

# U.S. COTTON BASIS AND QUALITY PREMIUMS DURING THE TRANSITION TO AN EXPORT ORIENTED MARKET

by

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(Under the direction of Dr. Lewell F. Gunter)

## ABSTRACT

The United States is a major cotton producer and exporter. As more than 60 percent of U.S. cotton is exported, U.S. cotton confronts more competition in the export market. Quality driven price discounts and premiums are dependent on the supply and demand for each quality characteristic. In this study, we examined trends in quality premiums/discounts and quality characteristics of U.S. cotton production over the past ten crop years and examine the relationship between premiums/discounts and production. We also examined the monthly cotton basis for seven regions for the period of August 2000 – July 2006. The results indicate the same seasonal basis pattern for all seven regions and some differences between the cotton bases across the regions. Compared with the seasonal and regional differences identified by earlier research covering the period, August 1988 – July 1998, both seasonal and regional basis patterns have changed as the export market for U.S. cotton has become dominate.

INDEX WORDS: Cotton, Quality, U.S., Price, Production, Basis, Regional Differences,  
Seasonal Patterns

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*Dedicated to My Husband, Xiaomeng and My Parents*  
*For Their Love and Support*

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# **CHAPTER 1**

## **INTRODUCTION**

### **1. Background Information**

#### **1.1. World Cotton Production, Consumption and Trade**

Cotton is the most important textile fiber in the world, accounting for nearly 40 percent of total world fiber production. While about 80 countries produce cotton, the world's four largest cotton-producing countries are China, the United States, India, and Pakistan, which together provide nearly 70 percent of world production. Other major producers include Uzbekistan, Brazil, and Turkey (USDA).

World cotton consumption increased more than 40 percent between crop year 1990 and 2005, when it reached 123 million bales. China is the largest consumer of cotton in the world accounting for nearly 40 percent of world consumption. Other major consuming countries include India, Pakistan, and Turkey. Brazil is a major cotton-consuming country, but is increasingly exporting cotton to the world market (USDA).

Trade is particularly important for cotton. More than 30 percent of the world's consumption of cotton fiber crosses international borders before processing. Through trade in yarn, fabric, and clothing, much of the world's cotton again crosses international borders at least once more before reaching the final consumer. Since crop year 1990, the leading exporter of cotton is the United States. China has had many peaks and valleys in imports over the time period—1990-2006, and it has been the leading importer of cotton since crop year 2001.

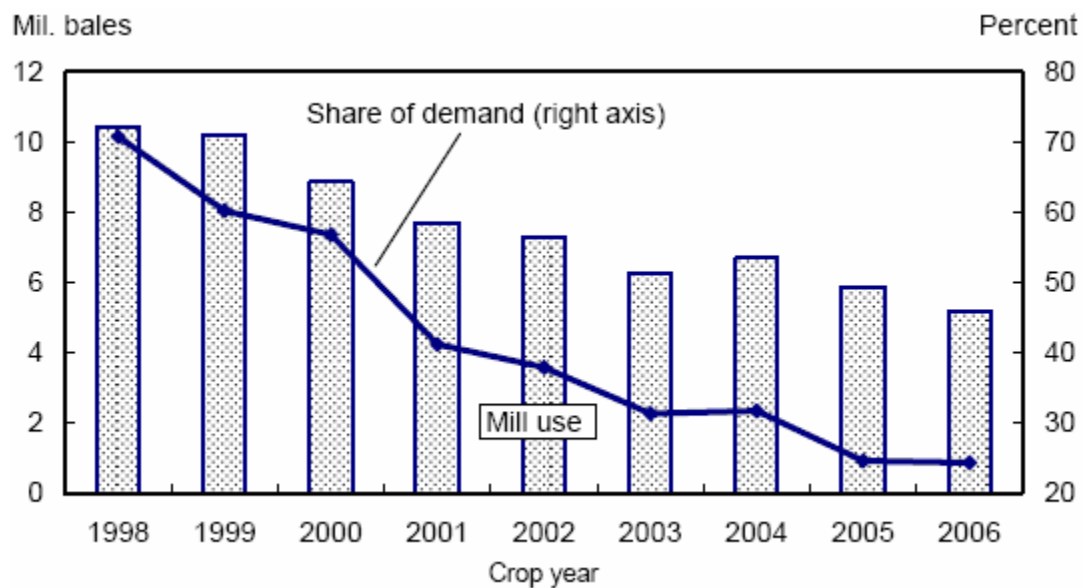
## 1.2. U.S. Cotton Production, Consumption and Trade

Cotton is one of the major agricultural commodities grown in the United States with an annual production value of over 5 billion dollars. Typically ranking second to China, U.S. cotton production accounts for about 20 percent of annual world production. Cotton is produced in 17 southern States along the Cotton Belt from Virginia to California. Major concentrations include areas of: Texas High and Rolling Plains; Mississippi, Arkansas, and Louisiana Delta; California's San Joaquin Valley; Central Arizona; and Southern Georgia. The two types of cotton grown in the United States are American Upland and American Pima or extra-long staple (ELS). Upland cotton, which usually has a staple length of 1 to 1 1/4 inches, is grown throughout the U.S. Cotton Belt and accounts for about 97 percent of annual U.S. cotton production. Pima cotton, which has a staple length of 1 1/2 inches or longer, is produced predominantly in California, Arizona, New Mexico, and southwest Texas(USDA, Briefing Rooms).

The two major uses of U.S. cotton are domestic mill use and exports. Domestic mill use consumed more than 60 percent of the U.S. cotton supply until late 1990's. As textile production moved out of the United States, however, domestic cotton consumption decreased sharply. As shown in Figure 1.1, domestic mill use was more than 10 million bales in 1990's while domestic use was only less than 2 million bales in crop year 2006.

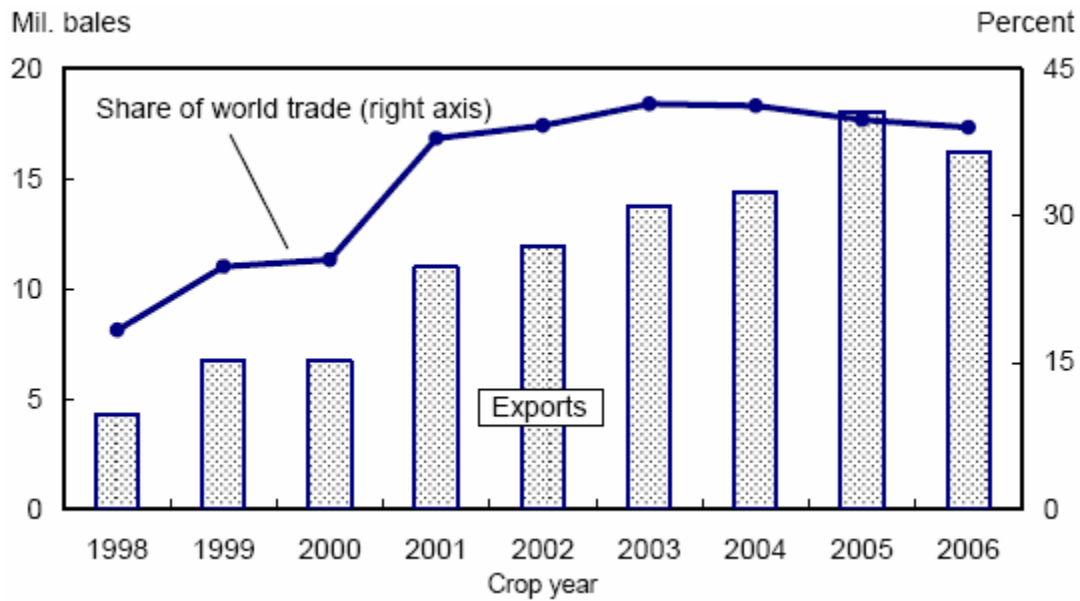
The steady fall of U.S. domestic cotton consumption since the late 1990's, has been accompanied by a steady increase in U.S. cotton exports, as foreign textile production has increased. As approximately 70 percent of U.S. cotton production is now exported, the United States is the leading exporter, accounting for over one-third of global trade in raw cotton (Figure

1.2). The major markets for U.S. cotton are China and Mexico. Smaller U.S. export markets include Korea, Turkey, and Indonesia. With its strong reliance on export markets, the U.S. cotton industry is heavily influenced by currency fluctuations, trade negotiations, and economic growth in its major importing markets. Also, U.S. cotton confronts more and more competition from some other cotton exporters.



**Figure 1.1. U.S. Cotton Mill Use, 1998-2006**

Source: "Cotton and Wool Situation and Outlook Yearbook 2006", Meyer et al., Economic Research Service, USDA.



**Figure 1.2. U.S. Cotton Exports, 1998-2006**

Source: “Cotton and Wool Situation and Outlook Yearbook 2006”, Meyer et al., Economic Research Service, USDA.

## 2. Problem Statement

As the major market for U.S. cotton has shifted from the domestic mills to export markets, U.S. cotton is now facing more challenges because the international market desires higher quality cotton (Estur, 2005; Jung and Lyford, 2007). The ongoing changes in spinning technology have increased the demand for higher quality fiber (Lyford, Jung, and Ethridge, 2004). Price guides the production, marketing and consumption of cotton. Clear price-quality relationships reveal the market rewards for quality characteristics (Lyford, Jung, and Ethridge, 2003). A better understanding of the price-quality relationship may help cotton producers to manage and market their crop for higher premiums, thus improve the competitiveness of U.S. cotton in the global market.

The transition from a domestic oriented market to an export oriented market may have affected price premiums and discounts for quality characteristics better and worse than the base

quality. This market transition may have also impacted regional and seasonal cotton price patterns in the U.S. Previous research has indicated that the monthly cotton basis has shown differences within the crop year as well as among the regions. The distance to markets affects regional cotton prices. During the period when U.S. cotton mostly relied on domestic markets, the proximity to either the domestic mills or export markets helped the Southeast and San Joaquin Valley have a stronger basis among the seven cotton producing regions. Incurring higher costs to transport cotton to eastern domestic mills or western export ports, the East Texas-Oklahoma, West Texas and Desert Southwest had the weaker basis. The shift of the major market of U.S. cotton from domestic mills to export market is expected to affect the regional differences in the cotton basis. In the next section, we will discuss the objectives of this study.

### 3. Objectives

The major objectives of this study are to examine two aspects of cotton prices that may have been impacted by recent changes in markets for U. S. cotton. We will examine the relationship between quality premiums and discounts and quality characteristics of U.S. cotton. We will also examine regional and monthly changes in the cotton basis. Specific objectives of this study are:

- To describe U.S. upland cotton quality characteristics classification and USDA AMS price reports.
- To explore trends in quality premiums (discounts) and quality characteristics of U.S. cotton production over the past ten crop years.
- To examine the relationship between U.S. cotton quality premiums (discounts) and production.



- To explore possible effects on the monthly cotton basis that may have resulted from the major market shift from domestic mills to the export market.

#### 4. Organization

The remainder of the thesis is divided into four chapters. Chapter 2 describes the cotton quality characteristics and AMS data. In Chapter 4, we present the premiums (discounts) by cotton quality characteristics, cotton production by quality characteristics, and the relationship between premiums (discounts) and production. We discuss the monthly cotton basis, and the Friedman test for changes or differences in the basis in Chapter 5. This chapter also includes the data description and the results of the tests. In the final chapter, chapter 6, we summarize the study, present the conclusions, point out limitations of the study, and give suggestion for future research.

## **CHAPTER 2**

### **COTTON QUALITY CHARACTERISTICS CLASSIFICATIONS AND AMS PRICE REPORTS**

#### **1. Cotton Quality Characteristics Classification**

The Agricultural Marketing Service (AMS) of USDA provides standardization, grading and market news services for cotton and for five other commodities. One aspect of the AMS cotton program is the development of cotton grade standards and cotton classification services. Quality classification is not mandatory but almost all cotton grown in U.S. is classed at the request of the growers who pay the fee for the service (USDA, AMS). Twelve AMS classing offices are located in nine states throughout the Cotton Belt.

The AMS cotton program provides quality reports which consist of daily, weekly, monthly and annual summaries. All quality reports provide quality characteristic statistics of all bales classed by classing office and by states.

The main fiber measurements included in USDA's official cotton grade include:

##### **1.1. Color.**

Color grade refers to the gradations of grayness and yellowness. The grayness (first digit) indicates how bright or dull the sample is and the yellowness (second digit) indicates the degree of color pigmentation. The color can be affected by rainfall, freezes, insects and fungi, and be stained through contact with soil, grass, or the cotton plant's leaf. Color also can be affected by excessive moisture and temperature levels while cotton is being stored, both before and after

ginning. Color affects the processing efficiency and the ability of fibers to absorb and hold dyes and finishes.

As shown in Table 2.1, there are 25 official color grades for Upland cotton, plus 5 categories of below-grade color.

**Table 2.1. Color Grades of Upland Cotton**

	White	Light Spotted	Spotted	Tinged	Yellow Stained
Good Middling	11	12	13	--	--
Strict Middling	21	22	23	24	25
Middling	31	32	33	34	35
Strict Low Middling	41	42	43	44	--
Low Middling	51	52	53	54	--
Strict Good Ordinary	61	62	63	--	--
Good Ordinary	71	--	--	--	--
Below Grade	81	82	83	84	85

Source: “The Classification of Cotton”, Agricultural Marketing Service, USDA, (Apr 2001): 11.

### 1.2. Fiber Length (Staple).

Fiber length is the average length of the longer one-half of the fibers (upper half mean length). It is reported both in 100ths and 32nds of an inch. Fiber length is largely determined by variety, but the cotton plant’s exposure to extreme temperatures, water stress, or nutrient deficiencies may shorten the length. Excessive cleaning or drying at the gin may also result in shorter fiber length. Fiber length affects the yarn strength, yarn evenness and spinning efficiency.

Table 2.2 presents the conversion chart of fiber length in 100ths and 32nds.

### 1.3. Leaf Grade

Leaf grade refers to small particles of the cotton plant’s leaf which remain in the lint after

the ginning process. Leaf content is affected by variety, harvesting methods, harvesting conditions, and ginning process. The amount of leaf remaining in the lint after ginning depends on the amount present in the cotton prior too ginning. Even with the most careful harvesting and ginning methods, a small amount of leaf remains in the cotton lint. These particles may detract the quality of the finished product.

There are 7 leaf grades, designed as leaf grade “1” through “7”, as shown in Table 2.3.

**Table 2.2. Length Conversion Chart**

32nds	Inches	32nds	Inches
24	0.79 & shorter	36	1.11 – 1.13
26	0.80 – 0.85	37	1.14 – 1.17
28	0.86 – 0.89	38	1.18 – 1.20
29	0.90 – 0.92	39	1.21 – 1.23
30	0.93 – 0.95	40	1.24 – 1.26
31	0.96 – 0.98	41	1.27 – 1.29
32	0.99 – 1.01	42	1.30 – 1.32
33	1.02 – 1.04	43	1.33 – 1.35
34	1.05 – 1.07	44 & +	1.36 & +
35	1.08 – 1.10		

Source: “Cotton Classification: Understanding the Data”, Agricultural Marketing Service, USDA, (Apr 2005): 4.

**Table 2.3. Leaf Grades of Upland Cotton**

Leaf Grade	Trash Measurement
1	0.13
2	0.2
3	0.34
4	0.51
5	0.72
6	1
7	1.25

Source: “The Classification of Cotton”, Agricultural Marketing Service, USDA, (Apr 2001): 12.

#### 1.4. Micronaire (Mike)

Micronaire (mike) is the measurement of the fiber fineness and maturity. Micronaire can be influenced by environmental conditions such as moisture, temperature, sunlight, plant nutrients, and extremes in plant or boll population. Fiber fineness affects yarn appearance, yarn uniformity, yarn strength and the quality of the end product. Table 2.4 provides the interpreting of micronaire measurements.

#### 1.5. Fiber Strength.

The reported strength is the force in grams required to break a bundle of fibers one tex unit in size. Fiber strength is largely determined by variety, but it also may be affected by plant nutrient deficiencies and weather. Fiber strength is closely related to yarn and fabric strength and to spinning efficiency. Table 2.5 provides the interpreting of fiber strength measurements.

#### 1.6. Length Uniformity.

Length uniformity is the ratio between the mean length and the upper half mean length of the fibers and is expressed as a percentage. Length uniformity is related to yarn uniformity and strength, spinning efficiency, and short fiber content. Cotton with a low uniformity is likely to have a high percentage of short fibers and may be difficult to process and likely to produce low-quality yarn. Table 2.6 provides the interpreting of length uniformity measurements

**Table 2.4. Micronaire Measurements of Upland Cotton**

Micronaire	Market Value
34 & below	discount
35-36	base
37-42	premium
43-49	base
50 & above	discount

Source: “The Classification of Cotton”, Agricultural Marketing Service, USDA, (Apr 2001): 9.

**Table 2.5. Fiber Strength Measurements of Upland Cotton**

Fiber Strength	Degree
23 & below	Weak
24-25	Intermediate
26-28	Average
29-30	Strong
31 & above	Very Strong

Source: “The Classification of Cotton”, Agricultural Marketing Service, USDA, (Apr 2001): 9.

**Table 2.6. Length Uniformity Measurements of Upland Cotton**

Length Uniformity Index	Degree
Below 77	Very Low
77-79	Low
80-82	Intermediate
83-85	High
Above 85	Very High

Source: “The Classification of Cotton”, Agricultural Marketing Service, USDA, (Apr 2001): 8.

