Cotton Pricing Guide

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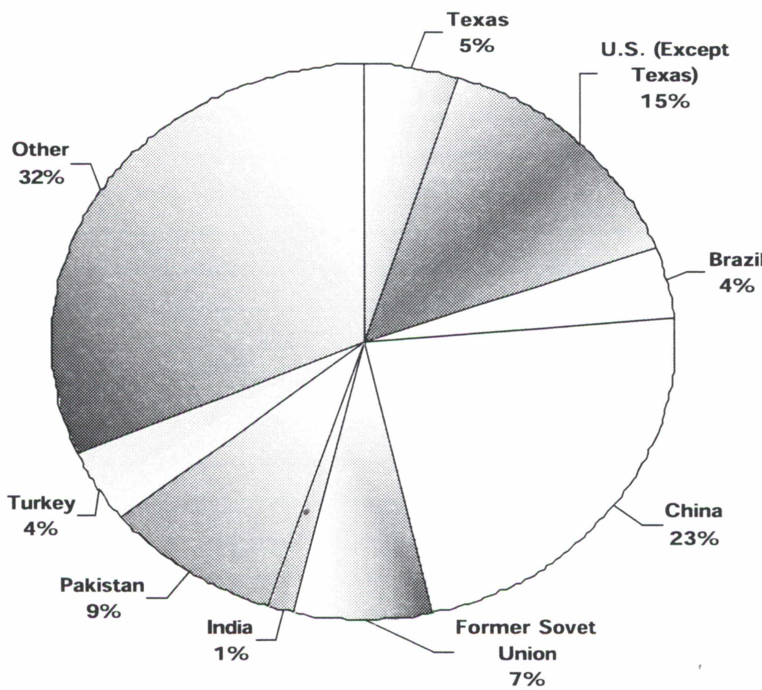

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INTRODUCTION

Every spring cotton producers face many marketing and production decisions. These decisions are influenced by the expected price of cotton at harvest. The purpose of this publication is to help producers make better pricing decisions. Historical data provide a benchmark against which to evaluate current acreage, production, use, stocks, and price. The forecasting model provides a method to estimate the upcoming season average price under various situations.

This publication is divided into five sections.

1. **Supply and Demand** explains how a supply and demand table is constructed.
2. **Forecasting Model** describes the price model and explains how to forecast United States season average price using the 2001/02 crop year as an example.
3. **Price Sensitivity Analysis** explains how to use historical information to predict what can happen to cotton prices under different scenarios.
4. **Season Average Price and Futures Price** explains the relationship among season average cash price, December futures, adjusted world price, and loan deficiency payments.
5. **Developing a Pricing Strategy** explains how the information in the three previous sections along with historical December futures prices can be used to develop a pricing strategy.

Supply and Demand

Table 1 shows the United States cotton supply and demand table for the past eleven years. It is divided into four sections: Supply, Demand, Ending Stocks, and Price. Table 1 will be used in the price-forecasting model, making it important for producers to understand each of the four sections.

Supply

Beginning stocks represent ending stocks from the previous crop year. The crop year for cotton starts August 1 and ends July 31 of the next year. For example, beginning stocks for the 1999/00 crop year are the ending stocks from the 1998/99 crop year.

Production is the bales of cotton produced during a crop year. Production depends on the number of acres planted, acres harvested, and the yield per harvested acre. Cotton planted in the spring will be harvested and marketed in the upcoming marketing year. For example, cotton planted in the spring of 1999 is harvested in the fall of 1999 and sold during the 1999/00 marketing year.

Imports represent raw cotton brought into the United States from other countries. Imports represent the smallest portion of **Total Supply**, which is the sum of beginning stocks, production, and imports.

Demand

Total demand is equal to the estimated uses for cotton in the next 12 months. Use is divided into two categories: mill use and exports. Figure 1 shows the use by category since 1980.

Mill Use is the largest component of demand. Mill use is the amount of cotton used by American mills to make clothing, fabric, yarn, carpet, and so forth. Mill use depends on cotton production, cost of cotton substitutes, textile imports, mill profitability, and general economic conditions.

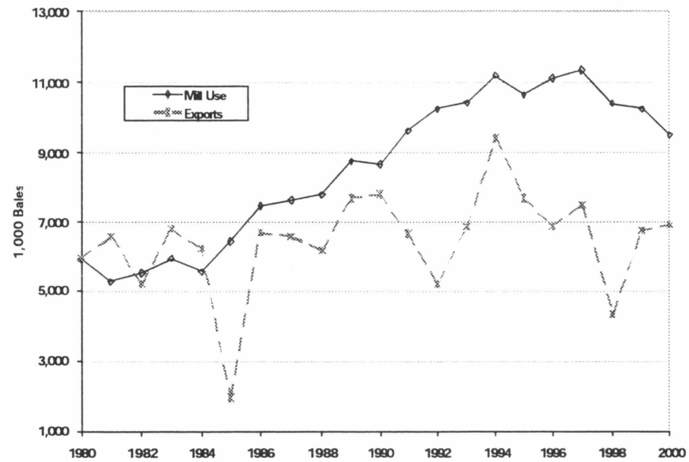
Table 1. United States Cotton Supply and Demand

Item	Units	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00**	00/01**
Planted	1,000 acres	12,348	14,052	13,240	13,438	13,720	16,931	14,653	13,898	13,393	14,870	15,540
Harvested	1,000 acres	11,732	12,960	11,123	12,783	13,322	16,007	12,888	13,406	10,684	13,420	13,100
Harvested/Planted	percent	95.0	92.2	84.0	95.0	97.1	94.5	88.0	96.5	79.8	90.2	87.3
Yield	lbs./harvested acre	634	652	700	606	708	537	705	673	625	607	631
Supply												
Beginning Stocks	1,000 bales*	3,000	2,344	3,704	4,662	3,530	2,650	2,609	3,971	3,887	3,940	3,920
Production	1,000 bales	15,505	17,614	16,218	16,134	19,662	17,900	18,942	18,793	13,918	16,970	17,220
Imports	1,000 bales	4	13	1	6	20	408	403	13	443	100	30
Total Supply	1,000 bales	18,509	19,971	19,923	20,802	23,212	20,958	21,954	22,777	18,248	21,000	21,170
Demand												
Mill Use	1,000 bales	8,657	9,613	10,250	10,418	11,198	10,647	11,126	11,349	10,401	10,240	9,500
Exports	1,000 bales	7,793	6,646	5,201	6,862	9,402	7,675	6,865	7,500	4,344	6,750	6,900
Total Demand	1,000 bales	16,450	16,259	15,451	17,280	20,600	18,322	17,991	18,849	14,745	16,990	16,400
Unaccounted	1,000 bales	285	(8)	190	8	38	(27)	8	(41)	436	90	(30)
Ending Stocks	1,000 bales	2,344	3,704	4,662	3,530	2,650	2,609	3,971	3,887	3,939	3,920	4,800
ES%	percent	14.2	22.8	30.2	20.4	12.9	14.2	22.1	20.6	26.7	23.1	29.3
Farm price	cents/lb	68.2	58.1	54.9	58.4	72.0	76.5	70.5	66.2	60.2	45.0	55.1

*Bale = 480 pounds
**Based on WASDE, March 8, 2001

Exports represent the amount of cotton exported to other countries. The quantity of cotton exported is increasingly reliant upon events around the world. The amount of cotton exported depends on exchange rates, cotton production in the other exporting countries, government production and trade policies in the United States and other countries, and worldwide demand for cotton.

Figure 1. Demand for Cotton, 1980-2000



Unaccounted

The **Unaccounted** component corrects for the small error that occurs because the USDA measures the supply of cotton differently than the Census Bureau determines its disappearance.

Ending Stocks

Ending Stocks represent the bales of cotton left at the end of the crop marketing year when total demand and unaccounted are subtracted from total supply.

If ending stocks increase relative to beginning stocks, supply has increased relative to demand and prices will tend to decrease. If ending stocks are lower than beginning stocks, supply has decreased relative to demand and prices will tend to increase. This relationship between ending stocks and season average price is like a see-saw: when ending stocks decrease, the price increases and vice versa.

Table 2. Ending Stocks versus ES%

Year	**1997-98**	**1998-99**
Demand	18,849	14,745
Ending Stocks	3,887	3,939
ES%	20.6	26.7
Price	66.2	60.2

Ending Stocks as a Percent of Use (ES%) is ending stocks divided by total demand times 100. For example, in 1999/00 ES% equals 23.1 percent (3,920/16,990*100). When ES% of total demand decreases, the season average price increases.

ES% gives a better indication of market strength and hence price than just ending stocks. As shown in Table 2, the crop years of 1997/98 and 1998/99 had relatively equal ending stocks (3,887 and 3,939 respectively). However, ES% varied by 6.1 points (20.6 and 26.7 respectively). The lower ES% in 1997/98 is due to the higher demand that year. Hence, prices were higher in 1997/98 than 1998/99.

Season Average Price

The **season average price** represents the United States average price per pound that producers receive for cotton during a crop year. If the ES% is large, supply is large relative to demand and season average price will decrease. In 1998/99, ES% was 26.7 and season average price was 60.2 cents per pound. If ending stocks are small, supply is small relative to demand and season average price will increase. In 1995/96, ES% was 14.2, and season average price was 76.5 cents per pound.

The relationship between ES% and price can be graphed to create an estimated price curve. ES% is on the horizontal axis, and season average cash price is on the vertical axis (Figure 2). The price curve was obtained statistically by analyzing the historical relationship between the natural logarithm (Ln) of ES% and season average price. The ES% curve explains 53 percent of the variation in season average price from year to year.

Figure 2. Price versus Ending Stock as Percent of Use (ES%)

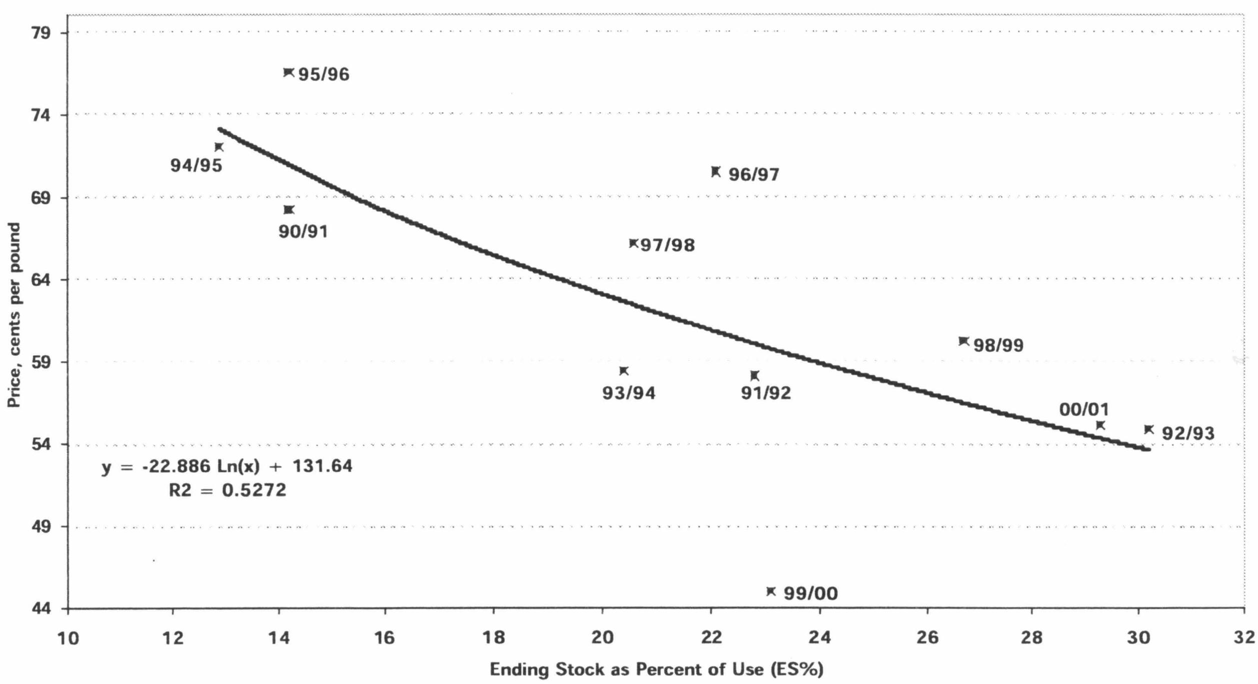
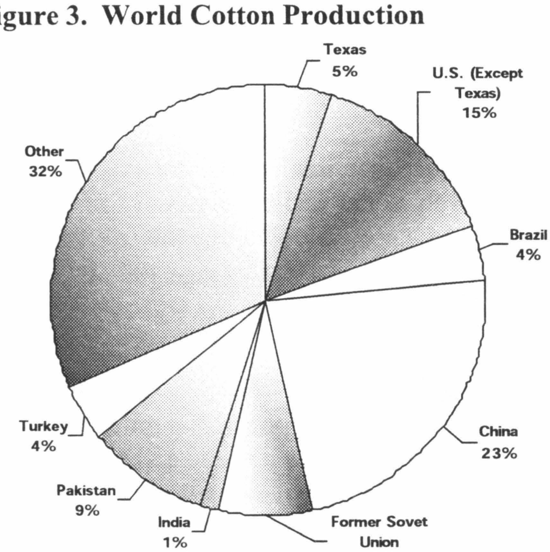


Figure 3. World Cotton Production



Actual prices deviate from the estimated price curve for several reasons. First, world stocks of cotton can have a significant effect on the price that United States producers receive. Second, the price of competing fibers like polyester, rayon, and wool can affect cotton prices. Third, government programs in the United States and other countries can affect price.

