COTTON QUALITY PRICE DIFFERENTIALS FROM TEXTILE MILLS' PERSPECTIVE: AN UPDATE

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Abstract

This paper investigates price discounts and premiums paid for cotton quality attributes by textile manufacturers for three US cotton producing regions. Data collected from textile firms in the 1998/99 marketing year (1998 crop) were used in hedonic price models to estimate the quality premiums and discounts for cotton from the South (SO), Southwest (SW), and San Joaquin Valley (SJV) regions. This analysis found substantial differences in price structure among regions, but less price differentiation based on quality than in prior years.

Introduction

U.S. textile mills use about 10.8 million bales of cotton each year, utilizing about 64% of U.S. cotton production. Textile firms typically purchase their cotton in anticipation of processing needs through contracts with shippers. They manufacture a wide array of textile products, using different types and configurations of processing equipment and technology, thus requiring cotton fiber with different combinations of fiber attributes. The combinations of cotton attributes tend to be somewhat different depending on the growth region of origin of cotton. Due to this and other considerations, there is a body of evidence showing that the structure of cotton prices (base prices and quality premiums and discounts) differs by region of origin of the cotton (Ethridge and Chen, 1997; Chen and Ethridge, 1996). The objective of this paper is to present the latest evidence on this matter using the most recent data obtained from U.S. textile manufacturers.

The Data Set and Model

The data set used in this analysis includes contracts for the 1998/99 marketing year (1998 crop year). The data set consists of the cotton quality attributes and the price of cotton, either from a sale or a purchase contract. They were collected from fifteen textile firms and marketing associations in the U.S. The data set contained sales accounting for 779,000 bales of cotton comprising 5.6% of total U.S. production and 7.4% of U.S. mill use from the 1998 crop. The contracts specified many of the recognized fiber attributes such as micronaire, color grade, strength, staple length, etc., in addition to the type of sale (fixed price or call), region of origin, and other stipulations. Call contracts were converted to an equivalent fixed price on the date of the transaction; that day's New York futures price (for the contract delivery month) was adjusted by the agreed upon basis stated in the contract.

The price-quality relationships were estimated by regressing the contract price on the fiber characteristics and other non-quality variables. Because of the declining marginal productivity of fiber attributes in the manufacturing process, a non-linear relationship best describes the pricing of cotton quality (Chen and Ethridge, 1996). The price-quality relationships in 1998/99 were explained by three different hedonic model specifications. These are as follows:

South: $$P = \beta_0 (DC_2)^{\beta_1} (L)^{\beta_2} e^{\beta_3 (LF) + \beta_4 (M) + \beta_5 (M^2)} e^{\beta_6 (DSCQ) + \beta_7 (DSCQ^2)}$$

Southwest: $$P = \beta_0 (DC_2)^{\beta_1} (DLF)^{\beta_2} e^{\beta_3 (STR) + \beta_4 (BALES)} e^{\beta_5 (BALES^2) + \beta_6 (DSCQ) + \beta_7 (DSCQ^2)}$$

San Joaquin Valley: $$P = \beta_0 e^{\beta_1 (DC1) + \beta_2 (DC1^2)} (DSCQ)^{\beta_3}$$

Where:

P = price (cents/lb.) of the cotton specified (fixed) by or derived (call) from the contract;

DC1 = 8-Cl, indicating whiteness (absence of grayness) of fiber. Cl is the first digit of the color grade which varies from 1 through7; since Cl has a maximum value of 7, subtracting from 8 converts Cl from an indicator of grayness to an indicator of whiteness;

DC2 = 6-C2, indicating the whiteness (absence of yellowness) of fiber. C2 is the second digit of the color grade which varies from 1 through 5; since C2 has a maximum value of 5, subtracting from 6 converts C2 from an indicator of yellowness to an indicator of whiteness;

DLF = 8-LF, LF is the leaf grade which varies from 1 through 7; D1 = l, if Leaf = 3; 0, otherwise; and D2 = 1 if Leaf = 5; 0, otherwise;

L= staple length (32nd's of an inch);

STR = minimum strength (grams/tex) in the contract;

M micronaire reading, an average of high and low micronaire in the contract;

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DSCQ = Daily Spot Cotton Quotation (cents/lb.) for base quality, which is used to adjust for the level of general market price over time in each regional market on the date of transaction (USDA);

BALES = number of bales specified in the contract.

The cotton growing areas in each contract were categorized into four regional specifications: Southwest region - Texas and Oklahoma; South - all cotton grown in the southeast and mid-south; San Joaquin Valley of California; and Other West - Desert Southwest. Initially, Other West was planned to be estimated, but was not possible due to insufficient number of observations. The data specific to the above three regions were used to estimate three regional models (See Tables lA, lB, and 1C).