### 1.7. Trash

Trash is a measure of amount of non-lint materials in the cotton, such as leaf and bark from the cotton plant. This measurement provides an estimate of the total amount of trash in the

bale. Although the trash and leaf grade are not the same, there is a correlation between these two as shown in Table 2.3.

## 2. AMS Price Report

AMS also provides official cotton price reports in the form of daily spot cotton quotations (DSCQ). The daily spot price is the average price over a particular region weighted by the quantity traded at locations within the region. The monthly or annual spot prices are the simple average of the daily cash price for that month or crop year. Monthly and annual cotton price reports provide the estimates of prices and quality premiums and discounts for each month and year.

The DSCQ and monthly (annual) cotton price statistics are available for seven regions:

1. Southeast: Alabama, Florida, Georgia, North Carolina, South Carolina, Virginia.
2. North Delta: Arkansas, Tennessee, Missouri.
3. South Delta: Louisiana, Mississippi.
4. East Texas-Oklahoma: East Texas, Oklahoma.
5. West Texas: West Texas except El Paso area.
6. Desert Southwest: Arizona, New Mexico and far West Texas.
7. San Joaquin Valley: San Joaquin valley of California.

The base qualities for the price statistics are color 41, staple 34, leaf 4, mike 35-36 and 43-49, strength 26.5-28.4 and uniformity 81. Based on the price of the base quality, other grades of these quality characteristics received premiums or discounts reported, in 100ths of a cent (e.g. a premium of 100 is a one cent per pound premium). AMS market reporters collect samples of market transactions and conduct interviews with market participants, primarily merchants and

marketing organizations, to obtain price information which is used to estimate daily prices and quality premiums and discounts (Brown et al.1995).



# **CHAPTER 3**

## **IMPACTS OF COTTON QUALITY CHARACTERISTICS**

### **ON PRICES AND PRODUCTION**

#### **1. Related Literature**

Cotton is a commodity with several quality characteristics which have impacts on the price that producers receive and the value that manufacturers get. Jung and Lyford reported increasing demand for higher quality cotton. They cited current changes in spinning technology requiring higher quality fiber as one source of increase demand for higher quality cotton, and state that “foreign textile manufacturers’ fiber quality requirements are more stringent, as compared to domestic demand” (Jung and Lyford, 2007: 2).

The African franc zone (AFZ) is the second largest exporter of cotton after the U.S. Cotton production in Africa is labor intensive while it is capital intensive in the U.S. Estur compared the competitiveness of these two largest exporters’ cotton and found that AFZ is very competitive with the U.S. in terms of production cost, and fiber quality.

Lyford, Jung, and Ethridge (2004) reported that there are enduring price differences based upon regions. They state: “To get desired quality, textile manufacturers are willing to pay based on their needs and the relative scarcity of fiber characteristics. In turn, producers and marketers respond to price incentives. As such, cotton price-quality information plays an important role in the efficiency of the overall cotton market”(Lyford, Jung, and Ethridge, 2004: 3).

Jung and Lyford used a needs assessment approach to explore the prospect for

improving West Texas cotton marketability. They found that given the present quality performance, great potential segments are from higher-end international segments with significant value-added. And this study foresees potential quality improvement and the economic returns of West Texas cotton in the short run.

Several models of hedonic prices, implicit prices of embodied quality attributes, have been developed to estimate producer returns from different quality attributes. Hedonic price-quality relationships at the mill level--the last stage before cotton is transformed into textile products--in U.S. have been estimated by Ethridge and Davis, 1982; Ethridge and Neeper, 1987; Chen, Ethridge, and Fletcher, 1997; Lyford, Jung, and Ethridge, 2003; Lyford, Jung, and Ethridge, 2004. The premiums and discounts attributed to heterogeneous quality characteristics are estimated in these researches.

However, the cotton quality characteristics are usually interdependent, Jung and Lyford reported that “there is no clear understanding about which fiber characteristics (or sets of characteristics) should be given priority to improve marketability and increase returns” (Jung and Lyford, 2007: 3). USDA AMS price statistics provide the quantity weighted average prices paid at early stages in the marketing chain. These price statistics also provide the premiums and discounts by quality characteristics. By using USDA AMS price statistics and quality statistics, we will explore trends in quality premiums (discounts) and examine the relationship between U.S. cotton quality premiums (discounts) and production.

## 2. Premiums and Discounts by Quality Characteristics

Quality driven price discounts and premiums are dependent on the supply and demand for each quality characteristic. Cotton quality is affected by many factors including variety

grown, weather conditions, and production practices. Demand for different quality characteristics is impacted by changes in processing technology and by changes in demand for final products. Annual price statistics and annual quality statistics for ten crop years (1996-2005) are examined here to reveal possible relationships among the quality characteristics, prices, and production. It should be noted that the price statistics may include not only sales from current production but also some sales of cotton carried over from the previous crop year, so prices observed for any crop year are not solely dependent on production in that year. The crop year is defined as August 1 through July 31 by USDA.

Annual cotton price statistics for each region provided by USDA AMS consist of 4 main tables. Color, staple and leaf are treated as interdependent quality characteristics and presented in one table. Mike, Strength and Length Uniformity are treated as independent quality characteristics do they appear in three separate tables.

Although there are many possible values and combinations of reported quality characteristics, U.S. cotton production tends to be concentrated in a limited subset of the possible quality grades. Table 3.1 shows average cotton production by selected quality categories for the three most recent crop years--2003, 2004 and 2005. All categories reported in the table account for about 90 percent of production over the past 3 years. In this study, our analysis is mostly concentrated on the quality categories shown in Table 3.1.

**Table 3.1. Average Quality Characteristics of U.S. Cotton Production, 2003-2005**

<b>Color</b>	<b><u>11&amp;21</u></b>	<b><u>31</u></b>	<b><u>41</u></b>	<b><u>51</u></b>	<b><u>42</u></b>	<b><u>Total</u><sup>1</sup></b>
Production %	25.2%	34.8%	25.7%	4.2%	3.7%	93.5%
<b>Staple</b>	<b><u>33</u></b>	<b><u>34</u></b>	<b><u>35</u></b>	<b><u>36</u></b>	<b><u>37</u></b>	<b><u>Total</u><sup>1</sup></b>
Production %	11.2%	25.1%	30.0%	18.3%	8.2%	92.9%
<b>Leaf</b>	<b><u>1&amp;2</u></b>	<b><u>3</u></b>	<b><u>4</u></b>			<b><u>Total</u><sup>1</sup></b>
Production %	13.4%	52.5%	30.1%			96.0%
<b>Mike</b>	<b><u>35-36</u></b>	<b><u>37-42</u></b>	<b><u>43-49</u></b>	<b><u>50-52</u></b>		<b><u>Total</u><sup>1</sup></b>
Production %	4.6%	26.4%	50.8%	8.0%		89.8%
<b>Strength</b>	<b><u>24-25</u></b>	<b><u>26</u></b>	<b><u>27-28</u></b>	<b><u>29-30</u></b>	<b><u>31-32</u></b>	<b><u>Total</u><sup>1</sup></b>
Production %	2.7%	6.2%	33.6%	36.1%	14.3%	92.9%
<b>Uniformity</b>	<b><u>79</u></b>	<b><u>80</u></b>	<b><u>81</u></b>	<b><u>82</u></b>	<b><u>83</u></b>	<b><u>Total</u><sup>1</sup></b>
Production %	9.1%	21.0%	28.8%	26.3%	10.4%	95.6%

<sup>1</sup>Total refers to the percent of U.S. production accounted for by categories in table.

## 2.1. Color-Staple-Leaf

There are nine possible categories of staple, six possible categories of leaf and twenty five possible categories of color in the complete price statistics set which cover all possible quality combinations of these three characteristics. The subset of quality categories we discuss here accounts for nearly 90 percent of total cotton production through the study period including crop years 1996 through 2005. The categories of color, staple and leaf we focus on includes:

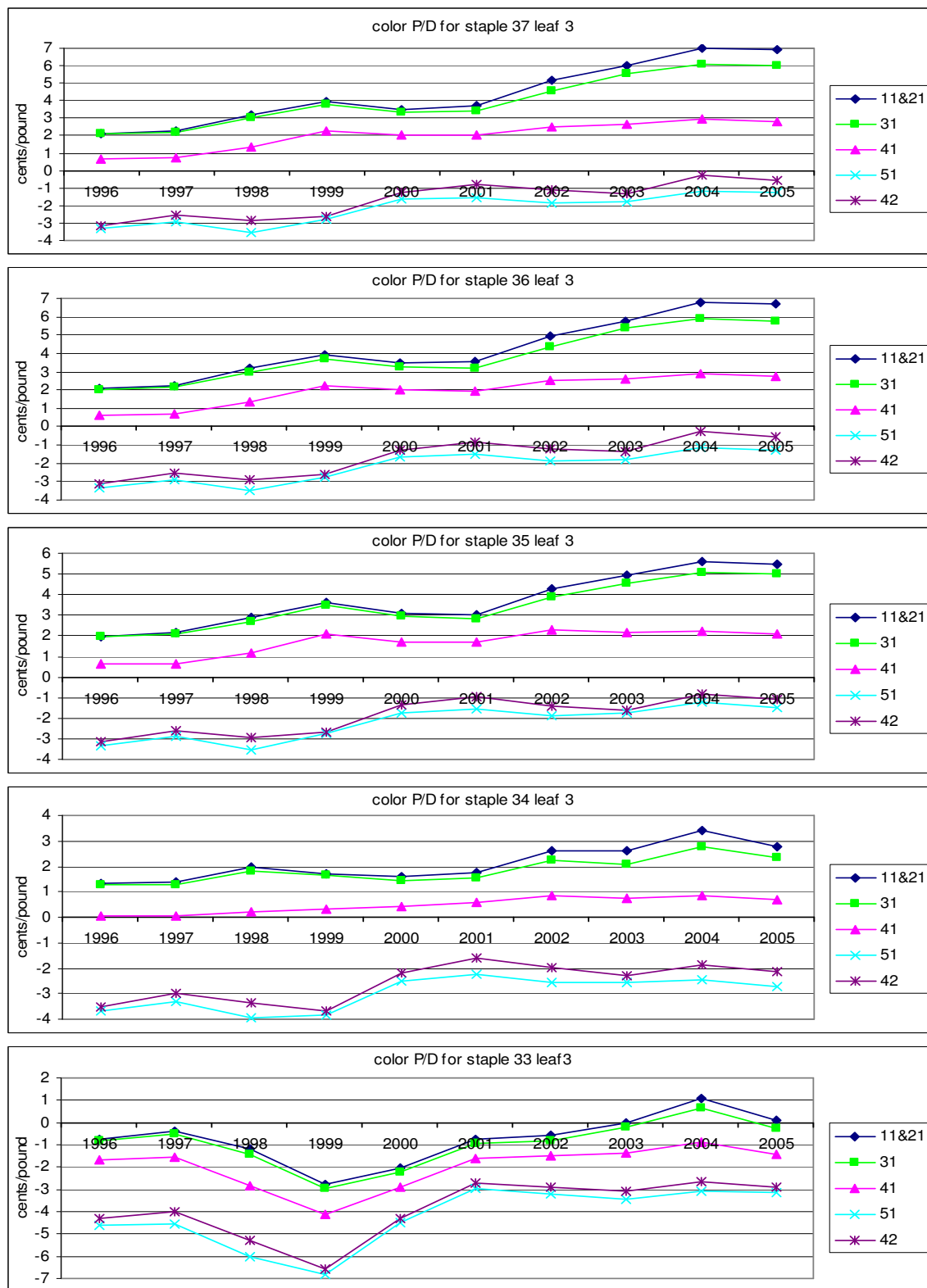
Color: 11&21, 31, 41, 51, 42.

Staple: 33, 34, 35, 36, 37.

Leaf: 3, 4.

For the interdependent characteristics of color, staple, and leaf, premiums and discounts for any one of these characteristics vary depending on the value of the other characteristics. In order to present the premiums/discounts for color and staple, the following graphs are arranged by the leaf grade. Figure 3.1 and Figure 3.2 are graphs of the color premiums/discounts for leaf grades 3 and 4, respectively. Figures 3.3 and 3.4 are the graphs of staple premiums/discounts for leaf grades 3 and 4, respectively.

The graphs in Figure 3.1 present the average annual color premiums and discounts for 5 different staple lengths and leaf 3 for the study period. The graphs are in the order of longer to shorter staple. Colors 11&21, 31 and 41 are the better colors and are more valuable. For leaf 3 cotton, colors 11&21, 31 and 41 received premiums when staple length was greater than 33. Colors 51 and 42 received discounts for all staple lengths. In general, for all colors here, the premiums (discounts) have had similar increasing (decreasing) trends through the study period with the lowest point in crop year 1996 and the highest point in crop year 2005. The trends are stronger for better color (11&21, 31 and 41) and higher staple. The stronger trends for better colors indicate that the better colors have become more desired through the study period. Discounts for lower quality colors are greater for shorter staple lengths, but all lower quality color discounts in Figure 3.1 are smaller in the post 2000 period than they were before 2000.

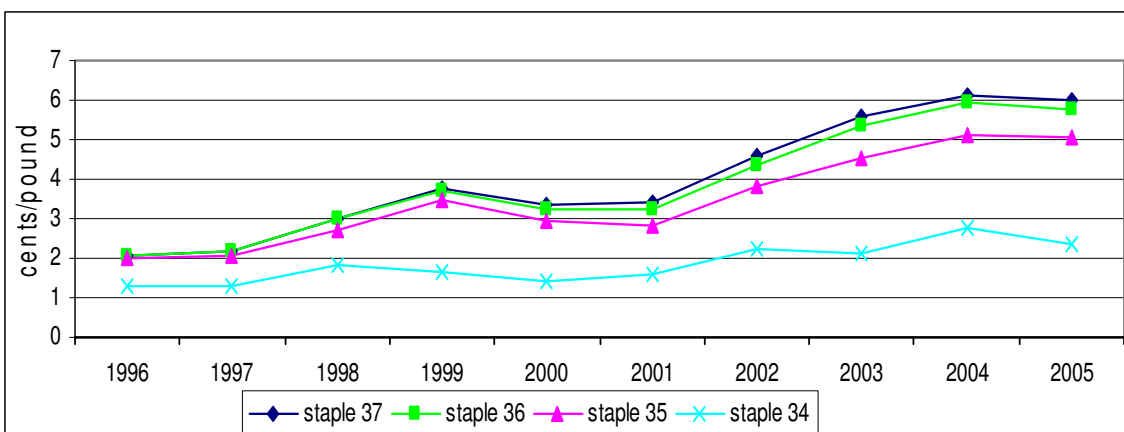


**Figure 3.1. Color Premiums & Discounts for Leaf 3 Cotton, 1996-2005**

Source: "Cotton Price Statistics: Annual Report", Agricultural Marketing Service, USDA.

Color premiums are highest for longer staple length cotton and color premiums have raised more for longer staple lengths. As Figure 3.1.a shows, the leaf 3 premiums for color 31 have increased more for longer staple cotton. Since the premiums increase more for better color as well as for longer staple, the largest increases in color premiums occurred for the combination of color 11&21, leaf 3 and staple 37.

In term of magnitudes of premiums, in 2005 color 11&21, 31 and leaf 3 premiums ranged from between 2.5 and 3 cents per pound for staple 34 to approximately 6 to 7 cents a pound for staples 36 and 37.



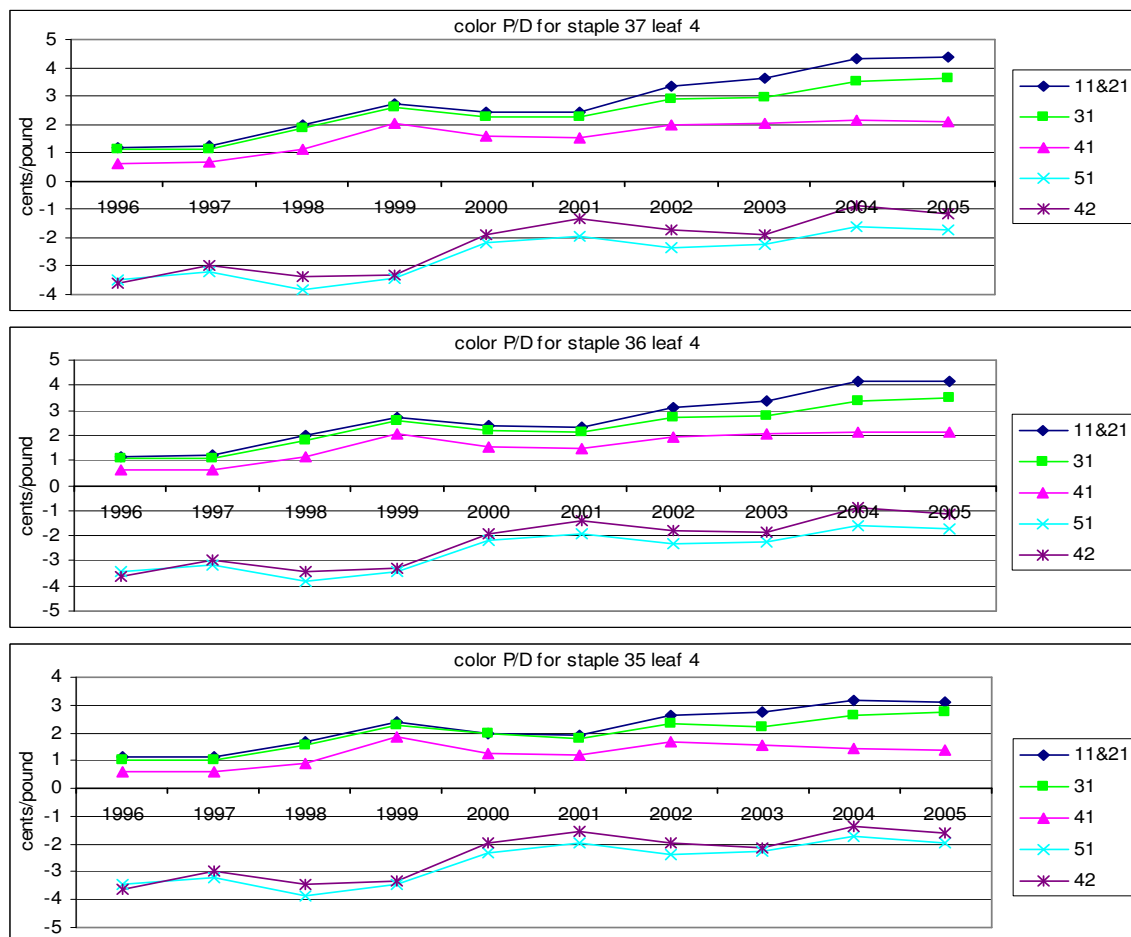
**Figure 3.1.a. Premiums for Color 31, Leaf 3 Cotton, 1996-2005**

Source: “Cotton Price Statistics: Annual Report”, Agricultural Marketing Service, USDA.