The biggest impact on United States cotton prices is the influence of the world market. The United States does not dominate world production nor the world market for cotton (Figure 3). While China produces the most cotton, it is not always an exporter. Price fluctuates depending on whether China is exporting or importing cotton.

Europe is the largest cotton importer in the world. The prices in Europe impact the United States price. The final forecasting model will incorporate these additional factors to increase the accuracy of the price equation.

FORECASTING MODEL

By following the steps in the next four sections, a producer can develop an estimate of supply, demand, and ending stocks as soon as an estimate of planted acres is available. The estimated ending stocks can be used to estimate the season average price, which can be used to help make planting decisions and to develop forward pricing strategies. Table 3 is used to demonstrate how the price forecasting model can be used in the winter of 2001 to estimate season average price for 2001/02.

Table 3. Estimated United States cotton supply, demand, stocks, and price

Item	Units	98/99	99/00*	00/01*	01/02
Supply					
Beginning Stocks	thou. bale	3,887	3,940	3,920	
Planted	thou. ac.	13,393	14,870	15,540	
Harvested	thou. ac.	10,684	13,420	13,100	
Yield	lb./ac	625	607	631	
Production	thou. bale	13,918	16,970	15,540	
Imports	thou. bale	443	100	30	
Total Supply	thou. bale	18,248	21,000	21,170	
Use					
Mill Use	thou. bale	10,401	10,240	9,500	
Exports	thou. bale	4,344	6,750	6,900	
Total Use	thou. bale	14,745	16,990	16,400	
Unaccounted	thou. bale	436	90	(30)	
Ending Stocks	thou. bale	3,939	3,920	4,800	
Stocks/Use	%	26.7	23.1	29.3	
Loan Rate	¢/lb.	51.9	51.9	51.9	
United States Season Average Price	¢/lb.	60.2	45.0	55.1	

*Based on WASDE, March 8, 2001

Supply

Beginning stocks is the first item to consider when estimating supply. An estimate can be obtained from the monthly USDA publication *World Agricultural Supply and Demand Estimates* (WASDE) at *http://usda. mannlib.cornell.edu/usda/.html*. Beginning stocks for the 2001/02 crop year are the ending stocks from the 2000/01 crop year. The estimated beginning stocks for 2001/02 in March 2001 were 4,800 thousand bales. In Table 3, 4,800 is entered in the box for 2001/02 beginning stocks.

The next supply item is production. Production depends on three items: planted acres, harvested acres, and yield per harvested acre.

Planted Acres

The number of acres a producer will plant is influenced by the profitability of cotton versus other crops and government programs. Before the 1996 Farm Bill, producers had to evaluate the benefits and costs of participating in a wide range of programs. Since 1996, producers are free to plant as many acres as they want based on the expected profitability of various crops.

Cotton is grown in all the southern states, but it is concentrated in Texas (Table 4), which accounts for 40 percent of the cotton acreage. Each the other states plants less than 10 percent of the total. As a result, the decisions made by Texas farmers have a dramatic impact on cotton production.

Table 4. Cotton Acres Planted, 1995 - 2000

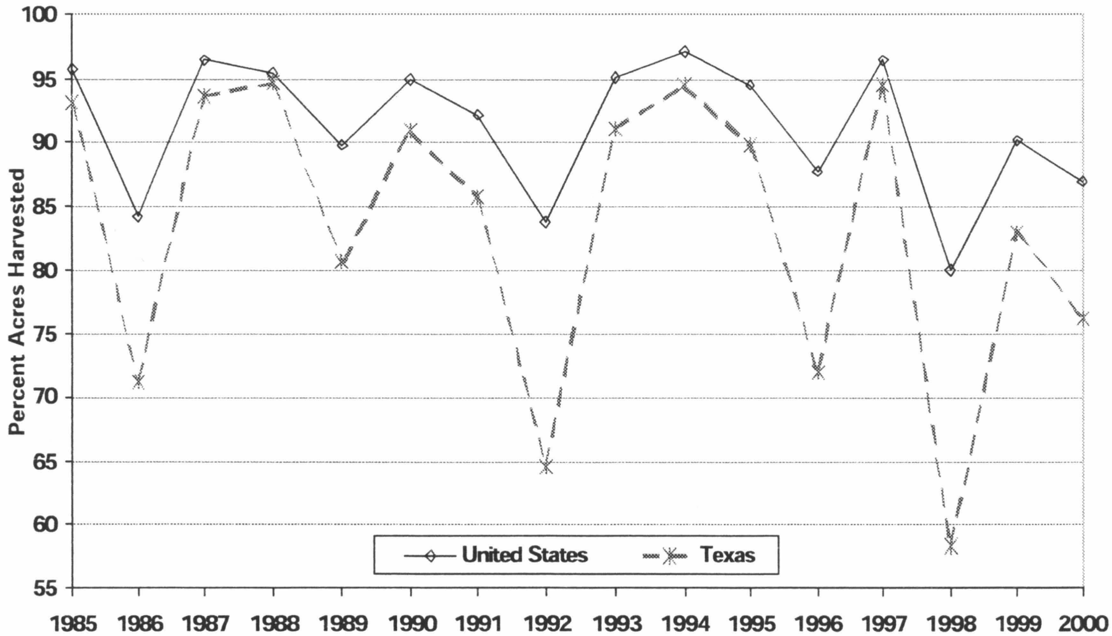
State	1995	1996	1997	1998	1999	2000	Average	Percent
	------	------	------	1, 000 Acres	------	------	------	
Alabama	590	520	535	495	565	610	553	3.8
Arkansas	1,170	1,000	980	920	970	930	995	6.8
California	1,170	1,000	880	650	610	770	847	5.8
Georgia	1,500	1,340	1,440	1,370	1,470	1,450	1,428	9.8
Louisiana	1,085	890	655	535	615	740	753	5.2
Mississippi	1,460	1,120	985	950	1,200	1,360	1,179	8.1
North Carolina	905	740	690	710	880	940	811	5.5
Tennessee	700	540	490	450	570	600	558	3.8
Texas	6,400	5,700	5,500	5,650	6,150	6,300	5,950	40.7
Virginia	107	103	101	92	110	110	104	0.7
Other States	1,630	1,442	1,392	1,242	1,444	1,540	1,430	9.8
United States	16,717	14,395	13,648	13,064	14,584	15,350	14,626	100.0

USDA reports producers' planting intentions in late March in *Crop Production: Prospective Plantings*. Prior to March 31, some private organizations like Sparks Commodities, Inc. or Cotton Incorporated, Inc. release estimates of planted acreage for the coming year. In January 2001, these private companies were estimating 15,900 thousand planted acres. In Table 3, 15,900 is entered in the planted acres box for 2001/02.

Harvested Acres

Producers do not harvest cotton from all the acres planted. Variable growing and harvesting conditions result in some cotton being left unharvested. Figure 4 indicates that the percentage of United States acres planted and harvested varied from 97.1 percent to 79.8 percent during the 1985 to 2000 period.

Figure 4. Harvested as Percent of Planted Acres: Texas and United States, 1985-2000



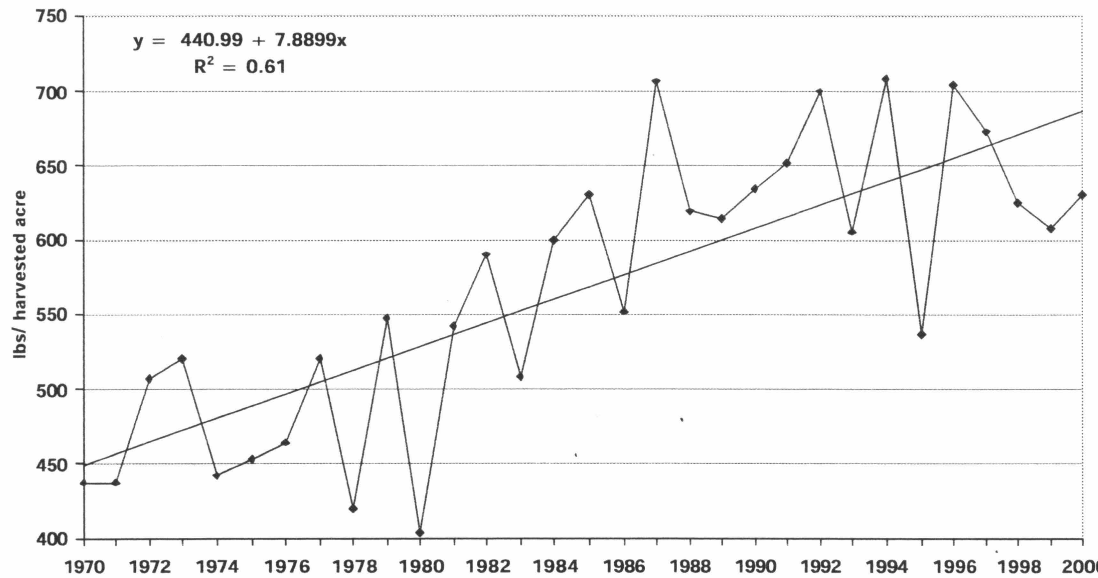
The percentage of planted cotton acres harvested varies more than most grain crops. Texas is the only state in which the abandonment rate varies widely from year to year. But because of the large amount of cotton grown in Texas, the percentage of acres harvested has a big impact on the national average percentage (Figure 4). The abandonment rate in Texas is mainly due to the large acreage that is not irrigated. As a result, during drought years when yields are poor, Texas producers abandon acres. For example in 1986, Texas producers harvested 71.1 percent of their planted acres, in 1992, 64.5 percent, and in 1998, 58.4 percent. Since the weather for the upcoming year is unknown in the late winter and early spring, a five-year average of the percent harvested is used to estimate harvested acreage. As the season progresses and the potential impact of the weather becomes apparent, the percent harvested estimate can be adjusted.

The five-year average percent harvested before the 2001/02 season was 88.4 percent. If 15,900 acres are planted, estimated harvested acreage in 2001/02 is 14,049 (15,900 X 0.884), which is entered in Table 3 in the harvested acres blank.

Yield

Next, yield per harvested acre must be estimated. The United States average yield per acre varies considerably from year to year (Figure 5). Since 1970, United States average cotton yields have increased about 7.9 pounds per acre per year according to the trend line formula. However, inspection of Figure 5 indicates this long-term trend has overestimated actual yields in recent years.

Figure 5. United States Cotton Yield, 1970-2000



During the 1990s, cotton yields have not trended up as they did during the 1970's and 1980's. Since 1987, in four years (1987, 1992, 1994, 1996) yields reached slightly above 700 pounds per acre. Since 1990 cotton yield has been under 625 pounds per acre four times (1993, 1995, 1999, 2000). However, the 1970 to 2000 trend line predicts average cotton yields will exceed 700 pounds per acre during the 2001/02 marketing year.

In recent years, an average of the previous five years gives a much more accurate yield estimate, given the lack of increasing yields in recent years. For the 2001/02 crop year, the averaging method predicts a yield of 648 pounds. The estimated yield entered in Table 3 for 2001/02 is 648.

With estimates of acres harvested and yield per acre, a producer can estimate total United States production. However, USDA reports yield in pounds per acre while all other numbers are in 480-pound bales. To determine production, harvested acres is multiplied times yield per harvested acre and then divided by 480 pounds per bale (14,049 * 648 /480). The estimated production in 2001/02 is 18,966 thousand bales, which is entered in the blank for 2001/02 production in Table 3.

Imports

Imports represent the smallest percentage of total supply, averaging less than 1 percent of total production. However, imports have ranged from 75 thousand bales to over 400 thousand bales. The large variation is due to a government program known as "Step 3." Imports of raw cotton are greatly limited by quotas, but if certain price conditions are met, more cotton is allowed into the country.

These conditions usually only occur in the late summer and early fall. In August and September, most of the current year's crop has not been harvested. Mills and exporters are using the stocks from the previous year. If the demand for cotton is strong compared to supply, price will rise. When the United States/Northern European price quotation stays above the Northern European price by more than 1.25 cents for four consecutive weeks, the President may authorize additional imports of upland cotton according to Step 3 regulations. The increased imports will lower the price of United States cotton, allowing United

States mills to stay competitive in the world market. By the time the current year's cotton production is harvested and ginned, Step 3 imports are usually reduced or eliminated.

Step 3 is usually activated in the fall after a year of very low ending stocks. While imports are not going to greatly affect season average price, they should be adjusted to reflect the current situation as the marketing year progresses. In most years, imports have been 50 thousand bales or less; therefore, 50 is entered for 2001/02 imports.

Having estimated beginning stocks, production, and imports for 2001/02, total supply is determined by adding these three sources of supply. Total supply is 23,816 thousand bales, which is entered as 2001/02 total supply in Table 3.

The total supply estimate can vary greatly from the original estimate until the fall harvest. Producers may change their planting intentions, and weather may greatly impact the percent harvested acres and yield per harvested acre. The impact of these changes on supply and hence season average price will be analyzed in the sensitivity section.