A log-linear specification of the model was estimated using ordinary least squares. In order to check for probable multicolinearity, the variance inflation factors were calculated and found to be within the threshold limit. Extensive error-term analysis was done (Brown and Ethridge, 1995) to insure that the hedonic models contained no systematic errors in the estimation. It is hypothesized that all quality variables are positively related to cotton price except M^2, because as M increases, price of cotton increases at first, then starts decreasing as M increases. In the preliminary regression analysis, variables with signs that were found inconsistent with economic theory or found to not be statistically significant were dropped out of the final model. A base price for each region was calculated based on the parameter estimates of those models using base attribute levels, holding all other non-quality variables at their mean values.

Results and Discussion

Parameter estimates from three regional models are reported in Table 2. All coefficients shown are of expected sign and are significantly different from zero at the 5 percent or 10 percent level. The coefficients of variation (R^2) varied form 0.44 to 0.63. Simplified comparisons of prices and quality premiums and discounts derived from the models are presented below. A comparison of the coefficient estimates across regions reveals that the attributes having the most impact on prices were length and micronaire in the South; strength in the Southwest; and first digit of the color grade in the San Joaquin Valley. Strong correlation between first and second digit of the color grade in the South and Southwest regions forced the exclusion of Cl from both models. Strong correlation was also observed between staple and strength in the South and Southwest, resulting in exclusion of fiber length from the model. It should also be noted that lack of statistically significant impacts of quality attributes in the various regions was likely due to little variation in quality specifications in the contracts; this is a limitation of the data set.

Base Prices

Calculation of regional base prices uses color grade 41, leaf 4, micronaire 4.2, strength 24.5, and length 34. Annual average DSCQ prices for each region were used (USDA, 1999). These were 61.90 cents/lb. for the South, 57.71 cents/lb. for the Southwest, and 63.78 cents/Ib. for the San Joaquin Valley. The base price differed across regions by about 6 cents/lb., suggesting that the influence of factors other than the quality attributes and other variables in the model have an effect on textile mills' purchase prices (Table 3). These factors may include (1) regional history of growing certain quality characteristics with consistency, (2) different intended end uses, (3) perceived differences in quality, and/or (4) attributes not measured in the current grading system.

Color Grade Premiums and Discounts

The second digit of the color grade for South and Southwest regions and first digit of the color grade for the San Joaquin Valley were significantly different from zero. The textile industry on the average paid 0.38% more as cotton became 1% less gray in the San Joaquin Valley; and 0.14% and 0.15% more as cotton became 1% less yellow in the South and Southwest regions, respectively. Discounts for the second digit of the color grade were low and almost the same for both the South and Southwest regions, but the discount for the first digit of the color grade for San Joaquin Valley was high (Table 4).

Leaf Grade Premiums and Discounts

Leaf grade differentials were present in the South and Southwest regions. For the Southwest, leaf was traded within a narrow range and for the South no premium was offered for lower leaf within the range of the data (Table 5). Low premiums and discounts may be reflective of mills' preference to remove leaf in their plants rather than risk fiber damage from excessive lint cleaning at the gin.

Staple Length Premiums and Discounts

Only the South exhibited premiums for staple across the range of the data (Table 6). Contracts showed a narrow range of minimum staple specifications (34-36).

Strength Premiums and Discounts

Fiber strength significantly affected cotton price only in the Southwest within the range of the contract data set. Larger premiums for higher strength for SW cotton suggests that textile manufacturers may use this cotton for products that

require strong fiber, and must pay premiums to obtain the higher strength (Table 7).

Micronaire Discounts

Micronaire had no significant impact on the prices of Southwest and San Joaquin Valley cotton for the 1998 crop year, at least within the quality ranges specified in the contracts. This implies that textile manufacturers are probably meeting micronaire needs from these two regions without having to differentiate on micronaire. For the South, discounts were observed for micronaire both lower and higher than 3.45, however, micronaire above 4.75 was discounted at almost 5 cents/1b. (Table 8)

Summary and Conclusions

This study examined the relationship between the prices paid by textile manufacturers for cotton and various quality attributes of the fiber, general market forces, and selected specification terms for contractual arrangements for cotton used in the 1998/99 marketing year. Comparison of estimated price flexibility for fiber attributes across regions in 1998/99 showed some important differences. For example, responsiveness in price paid by manufacturers for color was highest for cotton from the San Joaquin Valley, while price responsiveness for fiber length was greatest for cotton from the South. Price was most responsive to variations in strength in the Southwest.