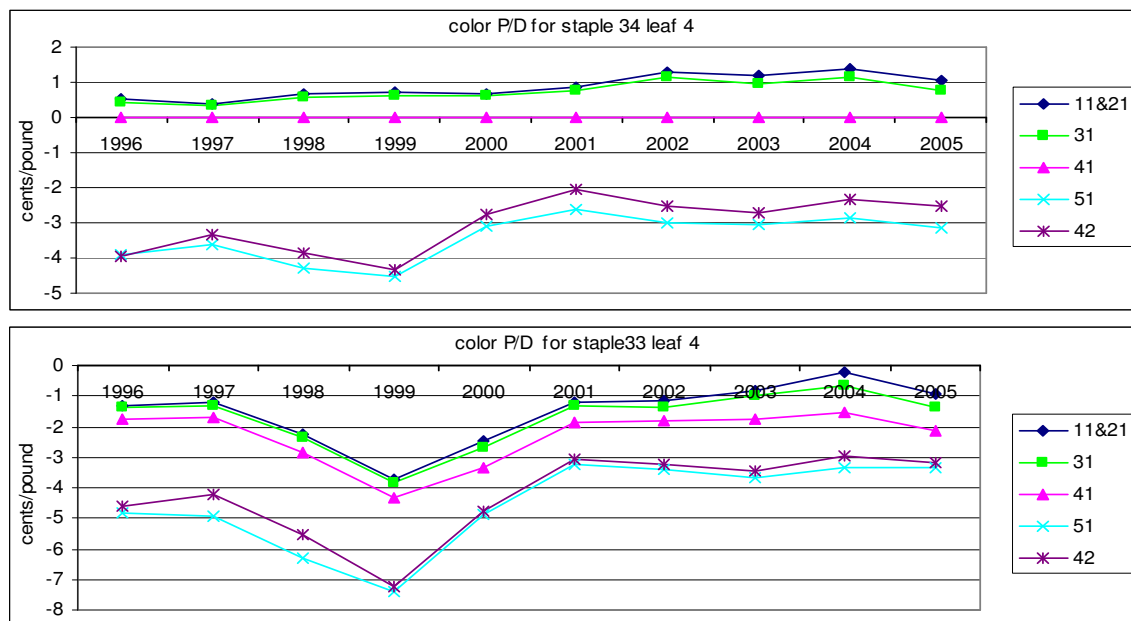
The graphs in Figure 3.2 present the color premiums and discounts for 5 different staples and leaf 4, and reveal a similar pattern of premiums and discounts as the leaf 3 graphs in Figure 3.1. The only difference between Figure 3.1 and Figure 3.2 is the leaf grade which is 3 for Figure 3.1 and 4 for Figure 3.2. In general, the premiums (discounts) for leaf 3 are larger (smaller) than the premiums and discounts for leaf 4 since leaf grade 3 is more valuable than leaf grade 4.

Colors 11&21, 31 and 41 received premiums when staple is greater than the base value of 34 and received discounts when staple is below 34. Colors 51 and 42 received discounts for all staples when leaf is 4. In general, for all colors here, trends in premiums and discounts were the same for leaf 4 cotton as trends for leaf 3 cotton.

In terms of magnitudes, color 11&21, 31 and leaf 4 cotton had premiums of about a penny a pound for staple 34 and between 3.5 and 4.5 cents per pound for staples 36 and 37. Leaf 4 cotton premiums for color 11&21 and 31 were therefore 1.5 to 2 cents lower than leaf 3 premiums for 34 staple cotton and about 2.5 cents per pound lower for staple 36 and 37.



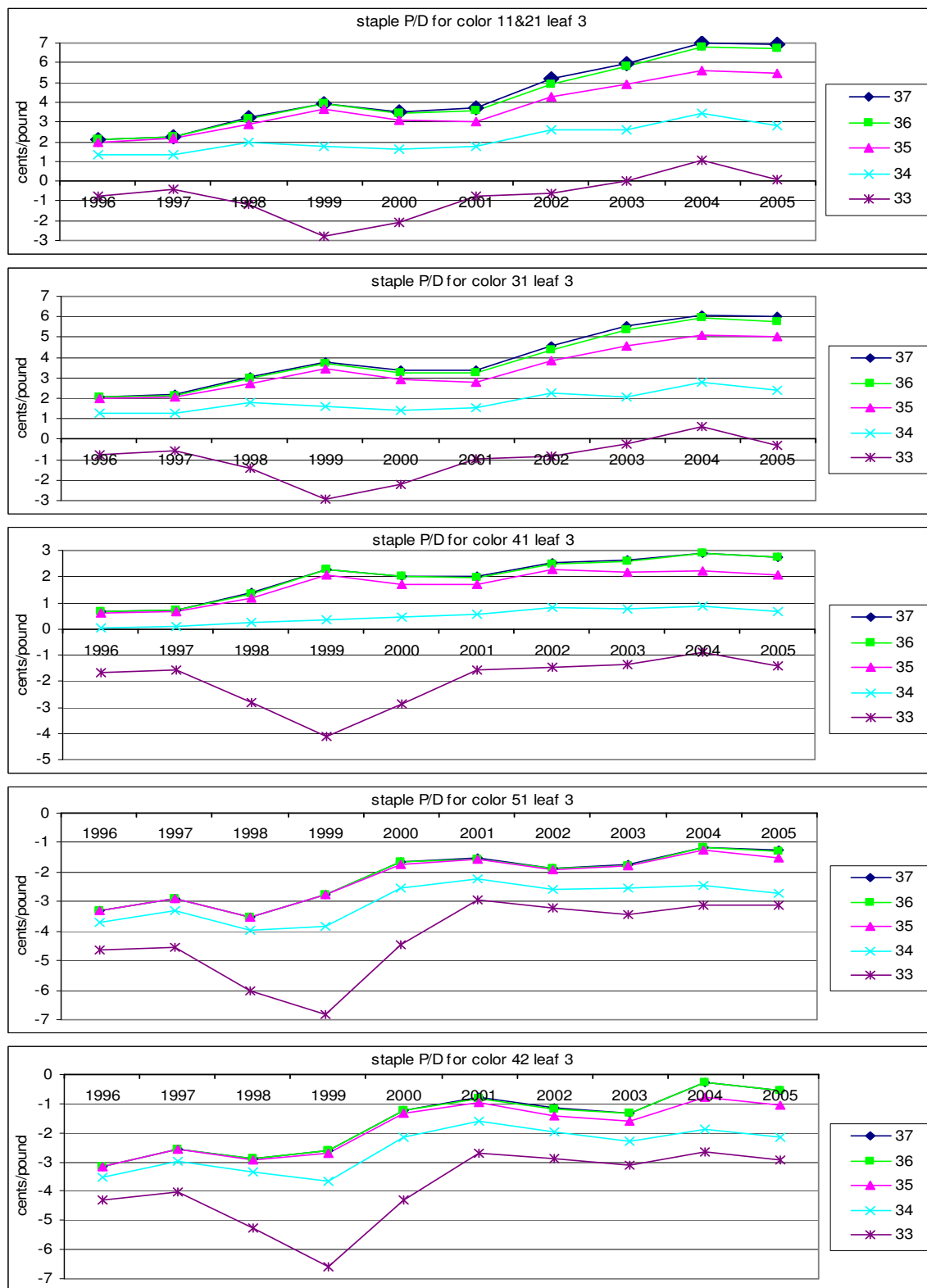




**Figure 3.2. Color Premiums/Discounts for Leaf 4 Cotton, 1996-2005**

Source: “Cotton Price Statistics: Annual Report”, Agricultural Marketing Service, USDA.

The graphs in Figure 3.3 present the staple premiums and discounts for 5 different color grades and leaf 3 for the study period. The graphs are in the order of better to worse color. Staples 34, 35, 36, and 37 received premiums while staple 33 received discounts when color was 11&21, 31 or 41. All of these staples received discounts when color was 51 or 42, although the discounts were smaller for longer staple cotton and the discounts decreased over time. In general, for staples 34 to 37, the premiums have a similar increasing pattern with the lowest point in crop year 1996 and the highest point in crop year 2005. The premiums of staples 37, 36 and 35 have somewhat stronger upward trends over the study period while the trend for staple 34 is flatter. The stronger premium increase trends for the longer staples with color 41 or better indicate that the longer staples became more desirable through the study period.

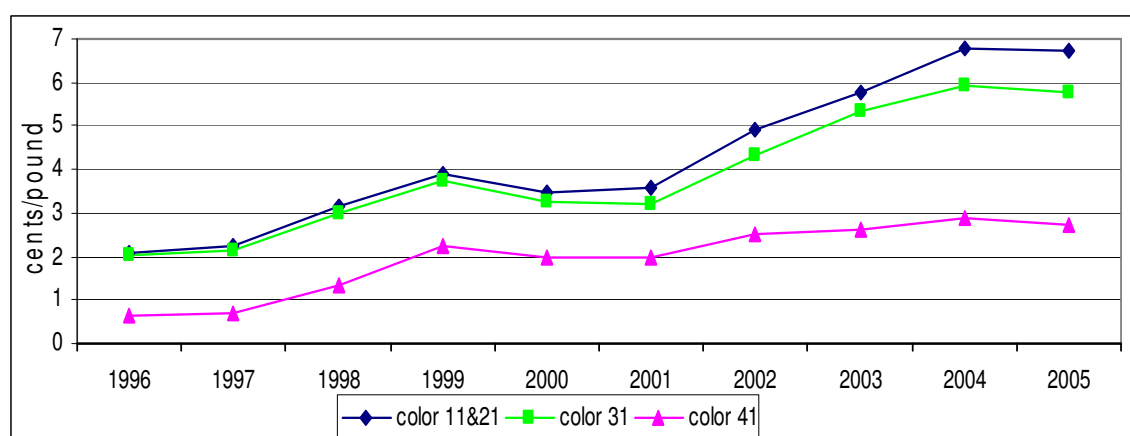


**Figure 3.3. Staple Premiums/Discounts for Leaf 3 Cotton, 1996-2005**

Source: "Cotton Price Statistics: Annual Report", Agricultural Marketing Service, USDA.

Staple premiums are highest for better color cotton and staple premiums have raised more for better colors. As Figure 3.3.a shows, the premiums for staple 36 and leaf 3 are higher and have increased more for the superior color grades. A similar pattern can be observed for other staple lengths and leaf counts.

In terms of magnitudes, premiums for leaf 3 and staple 35 range from about 2 cents a pound for color 41 to 5.5 cents a pound for color 11&21 in crop year 2005. Similar premiums for staples 36 and 37 were about 3 cents per pound for color 41 and about 7 cents per pound for color 11&21.



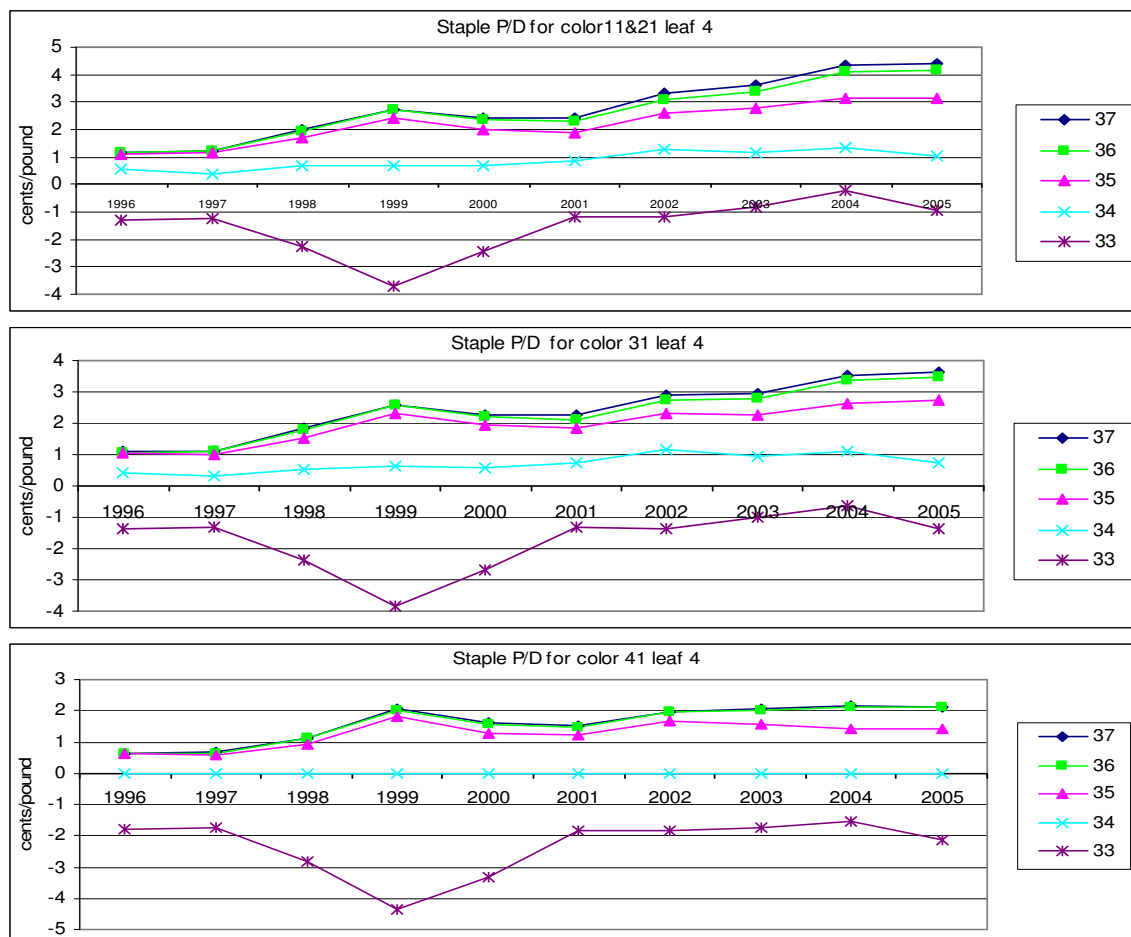
**Figure 3.3.a. Premiums for Staple 36, Leaf 3 Cotton, 1996-2005**

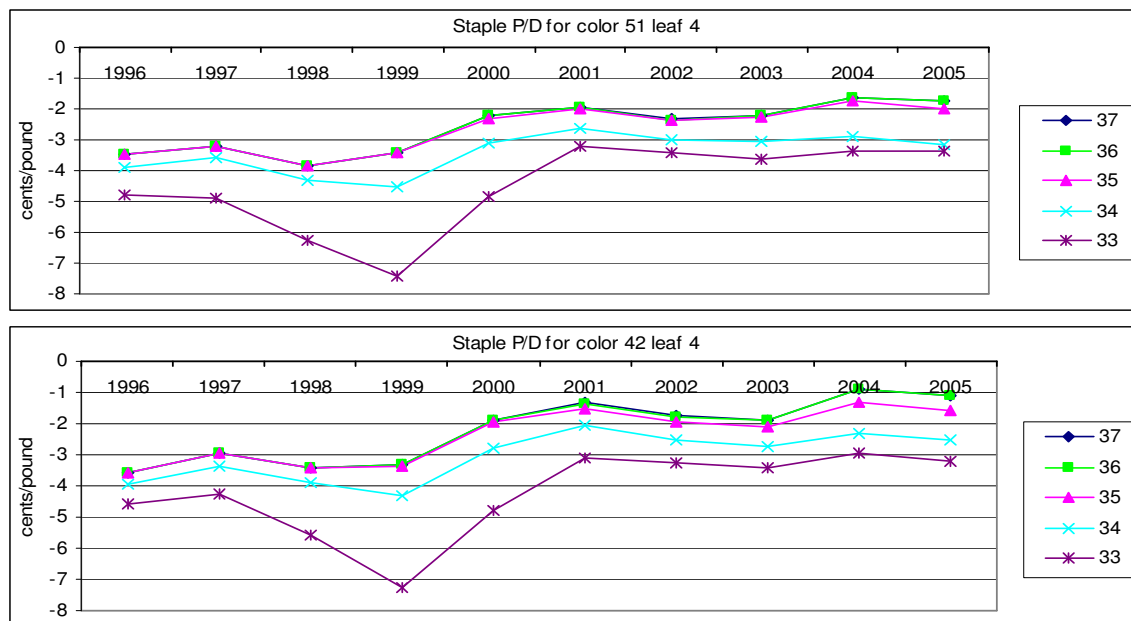
Source: “Cotton Price Statistics: Annual Report”, Agricultural Marketing Service, USDA.

