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ECONOMICS AND MARKETING

A Determination of Cotton Market Price Premiums Required to Justify More Lint Cleaning in the Gin Plant

Blake K. Bennett*, Sukant K. Misra, and James Richardson

INTERPRETIVE SUMMARY

Several studies have addressed the issue of the optimal level of lint cleaning in the gin plant. Conflicting results of previous studies have been addressed by concluding that changes in the market price structure altered the optimal number of lint cleanings. However this study questions the suggestions of previous research that price premiums and discounts change from year to year based on the level of lint cleaning that is demanded. The current study hypothesizes that fluctuations in the general price level of cotton dictate which level of lint cleaning provides the maximum net returns.

This analysis simulated net returns per bale of cotton for irrigated stripper-harvested cotton. Gin turnout and quality attributes for one, two, and three stages of lint cleaning in the gin plant were simulated for each case using the GINQUAL simulator. Ginning costs were estimated using the GINMODEL simulator which calculated variable, fixed, and total cost per bale for ginning cotton using one, two, and three lint cleaners. The effects of changes in net revenues at various levels of lint cleaning in the gin plant due to changes in market prices for cotton was accomplished through the evaluation of market prices between $1.10 and $1.76 per kg of cotton lint at $0.11 per kg intervals. Market prices were then adjusted until the net revenues generated from a higher level of lint cleaning were greater than the previous level's net revenues.

The study demonstrated how, as the market price for cotton increases, the premiums required to make successive levels of lint cleaning more profitable also increased. Specifically, price premiums must be about 57 percent greater to justify two lint cleanings over one lint cleaning if the market price for cotton ginned using only one lint cleaning equals $1.76 per kg than if that same cotton's associated market price equals $1.10 per kg. Similarly, this study found that a 56 percent increase in price premiums was required to justify three lint cleanings over two in the gin plant for cotton possessing a market price that equals $1.76 versus $1.10 per kg after one lint cleaning.

The levels of price premiums required to justify more cleaning is directly related to the lint that is lost at each stage of lint cleaning. As the market price of cotton increases, the lint that is lost during lint cleaning becomes more valuable. Therefore, if net price premiums do not increase enough to offset revenue that is negated due to lint loss, less cleaning should be done in the gin plant.

Currently, existing practice calls for two lint cleanings in the gin plant. Previous research has conflicted on the optimal level of lint cleaning. Specifically, Baker et al. (1977) found that two stages of lint cleaning are near optimum for bale value and fiber quality. Alternatively, Ethridge et al. (1995) and Bennett et al. (1997) indicated that less lint cleaning at the gin plant could become optimal if lint cleaning technology or market pricing structures change. This study demonstrates that, while the pricing structure is important, the level of market prices determine the optimal level of lint cleaning in the gin plant. An examination of general price levels that were received for Texas cotton over the span of these studies indicate that prices have ranged from a high of $1.76 per kg in 1995 (the market price year the Bennett et al. 1997 study was focused) to a low of $1.09 per kg in 1977 (the market price year the Baker et al. (1977) was focused). Therefore, it is the conclusion of this study that the results of the previous research did not differ due to differences in the market price structure but rather in the general price level of cotton.

B.K. Bennett*, 17360 Coit Road, Dallas, Texas 75252; S.K. Misra, College of Agricultural Sciences and Natural Resources, Texas Tech University, Box 42123, Lubbock, Texas 79409-2123; and J. Richardson, Department of Agricultural Economics, Texas A&M University, 2124 TAMU, College Station, Texas 77843-2124
* Corresponding author: b-bennett@tamu.edu

ABSTRACT

This analysis simulated net returns per bale of cotton for irrigated stripper-harvested cotton for one, two, and three stages of lint cleaning to deter-

mine the level of premiums required to justify more cleaning in the gin plant based on a variable price level of cotton lint. Through the examination of total returns, ginning costs, and the cost of lint loss at various price levels, this study shows that with higher levels of market price, increased levels of quality premiums become necessary to make successive levels of lint cleaning cost effective. Specifically, price premiums must be about 57 percent greater to justify two lint cleanings over one lint cleaning if the market price for cotton ginned using only one lint cleaning equals $1.76 per kg than if that same cotton's associated market price equals $1.10 per kg. Similarly, a 56 percent increase in price premiums was required to justify three lint cleanings over two in the gin plant for cotton possessing a market price that equals $1.76 versus $1.10 per kg after one lint cleaning. Thus, the levels of price premiums required to justify more cleaning is directly related to the lint that is lost at each stage of lint cleaning. Therefore, if net price premiums do not increase enough to offset revenue that is negated due to lint loss, less cleaning should be done in the gin plant.