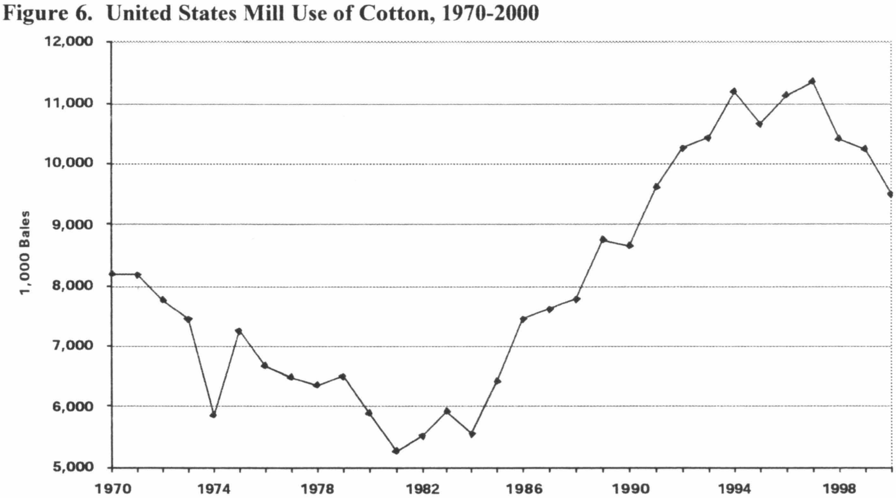
Demand

To estimate total demand, the three categories that make up demand must be estimated individually. Those categories are mill use and exports.

Mill Use

Mill use has historically been the largest component of demand and has generally increased since 1984. However, for the last five to seven years mill use has begun to decrease (Figure 6). The change in trend is caused by a more open market in which United States mills are less cost competitive than those in developing nations resulting in increases in imported textile products. As a result, mill use has decreased, while exports of raw cotton have increased.

Figure 6. United States Mill Use of Cotton, 1970-2000



The mill use component in the demand table represents the cotton bought after ginning. The mills turn the ginned cotton into thread, yarn, cloth, and so forth. Plants making consumer goods such as clothing, carpet, upholstery, and furnishings purchase these products.

The competitiveness of all fiber prices (cotton as well as polyester and rayon) affects mill use. Synthetic fiber prices are much more stable than cotton and have historically remained constant for months. As a result, the greatest indicators of mill use are this year's cotton production and last year's mill use. Using historical values of these variables since 1985, the following equation was estimated statistically:

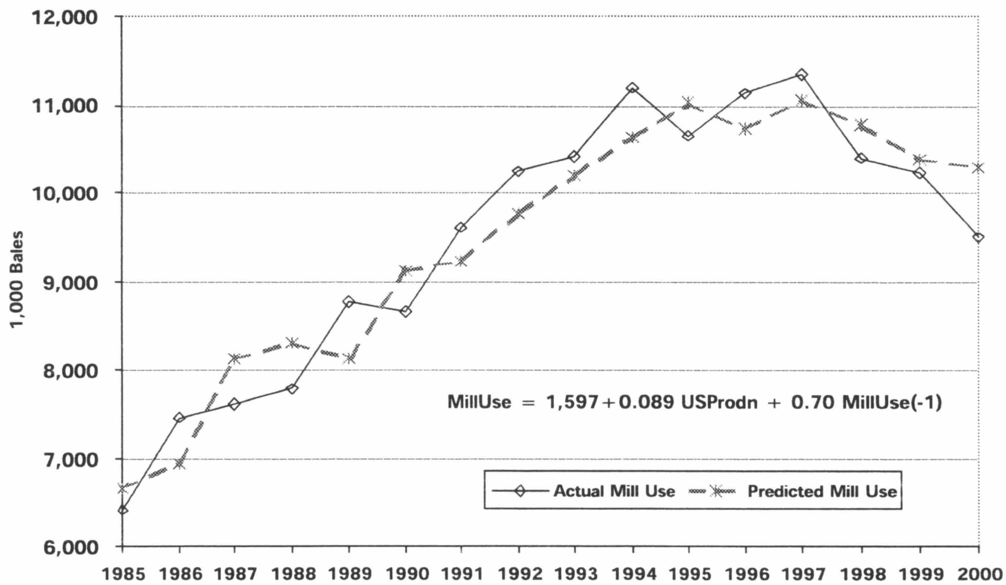
$$\textbf{MillUse} = 1{,}597.04 + 0.089\ \text{USProd} + 0.70\ \text{MillUse}(-1)$$
Mill Use = the current season's mill use in thousand bales
USProd = the current season's estimated production in thousand bales
MillUse(-1) = last year's mill use in thousand bales

This equation has historically explained 90 percent of the variability in mill use. For 2001/02, estimated production is 18,966 bales and last year's estimated mill use was 9,500 bales. Inserting these numbers into the equation gives an estimate of 9,935 thousand bales for 2001/02, which is the mill use estimate entered in the blank in Table 3.

$$\begin{aligned}\textbf{MillUse} &= 1{,}597.04 + .089*18{,}966 + 0.70*9{,}500\\ &= 1{,}597.04 + 1{,}687.97 + 6{,}650\\ &= 9{,}935.01\end{aligned}$$

For the 2000/01 crop year, USDA estimates mills will use approximately 9,500 thousand bales. Since 1997, mill use has been decreasing, and the above equation has been overestimating actual mill use (Figure 7).

Figure 7. United States Mill Use, Actual and Predicted, 1985-2000



The overestimation occurs from using historical data and the lagged variable, MillUse(-1). Equations using lagged variables are slow to pick up new trends, such as a switch in direction from increasing to decreasing. If this overestimation continues, an updated equation may better capture current mill use.

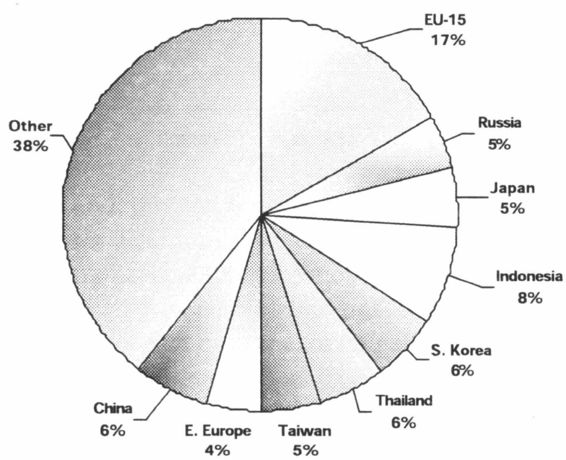
Mill use will probably not reach 9,935 bales in 2001/02. In the sensitivity analysis section, the impact of lower mill use numbers will be evaluated.

Exports

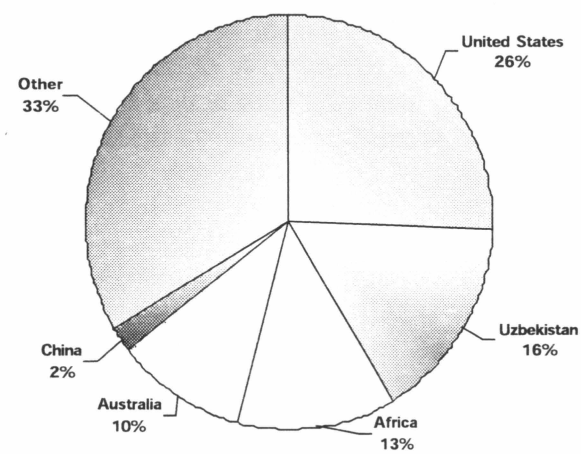
As the textile industry continues moving abroad, exports must rise to offset the decreased mill use to maintain current price levels. Production in the United States and other countries, exchange rates, government programs in the United States and other countries, and politics determine United States exports. Many of these factors are hard to forecast before planting for a crop-marketing year that does not begin until August.

Figures 8A and 8B indicate which countries are major players in the world cotton market. The many major importing countries show a much dispersed market for cotton (Figure 8A). Though many countries import raw cotton, many of the nations are in Asia, where the textile industry is growing. As a result, in 1998 United States exports decreased by over 3 million bales due to the Asian economic crisis. United States foreign policy in Asia, as well as the economic stability of the region, will greatly influence United States exports.

Figures 8A and 8B. Importing and Exporting Countries



A: Importing Countries



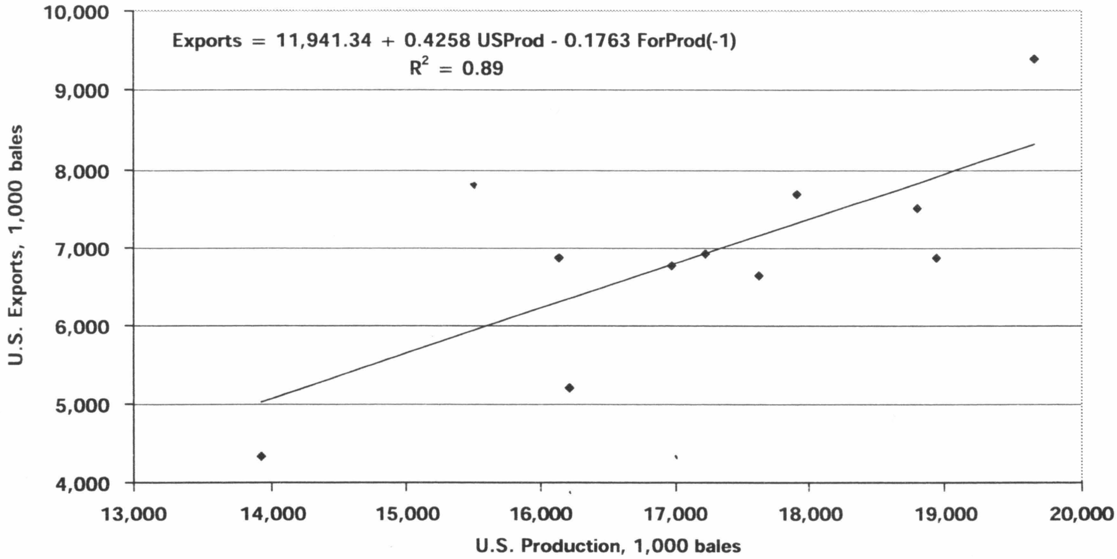
B: Exporting Countries

The European Union imports significantly more cotton than any other nation group. The European market should be closely watched because the price for cotton in Europe helps determine not only world cotton prices but is also used in calculating United States cotton support program payments. The price in the European market is measured as the average of the five cheapest types of cotton and is referred to as the "A-Index." The A-Index price will be incorporated into the price equation to help account for the level of price competition in the world market.

Figure 8B shows exporting nations that are competing with the United States in the global market. There are far fewer exporters than importers. China, however, appears on both charts because in some years it exports and other years it imports (Table 5). This constant shifting produces volatility in the world cotton market. If China exports, the additional cotton drives prices down. If China imports, less cotton is available and prices rise. Chinese imports and exports impact United States prices so a China variable is used in the price equation to capture this influence.

When the initial price estimates are made in the winter without knowing what is happening in China and other countries, the best indicator of cotton exports is the amount of cotton in the marketing system. The amount of cotton produced in the United States limits the amount available to export. The amount of cotton the rest of the world produced last year determines the competition for United States cotton. Foreign production combined with United States production is equal to the amount of cotton in the marketing system. In April, a reasonable estimate of exports for the upcoming crop marketing year can be made using the following equation:

Figure 9. United States Cotton Exports



Exports	= 11,941.34 + 0.4258 USProd –0.1763 ForProd(-1)
USProd	= United States production in thousand bales
ForProd(-1)	= Foreign production from the previous year in thousand bales

United States production was estimated for 2001/02 at 18,966 thousand bales, and foreign production in 2000/01 was 70,240 thousand bales. In 2001/02, expected exports based on the equation shown in Figure 9 are 7,634 thousand bales.

Exports = 11,941.34 + 0.4258*18,966 –0.1763*70,240
= 11,941.34 + 8,075.72– 12,383.31
= 7,633.75

Estimated exports for 2001/02, 7,634, are entered in the blank in Table 3.

Having estimated the two categories of demand, total demand can be estimated by summing mill use and exports. The total demand for 2001/02 is 17,569, which is entered in total demand in Table 3.

Unaccounted

Before estimating ending stocks for cotton, the USDA adds another category on the supply and demand table, known as **unaccounted**. The USDA generally accounts for the supply side of cotton while the Census Bureau determines most of the use numbers. These two agencies use different counting systems that must be reconciled. Reconciling the numbers is done with the unaccounted category. The number is usually very small and insignificant. Therefore, early in the season, an estimate of zero is used and entered in the unaccounted box in Table 3.

Ending Stocks

The ending stocks for 2001/02 can be calculated by subtracting total demand plus unaccounted from total supply. The 2001/02 estimate for ending stocks is 6,247. Percent use for 2001/02 is 35.6 percent (6,247/ 17,569*100). These estimates of ending stocks and percent use are entered in Table 3.