This analysis has two limiting factors. One is that the non-inclusion of some of the quality characteristics in the regional models does not necessarily imply that those attributes did not contribute to the price of cotton. High correlation between some of these attributes prohibited their inclusion in the model. One reason for such high correlation among the quality attributes is that textile manufacturers stipulate in their contracts a specific combination of quality attributes, not the way cotton is grown or produced. The other limitation is that the absence of wider ranges of quality in contract specification may make statistical delineations of sources of price impacts infeasible.

While this study provides objective evidence of the patterns of the regional market values for cotton fiber attributes that were paid by the textile manufacturers in 1998/99, it does not provide the definitive explanation for textile mill price differences across regions. It is important for all market participants to know what values the market is placing on the fiber attributes in order to participate in the market and make rational decisions. A future need is to understand the reasons for the difference.

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Table 1A. Summary of Data Used in the Analysis, South Region.

Variables	Mean	S.D	Range
Price	68.87	3.90	57.28 - 76.38
C1	4.50	0.52	3-5
C2	1.16	0.37	1-2
Leaf	4.50	0.52	3 - 5
Length	34.92	0.67	34 - 36
Micronaire	4.11	0.11	3.30 - 4.75
Strength	27.20	0.44	25-29
Bales	768.46	730.73	50-6120
DSCQ	61.90	4.14	55.27 - 73.97

Table 1B. Summary of Data Used in the Analysis, Southwest Region.

Variables	Mean	S.D	Range
Price	66.93	4.90	57.28 - 76.00
C1	4.28	0.45	4-5
C2	1.46	0.50	1-2
Leaf	4.28	0.45	4 - 5
Micronaire	3.86	0.40	3.1-4.18
Strength	27.41	0.58	27.0 - 29.0
Bales	983	867	90 - 6,120
DSCQ	57.71	4.98	52.50 - 84.65

Table 1C. Summary of Data Used in the Analysis, San Joaquin Valley Region.

Variables	Mean	S.D	Range
Price	77.84	6.24	58.16 - 87.95
C1	3.58	0.59	3-5
C2	1	0.00	1-1
Leaf	3.58	0.59	3-5
Length	35.96	0.24	34-36
Micronaire	4.06	0.20	3.2-4.15
Strength	28.25	0.48	27-29
Bales	797.27	482.62	180-2880
DSCQ	63.78	6.16	58.84 - 82.05

Table 2. Hedonic Price Model Parameter Estimates for the Three Production Regions, Dependent Variable Ln(Price).

Independent Variables	South	Southwest	San Joaquin Valley
	β's	β's	β's
Intercept	0.3248	0.5385	0.8868**
	(0.50)	(1.06)	(1.85)
DC_1			0.3813*
	NA	NA	(2.49)
$DC1^2$			-0.0402*
	NA	NA	(-2.27)
DC2	0.1432*	0.1528*	
	(6.25)	(4.98)	NA
DLF	-0.0277*	0.0838*	
	(-7.49)	(3.15)	NA
L	0.4545*		
	(5.30)	NA	NA
STR		0.3740*	
	NA	(2.76)	NA
M	0.3564**		
	(1.56)	NA	NA
M^2	-0.0483**		
	(-1.80)	NA	NA
BALES		0.0000*	
	NA	(1.97)	NA
$BALES^2$		-0.0000**	
	NA	(-1.85)	NA
DSCQ	0.0354	0.0552	0.6137*
	(3.49)*	(8.72)*	(8.34)
$DSCQ^2$	-0.0002*	-0.0003*	
	(-2.57)	(-7.19)	NA
R-squares	0.5481	0.6321	0.4379
Observations	574	262	98

t-ratios are in parentheses,
'*'- Indicate coefficients are significant at 5% ;
'**' - Indicate coefficients are significant at 10% .

Table 3. Base Price for US Cotton (cents/lb), by Region.

Region	Base Price
South	68.46
Southwest	63.15
San Joaquin Valley	75.12

Table 4. Premiums and Discounts (Points/lb) for First and Second Digit of Color Grade (C_1 and C_2) From Base Quality for US Cotton, by Region.

Color	South	Southwest	San Joaquin Valley
31	---	---	+147
41	---	---	0
51	---	---	-713
41	0	0	----
42	-218	-223	----

Table 5. Premiums and Discounts (Points/lb) from Base Quality for Leaf Grade (LF).

Leaf Grade	South	Southwest
3	0	+119
4	0	0
5	-189	-150

Table 6. Premiums and Discounts (Points/lb) from Base Quality for Staple Length (L).

Staple Length	South
34	0
35	+91
36	+181

Table 7. Premiums and Discounts (Points/lb) from Base Quality for Strength (STR).

Strength	Southwest
23	-147
24.5	0
25	+48
26	+142
27	+234
28	+323
29	+411

Table 8. Discounts (Points/lb) from Base Quality for Micronaire (M).

Micronaire	South
3.35	-19.2
3.45	0
4.20	-68.5
4.75	-449