The graphs in Figure 3.4 present the staple premiums and discounts for 5 different color grades and leaf 4. The graphs are in the order of better to worse color. The only difference between the Figure 3.3 and Figure 3.4 is the leaf grade which is 3 for figure 3 and 4 for Figure 3.4. Similar to Figures 3.1 and 3.2, the premiums (discounts) for leaf 3 are larger (smaller) than for leaf 4 since leaf grade 3 is more valuable than leaf grade 4. Staples 35, 36, and 37 received

premiums when color is 11&21, 31 or 41. Corresponding with the base quality for the pricing, there were no premiums or discounts for staple 34, color 41, and leaf 4. Staple 33 received discounts regardless of color. Trends in premiums and discounts for leaf 4 cotton were similar to those discussed for leaf 3 cotton.

In terms of magnitude, staple 36 and 37 cotton with color 11&21 received a premium of about 7 cents per pound with a leaf 3 rating. For leaf 4 cotton, this premium is only 4 to 4.5 cents per pound. Similar drops in premiums for leaf 4 versus leaf 3 can be observed in figures 3 and 4.





**Figure 3.4. Staple Premiums/Discounts for Leaf 4 Cotton, 1996-2005**

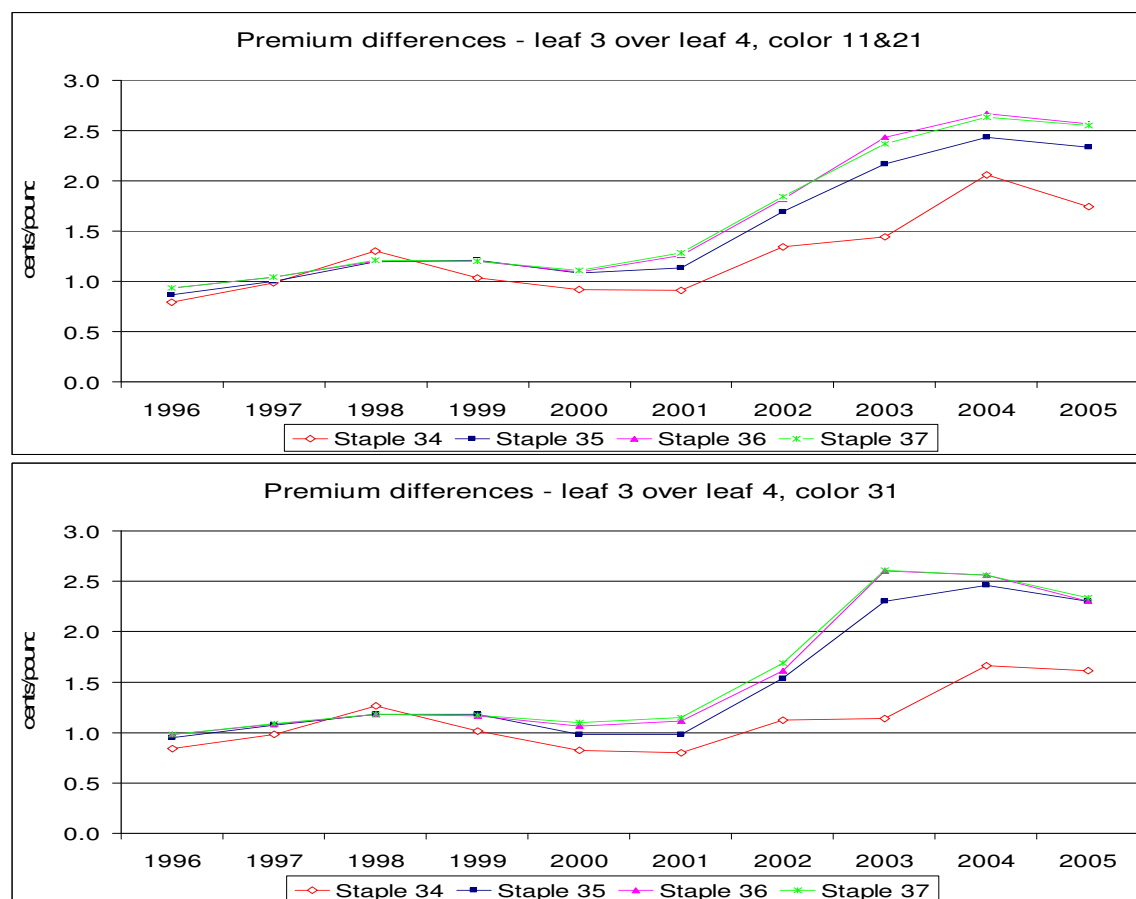
Source: “Cotton Price Statistics: Annual Report”, Agricultural Marketing Service, USDA.

## 2.2. Leaf

A comparison of Figures 3.1 and 3.3 with 3.2 and 3.4 reveals the difference between leaf 3 and 4 premiums for all color and staple combinations discussed here. It was observed for color and staple that premiums for high quality in one characteristic are greater when combined with high quality in another characteristic. As shown in Figure 3.5, this relationship also holds true for premiums for leaf 3 cotton over the base leaf 4 quality standard. For colors 11&21 and 31 and staples 35 through 37, leaf 3 cotton has had about a 2.5 cent premium over leaf 4 cotton for the most recent 3 years. These leaf 3 premiums were around 1 cent per pound from 1996 to 2001, but have risen steadily since then.

The leaf 3 premium for colors 11&21 and 31 and staple 34 is smaller than that for the longer staples, with a premium of 1.5 to 2 cents for color 11&21 in the most recent three years,

and somewhat less for color 31. Premiums for color 41 were less than 1 cent for all staple lengths, 34-37, throughout the study period.



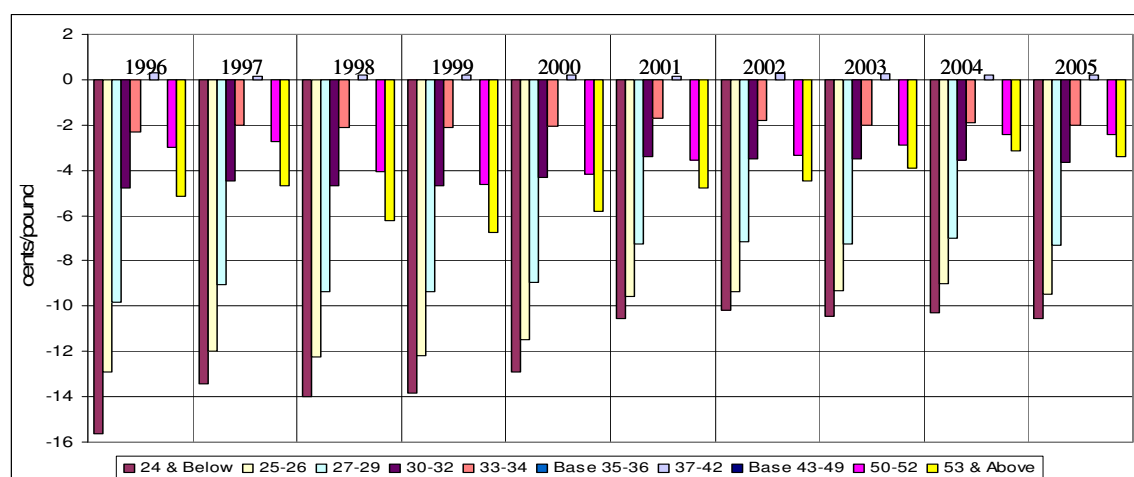
**Figure 3.5. Premium Differences between Leaf 3 and Leaf 4, 1996-2005**

Source: "Cotton Price Statistics: Annual Report", Agricultural Marketing Service, USDA.

### 2.3. Mike

The base mike for pricing is 35-36 and 43-49. Between these two base ranges, mike 37-42 is a quality range with premiums. Lower than mike 35 or higher than mike 49 are the quality ranges with discounts. Figure 3.6 shows the premiums and discounts for different mike ratings

through the study period. The discounts for low mike (lower than 35) tends to become smaller from crop year 1996 to crop year 2005. Premiums for mike 37- 42 are small and stable in scale. Discounts for high mike (higher than 49) became larger from crop year 1996 to crop year 1999, and then became smaller through the rest of the study period to reach the smallest point at the end of the study period, crop year 2005. Although the magnitude of the discounts for low mike are quite large, production in the lowest mike categories is normally insignificant, as will be shown later. Mike premiums were less than 0.5 cents per pound for the entire data period.



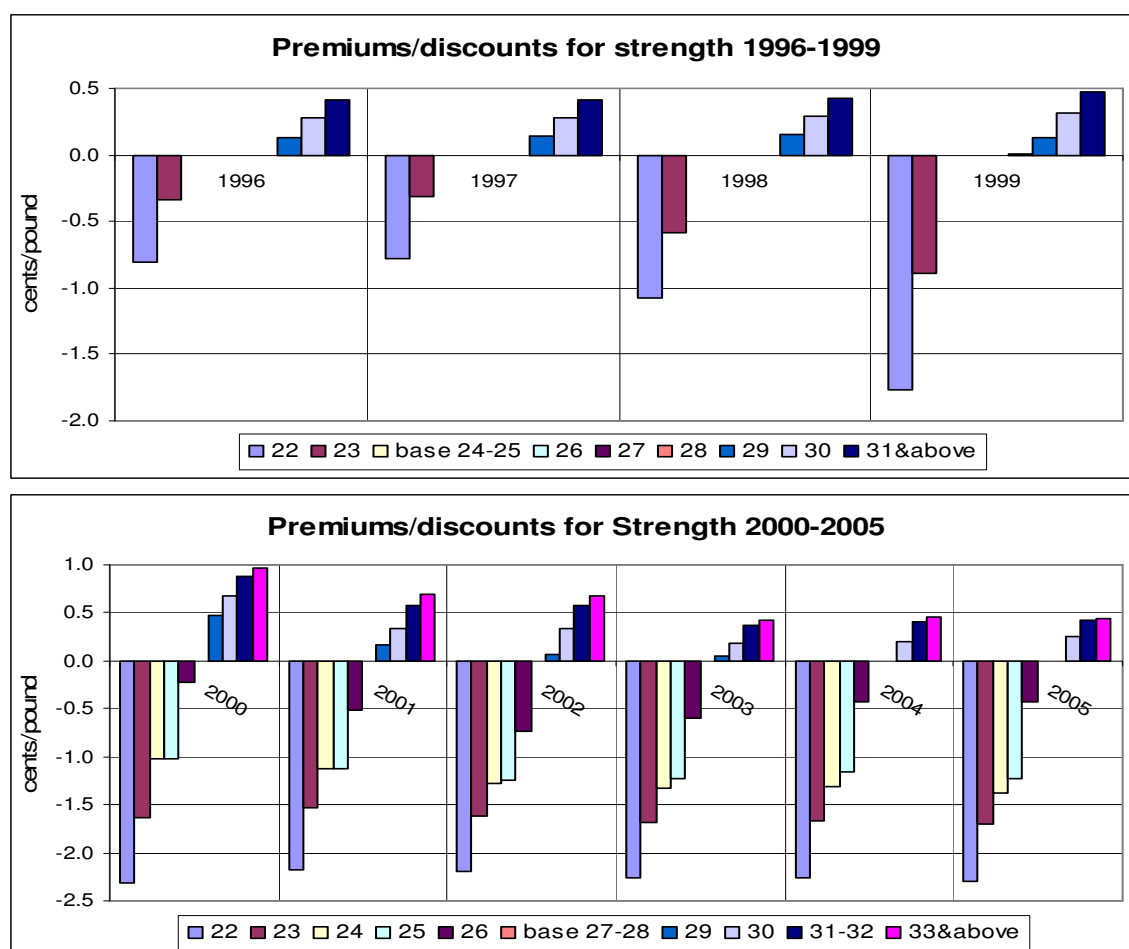
**Figure 3.6. Premiums/Discounts for Mike, 1996-2005**

Source: “Cotton Price Statistics: Annual Report”, Agricultural Marketing Service, USDA.

## 2.4. Strength

Strength is reported in term of grams per tex. The base for strength has been changed within the study period. The base strength for pricing was 24-25 prior to crop year 1999. Since crop year 2000, the base strength is 26-27. The first graph in Figure 3.7 illustrates the premiums and discounts for strength with the base strength 24-25 for crop years 1996 to through 1999. Although the base is set as strength 24-25, there was no premium applied for strength 26-28

within this period. Discounts for lower strength became larger from crop year 1996 to 1999 while premiums for higher strength were stable. The second graph in Figure 3.7 shows strength premiums and discounts with the updated base strength 27-28 for crop year 2000s to 2005. The premiums for higher strength tended to decrease from crop year 2000 to 2003 and became stable from crop year 2003 to 2005. The discounts for lower strengths were generally stable. Magnitudes of all strength premiums were less than 1 cent per pound, 2000-2005, and discounts were greater than 1 cent per pound only for the two lowest strength categories.



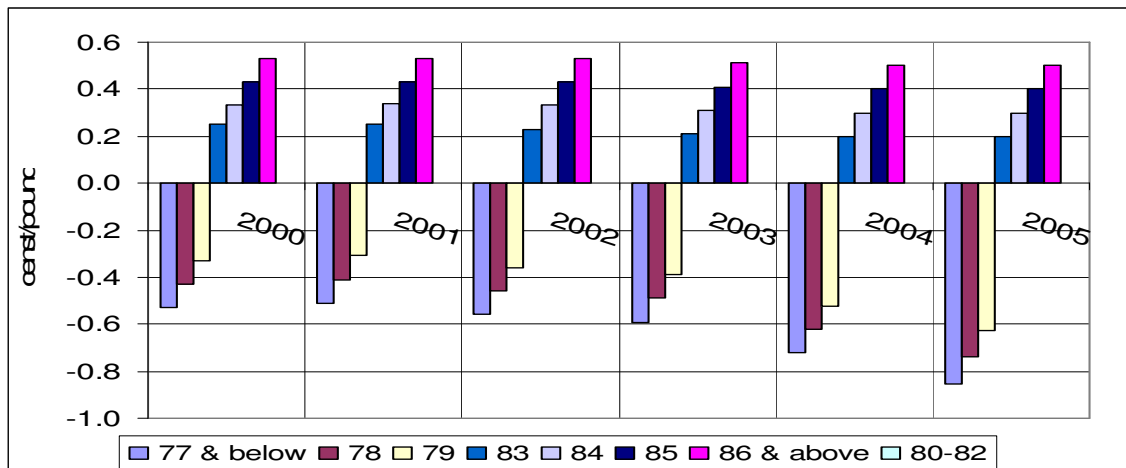
**Figure 3.7. Premiums/Discounts for Strength, 1996-2005**

Source: "Cotton Price Statistics: Annual Report", Agricultural Marketing Service, USDA.



## 2.5. Length Uniformity

AMS started to provide premium and discount data for length uniformity for crop year 2000 and has continued to provide these data since then. Although the base for uniformity is 81, uniformity 80 and 82 can also be treated as base since there are no premiums or discounts applied for these two uniformities within the study period. Figure 3.8 illustrates the premiums and discounts for length uniformity for crop years 2000 to 2005. The discounts for lower uniformity became larger from crop year 2000 to crop year 2005 approximately doubling over this period. Premiums for greater uniformity were generally stable with some minor decreases for some uniformity categories. Uniformity premiums were under 0.5 cents per pound for all six years, and discounts were all less than a penny a pound over this time period.



**Figure 3.8. Premiums/Discounts for Length Uniformity, 1996-2005**

Source: "Cotton Price Statistics: Annual Report", Agricultural Marketing Service, USDA.

## 3. Production by Quality Characteristics

The annual cotton quality statistics provide number and percentage of classed bales by all quality characteristics at the state level. As was true for the price statistics, color, staple and leaf

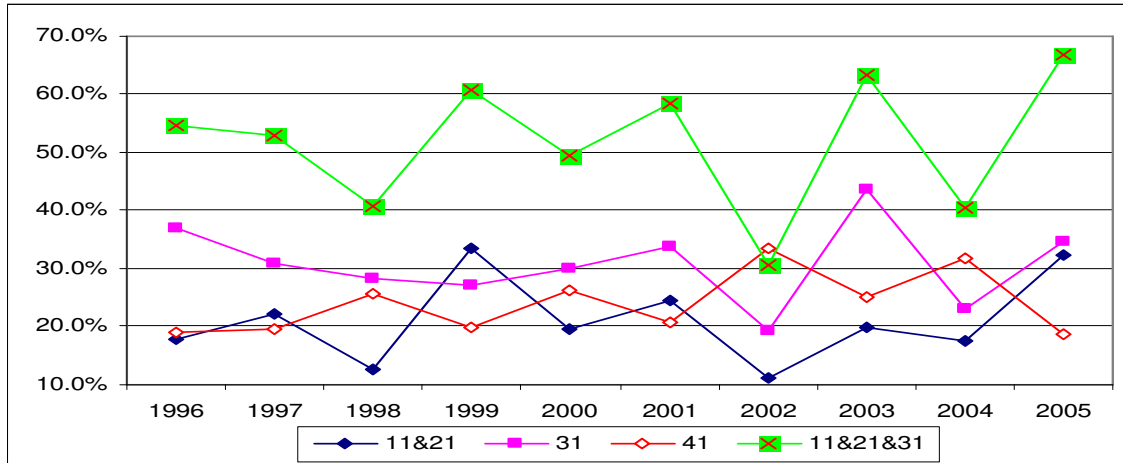
are treated as interdependent quality characteristics and presented in one table. Mike, Strength and Length Uniformity are treated as independent quality characteristics so they appear in three separate tables. We will first discuss production patterns over time for each characteristic individually, and then examine production of combinations of color and staple characteristics.