The initial ending stock equation (Figure 2) only explained 53 percent of the variation in season average cotton price from year to year. Two other major variables impact United States cotton prices: the A-Index and net trade by China.[1] By adding these variables, a new price equation can be estimated which explains 94 percent of the variation in farm price from year to year (Figure 10). The equation estimate for the season average price is

Price = 77.52 – 9.16 Ln(ES%) + 0.151 A-Index(-1) - 0.002 China(X-I)
Ln (ES%) = the natural log of ending stocks as percent of use
A-Index(-1) = the A-index the previous year in cents per pound
China (X-I) = China's exports minus China's imports in thousand bales

The A-index is the average of the five cheapest cottons available in the European market. It is an important determinant of United States price because Europe is the largest importer of cotton on the world market and United States government price support programs are tied to this index. The A-index price can be found in *Cotton and Wool Outlook.*

China (X-I) is net Chinese exports. China is the largest producer of cotton in the world. In addition, China fluctuates between being a net importer and net exporter. When Chinese exports exceed imports, United States prices decline and vice versa. Data on China are available in *WASDE* and *Cotton and Wool Outlook*.

When first estimating cotton price in the late winter/early spring, data for the A-Index and China may not be available through the USDA. Nevertheless, a number of private sources make it available. For the 2001/02 year, the A-Index is estimated at 65 cents, and China (X-I) is –1,000 (making China a net importer). Using the new price equation, the estimated season average price is

Price = 77.52 – 9.16 Ln(ES%) + 0.151 A-index(-1) - 0.002China(X-I)
= 77.52 –9.16Ln(35.6) + 0.151*65 - 0.002(-1,000)
= 77.52 – 9.16*3.57 + 9.815 + 2
= 77.52 –32.70 + 9.815 + 2
= 56.635

According to the price equation, the season average producer price should be 56.64 cents, which is the entered in Table 3.

The estimated price curve explains 94 percent of the variation in the season price from year to year. In most years, the difference between the predicted and actual price is less than 2.8 cents a pound (Figure 11). The estimated equation has no turning point errors. Even during years when the price estimate is off,

[1] In 1999, the United States cotton crop was of a lower quality than usual. As Figure 10 indicates, prices were much lower than in previous years with similar levels of ending stocks. Therefore, a dummy variable (D99) was included in the equation to account for lower quality in 1999/00. The dummy variable should not be included in price estimates in years other than 1999/00.

Figure 10. Price versus Ending Stock as Percent of Use (ES%)

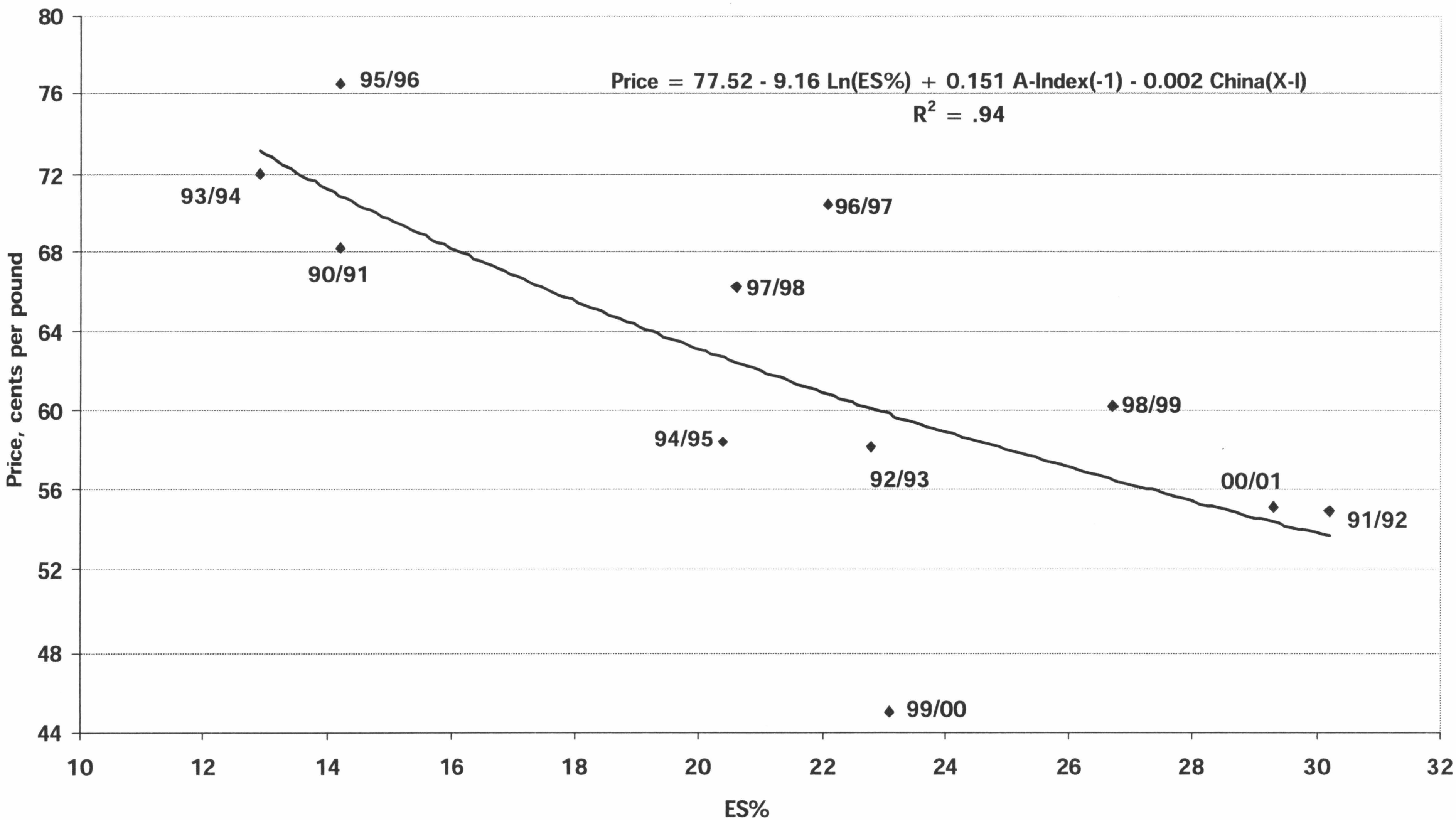
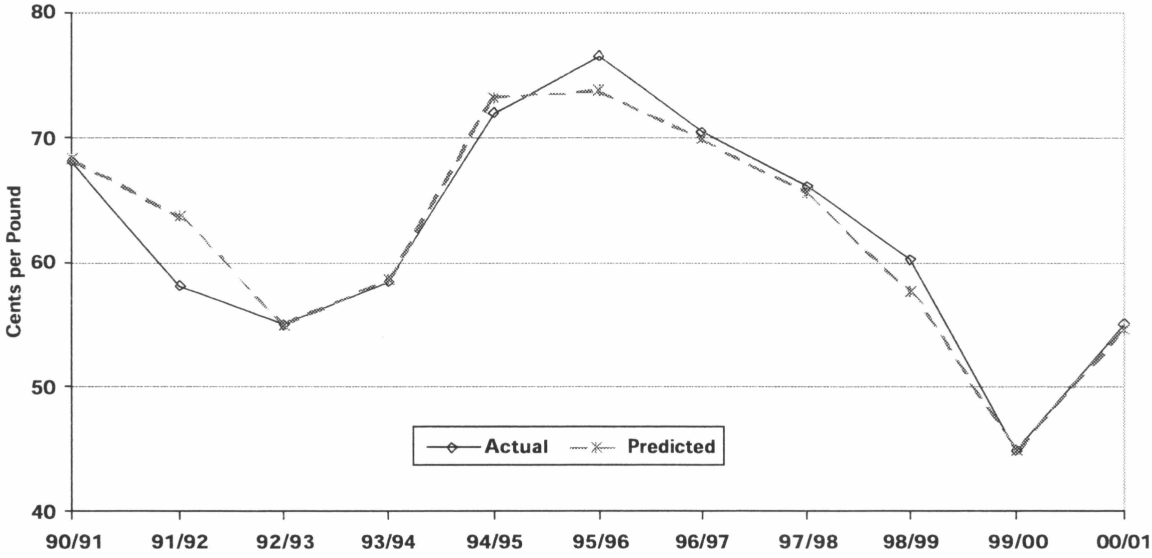


Figure 11. Actual versus Predicted Price



it predicted the proper price direction. For example, in 1995 the predicted price was off by 2.7 cents. Nevertheless, the estimated price for 1995/96 was greater than the actual price in 1994/95. Price direction is important when deciding on a pricing strategy. Over time the relationship between price and ending stock changes; therefore, this equation needs to be re-estimated every three to four years.

Figure 12 illustrates how Chinese trade can affect the United States price. Each line on the graph represents a different level of China's net exports (-3,000, 0, and 1,500). The A-index is constant at its mean of 72.42 cents for all three curves. At a given level of United States ending stocks, when China imports 3,000 thousand bales, the United States price increases 6 cents per pound. When China exports 1,500 thousand bales, the United States price declines by 3 cents per pound.

The A-Index has a similar affect on United States price (Figure 13). By keeping Chinese net exports constant at –1,120 (the average of the last 10 years), the relationship between the A-Index and United States cotton price is demonstrated. The range of price between the three A-Index curves, given a constant ending stocks level, is 4.53 cents.

Another way to estimate season average price is by using Table 6. The table shows the estimate of the price impact of various ES%, A-Index, and China(X-I) levels. To use the table, the appropriate level of ending stocks is found first. Reading across to the price impact column immediately adjacent to the ending stock level gives the impact of ending stocks on price. The price impact should be added to the base amount, 77.52¢ per pound. For the A-Index and China(X-1), the same process is repeated. For example, if ES% is 22, A-Index is 70, and China(X-I) is 1,500, the price would be 56.78¢ per pound.

Level				**Price Impact**
Base	=	77.52	=	77.52¢
ES%	=	22%	=	-28.31¢
A-Index(-1)	=	70¢/lb	=	10.57¢
China(X-I)	=	1,500 thou bales	=	-3.0¢
Season Average Price	=	77.52 - 28.31 +10.57 – 3.00	=	56.78¢