INTRODUCTION

To provide textile mills cotton fiber with acceptable levels of trash, ginners may clean stripper-harvested cotton several times. Prior studies have suggested that a combination of cotton ginning machinery for stripper-harvested cotton, and a gin process which includes two lint cleanings, produce satisfactory lint grades and near-maximum bale value for most cotton (Baker, 1994). Baker further suggests that more cleaning may be necessary in situations or areas that possess excessive amounts of foreign matter. A previous study by Baker et al. (1977) also found two stages of lint cleaning to be near optimum for bale value and fiber quality.

Several other studies have addressed the optimal number of lint cleanings in the gin plant. Ethridge et al. (1995) found that two lint cleanings were best if the effects on prices, lint loss, and cost of lint cleaning are to be taken into consideration. Their study considered only the energy costs of lint cleanings in their estimates, and estimated price per pound of lint based on a pre-HVI market price structure that existed in 1992.

Bennett et al. (1997) addressed the consequences of successive stages of lint cleaning by considering the criteria of maximizing net revenue, i.e., net of other costs besides energy. The study found that net returns were consistently higher for one lint cleaning in the gin plant for all cultivars regardless of the time of harvest. This study also concluded that the pricing structure for cotton had changed with the inception of the HVI measurements of fiber attributes. They hypothesized the change in the pricing structure redefined the optimal level of lint cleaning at the gin plant.

Questions arise from the conflicts that are found from previous studies regarding the optimal level of lint cleaning in the gin plant. One answer to these questions is provided by both Ethridge et al. (1995), and Bennett et al. (1997). Both studies indicated that less lint cleaning at the gin plant could become optimal if lint cleaning technology or market pricing structures change. However, our study hypothesizes that the pricing structure is not the cause of changes in the optimal level of lint cleaning from previous studies, but rather the general level of prices are dictating which alternative provides the greatest net returns. An examination of general price levels that were received for Texas cotton over the span of these studies indicates that prices have ranged from a high of $1.76 per kg in 1995 (the market price year the Bennett et al. (1997) study was focused) to a low of $1.09 per kg in 1977 (the market price year the Baker et al. (1977) study was focused). Because of this wide variability in the general price level of cotton during the times of the previous studies, the current research attempts to demonstrate that it is in fact the value of the lost lint that determines the level of lint cleaning rather than the pricing structure.

MATERIALS AND METHODS

For the purposes of this analysis, three irrigated cotton cultivars (Paymaster HS-26, Paymaster 145, and All-Tex Excess) were chosen based on their popularity of use in the Southern High Plains of Texas at the time of this study. The expected quality characteristics and gin turnout of each cultivar were averaged to provide the analysis with a typical cotton cultivar that might be ginned in the area.

Cotton Quality and Lint Loss. The GINQUAL (Barker et al., 1991), ginning simulator was used to determine changes in grade, staple length, strength, length uniformity, and micronaire of cotton receiving 0, 1, 2, and 3 stages of lint cleanings. A lint turnout percentage, representing a ratio of the saleable lint weight to the weight of seed cotton entering the system, was also determined from the GINQUAL model.

The GINQUAL model simulated the processing of stripper-harvested cotton at a rate of 15 bales per hour through a single 2.4 m (96 in.) wide overhead cleaning stream consisting of: (1) an airline cleaner, (2) first tower dryer, (3) first incline cleaner, (4) first stick machine, (5) second tower dryer, (6) second incline cleaner, (7) second stick machine, and (8) extractor feeder. The lint cleaning simulation used zero to three 2.2 m (88 in. wide) sequential lint cleaners. The simulated lint cleaners used a combing ratio of 30:1 with 0.4 m (16 in.) diameter saws operating at 1000 rpm. The first and second tower dryers' drying temperatures were held constant at 149 and 66 degrees Centigrade (300 and 150 degrees Fahrenheit), respectively, and the atmospheric temperature and relative humidity at 16 Centigrade (60 degrees Fahrenheit) and 30 percent humidity, respectively. Initial values for micronaire, length, strength, and uniformity ratio provided by tables included in the GINQUAL model were used in the simulation.

The lint loss in the gin plant due to precleaning and successive levels of lint cleaning were estimated from the GINQUAL output for the different cultivar categories. Lint loss for each level of lint cleaning was calculated by subtracting the current level of turnout in percent from lint turnout for one less lint cleaner. The resulting lint turnout difference was multiplied by 1,044.2 kg. of initial seed cotton entering the gin plant and was further adjusted to a lint loss weight per bale.

Cost Estimates. A survey of fifteen ginners on the Texas High Plains was taken by personal interview to determine the total cleaning cost in the gin plant. The results were used in the GINMODEL (Childers, 1995) to determine ginning costs. 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 100 percent to ten percent. For the purpose of this analysis, per bale ginning cost was simulated for three categories of gins, owning and operating one, two, and three lint cleaners. Since no differences were observed from the results of survey gins operating between 50 and 100 percent utilization, it was assumed that gins were operating at 100 percent utilization.

