in acreage. From 1990 to 2004, cotton production increased steadily from 15.5 million bales to 23.2 million bales. In 2005, production increased to 23.9 million bales and started to decline until it reached 12.8 million bales in 2008. As a consequence, the average number of bales processed per gin in the U.S. declined from 26,920 bales in 2005 to 17,453 in 2008 (Figure 1).

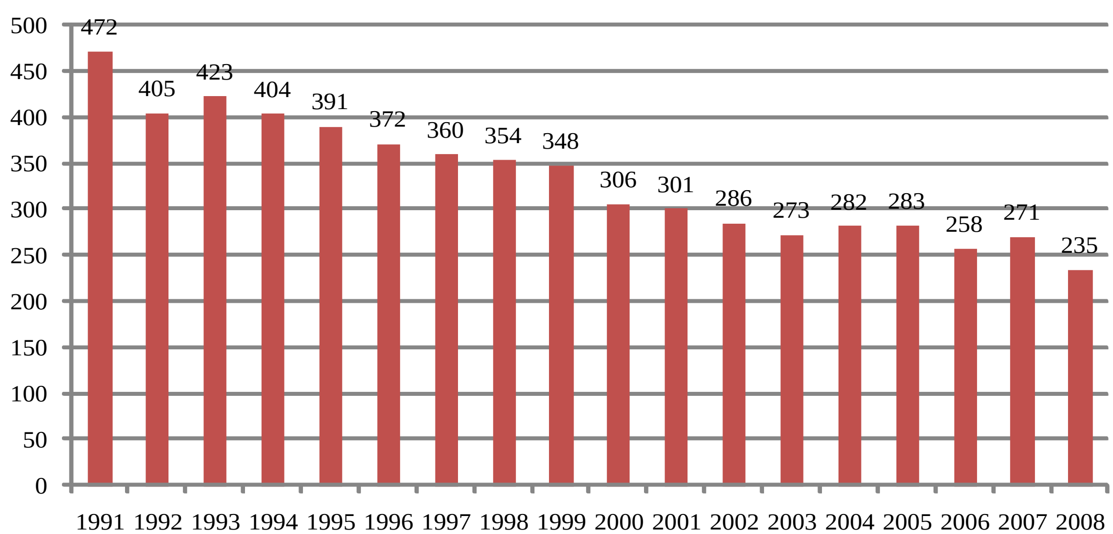
While cotton production and acreage have tracked each other closely, the number of gins has steadily declined for the past three decades (Figure 2). Even in the lead up to the period of increased cotton output prior to 2005, there were fewer gins every year, some of which have consolidated their operations and have existed alongside smaller gins. A cursory look at transitional probabilities across output sizes (probabilities or likelihood associated with the proportion of gins moving up and down output levels from one period to the next) reveals that there was a higher tendency for gins to move to higher production levels over the period 1994 to 2004 than there was for 2005 to 2008 (as seen from a comparison of output column with less than 40,000 in Tables 2a and 2b).[1] In fact, the opposite was

Figure 1. Total Bales Ginned in the U.S. and Average Bales Processed Per Gin



Source: NASS

Figure 2. Number of Cotton Gins in the United States, 1991-2008



Source: NASS

observed post-2005. There was a higher concentration of smaller gins that processed less than 15,000 bales and a lower concentration of gins that processed beyond 40,000 bales. The decline in acreage beginning 2005 has forced gins to process smaller volumes. To underscore this point, Tables 2a and 2b show that the probabilities along the upper triangle (which indicate the probabilities of gins moving to process higher output levels) are generally smaller in magnitude for 2005 to 2008 relative to pre-2005. This implies that gins, before 2005, were more likely to move up to higher output levels of production than for the period 2005-2008.

Table 2a. Transitional Probability Matrix for the United States, 1994-2004

	2004			
1994	<15,000	15,000-19,000	20,000-39,000	>40,000
<15,000	0.4002	0.0594	0.3386	0.2018
15,000-19,000	0.2865	0.1899	0.2764	0.2472
20,000-39,000	0.3182	0.1448	0.2970	0.2399
>40,000	0.2712	0.2140	0.2656	0.2491