Figure 12. Affect of China Trade on United States Cotton Price

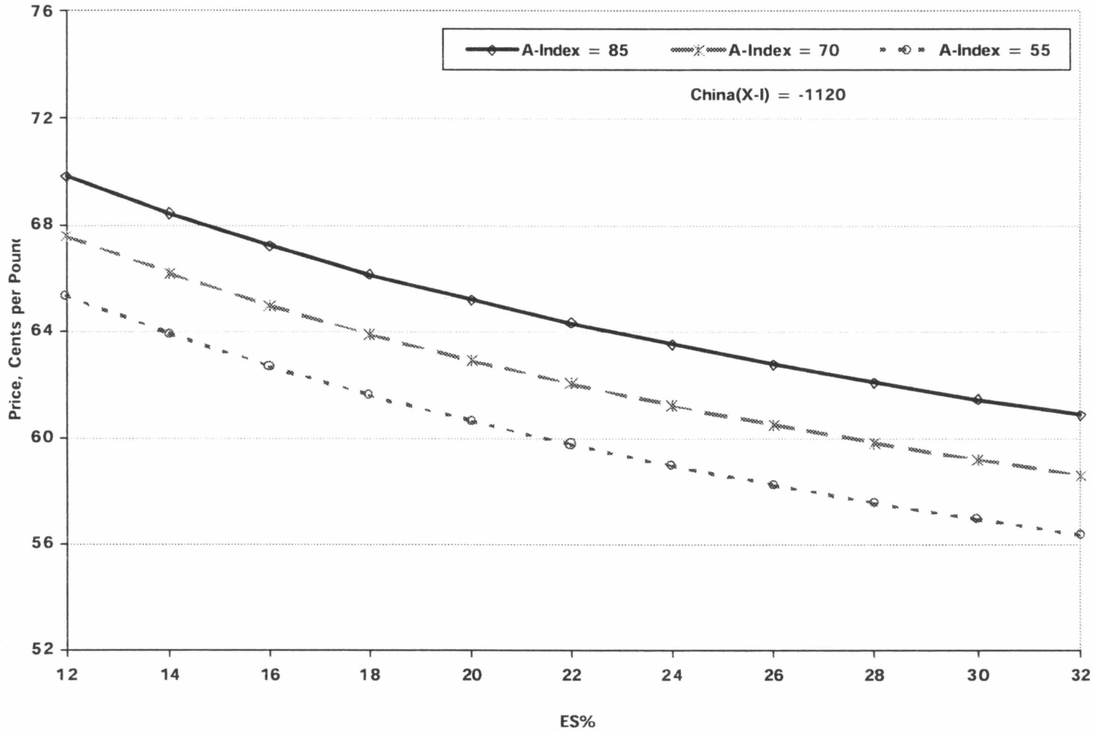


Figure 13. Affect of A-Index on United States Cotton Price

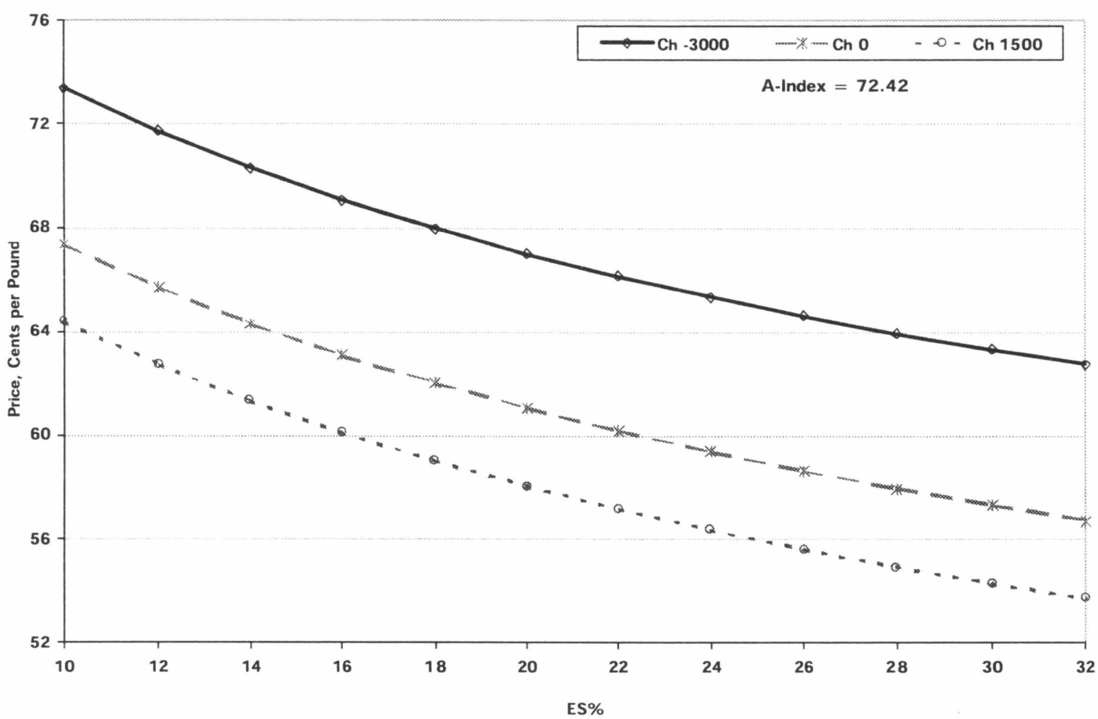


Table 6. Price Impact of Ending Stock Percent Use, A-Index(-1) and China(X-I)					
Base = 77.52 cents per pound					
Ending Stocks		A-Index		China (X-I)	
Level *ES%*	*Impact* *¢/lb*	*Level* *¢/lb*	*Impact* *¢/lb*	*Level* *thou bales*	*Impact* *¢/lb*
12	-22.76	52	7.85	-4,500	9
14	-24.17	54	8.15	-4,000	8
16	-25.40	56	8.46	-3,500	7
18	-26.48	58	8.76	-3,000	6
20	-27.44	60	9.06	-2,500	5
22	-28.31	62	9.36	-2,000	4
24	-29.11	64	9.66	-1,500	3
26	-29.84	66	9.97	-1,000	2
28	-30.52	68	10.27	-500	1
30	-31.15	70	10.57	0	0
32	-31.75	72	10.87	500	-1
34	-32.30	74	11.17	1,000	-2
36	-32.83	76	11.48	1,500	-3
38	-33.32	78	11.78	2,000	-4
40	-33.79	80	12.08	2,500	-5
42	-34.24	82	12.38	3,000	-6
44	-34.66	84	12.68	3,500	-7
46	-35.07	86	12.99	4,000	-8
48	-35.46	88	13.29	4,500	-9
50	-35.83	90	13.59	5,000	-10

PRICE SENSITIVITY ANALYSIS

The estimated price from the model is based on assumptions about yield, harvested acres, and demand. The actual levels of these variables may change dramatically from spring until harvest. The potential impact of these changes on price can be determined by assuming alternative yield and demand levels.

Two of the most variable factors affecting cotton price are percent of harvested acres and yield. During the 1990s, both of these factors varied widely and neither had a consistent trend over time. The estimates of planted and harvested acres and yield used in Table 3 are based on averaging data from the previous five years. These estimates do not consider the possibility of extremely favorable and unfavorable weather conditions.

At first glance, abandonment of acres and yields appear linked so that when yields are low abandonment would be high. However, the linkage is not necessarily true. Yield only measures the production per *harvested* acre. The abandoned acres do not contribute to the final calculation of yield. As a result, there is little association between percent harvested and yield. For example, Table 7 shows that in the crop years 1992/93 and 1994/95 yields were similar (700 and 708, respectively). However, in 1992/93 only 84.0 percent of the crop was harvested, and in 1994/95, 94.5 percent of the crop was harvested. In 1992/93, Texas harvested about 65 percent of its planted acres. The extremely low yields on abandoned acres in Texas did not go into the yield calculation because these acres were not harvested.

Table 7. Percent Harvest & Yield		
Year	Percent Harvested	Yield (lb/acre)
1990/91	95.0	634
1991/92	92.2	652
1992/93	84.0	700
1993/94	95.0	606
1994/95	97.1	708
1995/96	94.5	537
1996/97	88.0	705
1997/98	96.5	673
1998/99	79.8	625
1999/00	90.2	607
2000/01	87.3	631

In the original balance sheet estimates (Table 3), percent harvested was calculated at 88.4 percent and yield was calculated at 648 pounds per acre. These numbers are historical averages. However, if Texas has a drought causing higher abandonment rates, percent harvested will drop, lowering supply and ultimately causing higher cotton prices. On the other hand, yield may be higher or lower than the average depending on growing conditions.

Ever-changing local and world events have a significant impact on the amount of cotton used during a crop year. The movement of the textile industry to Mexico is causing mills to shut down in America. As a result, mill use is likely to decrease. Depending on the competitiveness of United States cotton on world markets, exports may or may not compensate for the shrinking domestic market. Increases and decreases in United States production and price of synthetic fibers can also affect the demand of cotton at mills.

Table 8 is used to show season average price changes when factors such as yield and use change. Scenario 1 demonstrates the affect of a smaller percent harvested. Scenario 2 represents a yield increase. In Scenario 3, a smaller and more realistic mill use number is used.

Scenario 1

In the original balance sheet, an estimated 88.4 percent harvested acres was used. However, if Texas experiences drought, this percentage will drop significantly. If only 80.0 percent of planted acres are harvested, harvested acres will be 12,720 thousand acres. Since the very low yields on the abandoned acres are not calculated in the final yield estimate, the yield will remain at 648 pounds per acre. The new production estimate is 17,172 thousand bales (12,720*648/480).

The production estimate is used in both use equations. Mill use and exports need recalculation with the lower production estimate. The new estimates for mill use and exports are 9,775 and 6,870, respectively.

$$\begin{aligned}\textbf{Mill Use} &= 1597.04 + 0.089\text{ USProd} + 0.70\text{ MillUse(-1)}\\ &= 1597.04 + 0.089*17{,}172 + 0.70*9{,}500\\ &= 9{,}775\end{aligned}$$

$$\begin{aligned}\textbf{Exports} &= 11{,}941.34 + 0.4258\text{ USProd} - 0.1763\text{ ForProd(-1)}\\ &= 11{,}941.33 + 0.4258*17{,}172 - 0.1763*70{,}240\\ &= 6{,}870\end{aligned}$$

Total supply decreased more than total demand decreased, resulting in smaller ending stocks (5,377). The new ES% is 32.3. Since the ES% is lower and the other variables remain constant, the season average price is higher. The new price estimate is 57.5 cents per pound.

Scenario 2

If yield reaches 700 pounds per acre, production will increase to 20,488 thousand bales (14,049 * 700/ 480). As in Scenario 1, changes in production cause changes in mill use and exports. The increased yield causes mill use to rise to 10,070 thousand bales and exports to rise to 8,282 thousand bales. However, the increased demand does not offset increased supply. Ending stocks and ES% will also increase causing price to decline. The price when yield increases to 700 pounds per acre is 56.0 cents.

Table 8. Estimated United States cotton supply, demand, stocks, and price

Item	Units	01/02 Original Estimates	01/02 Harvest Decrease	01/02 Yield Increase	01/02 Mill Use Decrease
Supply					
Beginning Stocks	thou. bale	4,800	4,800	4,800	4,800
Planted	thou. ac.	15,900	15,900	15,900	15,900
Harvested	thou. ac.	14,049	12,720	14,049	14,049
Yield	lb./ac	648	648	700	648
Production	thou. bale	18,966	17,172	20,488	18,966
Imports	thou. bale	50	50	50	50
Total Supply	thou. bale	23,816	22,022	25,338	23,816
Use					
Mill Use	thou. bale	9,935	9,775	10,070	9,000
Exports	thou. bale	7,635	6,870	8,282	7,635
Total Use	thou. bale	17,569	16,645	18,352	16,635
Unaccounted	thou. bale	0	0	0	0
Ending Stocks	thou. bale	6247	5,377	6,986	7,181
ES%	%	35.6	32.3	38.1	43.2
Loan Rate	¢/lb.	51.9	51.9	51.9	51.9
U. S. Season Average Price	¢/lb.	56.6	57.5	56.0	54.8

Scenario 3

As discussed in the demand section, the mill use equation over-estimates mill use in recent years. The estimate for 2001/02 according to the equation is 9,935 thousand bales, an increase over last year. However, for four consecutive years mill use has steadily declined by almost 500 thousand bales a year.

If this trend continues, in 2001/02 mill use will be around 9,000 thousand bales. This change will only affect the demand side of the balance sheet. The decrease in demand will increase ending stocks to 7,181 and increase ES% to 43.2. Without any other changes, the new price is 54.8 cents per pound.

The sensitivity analysis only covers three alternative scenarios for 2001/02. Many others are possible, including changes in planted acres, Chinese net trade, and world prices reflected in the A-Index. These variables can occur in an almost unlimited number of combinations. The United States price of cotton will eventually be determined by the weather during the growing season and international events. Since these events cannot be controlled by individuals, producers should base their initial pricing strategy on the most likely price estimate for the current year compared to pricing opportunities in previous years with similar supply and demand conditions.

SEASON AVERAGE PRICE AND FUTURES PRICE

Many of the pricing strategies available to producers during the growing season are tied to December cotton futures prices. Hence, the season average cash price estimate needs to be converted to an equivalent December futures price. This conversion is accomplished by analyzing the historical relationship between season average price and December cotton futures at harvest during October. Table 9 shows this relationship, called basis, for the years 1995 to 1999. On average during October, December futures are 6.7 cents more than the season average price. The basis ranges from –3.6 to –9.0 cents. However, the range in either cash or futures prices is approximately 30 cents per pound over that same period. Basis varies much less than cash and futures, and therefore can be used to convert the estimated season average price into an equivalent December cotton futures price.

Table 9. Season Average Price and December Futures

Year	Season Average Price	December Futures in October	Season Average Basis
	-----------Cents per pound-----------		
1995	76.5	85.5	-9.0
1996	70.5	74.1	-3.6
1997	66.2	71.7	-5.5
1998	61.2	70.4	-8.7
1999	46.6	53.1	-6.5
Average	**64.3**	**71.0**	**-6.7**

The equation for determining the December future price level is

December futures = season average price – season average basis.

For example, the season average price estimate for 2001/02 is 56.6 cents per pound. The equivalent December futures price level is 63.3 cents per pound (56.6 – (-6.7)). In other words, if season average cash price is 56.6, December futures should be about 63.3 cents per pound in October. If the season average cash price estimate is 70 cents per pound, December cotton futures should trade around 76.7 cents (70 – (-6.7)).

Futures and Adjusted World Price

The adjusted world price is critical to cotton producers. It determines the loan deficiency payments made to farmers. Similar to the season average price, adjusted world price is related to December futures and a basis. Historically, the adjusted world price in October has been 15.2 cents lower than the December futures in October (Table 10). The estimate for the October adjusted world price for 2001/02

Table 10. Adjusted World Price and December Futures			
Year	Adjusted World Price in October	December Futures in October	Season Average Basis
	-----------Cents per pound-----------		
1995	74.4	85.5	-11.1
1996	60.6	74.1	-13.5
1997	63.5	71.7	-8.2
1998	47.4	70.4	-23.0
1999	33.3	53.1	-19.8
Average	**55.8**	**71.0**	**-15.2**

is 48.1 cents. The loan deficiency payment is the difference between the loan rate (51.92) and the adjusted world price. The 2001/02 deficiency payment should be approximately 3.82 cents per pound (51.92 – 48.1).

The relationships between season average cash price, December futures, adjusted world price, and loan deficiency payment (Table 11) are important when developing a pricing strategy. Based on the season average cash price, the approximate equivalent December futures price, average world price, and loan deficiency can be estimated.

Table 11. 2001/02 Price Relationships				
Item/Scenario	Original Estimate	Harvest Decrease	Yield Increase	Mill Use Decrease
	---------------------Cents per pound-----------------			
Season Average Price	56.6	57.5	56.0	54.8
Season Average Basis	-6.7	-6.7	-6.7	-6.7
Est. December Futures in October	63.3	64.2	62.7	61.3
Oct. Adjusted World Price Basis	-15.2	-15.2	-15.2	-15.2
Est. Adjusted World Price in October	48.1	49.0	47.5	46.1
Loan Rate	51.9	51.9	51.9	51.9
Loan Deficiency Payment	3.8	2.9	4.4	5.8

DEVELOPING A PRICING STRATEGY

The information in the supply and demand table along with the relationship between cash, futures, adjusted world price, and loan deficiency payments can all be used to develop an initial pricing strategy. The strategy will depend upon three components: 1) expected direction in price compared to previous years, 2) pricing opportunities available in previous years with similar supply and demand, and 3) the historical probability distribution of December cotton futures prices. The initial pricing strategy will have to be adjusted during the growing season as new information becomes available.