The costs associated with lint loss in the gin plant due to precleaning and successive levels of lint cleaning were estimated by multiplying the price of cotton after each stage of lint cleaning and the lint loss calculated from the GINQUAL outputs for different levels of lint cleaning. Total ginning cost per bale and the cost of total lint loss per bale were added to obtain a total ginning cost to the producer for each configuration.

Effect of Market Price on Level of Lint Cleaning. Given our hypothesis that the price level and not the pricing structure determines the optimal level of lint cleaning, it was initially assumed that cotton cleaned with only one lint cleaning in the gin plant would have an associated market value of $1.10 per kg. Net revenues associated with cotton worth $1.10 per kg after one lint cleaning were then determined by subtracting the cost of ginning and the cost of the lint lost during cleaning from the total revenues. Because more lint would be lost if the cotton was lint cleaned twice, we calculated the market premiums required to optimize net returns for cotton lint cleaned twice. Similarly, a market premium was then determined which would optimize net returns for cotton lint cleaned three times. This approach was used for cotton valued at $1.10 to $1.76 per kg on $0.11 per kg intervals after one lint cleaning.

Finally, a test was performed to determine if the most appropriate level of lint cleaning could be determined given historical prices. This test included a probabilistic analysis for Texas cotton prices examined for the seasonal average Texas cotton prices between 1987 and 2008. Parameters were developed to simulate the random cotton prices as fractional deviates from the mean. A cumulative probability distribution of cotton price was then developed to show the probabilities of realizing alternative price levels.

RESULTS AND DISCUSSION

The results of this study are presented below in two different sections. The first section discusses price premiums required to justify more lint cleaning in the gin plant. The quantity of lint lost during each stage of lint cleaning, and the value of that lint loss is discussed in the second section.

Lint Loss and Lint Loss Value. Lint lost at various stages of lint cleaning is presented in Table 1. It should be noted that with successive stages of lint cleaning the level of lint that is lost increases at a decreasing rate. Cotton lint loss weights were 4.70 and 1.78 kg per bale between one and two and two and three lint cleanings in the gin plant, respectively. These lint loss estimates translate into revenue loss of $5.18 per bale for cotton with two lint cleanings and a market price of $1.10 per kg ($1.10*4.70). An additional $2.00 per bale of revenue was observed to be lost under the same market price scenario when the cotton was lint cleaned three times ([$1.10+$0.014]*1.78).

The value of lint loss increased as the market price of cotton increased. For example, the value of lint lost between one and two lint cleanings was observed to be $8.28 per bale when the associated market price of cotton after one lint cleaning is $1.76 per kg ($1.76*4.70). An additional $2.54 per bale was lost when the cotton was lint cleaned a third time in the gin plant and when the market price for cotton was $1.76 cents per pound ([$1.10+$0.0250]*1.78).

Price Premiums Required to Justify More Lint Cleaning. Successive lint cleaning in the gin plant necessitated larger price premiums to cover the additional cost of ginning and additional cotton lint loss. Table 1 shows that if the price associated with one lint cleaning is equal to $1.10 per kg (50 cents per lb), the price premium required to justify one additional lint cleaning in the gin plant was equal to 2.51 cents per kg. Further cleaning (the use of three lint cleaners) would require a price premium of 3.52 cents per kg over one lint cleaning (1.01 cents per kg premium over two lint cleanings). If cotton is cleaned once in the gin plant and has an associated market value of $1.10 per kg, that same cotton would have to bring $1.13 per kg (51.14 cents per pound) to justify two lint cleanings and $1.14 per kg (51.60 cents per pound) to justify three lint cleanings.

As the price of cotton ginned using only one lint cleaner in the gin plant increases, the price premiums required to make more cleaning cost effective also increase. Specifically, cotton that had an associated market price of $1.76 per kg (80 cents per pound) after one lint cleaning would require a price premium of 3.94 cents per kg to justify the use of two lint cleaners over one lint cleaner. The use of three versus one lint cleaner would require a price premium of 5.51 cents per kg (an additional 1.57 cents per kg price premium over two lint cleanings). In other words, cotton that was worth $1.76 per kg after one lint cleaning must demand a market price of $1.80 per kg (81.79 cents per pound) after two lint cleanings. Similarly, the market price must equal $1.82 per kg (82.50 cents per pound) to justify lint cleaning this cotton three times. These findings demonstrate how, as the market price for cotton increases, price premiums required to justify more lint cleaning also increase.