### 3.1. Color-Staple-Leaf

U.S. cotton production is concentrated in colors 11&21, 31 and 41 with 70 to 80 percent of annual production typically having these three colors. As shown in Figure 3.9, annual cotton production of color 11&21 and 31 has some fluctuation within the study period while the production of color 41 is relatively stable. Of colors not shown in Figure 3.9, colors 32 and 42 are most common, but their production is normally less than 10 percent of annual production. Production with color 51 and 52 is insignificant for the study period.

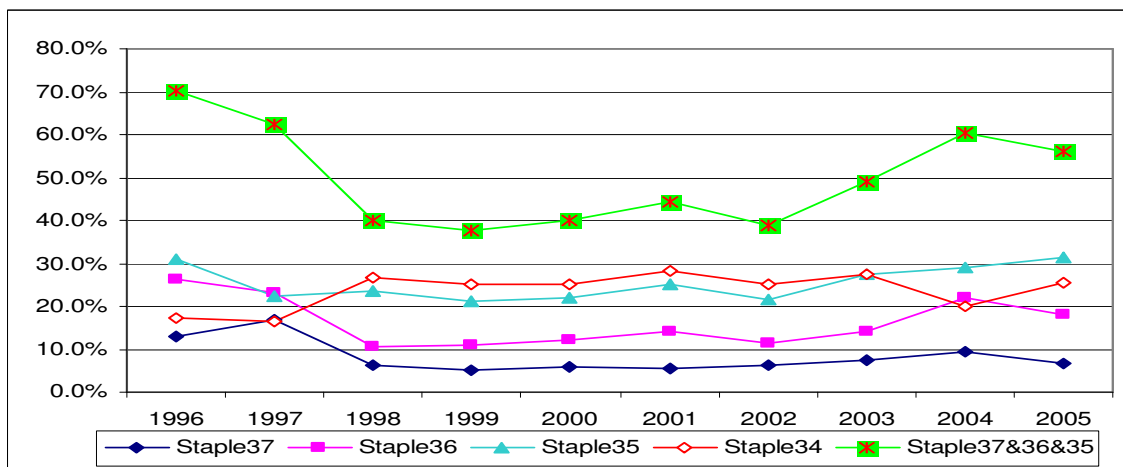
U.S. cotton production is spread among the five staple lengths selected in this study. As shown in Figure 3.10, higher percentages of cotton production with staple 35 occurred at the beginning and the end of the study period. In the middle of the study period, the most common staple length produced was staple 34. Production of longer staple lengths 37, 36, and 35 decreased from the beginning of the study period and then slightly increased in recent crop years.

As indicated by Figure 3.11, U.S. cotton production was concentrated in leaf 1&2, 3, and 4 with more than 90 percent of cotton produced with these 4 grades. Leaf 1&2 production has trended downward since 1999 while production of leaf 3 and 4 cotton experienced slightly upward trends since 1999.



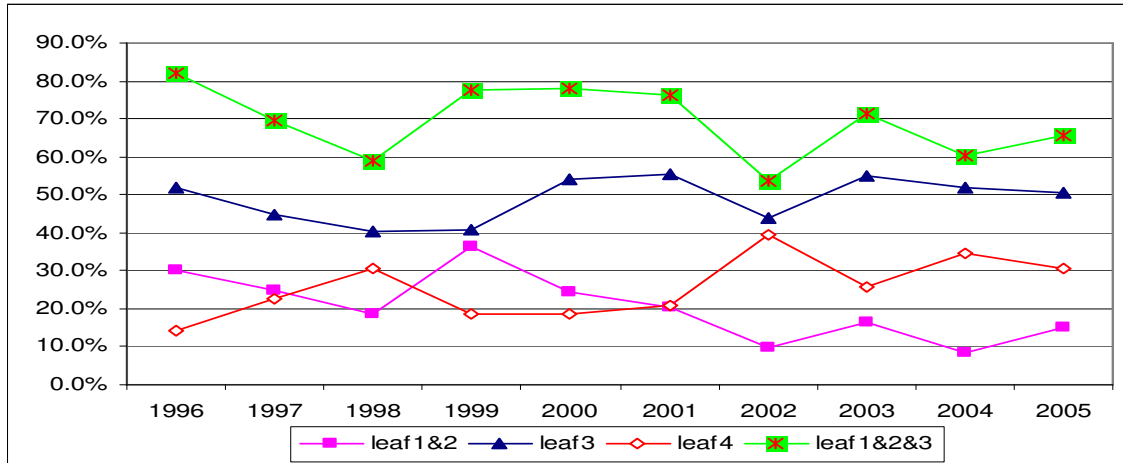
**Figure 3.9. U.S. Cotton Production by Color 11&21, 31, and 41, 1996-2005**

Source: “Cotton Quality: Annual Report”, Agricultural Marketing Service, USDA.



**Figure 3.10. U.S. Cotton Production by Staple 37, 36, 35, and 34, 1996-2005**

Source: “Cotton Quality: Annual Report”, Agricultural Marketing Service, USDA.

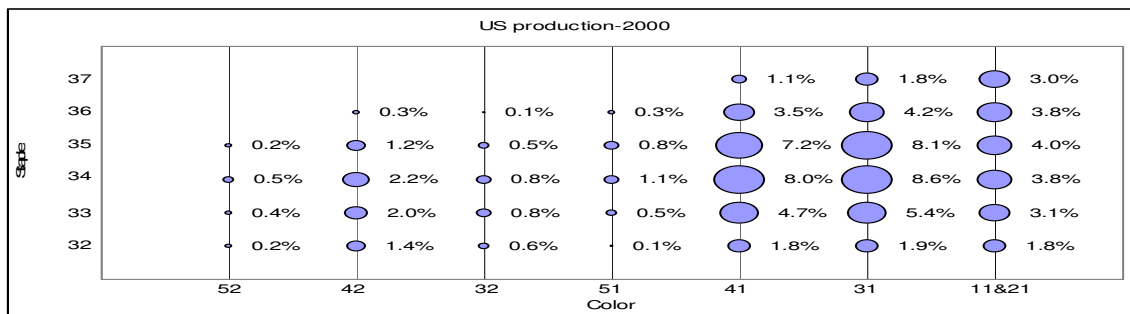
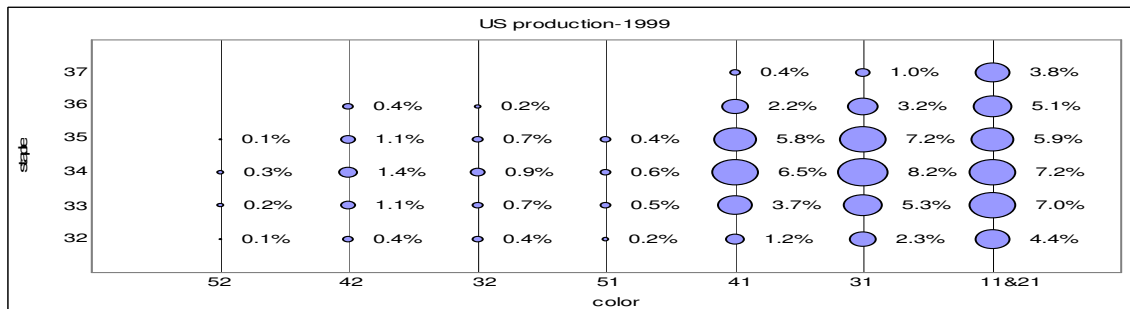
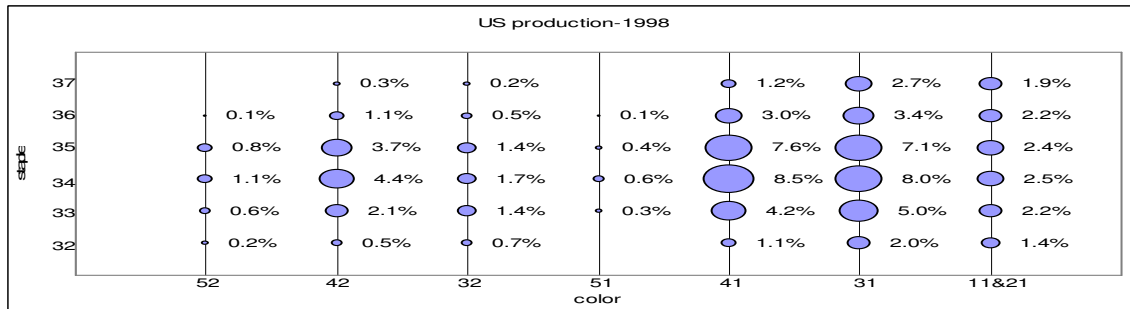
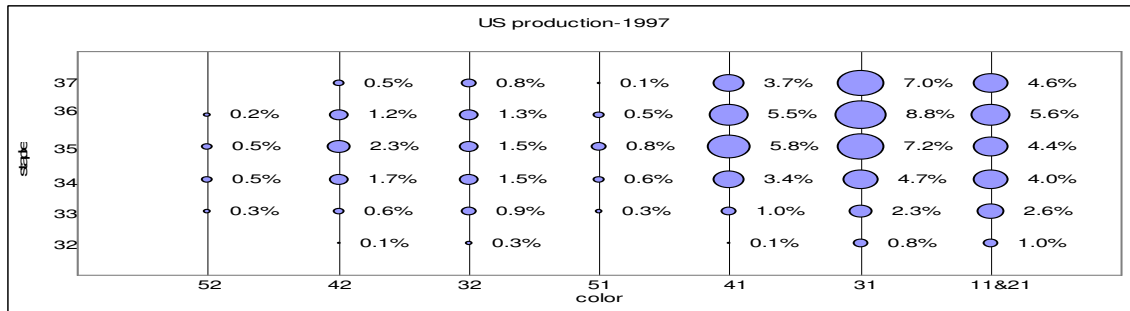
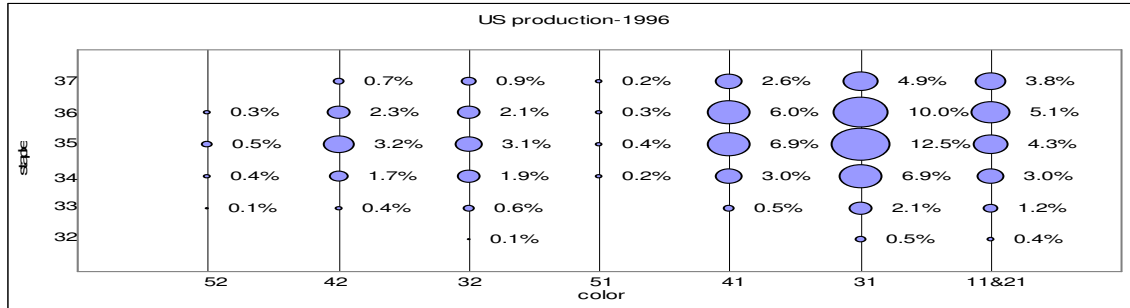


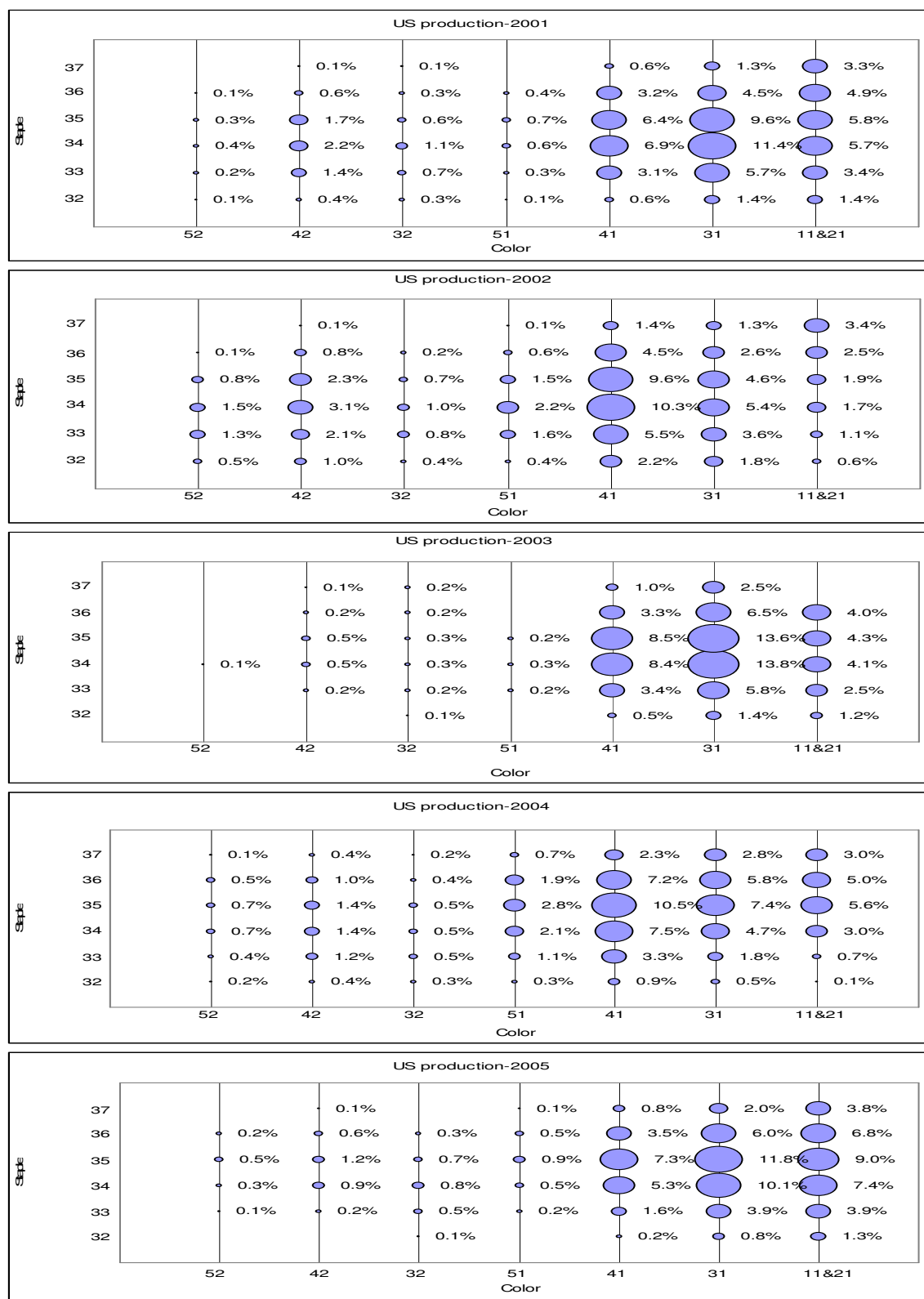
**Figure 3.11. U.S. Cotton Production by Leaf 1&2, 3, and 4, 1996-2005**

Source: “Cotton Quality: Annual Report”, Agricultural Marketing Service, USDA.

The bubble charts in Figure 3.12 show annual production percentages for several combinations of staple and color for 1996-2005. These graphs show combined leaf 3 and 4 production percentages for each staple-color combination. The bubble sizes for each graph are proportional to the percentage of production accounted for by each combination, so the annual distribution of cotton production by color and staple is relatively easy to observe in each graph.

Although it is difficult to discern production trends in Figure 3.12, is relatively easy to see individual year with significant deviations from the normal distribution of color and staple – likely due to variations in weather, pest, or disease conditions. Colors 42 and 11&21 stand out as experiencing volatility between years, and 1996 and 1997 stand out as years with high long staple production.



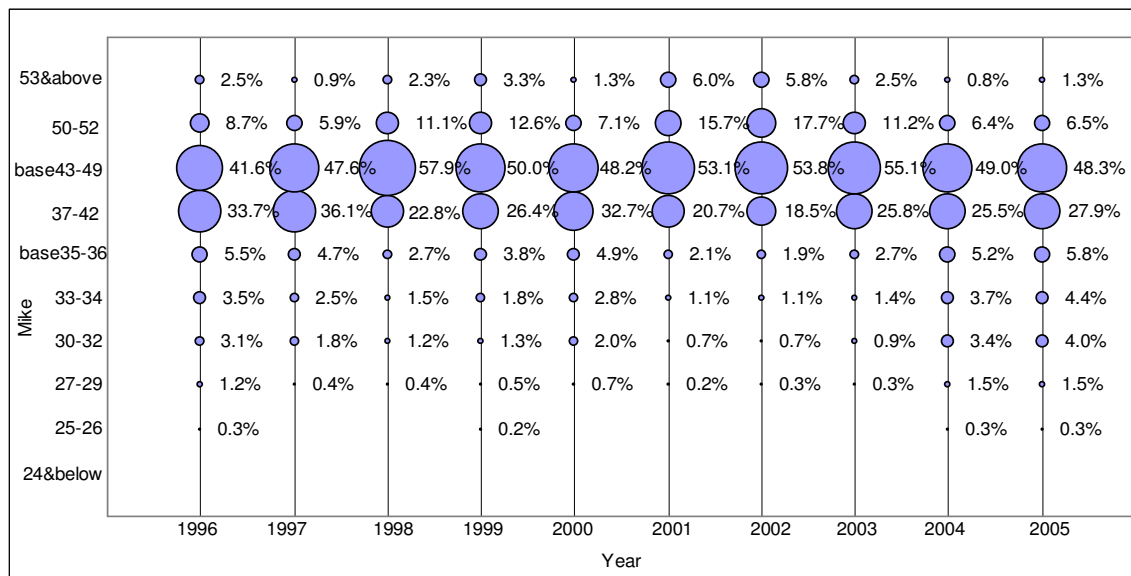


**Figure 3.12. U.S. Cotton Production by Color and Staple, 1996-2005**

Source: “Cotton Quality: Annual Report”, Agricultural Marketing Service, USDA.