Price Direction

Expected price direction is determined by comparing this year's season average price estimate to last year's season average price. If the price direction is down, the best pricing opportunities will likely come in the early part of the year. However, if price is predicted to rise, waiting to price the crop may be better. In March 2001, the season average price for 2000/01 was 55.1 cents per pound. The forecasting model predicted a season average price of 56.6 cents per pound for 2001/02. The higher estimated price for 2001/02 is a weak upward price signal, suggesting the producer hold off pricing early in the season because prices are expected to increase. However, the forecasting model has been over-estimating mill use. Using a more realistic mill use number (9,000 thousand bales) results in a price estimate of 54.8 cents for 2001/02. The price direction signal for 2001/02 is very weak and does not give a good indication of when the best pricing opportunities may occur.

Futures Target Price Levels

Once price direction is established, the next step is to determine target price levels to begin pricing. The target levels are determined by looking at futures price levels from previous years with similar cash price levels. Once these years are determined, the December future charts for these years should be selected from Appendix A. By comparing futures charts for similar years, the best prices offered can be determined. The 1992/93 and 2000/01 years had the closest prices to the estimated season average price for 2001/02.

When looking at the December futures chart for a similar year, the overall price trend, the duration of high and low prices, and when the highs and lows occurred are important. To determine trend, the producer should see if prices were higher in the spring and summer or at harvest. He/she should look for the highest prices and when they occurred. A range of high prices that lasted for one or two weeks should be determined. This price range becomes the initial price target.

In 1992, December futures prices started at some of their highest prices (62.5 to 64.0 cents per pound), then dropped during February and March. Producers got a second chance to price above 62 cents in April and May. In late June, prices peaked in the 64 cents range. Prices fell steadily through late October then rose slowly in late fall.

In 2000, the December futures prices started much lower than in 1992 and had many up and down swings. The peak prices came in February (62-cent range), May (64-cent range), and August (66-cent range). During early July, prices reached some of their lowest price levels, below 55 cents for a few days.

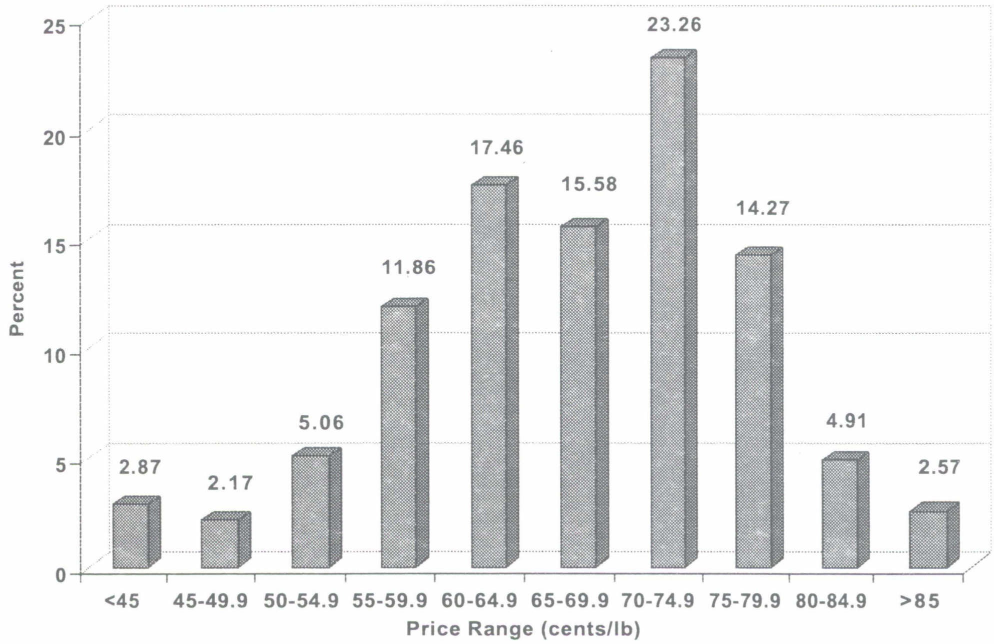
Based on futures prices in 1992 and 2000, the high prices in December 2001 futures should be in the 62 to 64-cent range. This price range estimate is consistent with a season average price estimate of 56.6 cents and a historical average harvest basis of –6.7 cents, yielding an equivalent December futures price level of 63.3 cents. Hence, these two indicators suggest that the 2001 pricing strategy target should start in the range of 62 to 64 cents for the December 2001 cotton futures contract.

In terms of timing, the highest futures prices occurred in the spring and summer in both 1992 and 2000. Since the price direction signal is weak for 2002, only a relatively small percentage of the crop should be priced early (maybe 10 to 20 percent). In both 1992 and 2000, the futures market offered a second chance to price in the desired price range in late June and in early August. By this time, the expected supply and demand picture for 2001/02 will be clearer, and the pricing strategy can be modified accordingly.

December Futures Price Distribution

The final step in developing a pricing strategy is to compare currently available December futures prices to past futures price levels. The historical distribution of December closing futures prices from 1980 to 2000 is shown in Figure 14. The distribution is based only on December futures prices. It does not include other futures contract months. Figure 14 indicates the percentage of time prices traded within the price ranges shown on the horizontal axis. For example, the most likely price range for December cotton futures is between 70.0 and 74.9 cents. During the last 21 years, prices traded in this range 23.26 percent of the time. December futures only trade above 80 cents about 7.48 percent of the time (4.91 + 2.57). Prices have historically traded below 55 cents 10.10 percent of the time (2.87 + 2.17 + 5.06).

Figure 14. Price Distribution, December Cotton Futures, 1980-2000



The historical distribution of prices is used to help evaluate the current level of futures prices. If current prices are high relative to historical prices, the producer should price aggressively, maybe as much as 50 to 70 percent of expected production. If current prices are relatively low compared to historical prices, say less than 60 cents, the producer should be less aggressive in pricing early in the season—unless the supply and demand analysis strongly indicates prices are going lower.

The three components of the pricing strategy need to be combined to develop the initial pricing strategy for the growing season. In early March 2001, the price direction signal gave a weak indicator of higher futures. The comparison to December futures prices from similar seasons suggests an initial price target in the 62 to 64-cent December futures price range. The current futures prices are in the bottom 1/3 of historical futures prices.

Several factors are important in considering when and how much expected production to price. A weak upward price direction suggests few early sales. The December futures charts for 1992 and 2000 indicate futures traded in the target 62 to 64-cent range in both spring (March and April) and in the summer (late July through August). With current December 2001 futures prices in the bottom 1/3 of the historical price distribution few early sales are indicated. All these indicators suggest that the initial strategy should be to price only a small percentage of expected production in the 62 to 64-cent price range in March and April. In previous similar seasons, 1992 and 2000, producers had a second opportunity to price within the target price range in the summer. Of course, the supply and demand estimates and the pricing strategy will have to be updated each month as new information becomes available.

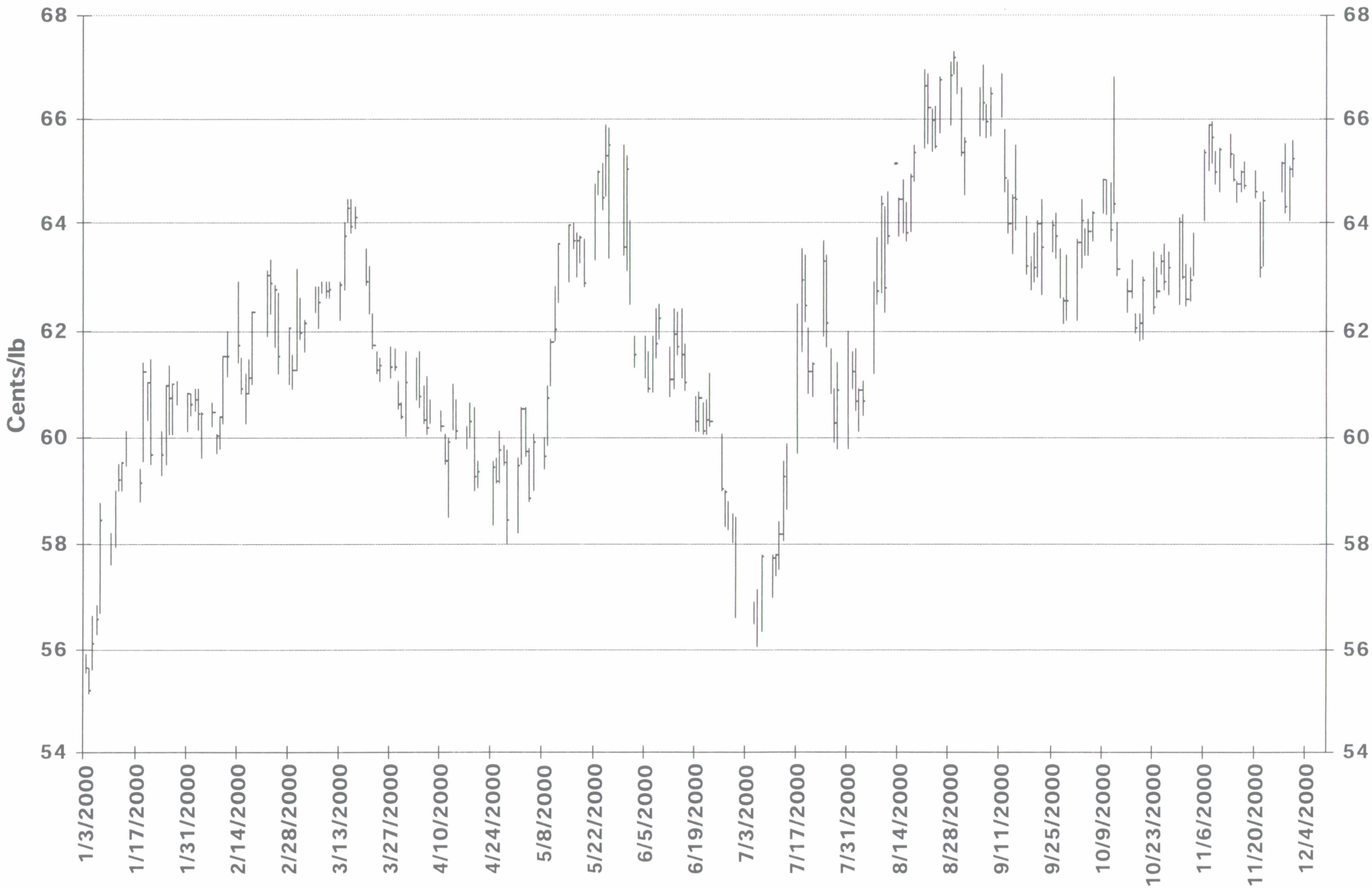
SUMMARY

The historical supply and demand tables make it possible to put current supply and demand estimates in historical perspective. The price forecasting equation permits the producer to estimate the season average price based on projected ending stocks, A-Index price, and Chinese exports and imports. A pricing strategy can then be developed based on the expected direction in price, price targets from December futures prices based on similar years, and an evaluation of the current price level relative to historical futures prices. By monitoring supply and demand each month as new information becomes available, producers can modify their strategy during the growing season.

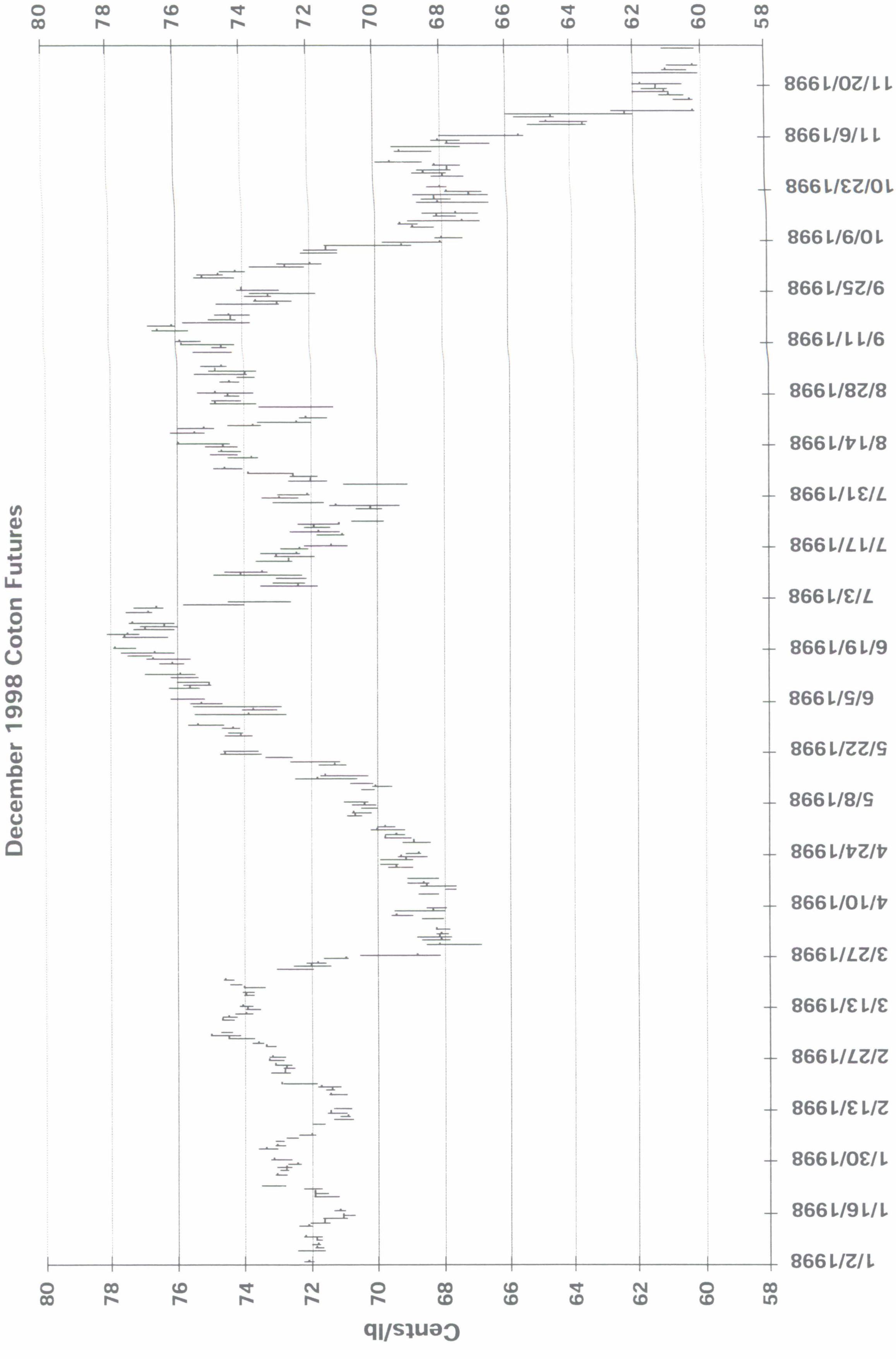
The best prices rarely occur at harvest. But this pricing guide can only improve producers' decisions if they know their costs of production, have a clearly defined pricing objective, and know the advantages and disadvantages of forward pricing with cash contracts, futures, and options. Cotton producers who know how to use these pricing tools will have the opportunity to increase average prices or reduce price risk over time.