A summary of the findings of this study detailing the optimal number of lint cleanings depending on the market price for cotton are presented in Table 2. For example, the table indicates that if the market price for cotton is $1.10 per kg, it should be lint cleaned once if a premium for two lint cleanings is less than 2.53 cents per kg (1.15 cents per pound). Similarly, it should be lint cleaned twice if the premium received in the market ranges between 2.53 and 3.41 cents per kg (1.15 and 1.55 cents per pound). If the premium received in the market exceeds 3.41 cents per kg, then it would be cost effective to clean that cotton three times.

Table 1. Price premium required to make net revenues associated with higher levels of lint cleaning greater than lower levels of lint cleaning, lint loss and value of lint loss.

Market Price After One Lint Cleaning ($/kg)	Price Premium Required to Make Two Lint Cleanings Cost Effective (Cents/kg)	Price Premium Required to Make Three Lint Cleanings Cost Effective (Cents/kg)	Lint Loss (kg/bale)		Lint Loss Value ($/bale)	
			2 Lint Cleanings	3 Lint Cleanings	2 Lint Cleanings	3 Lint Cleanings
$ 1.10	2.51	3.52	4.70	1.78	5.18	2.00
$ 1.21	2.75	3.85	4.70	1.78	5.69	2.20
$ 1.32	3.00	4.19	4.70	1.78	6.21	2.40
$ 1.43	3.24	4.54	4.70	1.78	6.73	2.60
$ 1.54	3.48	4.87	4.70	1.78	7.25	2.80
$ 1.65	3.72	5.20	4.70	1.78	7.76	3.00
$ 1.76	3.94	5.51	4.70	1.78	8.28	3.20

Table 2. Optimal number of lint cleanings depending on the market price.

Market Price After One Lint Cleaning ($/kg)	Price Premium (Cents/kg)													
	0.44	0.88	1.32	1.76	2.20	2.64	3.08	3.52	3.96	4.41	4.85	5.29	5.73	6.17
	Optimal Number of Lint Cleanings													
$ 1.10														
$ .1.21														
$ 1.32												Three Lint Cleanings		
$ 1.43			One Lint Cleaning											
$ 1.54									Two Lint Cleanings					
$ 1.65														
$ 1.76														

Finally, the simulated cumulative probability distribution of Texas cotton prices is presented in Figure 1. The graph of cumulative probabilities shows the likelihood of Texas cotton cash prices being less than or equal to the price values ($/kg) along the x-axis. For example, given past history, there is roughly a 30% chance of Texas cotton prices being less than or equal to $1.00/kg. The probability rises to 50%, 70%, and 90% that prices will be less than or equal to $1.20/kg, $1.40/kg, or $1.60/kg, respectively (Figure 1). This suggests that historical cotton prices have fallen on the mid to lower end of the price scale presented in Table 2 thus requiring between a $0.0220 and a $0.0308/kg price premium for cleaning the cotton with two lint leanings in the gin plant.

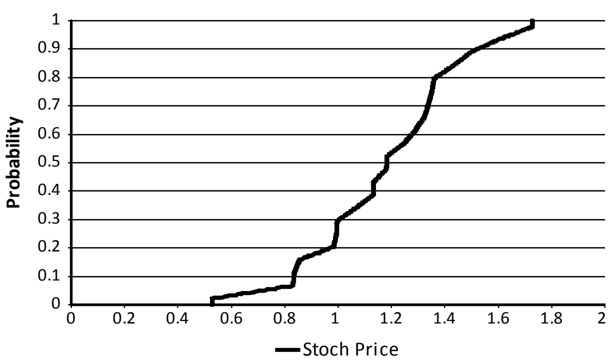

Figure 1. Cumulative probability distribution of cotton price.

CONCLUSIONS

This analysis simulated net returns per bale of cotton for irrigated stripper-harvested cotton. It was found that as the market price for cotton increases, premiums required to make successive levels of lint cleaning more profitable also increased. Specifically, price premiums must be about 57 percent greater to justify two lint cleanings over one lint cleaning if the market price for cotton ginned using only one lint cleaning equals $1.76 per kg than if that same cotton's associated market price equals $1.10 per kg. Similarly, this study found that a 56 percent increase in price premiums was required to justify three lint cleanings over two lint cleanings in the gin plant for cotton possessing a market price that equals $1.76 versus $1.10 per kg after one lint cleaning.

While the study utilizes cotton varieties that may exhibit different quality attributes from other varieties, the overall findings are applicable to all varieties. These findings suggest that the levels of price premiums required to justify more cleaning is directly related to the lint that is lost at each stage of lint cleaning. As the market price of cotton increases, the lint that is lost during lint cleaning becomes more valuable. Therefore, if net price premiums do not increase enough to offset revenue that is negated due to lint loss, less cleaning should be done in the gin plant. While the level of lint cleaning decisions are impacted to some extent by price premiums and discounts, the major determining factor is the general price level.

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