### 3.2 Mike

Figure 3.13 shows U.S. cotton production by mike through the study period. The mike category with most cotton production is one of the base mike categories 43-49. Combined with the other base-mike 35-36, cotton production with base mike is about 50 to 60 percent of annual U.S. production within the study period. Mike 37-42 received premiums and is the second large mike production category. There is some fluctuation of premium mike production over this ten crop years with the largest percentage of 36.1 percent (1997) and the smallest 18.5 percent (2003). In general, these three mike categories account for about 70 to 80 percent of annual production. Cotton production with low mike (lower than 35) was relatively small, usually less than 10 percent. Cotton production with high mike (higher than 50) ranged from about 7 to 23 percent.

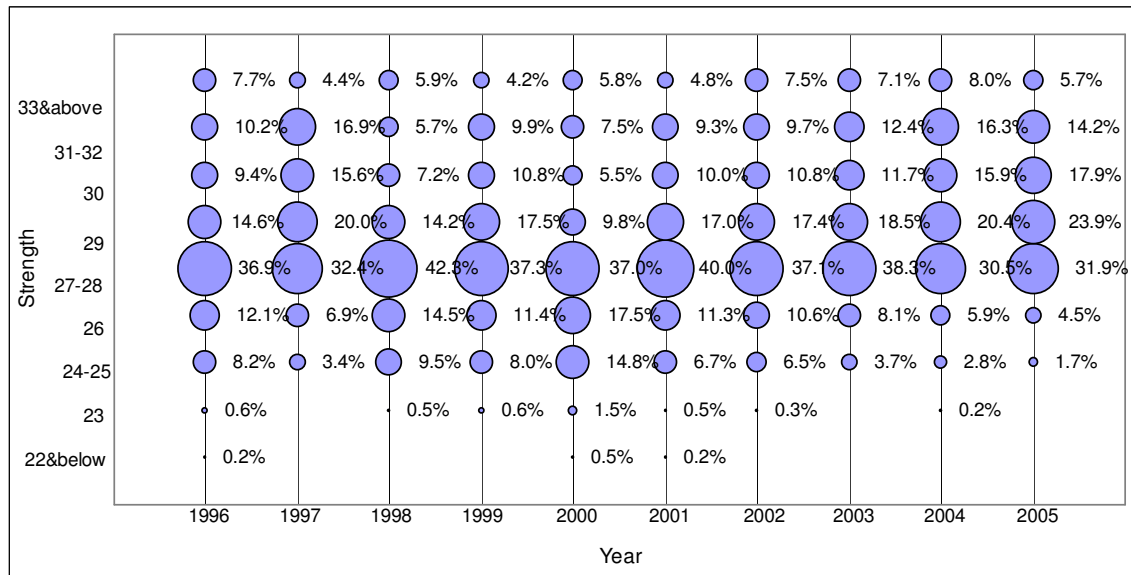


**Figure 3.13. U.S. Cotton Production by Mike, 1996-2005**

Source: “Cotton Quality: Annual Report”, Agricultural Marketing Service, USDA.

### 3.3. Strength

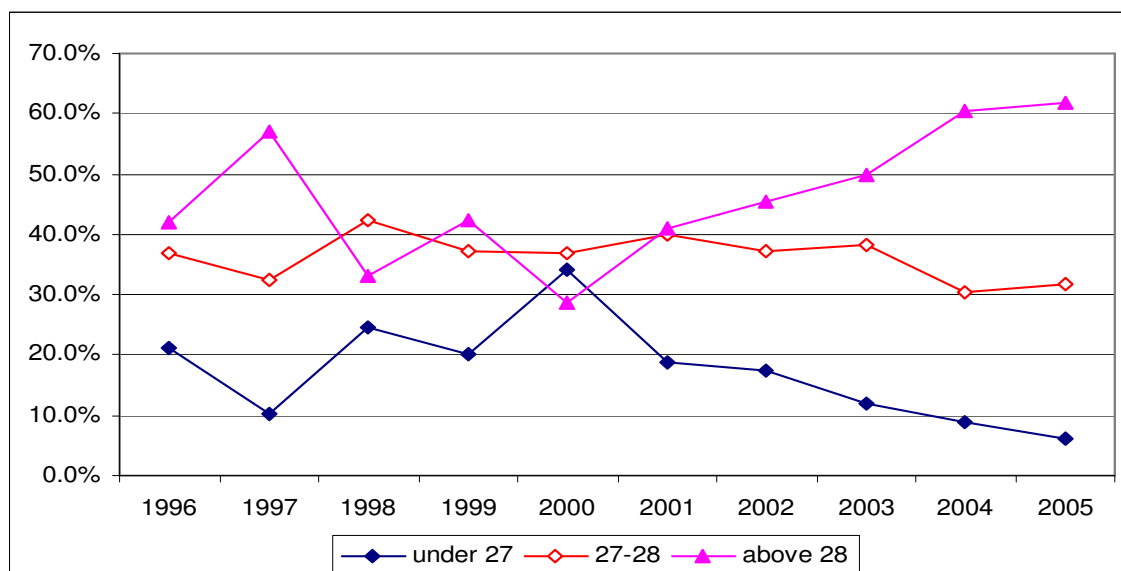
The base strength changed within the study period. The first base strength was 24-25 for crop year 1996 to 1999 and the base increased to strength 27-28 for crop year 2000 to 2005. Figure 3.14.a shows U.S. Cotton production by strength through the study period. The most common strength category produced, accounting for about 30 to 40 percent of production, was for the more recent base strength, 27-28, for all years within the study period. Although there are some annual fluctuations, Figure 3.14.b shows that production with less than current base strength (lower than 27) tended to increase from the beginning of the study period to crop year 2000, and then decreased gradually to its smallest percentage in crop year 2005. Production with greater than current base strength (stronger than 28) initially decreased and then increased through the study period.



**Figure 3.14.a. U.S. Cotton Production by Strength, 1996-2005**

Source: “Cotton Quality: Annual Report”, Agricultural Marketing Service, USDA.



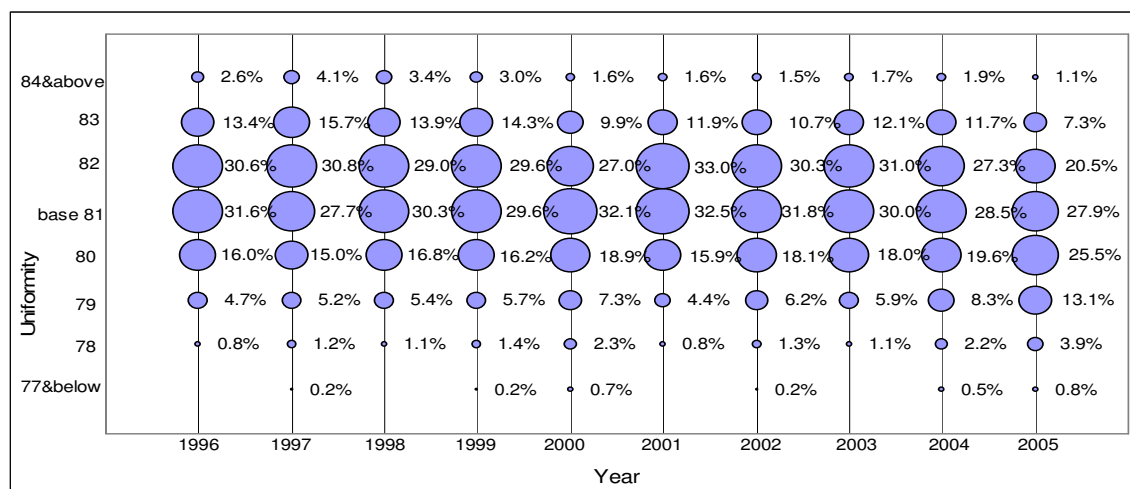


**Figure 3.14.b. U.S. Cotton Production by Strength Categories, 1996-2005**

Source: “Cotton Quality: Annual Report”, Agricultural Marketing Service, USDA.

### 3.4. Length Uniformity

Although reporting of premiums and discounts for length uniformity started for crop year 2000, annual cotton quality statistics has reported cotton production by uniformity for all crop years within the study period. Figure 3.15 shows U.S. cotton production by length uniformity through the study period. Most cotton production was concentrated around the base--uniformity 80, 81 and 82 which account for about 70 percent of U.S. production annually. Production with higher uniformity (higher than 82) accounted for 10 to 20 percent of U.S. production with a minor decreasing trend through the study period. Production with lower uniformity (lower than 80) ranged from 5 to 17 percent of U.S. production, with a minor increasing trend through the study period. Overall, the distribution of production by uniformity showed a slight decreasing trend.



**Figure 3.15. U.S. Cotton Production by Length Uniformity, 1996-2005**

Source: “Cotton Quality: Annual Report”, Agricultural Marketing Service, USDA.

#### 4. Relationship between Premiums (Discounts) and Production

Premiums and discounts for various quality characteristic combinations reflect the supply and demand for cotton with those characteristics. Annual variations in production of cotton with any specific set of qualities, due to weather, pests, or disease, may have short-term impacts on premiums and discounts, but it is often possible to observe either stability or trends in premiums or discounts over time despite these variations.

Stability of premiums and discounts over time indicates a general balance in supply and demand - where prices of higher quality cotton reflect a willingness of the market to pay more for superior characteristics, but where the quantity demanded of that cotton stays generally in line with the supply of that cotton.

Trends in premiums and discounts are evidence of market pressure to produce more or less cotton with certain quality characteristics. Increasing premiums for certain characteristics indicate that demand for cotton with those characteristics is high relative to its supply, and that the price of that cotton is thus being bid up – relative to the price of base quality cotton.

Premiums would be expected to eventually stabilize at some level, however, because final demand limits how high prices will go even if there is no supply response. To the extent that there is a supply response to increase production of cotton with characteristics experiencing rising premiums, the premium may stabilize at less than its maximum level as new supply and demand levels come into a general balance.

Although it is difficult for cotton producers to control production and produce desired quality characteristics in any given year, over time they may be able to respond to the market's demand for quality as expressed through premiums and discounts. Researchers may respond to increasing premiums for a characteristic by developing new varieties more likely to produce that characteristic or by studying the linkages between various production practices and the desired characteristic. Producers may respond by adopting varieties and production practices that, on average, produce more cotton with the desired characteristics - if production costs and possible changes in yields do not offset gains from the premiums.

Production responses to premiums and discounts should be most likely for characteristics with relatively large discounts or premiums, and for characteristics with significant trends in premiums or discounts. In examining premium and discount data for different quality characteristics for the period 1996-2005, it was shown the discounts or premiums for many cotton quality characteristics have been relatively small.

If attention is focused only on quality levels which are normally produced in significant quantities, many premiums and discounts are less than one cent per pound. Premiums for mike have been under 0.5 cents per pound for the entire data period and discounts for mike have been under 0.5 cents per pound for over 98 percent of cotton produced in each of the ten years in the data period. Strength premiums rose above 0.5 cents per pound for the two highest categories in

2000 and 2001, but production in these categories has been relatively high in recent years and the premium has fallen below 0.5 cents. Discounts for strength grades 24 and 25 have increased since 2000, from about 1.0 cents per pound to 1.2 to 1.5 cents, and production of these grades has fallen to between 1.7 and 3.7 percent of the crop in the most recent three years. Uniformity premiums have been stable and under 0.6 cents per pound for the 6 years (2000-2005) this premium has been reported. Uniformity discounts have been steadily increasing over these six years, but they are still relatively small, ranging from about 0.6 to 0.8 cents per pound in 2005.

The largest premiums for cotton quality were for combinations of high qualities of color, staple, and leaf. These high value combinations also had the strongest trends with premiums that increased steadily throughout most of the data period. The high quality combination premiums appear to have leveled out from 2004 to 2005, but it is not known whether they will stabilize at this level.

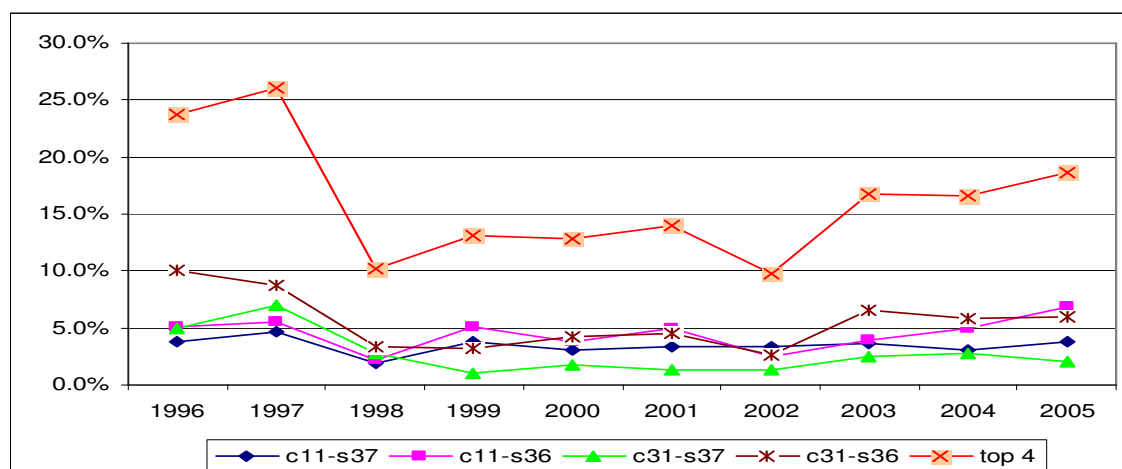
Premiums are expressed relative to the “base” qualities for each characteristic. For color-leaf-staple the base quality values are color 41, leaf 4, and staple 34. The highest premiums were approximately 7.0 cents per pound in 2005 for color 11&21, leaf 3, and staple 37. The premium for this quality bundle was about 2.0 cents per pound in 1996-1997.

Premiums associated with each individual color, leaf, and staple characteristic depend on the quality of all three characteristics combined. Figures 3.1 through 3.5 provide extensive detail on levels and trends for premiums associated with several quality combinations. Generally, colors 11&21 and 31 have had 3 to 4 cent premiums over color 41 in recent years. Staples 37 and 36 have had a 2 to 4 cent premium over staple 34 in recent years, and leaf 3 has had a premium of about 2.5 cents per pound over leaf 4 when combined with good color and longer staples. All

premiums for these individual characteristics are at their highest when combined with the best grades for the other characteristics.

Production of the highest premium colors, 11&21 and 31 has been erratic over the data period with large year to year changes. As a percentage of production these categories counted for as little as 30 percent of production and as much as 68 percent of production with no clear trend. Production of longer staple cotton (35-37) has trended generally upward from 1998 to 2005, increasing from about 40 percent of production to 50 percent. Leaf 3 production dropped to about 40 percent of the crop in 1998-1999, but has been over 50 percent in each year, except 2002, since that time.

Figure 3.16 shows that the production percentage of the 4 highest color-staple combinations has shown the upward trend since 1998, increasing from about 10 percent of production to almost 20 percent.



**Figure 3.16. Production of High Premium Color-Staple Combinations, 1996-2005**

Source: “Cotton Quality: Annual Report”, Agricultural Marketing Service, USDA.

## **CHAPTER 4**

### **COTTON BASIS: REGIONAL DIFFERENCES AND SEASONAL PATTERNS**

#### **1. Related Literature**

The basis, usually defined as the cash price minus the future price, is crucial for making marketing decisions and for risk management strategies. “The basis is said to strengthen when the spot price rises relative to the futures price, say, when the basis moves from 320 under to 290 under. The basis weakens when the spot price falls relative to the futures” (Seamon, Kahl, and Curtis, 1997: 1). Research has been done for examining the basis of a commodity which is concentrated on one location (e.g., McKenzie, 2005; Bailey, 1984). Some recent research has expanded to the prices in multiple locations (e.g., Brennam, Williams, and Wright, 1997).

Cotton future contracts are traded at the New York Board of Exchange. Elam (2000) found that the cotton futures market tended to revert to a long-run average price. This study suggested that cotton producers could base hedging decisions on whether or not the current futures price is above or below the long-run average. Similarly, Johnson, and Bennett (2000) found that cotton producers can use moving averages to identify changing cotton futures market trends and select entry and exit points for hedges. Bailey, Brorsen, and Richardson (1984) used time series analysis and an AR model to describe the stochastic processes of the cotton cash price and futures price.

Although basis is defined as the cash price minus the futures price, we must realize that basis is not a single number. It's just the difference between two prices and will be less well-behaved than either the cash price or the futures price (Peterson, Cook, and Piszczor, 2004).