APPENDIX A. DECEMBER COTTON FUTURES, 1990 - 2000

December 2000 Cotton Futures



December 1999 Cotton Futures


December 1998 Coton Futures
Cents/lb
80
78
76
74
72
70
68
66
64
62
60
58
1/2/1998
1/16/1998
1/30/1998
2/13/1998
2/27/1998
3/13/1998
3/27/1998
4/10/1998
4/24/1998
5/8/1998
5/22/1998
6/5/1998
6/19/1998
7/3/1998
7/17/1998
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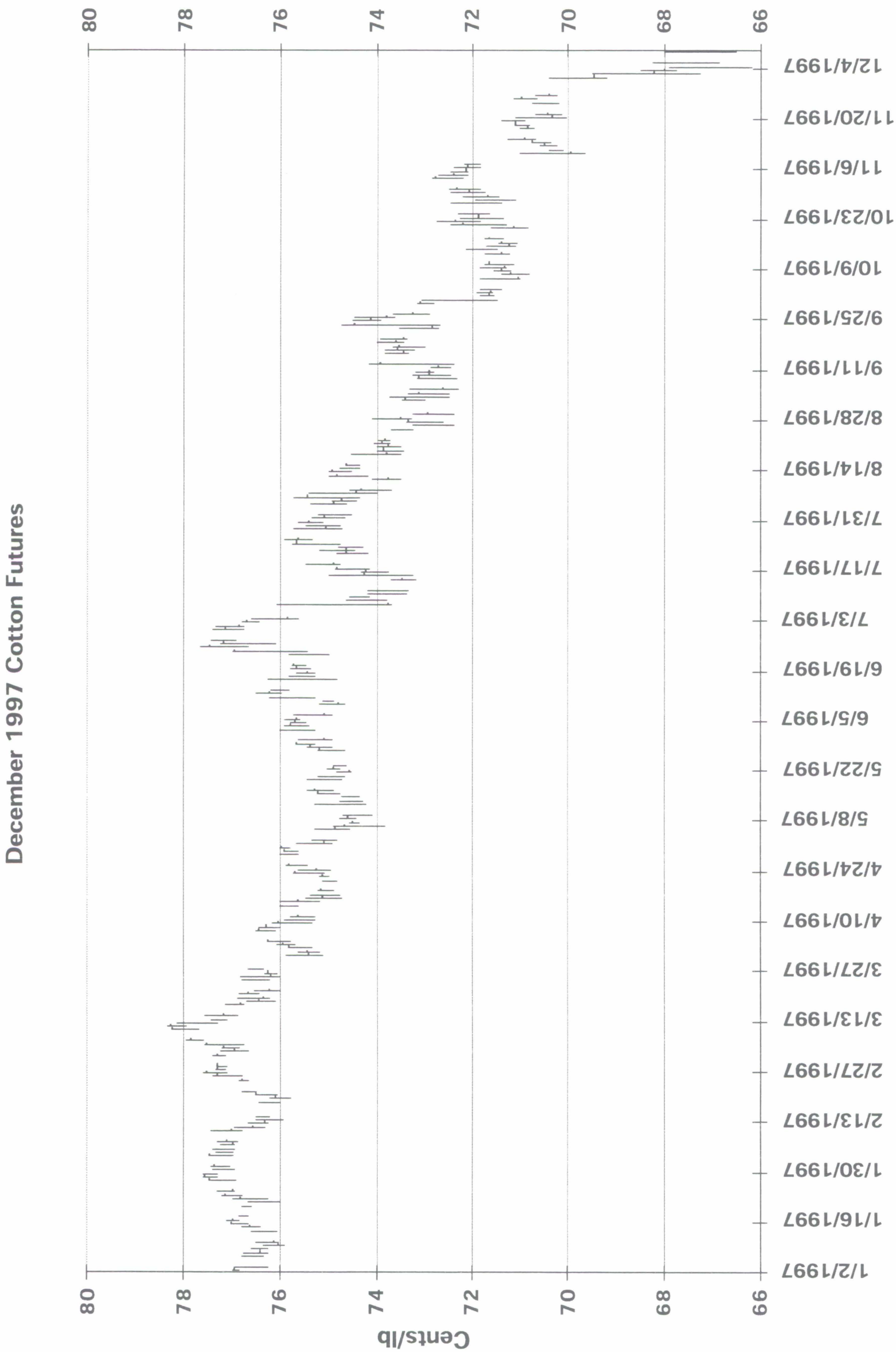
11/6/1998
11/20/1998


December 1997 Cotton Futures
Cents/lb
80
78
76
74
72
70
68
66
1/2/1997
1/16/1997
1/30/1997
2/13/1997
2/27/1997
3/13/1997
3/27/1997
4/10/1997
4/24/1997
5/8/1997
5/22/1997
6/5/1997
6/19/1997
7/3/1997
7/17/1997
7/31/1997
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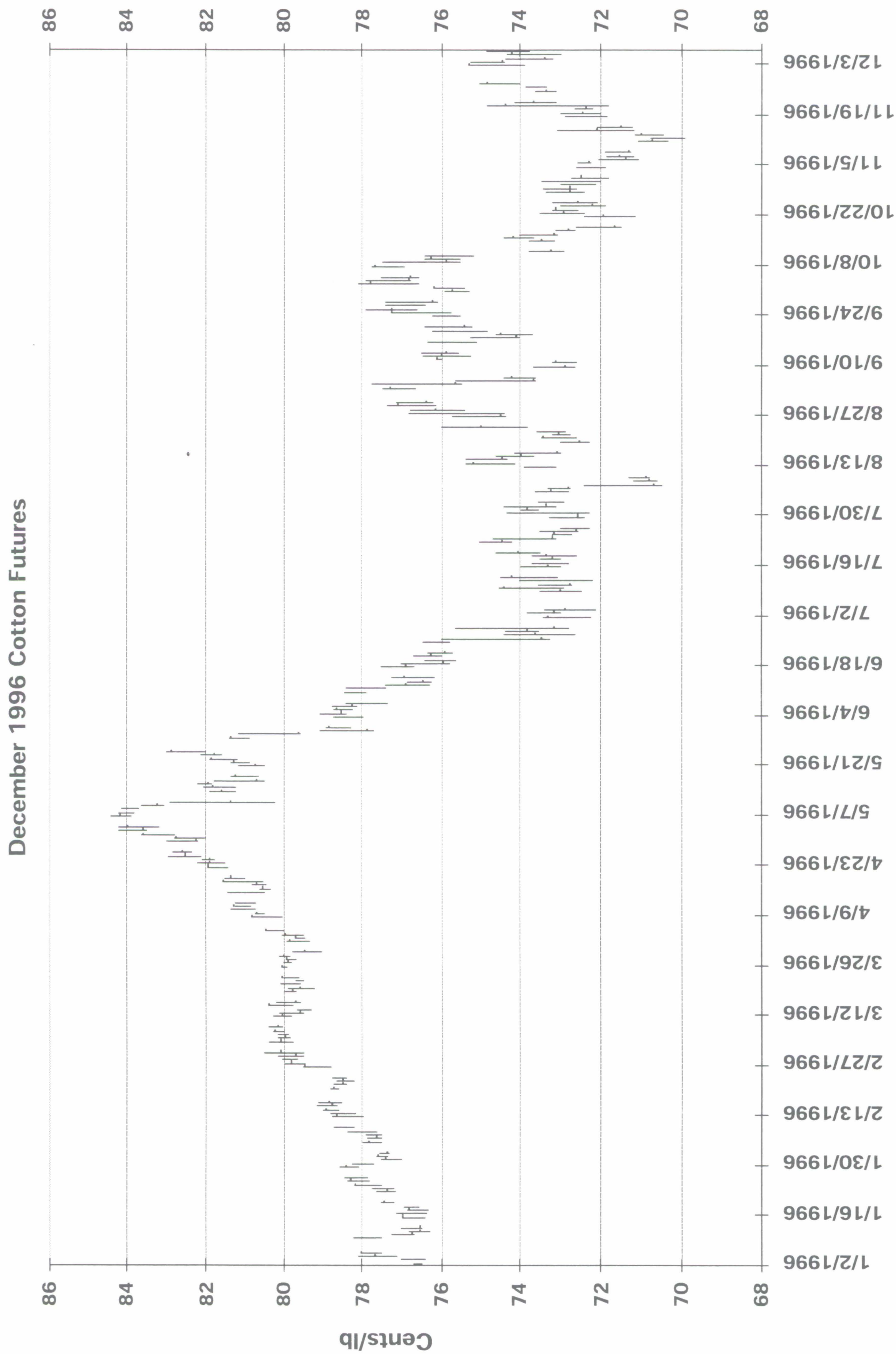
11/20/1997
12/4/1997