Table 2b. Transitional Probability Matrix for the United States, 2005-2008

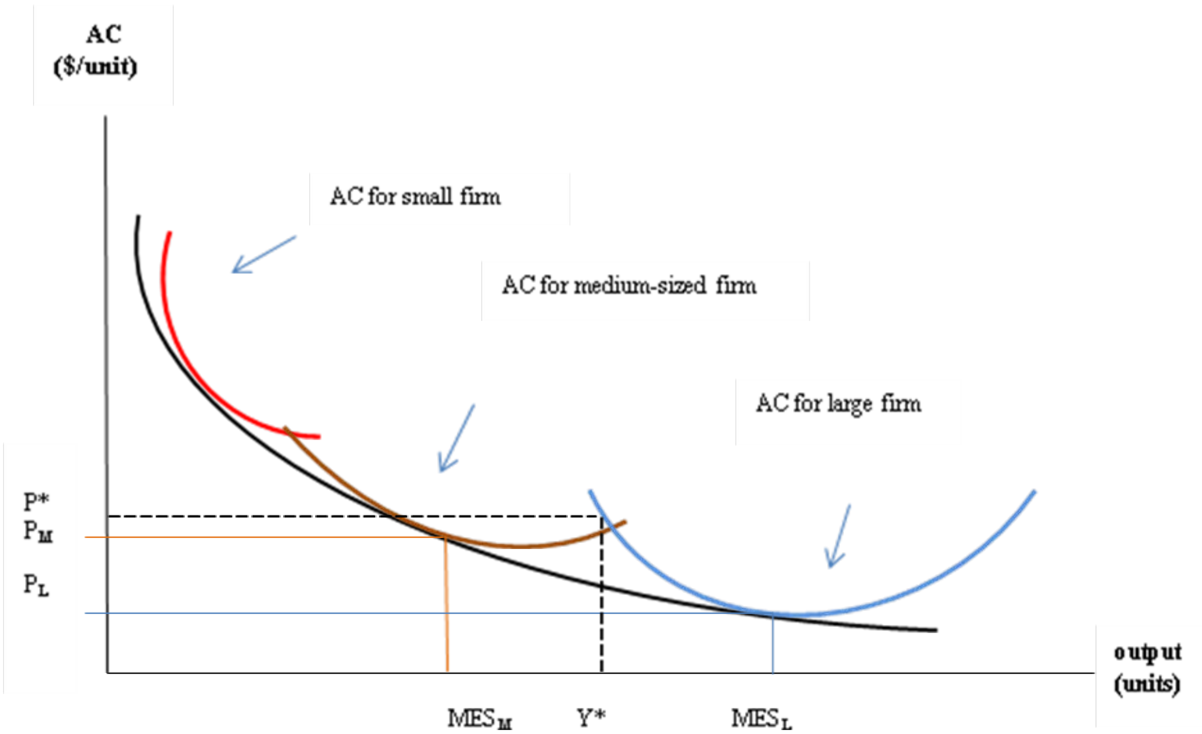
	2008			
2005	<15,000	15,000-19,000	20,000-39,000	>40,000
<15,000	0.6098	0.1013	0.2029	0.0859
15,000-19,000	0.3861	0.1886	0.2488	0.1766
20,000-39,000	0.5998	0.1049	0.2059	0.0894
>40,000	0.5235	0.1331	0.2260	0.1174

What is happening to the ginning industry in the U.S. is best illustrated using Figure 3. Figure 3 shows three average cost (AC) curves for three types of firms: small, medium, and large. Consider the AC curves for the medium and large firms. For the medium-sized firm, the output level at which its AC is minimum is P_M at output MES_M (minimum efficient scale for the medium-sized firm). Hence, if the medium-sized firm produces beyond this point, its AC starts to rise. For the large firm, its minimum efficient scale is at MES_L that corresponds to price, P_L. Again, should the large firm produce above this level, the AC it faces starts to rise. Notice that $MES_L > MES_M$ as the large firm benefits from economies of scale over a wider range of output. That is, the large firm (with higher fixed costs) is able to spread its fixed costs over a larger amount of output before it reaches a point near capacity when more than a proportional amount of the variable inputs are necessary to increase output compared to the medium-sized firm. To determine which kind of firms will operate in a particular industry, we have to take into the account the relative position of effective market demand with firms' average costs.

Even if large capacity firms are willing and able to operate at higher output levels, they are constrained by the effective market demand. In Figure 3, if the effective market demand's location shifts from a higher level to a lower level, say Y*, two things can be observed: (a) it is more cost efficient for the medium-sized firm to produce at Y* relative to the large firm even if it could, and (b) the average cost of production increases with lower output.

Using the average cost curves estimated by McPeek (1997) across four gin size categories for the ginning industry in the Texas Southern High Plains, the effects of acreage reduction on industry structure and average cost of ginning in the U.S. are empirically illustrated. McPeek classified gins according to their rated capacity: (a) 14 bph, (b) 21 bph, (c) 28 bph, and (d) 35 bph. All gins were assumed to operate for 19 hours per day, and for 71 days per season. Each of the four cost curves were estimated by McPeek (1997) using a computerized cost simulation program called GINMODEL. GINMODEL calculates the cost of ginning using both technical and economic relationships derived from personal interviews with ginners and equipment manufacturers. McPeek's inputs to GINMODEL included input costs, investment costs, interest costs, depreciation and other relevant cost data. Without altering the relative average cost relationships across gin sizes, we updated McPeek's values. We added $0.25 to average fixed costs (to

Figure 3. Average Cost and Minimum Efficient Scale



account for interest rate changes and inflation) and $0.50 to variable costs (to account for higher cost of bagging and ties). The average cost relationships used are shown in Table 3.