For calculating the basis, we should recognize that the cash price series may not always be available. Even when cash prices are available, Peterson, Cook, and Piszczor (2004) suggested that the accuracy of the cash price should receive more attention. "How much volume and how many individual transactions went into the cash price? Does it represent a valid "test" of the market, or is it just a nominal quote? What type of price is that cash price: a single transaction, a midpoint of the range, a simple average, a weighted average, or something else? The answers to these questions can have a big impact on the basis values that are calculated and conclusions that are drawn from them"( Peterson, Cook, and Piszczor, 2004: 1).

Basis behavior is the major determinant of hedging success or failure (Peterson, Cook, and Piszczor, 2004). Naik and Leuthold (1988) have proposed a general theory, utilizing a mean-variance framework of expected utility theory, of intertemporal price relationships for storable commodities. The basis is found to consist of basis risk premium, adjusted speculation, and expected maturity basis apart from cost of storage, opportunity cost, and convenience yield (Naik and Leuthold, 1991).

Accurately forecasting the basis is crucial to risk management strategies adopted by the participants in the market. Tonsor, Mintert, and Dhuyvetter (2003) evaluated the time-to-expiration approach to forecast the feeder cattle, live cattle, and hog basis. "The use of a time-to-expiration method of calculating the historical average basis results in very little improvement in basis prediction accuracy compared to the calendar approach"( Tonsor, Mintert, and Dhuyvetter,

2003: 2). Similarly, Zhang and Houston (2005) constructed a model for the soybean basis and the results showed that higher futures volatility would lead to a lower basis. Tilley and Campbell (1988) hypothesized the hard-red winter wheat basis to be related to export commitments and free stocks, grain embargoes, liquidity, and contract month. The results revealed that the Gulf-Kansas City HW wheat basis is reflecting fundamental changes in the market.

Some research has been done about how to improve the accuracy of forecasting cotton basis. Chen and Bessler (2000) attempted to improve forecasting accuracy of cotton basis by combining the structural and time series approaches. Although this attempt failed to show improvement in forecasting accuracy, “the simulation results demonstrate that the superior performance of the structural model in handling major policy changes, while the time series approach shows greater accuracy in forecasting normal price movement” (Chen and Bessler, 2000: 103).

Varangis, Thigpen and Akiyama (1993) found that the New York futures market does not provide an appropriate mechanism for hedging the price risk in Egyptian cotton because of the high basis risk. Based on a portfolio selection problem in which the hedger selects the optimal proportions of unhedged and hedged output to minimize risk, Varangis et al. (1993) suggested that despite the existence of relatively high basis risk (that is, a relatively low correlation between spot and future prices), hedging reduces cotton price volatility by 30 to 70 percent for Francophone African countries.

Seamon, Kahl, and Curtis (1997) found that the seasonal patterns of average cotton basis is weakest around harvest and strengthens during the remainder of the crop year for the period when domestic mills use was the dominant market for U.S. cotton. They attributed this seasonal pattern to “harvest uncertainty early in the crop year, a good knowledge of supplies in the middle



of the crop year, and uncertainty about the new crop late in the crop year” (Seamon, Kahl, and Curtis, 1997: 4). They also reported that the basis showed more variation from year to year for regions dependent on exports. “Thus, the usefulness of the average historical basis in predicting the future basis appears to differ depending on the region”(Seamon, Kahl, and Curtis, 1997: 1).

Seamon and Kahl (2000) explored the factors which affect the cotton basis for five major cotton production regions and found the basis in different regions is affected by different factors.

Using the nonparametric Friedman test, Seamon, Kahl, and Curtis (2001) examined whether the cotton basis differs across regions over the crop year. The basis for a storable commodity produced once a year should differ by location because of transportation costs. The results indicated that the cotton basis can be expected “to be strongest in eastern and western markets (home to domestic textile mills and major cotton export activity, respectively), and to weaken with distance to these two markets” (Seamon, Kahl, and Curtis, 2001:159).

## 2. Average Monthly Cotton Basis

### 2.1. Calculating Basis

USDA AMS reports the daily and monthly cotton cash price for seven regions:

- Southeast: Alabama, Florida, Georgia, North Carolina, South Carolina, Virginia.
- North Delta: Arkansas, Tennessee, Missouri.
- South Delta: Louisiana, Mississippi.
- East Texas-Oklahoma: East Texas, Oklahoma.
- West Texas: West Texas except El Paso area.
- Desert Southwest: Arizona, New Mexico and far West Texas.
- San Joaquin Valley: San Joaquin valley of California.

The monthly cotton basis for each region is calculated as the monthly average cash price minus the monthly average futures price. The regional daily cash price is the quantity weighted average price in a region for each day. The monthly cash price is the simple average of the daily cash prices for that month. The monthly future price used here is the average settlement price of the July contract traded at the New York Board of Exchange. Although the nearby future contract is often used for calculating the basis, the July contract can be used to more clearly reflect the seasonal/regional patterns (Seamon et al., 2001). Seamon, Kahl and Curtis (2001) analyzed regional differences and seasonal patterns for the July contract basis for the period August 1988 through July 1998-a period when the domestic market was the dominant market for U.S. cotton producers. In order to analyze possible basis impacts from an export oriented market, we repeated the Seamon et al. analysis for a more recent period. For our updated analysis the basis is calculated for each region and month from August 2000 to July 2006. Given that the crop year is defined as August 1 through July 31 by USDA, the basis is calculated for each region for each month of six recent complete crop years.

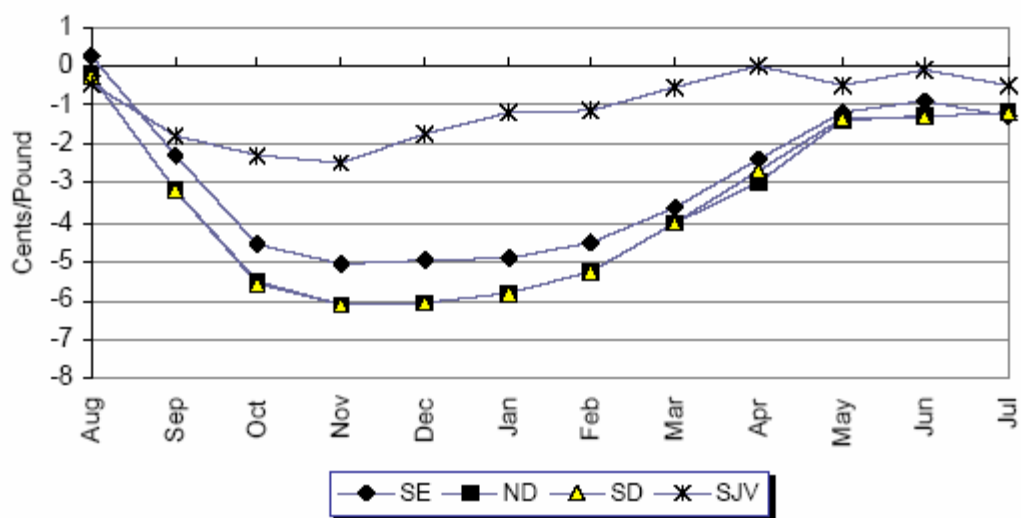
## 2.2. Historical Cotton Basis

Basis is the difference between the local cash price and the futures price, usually defined as the local cash price minus the futures price. Regional differences in the basis are expected to reflect differences in transportation costs. Thus, the basis should be weaker (larger difference between cash and futures price) the farther a commodity is from major consumption markets. For a seasonally produced storable commodity with stable demand, the cash price and the futures price will converge as the futures contract nears maturity. Cotton is a seasonally produced storable commodity and is thus expected to have some regional differences and seasonal patterns

in the basis. Seamon, Kahl and Curtis (2001) indicated that the Southeast, San Joaquin Valley, North Delta and South Delta had a stronger basis than other regions during their study period from August 1988 to July 1998, due to the proximity to the domestic mills or western export ports (see Figure 4.1 and Figure 4.2). In this period, domestic consumption was the leading use of the U.S. cotton supply with more than 70 percent of U.S. cotton going to domestic mills annually. Since they incurred higher costs to transport cotton to eastern domestic mills or western export ports, the East Texas-Oklahoma, West Texas and Desert Southwest had a weaker basis.

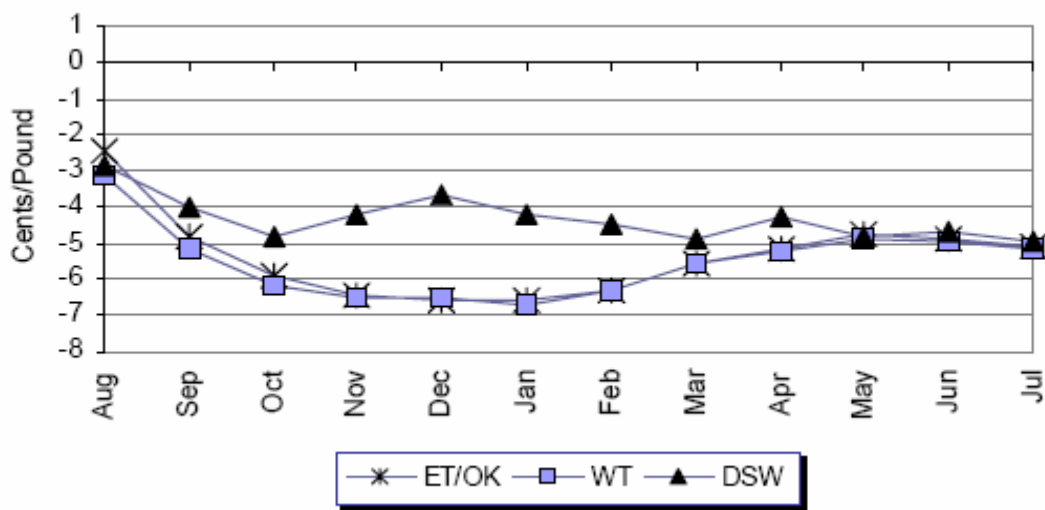
Seamon, Kahl and Curtis (2001) suggested that the cotton basis calculated using the futures contract expiring in July has a theoretical seasonal pattern which weakens from July until harvest and then strengthens. At harvest time, the opportunity and physical cost of storage are large since there are many months for storage. The convenience yield is small due to the large stocks. Based on the theory of storage, the basis is at the lowest level at harvest time. Afterwards, as the crop year progresses, the basis will strengthen when convenience yield increases and the opportunity and physical storage costs decrease, thus the basis becomes strongest right before significant quantities of the new crop are harvested.

However, the theoretical seasonal basis pattern relies on the assumption of stable demand. Seamon, Kahl and Curtis (2001) noticed that the cotton basis of the Southeast, North Delta and South Delta were consistent with the theoretical seasonal pattern. Within the study period from August 1988 to July 1998, most cotton from these regions went directly to the domestic mills which had relative stable demand. The regions more dependent on the export markets, such as San Joaquin Valley and Desert Southwest, had less apparent seasonal patterns.



**Figure 4.1. Average Monthly Cotton Basis for SE, ND, SD, and SJV, 1988-1998**

Source: “Regional and Seasonal Difference in the Cotton Basis”, Seamon et al. (2001), Journal of Agribusiness.



**Figure 4.2. Average Monthly Cotton Basis for ET/OK, WT and DSW, 1988-1998**

Source: “Regional and Seasonal Difference in the Cotton Basis”, Seamon et al. (2001), Journal of Agribusiness.

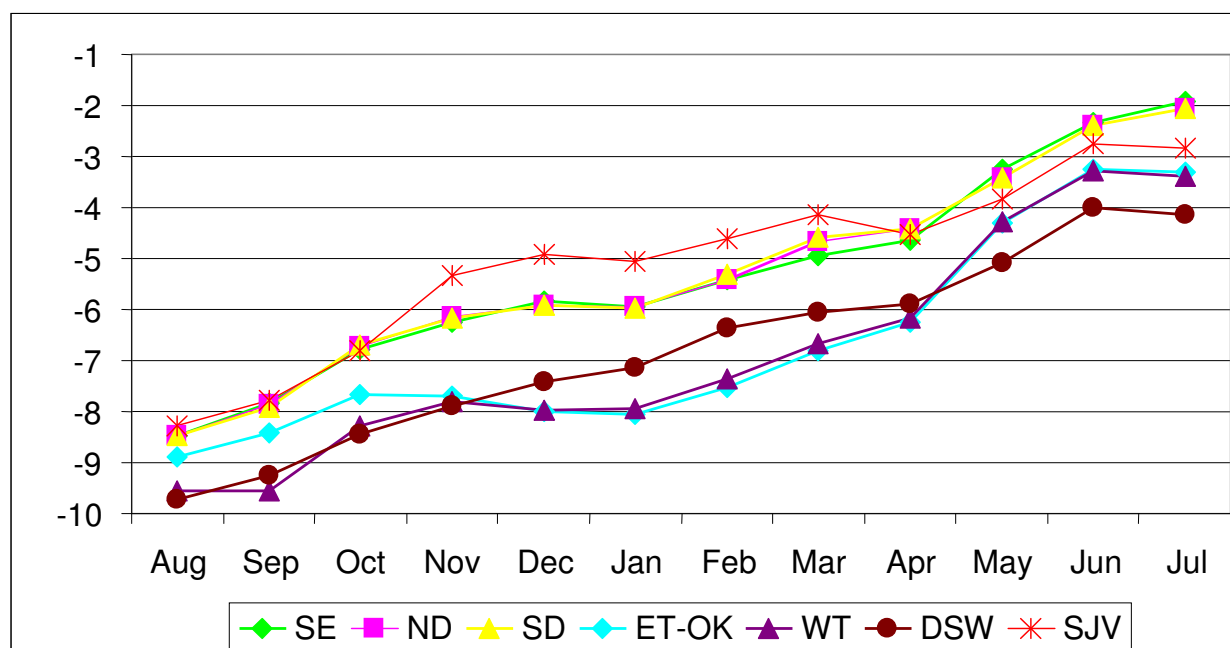
## 2.3. Cotton Basis of Current Study Period

### 2.3.1. Average Monthly Cotton Basis

The average monthly cotton basis for the seven regions from August 2000 to July 2006 is shown in Figure 4.3. The monthly cotton basis in the Southeast, North Delta, South Delta and San Joaquin Valley are stronger than the basis in the other regions—East Texas-Oklahoma, West Texas and Desert Southwest. This regional difference is similar to what Seamon et al. (2001) found in their research for the period August 1988 to July 1998. Although domestic consumption fell dramatically since the late 1990's, the proximity to the domestic mills and eastern ports helped the Southeast and Delta regions keep a stronger basis. Furthermore, as the export market became more important and, more and more cotton exports are traded through the western ports, the monthly cotton basis of San Joaquin Valley continue to be strong. The monthly cotton basis for East Texas-Oklahoma, West Texas and Desert Southwest are still weakest of the seven regions since transportation costs to eastern/western ports for export or eastern domestic mills for domestic consumption continue to disadvantage these regions.

The seasonal pattern of this period, August 2000 to July 2006, tends to be different from the seasonal pattern indicated by Seamon et al. (2001) for the study period from August 1988 to July 1998. The theoretically expected seasonal pattern is to be weakest at harvest time and then strengthen as the crop year progresses to reach the strongest in August. Depending on the assumption of stable demand, this theoretical seasonal pattern applied well for those regions which mostly supplied domestic mills, but not for the regions which were mostly dependent on the export market. Due to the dependence on the export market and the variability of export market demand, the theoretical seasonal pattern doesn't hold for any of the seven regions any longer, even for the Southeast and the Delta regions. As Figure 4.3 shows, the basis starts from

the weakest at August, the beginning of the crop year, then strengthens as the crop year progresses to approach the strongest at the end of the crop year, June or July. Although there are differences for the basis across regions, the seasonal patterns for each region are similar.



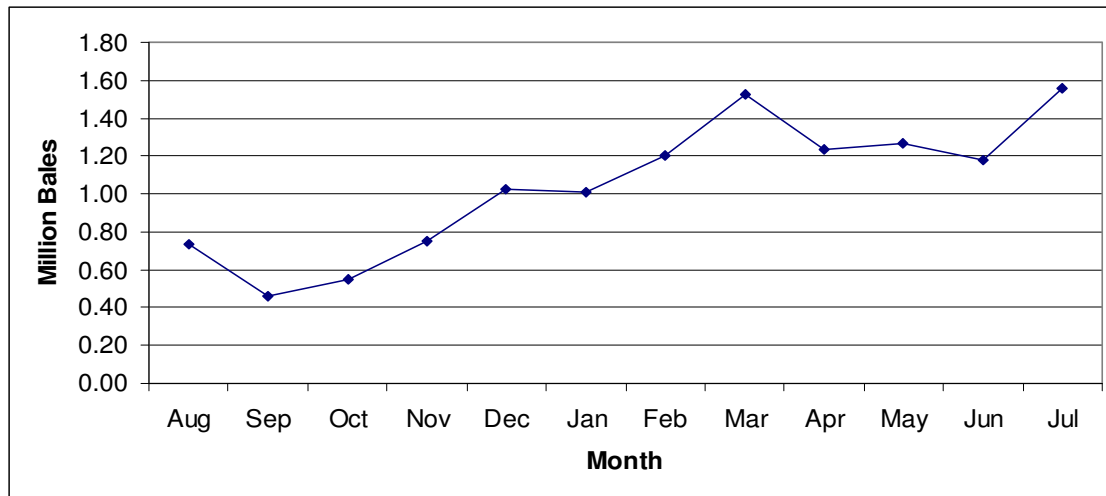
**Figure 4.3 Average Monthly Cotton Basis for Seven Regions, 2000-2006**

Source: “Cotton Price Statistics: Monthly Report”, Agricultural Marketing Service, USDA.  
 “Cotton Contract: Daily Cotton Statistics”, Historical Data Files, New York Board of Trade.

### 2.3.2. Export Patterns

While domestic consumption, mostly concentrated in Southeast region, is generally stable through the crop year (USCENSUS), the change in the seasonal pattern of the basis may be due to the stronger demand for the exports. As approximately 70 percent of U.S. cotton is exported now, the cash price and basis for each region are mostly affected by the demand of the export market. Although export demand is not stable through the crop year, the average monthly export

through these six crop years appears to have a seasonal pattern, as figure 4.4 shows, which coincides with the seasonal basis pattern.



**Figure 4.4. Average Monthly Exports, 2000-2006**

Source: “U.S. Trade Exports - FAS Commodity Aggregations”, Foreign Agricultural Service, USDA.

Although the exports pattern can be used to explain the changes in the overall seasonal basis pattern, it’s hard to explain the large change of the basis in August. The basis in August was almost always the strongest within the crop year, indicated by the observed seasonal pattern of the period August 1988 to July 1998. But for the period August 2000 to July 2006, the basis in August becomes the weakest within the crop year. This change may be partly due to bigger U.S. cotton stocks than before, which can relieve the shortage of the cotton supply in August, decreasing the cash price and basis in August.

### 3. Friedman Test

The Friedman test is a non-parametric statistical test developed by the U.S. economist Milton Friedman (Daniel, W.W., 1990). Similar to the parametric repeated measures ANOVA, it

is used to detect whether the observations differ by treatment after the effect of the blocks has been removed. The Hypothesis of Friedman Test is:

H<sub>0</sub>: The populations within a block are identical

H<sub>1</sub>: At least one treatment is different from at least one other treatment

The first step is to assign ranks to the original observations. The observations within each block are ranked separately from smallest to largest. Each block contains a separate set of ranks. When H<sub>0</sub> is true, either small or large ranks should be randomly distributed over the columns in each block. If H<sub>0</sub> is false, either small or large ranks should tend to show a preference for a particular column.

The second step is to obtain the sums of the ranks in each column. When H<sub>0</sub> is true, the sums of ranks are expected to be fairly close in size, so close that we can attribute the differences to chance. If H<sub>0</sub> is false, at least one sum is expected to be different in size from at least one other sum, so we cannot attribute the difference to chance alone.

The formula for the Friedman test statistic is as the following (Daniel, W.W., 1990):

$$X_r^2 = \frac{12}{bk(k+1)} \sum_{j=1}^k R_j^2 - 3b(k+1)$$

where b is the number of blocks, k is the number of the treatments and  $R_j$  is the rank sum of the treatment  $j$ .

When ties occur, the tied observations are given the mean of the rank positions for which they are tied. The test statistic is adjusted by dividing it by

$$1 - \sum_{i=1}^b \frac{\sum t_i^3 - \sum t_i}{bk(k^2 - 1)}$$

where  $t_i$  is the number of observations tied for a given rank in the  $i$ th block (Daniel, W.W., 1990).



#### 4. Regional Differences

Seamon, Kahl and Curtis (2001) applied the nonparametric Friedman test to the cotton basis for two reasons: First, the Friedman test doesn't require the observations to be independent. The cotton basis observations are not independent since the cash price is determined simultaneously and the same future price is used to calculate the basis for any month within the crop year. Second, the Friedman test doesn't require that observations are from the normal distribution. Gujarati (1995) has indicated that the cotton basis observations are not drawn from a normal distribution.

Each region designated as a treatment and each month of each crop year is the block. Since the cotton basis for seven regions and recent 6 crop years is used in this research, there are 7 treatments and 72 blocks included in this analysis. Each observation,  $B_{ij}$  with  $i=1,2,\dots,72$  and  $j=1,2,\dots,7$  represents the monthly basis of the month  $i$  and in region  $j$ . The seven observations within each block are ranked from smallest to largest with 1 assigned to the smallest and 7 assigned to the largest observation. When there are ties within each block, each observation receives the average rank they would have received. The rank sums for each treatment (region) are recorded in the second column of the Table 4.1.

The cotton basis in at least one region is significantly different from any other region if there are significant differences in the rank sums for each region. The calculated Friedman statistic is 187.5266. Compared with tabulated  $\chi^2$  value with  $k-1$  degrees of freedom, the null hypothesis is rejected at 99 percent confidence level which implies that cotton basis in at least one region is different from any other regions.

After a significant difference is observed by using the Friedman test, multiple-comparison analysis is applicable to determine the regions in which the cotton basis differs. The  $q$  value is defined as (Zar, J. H., 1984):

$$q = \frac{R_j - R_{j+1}}{\sqrt{\frac{bk(k+1)}{12}}}$$

where the  $R_j - R_{j+1}$  is the difference of the rank sum of any two regions. The third column of the Table 4.1 shows the results of the multiple-comparison. The regions found to have significantly different basis at 95 percent confidence level are identified by different alphabetical letters. For the study period from August 2000 to July 2006, there is no significant difference in the basis found for the following regions: A) North Delta, South Delta, Southeast and San Joaquin Valley; B) East Texas-Oklahoma, West Texas and Desert Southwest.

The result of the multiple-comparison coincides with the graph in the Figure 4.1 which shows that the basis of Southeast, San Joaquin Valley, North Delta and South Delta are similar and stronger within the seven regions through the crop year. Starting from the same level from the beginning of the crop year, the basis of Southeast and San Joaquin Valley are slightly stronger than the basis of the Delta regions for several months. Then the basis of the Delta regions becomes stronger latter in the crop year. So the basis is not significantly different across these four regions. The basis for East Texas-Oklahoma, West Texas and Desert Southwest is generally weaker than that in the other four regions. While the basis of the East Texas-Oklahoma is stronger than the other two regions early in the crop year, the basis of Desert Southwest becomes stronger in the following several months and then becomes weaker latter in the crop year. Overall, there is no significant difference among the basis for these three regions.

This result is different from what Seamon, Kahl and Curtis (2001) found for their study period. They indicated that there was no significant difference in the basis for the following regions: A) Southeast and San Joaquin Valley; B) North Delta, South Delta, and Desert Southwest; C) East Texas-Oklahoma and West Texas. The basis of Delta regions is no longer significantly different from the basis in the Southeast and San Joaquin Valley. The Southeast and San Joaquin Valley bases, relative to the other regional bases, appear to have weakened from the earlier to the latter study periods, while the Delta region's bases have not weakened as much. Seamon, Kahl and Curtis (2001) attributed the strong San Joaquin basis during the November through March period to increased export demand during those months. The relative weakening of the San Joaquin Valley basis may be due to the end of this seasonal pattern in export demand and to the increased participation of all regions in the export market.

**Table 4.1. Statistical Results of the Friedman Test for the Regional Differences in Monthly Cotton Basis for Seven Regions, August 2000—July 2006.**

Region	Rank Sum	<i>Q Grouping</i>
North Delta	372	A
South Delta	370	A
Southeast	368	A
San Joaquin Valley	367	A
East Texas-Oklahoma	197	B
West Texas	174	B
Desert Southwest	170	B

## 5. Seasonal Patterns

To determine if the monthly cotton basis has significant seasonal pattern, the Friedman test is used again. Recall the Friedman test is to test whether there are observations differ by treatments, the null hypothesis is that there is no significant difference of the monthly basis through the whole crop year now. The basis data is organized by each region for the seasonal Friedman test. For a given region, 6 crop years are the blocks and 12 months of the crop year are the treatments. Each observation,  $B_{ij}$  with  $i=1,2,\dots,6$  and  $j=1,2,\dots,12$  represents the monthly basis of the crop year  $i$  and in month  $j$ . The twelve observations within each block are ranked from smallest to largest with 1 assigned to the smallest and 12 assigned to the largest observation. After getting the rank sums, the Friedman test statistic is calculated using the previously stated formulas. The second column of the Table 4.2 presents the seasonal Friedman statistic for each region. After comparing the Friedman statistic for each region with the tabulated  $\chi^2$  values with  $k-1$  degrees of freedom, the null hypothesis is rejected at 99 percent confidence level, implying that the monthly cotton basis is found to be different in at least one month for all of these seven regions. The results of seasonal Friedman test coincide with the graph in the Figure 4.1. Figure 4.1 shows that the monthly cotton basis of all seven regions follows a stable increasing pattern throughout the crop year, which indicates that the monthly basis is likely to be different early in the crop year than it is late in the crop year.

**Table 4.2. Statistical Results of the Friedman Test for the Seasonal Differences in Monthly Cotton Basis for Seven Regions, August 2000—July 2006.**

Region	Seasonal Friedman Statistic
North Delta	52.3846
South Delta	52.7102
Southeast	56.5627
San Joaquin Valley	37.6410
East Texas-Oklahoma	36.3609
West Texas	38.7631
Desert Southwest	43.9744

Since significant differences within the crop year for all seven regions are observed by using the Friedman test, multiple-comparison analysis is applied for each region to determine the months in which the cotton basis differ. Again, the formula for the q value is used here to calculate the test statistic for each region. The months found to have significantly different basis at 95 percent confidence level are identified by different letters. Table 4.3 reports the rank sums and the results of monthly differences in the basis for Southeast and San Joaquin Valley as examples of the seasonal results.

**Table 4.3. Statistical Results of the Friedman Test for the Seasonal Patterns in Monthly Cotton Basis for Seven Regions, August 2000—July 2006.**

SOUTHEAST				SAN JOAQUIN VALLEY			
Month	Rank Sum	Q Grouping		Month	Rank Sum	Q Grouping	
June	68	A		June	63	A	
July	66	A		July	52	A	
May	60	A		May	50	A	
April	48	A	B	February	50	A	
March	45	A	B	March	49	A	B
February	41	A	B	December	43	A	B
December	34	A	B	November	42	A	B
November	30	A	B	January	37	A	B
January	29	A	B	April	36	A	B
October	26		B	October	24	A	B
September	14		B	September	14		B
August	8		B	August	8		B

The results for San Joaquin Valley indicate that the monthly basis in June, July, May and February is stronger than the monthly basis in September and August at the 95 percent confidence level. Increased export demand from the early to the late crop year increases cash prices relative to the future prices in all seven regions. Thus the monthly cotton basis is stronger late in the crop year.

Compared to other regions, the Southeast and Delta regions have had historical advantageous proximity to the domestic mills which were mostly located in the Southeast region.

So the monthly cotton basis of these regions was previously more consistent with the theoretical seasonal pattern, indicated by Seamon, Kahl and Curtis (2001), with the weakest basis at the harvest time and the strongest in August. With the steady fall of domestic mills use from the late 1990's, however, the cotton from these regions became more dependent on the export market. The results for the Southeast indicate that the monthly basis in June, July and May is stronger than the monthly basis in October, September and August at the 95 percent confidence level. The theoretical seasonal basis pattern doesn't hold for Southeast any longer. The multiple-comparison analysis for the other five regions indicates a similar pattern as the two mentioned above. The monthly cotton basis for all seven regions follows the same pattern: weaker at the beginning of the crop year and stronger as the crop year progresses.

## **CHAPTER 5**

### **SUMMARY AND CONCLUSION**

The U.S. is a major cotton producer, accounting for 20 percent of world production annually. As textile manufacturing moved out of the U.S., domestic mill consumption has experienced a dramatic decrease since the late 1990's. The steady fall of domestic cotton consumption has been accompanied by a steady increase in U.S. cotton exports, as foreign textile production has increased. As approximately 70 percent of U.S. cotton production is now exported, the United States is the world's leading exporter, accounting for over one-third of global trade in raw cotton. Now U.S. cotton confronts competition from other cotton exporters in the global market.

This study examined two types of cotton price relationships which may have been impacted by the recent changes in the market for U.S. cotton. Specifically, the objectives of this study were to examine the effects of cotton quality characteristics on prices and production and the effects of market changes on the monthly cotton basis.

#### **1. Study Summary**

First, we discussed cotton quality classifications and the major quality characteristics which affect the prices that producers received. We also discussed the Agricultural Marketing Service, USDA annual cotton price statistics and cotton quality statistics which are used in this study.



Annual cotton price statistics for the past ten crop years (1996 – 2005) were examined for the premiums and discounts associated with each quality characteristics. Color, leaf, and staple premiums are interdependent and discussed together. In general, high premiums are more apparent for combination of higher quality characteristics. The discounts for poorer mike became smaller in the study period while the premiums for better mike were stable. The discounts for poorer strength increased at the beginning of the study period and then became stable as did premiums for high strength. Discounts for lower uniformity became slightly larger, while the premiums for greater uniformity were generally stable. Premiums and discounts for mike, strength and uniformity, however, were small in terms of magnitude, usually less than 1 cent, while the largest premiums for superior color-staple-leaf combination were about 7 cents per pound.

The ten years' annual cotton production by quality characteristics were examined to reveal the potential relationship between the premiums (discounts) and production by each quality characteristics. We found that the most production response happened for the characteristics with relatively large discounts or premiums. The largest premiums for cotton quality were for combinations of high qualities of color, staple, and leaf. These high value combinations also had the strongest trends with premiums that increased steadily throughout most of the data period. The production percentage of the 4 highest color-staple combinations has also shown an upward trend since 1998, increasing from about 10 percent of production to almost 20 percent.

With respect to the cotton basis, we tested for the regional and seasonal differences in the basis and compared our results to those found in a previous study. Based on data availability, the

average monthly cotton basis was calculated for six recent crop years (crop year 2000-2006) for seven regions. Compared with the cotton basis results found by Seamon et al. (2001) for crop year 1988-1997, both regional differences and the seasonal patterns of the basis have changed since the earlier study period. The shift of the major U.S. cotton market from domestic mills to the export market is a possible reason for such changes.

Based on the results of Friedman test and multiple-comparison analysis, the cotton basis in at least one region is different from all other regions for the study period from August 2000 to July 2006. Additional tests revealed that the monthly cotton basis in the North Delta, South Delta, Southeast and San Joaquin Valley are stronger than the basis in the other regions—East Texas-Oklahoma, West Texas and Desert Southwest. There is no significant difference in the basis found for the following regions: A) North Delta, South Delta, Southeast and San Joaquin Valley; B) East Texas-Oklahoma, West Texas and Desert Southwest.

The seasonality of the monthly cotton basis is affected by the export market demand too. In the earlier study, the seasonal cotton basis patterns were weakest at harvest time (October and November) and strongest in August when the domestic mills use dominated. Coinciding with the monthly average cotton export pattern within the current study period, August 2000—July 2006, a similar seasonal cotton basis pattern exists for all regions: weaker at the beginning of the crop year in August and stronger as the crop year progresses.

## 2. Conclusions

The interdependence of color, staple, and leaf characteristics in determining cotton prices makes it difficult to discern the rewards and penalties associated with differences in each of these characteristics. In this study we attempted to clarify these relationships and identify trends and

magnitudes of price differentials and production of cotton with selected quality attributes. We found that cotton that combined the highest qualities of color, leaf, and staple not only had the highest price premiums, but had also experienced the largest upward trends in price premiums from 1996 to 2005. There also appears to have been a moderate supply response to increasing premiums for high quality cotton since 1999. The upward trends in high quality premiums and production both correspond to the period of decreased domestic mill use and increased cotton exports.

As the major consumption market shifted from domestic mills to the export market, the cotton cash price and basis are more affected by demand and supply in the world market. Regional differences and seasonal patterns in the monthly cotton basis of recent crop years (crop year 2000-2006) are different from what Seamon et al. (2001) found for the previous study period, August 1988 – July 1998.

Because of their proximity to the western or eastern ports, the Southeast, Delta, and San Joaquin Valley regions had a stronger basis than the East Texas-Oklahoma, West Texas and Desert Southwest regions for the period of August 2000 – July 2006. The basis in Delta regions was weaker than the basis in the Southeast and San Joaquin Valley for the previous study period, but there is no significant difference found for these four regions for the current study period.

The monthly cotton basis for all regions is now mostly affected by export market demand. The seasonal basis pattern coincides with the monthly average cotton export pattern during the more recent study period and a similar seasonal cotton basis pattern exists for all regions.

### 3. Limitation and Future Research

The limitations of this study are caused primarily by data problems. The AMS price statistics may include not only sales from current production but also some sales of cotton carried over from the previous crop year, so prices observed for any crop year are not solely dependent on production in that year.

Since the AMS price and quality statistics are the only publicly available cotton price and production information, we utilize them in our analysis. It should be noted that the accuracy of the AMS price data is not assured. The official cotton price reported by USDA, AMS is in form of the Daily Spot Cotton Quotations (DSCQ). The AMS market reporters conduct interviews with the market participants to collect the samples of market information. The reporters then arrive at a subjective determination of the market activity and the DSCQ are formulated (Brown et al. 1995). The lack of transparency and objectivity of the formulate procedure make it difficult to judge the accuracy of the AMS price data. Moreover, prices reported by AMS are mix of prices observed at different levels of the marketing chain. The final reported price for each region is quantity weighted average price within that region. Such an average price may not always be an accurate reflection of market information at any point.

In future study, comparing the farmer level price premiums and mill level price premiums may help to better understand the effectiveness of the marketing system in communicating the mill users' needs.

In this study, we were not able to bring possible impacts of final destination of U.S. cotton exports into the basis analysis. By looking at the final destinations of U.S. cotton, we could analyze their impacts on the monthly cotton basis. Additionally, the changes in inventory

patterns from the previous study period to the current study period could be examined to see how stocks may affect the monthly cotton basis.

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