Based on Table 3, we computed for the resulting average cost of ginning per gin size across different output levels to find the minimum efficient scale for each gin size (assuming each gin operates for 19 hours per day for 71 days per season). The results are shown in Table 4. When the ginning industry averaged 26,319 bales per gin in 2004, it was profitable for size 2 gins to operate. However, when ginning volume declined in 2008 to 17,453 bales per gin, it was more cost efficient for size 1 gins to operate. Size 2 gins that continue to operate incurred more costs than size 1 gins. Using some interpolation between discrete cost points, in 2004, average total ginning cost was at $44.9 per bale while in 2008 it increased to $54.2 per bale. In relative terms, this increase in average costs represents about 17% of the average ginning cost in 2008.

The costs to the economy of the recent acreage reductions come in the form of higher ginning costs as well as costs sunk in fixed investments in the form of equipment and other fixtures made by larger gins that are likely to disinvest (cut capacity or close entirely) from industry. These costs need to be accounted for in looking at the policy effects of increased biofuel production in the U.S.

Table 3. Average Cost Functions

Rated Capacity (bales per hour)	Average Cost Function (US$/bale)
14	25.04 + 508,214.93 * (1/number of bales)
21	22.31 + 593,836.74 * (1/number of bales)
28	22.14 + 623,010.17 * (1/number of bales)
35	20.75 + 680,587.09 * (1/number of bales)

Source of basic data: McPeek (1997), with authors' calculations.

Table 4. Comparison of Average Cost Across Gin Sizes Across Output Levels

		Average total cost (US$/bale)			
Ginning rate	**Ginning volume**	Size 1	Size 2	Size 3	Size 4
(bales per hour)	(bales per season)	**14 bph**	**21 bph**	**28 bph**	**35 bph**
6	8,094	87.83	95.67	99.12	104.84
7	9,443	78.86	85.19	88.12	92.82
8	10,792	72.13	77.33	79.87	83.82
9	12,141	66.90	71.22	73.46	76.81
10	13,490	62.71	66.33	68.33	71.20
11	14,839	59.29	62.33	64.13	66.62
12	16,188	56.43	58.99	60.63	62.79
13	17,537	54.02	56.17	57.67	59.56
14	**18,886**	**51.95**	**53.75**	**55.13**	**56.79**
15	20,235		51.65	52.93	54.39
16	21,584		49.82	51.01	52.28
17	22,933		48.20	49.31	50.43
18	24,282		46.76	47.80	48.78
19	25,631		45.48	46.45	47.30
20	26,980		44.32	45.23	45.98
21	**28,329**		**43.27**	**44.14**	**44.78**
22	29,678			43.14	43.68
23	31,027			42.22	42.69
24	32,376			41.39	41.77
25	33,725			40.62	40.93
26	35,074			39.91	40.16
27	36,423			39.25	39.44
28	**37,772**			**38.64**	**38.77**
29	39,121				38.15
30	40,470				37.57
31	41,819				37.03
32	43,168				36.52
33	44,517				36.04
34	45,866				35.59
35	**47,215**				**35.17**

Source: Authors' computations

Summary

As a result of sustained acreage reductions since 2006, the cotton ginning industry in the U.S. has seen the contraction of effective ginning demand to a level that, relative to firms' minimum efficient scale (MES), makes smaller gins more cost efficient (and capable of staking it out in the industry) given the smaller fixed costs and stranded investments attendant to smaller operations. Whereas in 2004, a typical gin processed 26,319 bales, this volume went down to only 17,453 bales in 2008. As a result, the industry is beginning to move towards smaller-sized and lesser number of gins. Also, concurrent with smaller volumes of output, the average cost of ginning has increased from $44.9 per bale in 2004 to $54.2 per bale in 2008. In relative terms, this increase in average costs represents about 17% of the average ginning cost in 2008.

Endnote

[1] Transitional probabilities (represented by a matrix) define the likelihood that a gin will move from producing at a particular output level at time t (rows) to another level at time $t+1$ (columns) such that the diagonal elements of the matrix represents the likelihood that a gin will remain or continue to produce at the same level of output at time $t+1$ as in time t. For example, the (i,j) entry represents the likelihood that a gin in the ith output category at time t will move to the jth output category at time $t+1$. These transitional probabilities are derived using maximum entropy econometrics for ill-posed problems developed by Golan and Amos (2001) implemented in Maple 13. This is an ill-posed problem because there are more unknowns than given values. The complete program is available from the author upon request.

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