December 1996 Cotton Futures
Cents/lb
86
84
82
80
78
76
74
72
70
68
1/2/1996
1/16/1996
1/30/1996
2/13/1996
2/27/1996
3/12/1996
3/26/1996
4/9/1996
4/23/1996
5/7/1996
5/21/1996
6/4/1996
6/18/1996
7/2/1996
7/16/1996
7/30/1996
8/13/1996
8/27/1996
9/10/1996
9/24/1996
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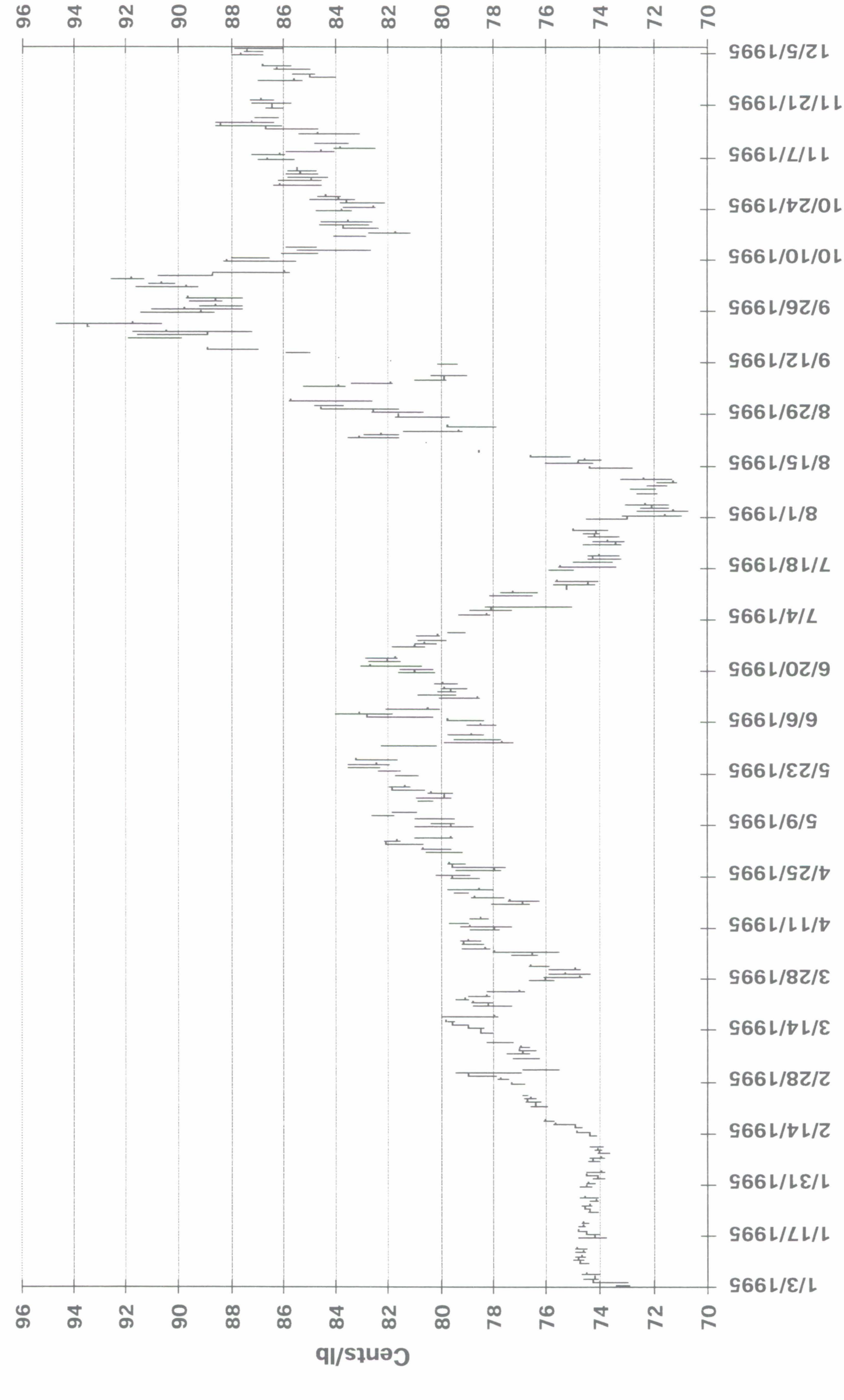
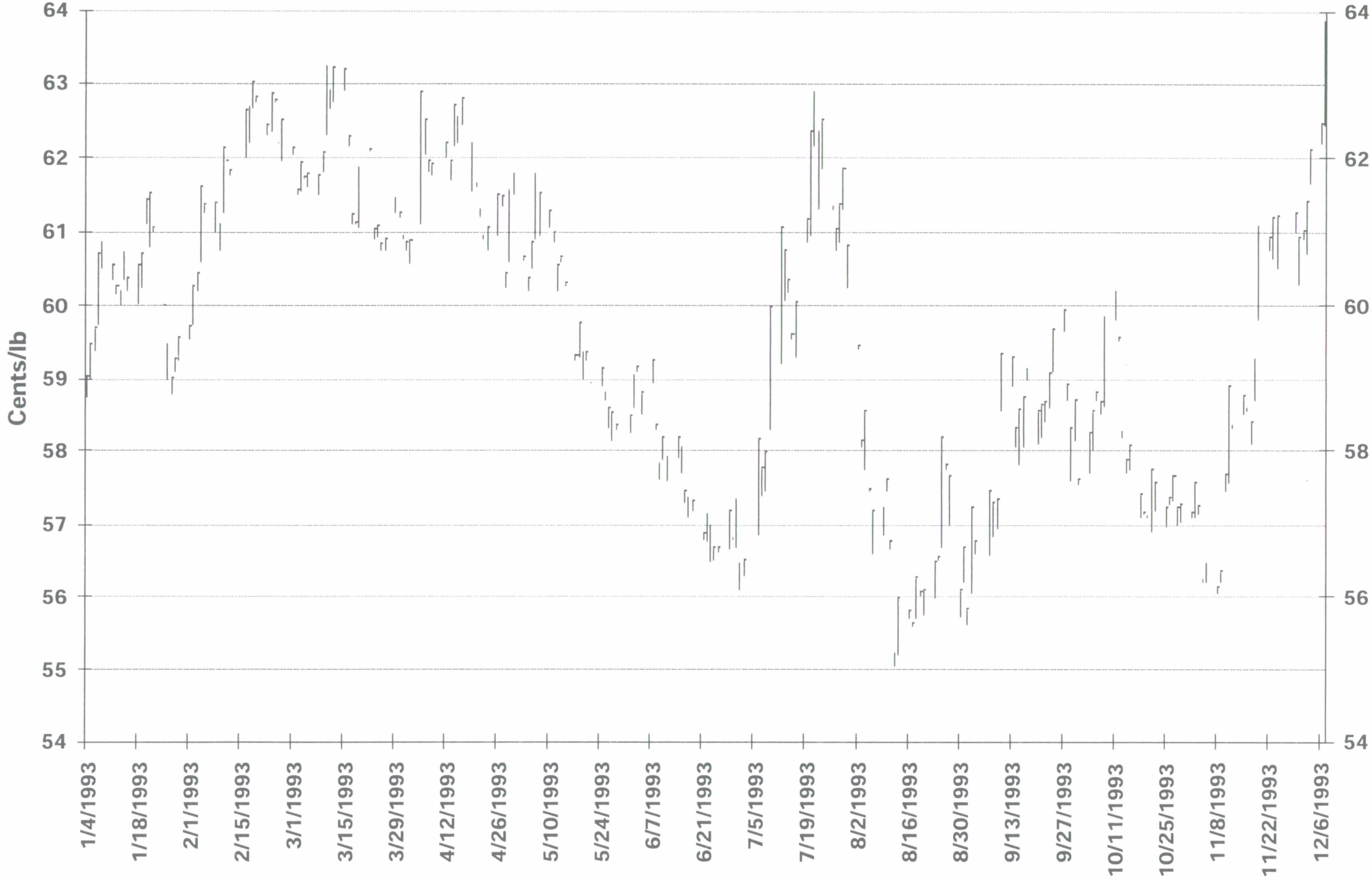
10/22/1996
11/5/1996
11/19/1996
12/3/1996

December 1995 Cotton Futures

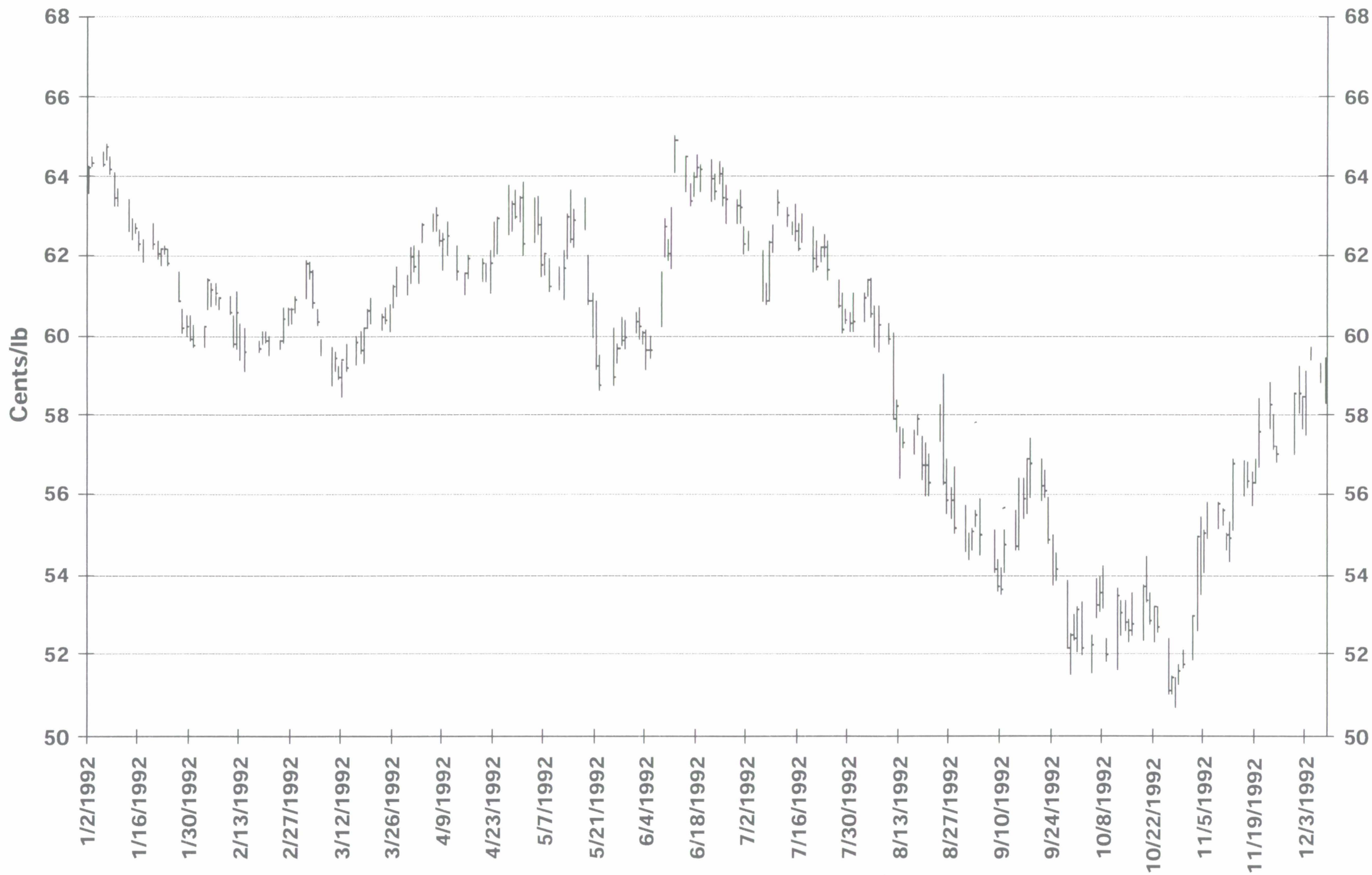


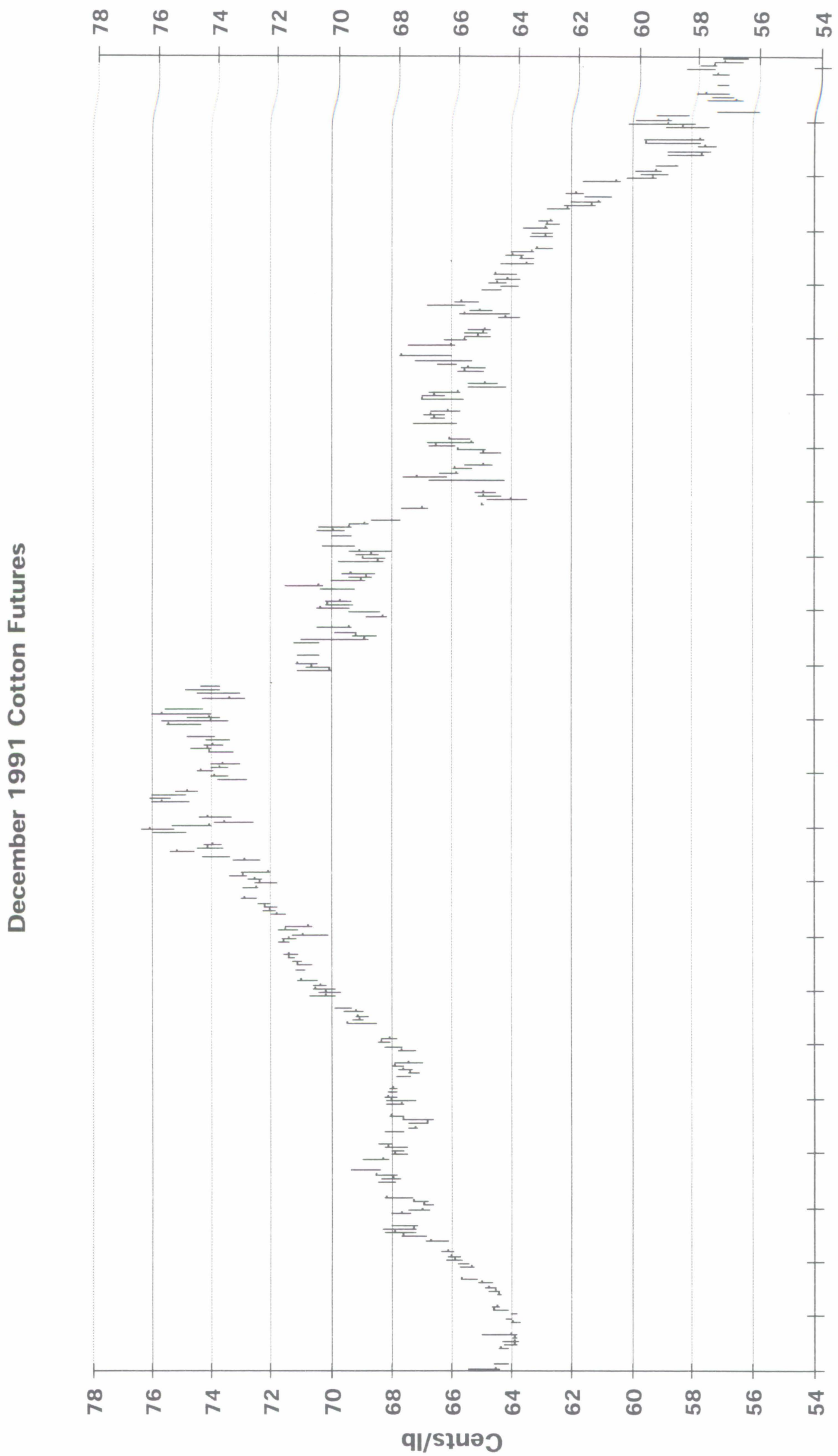
December 1994 Cotton Futures

December 1993 Cotton Futures



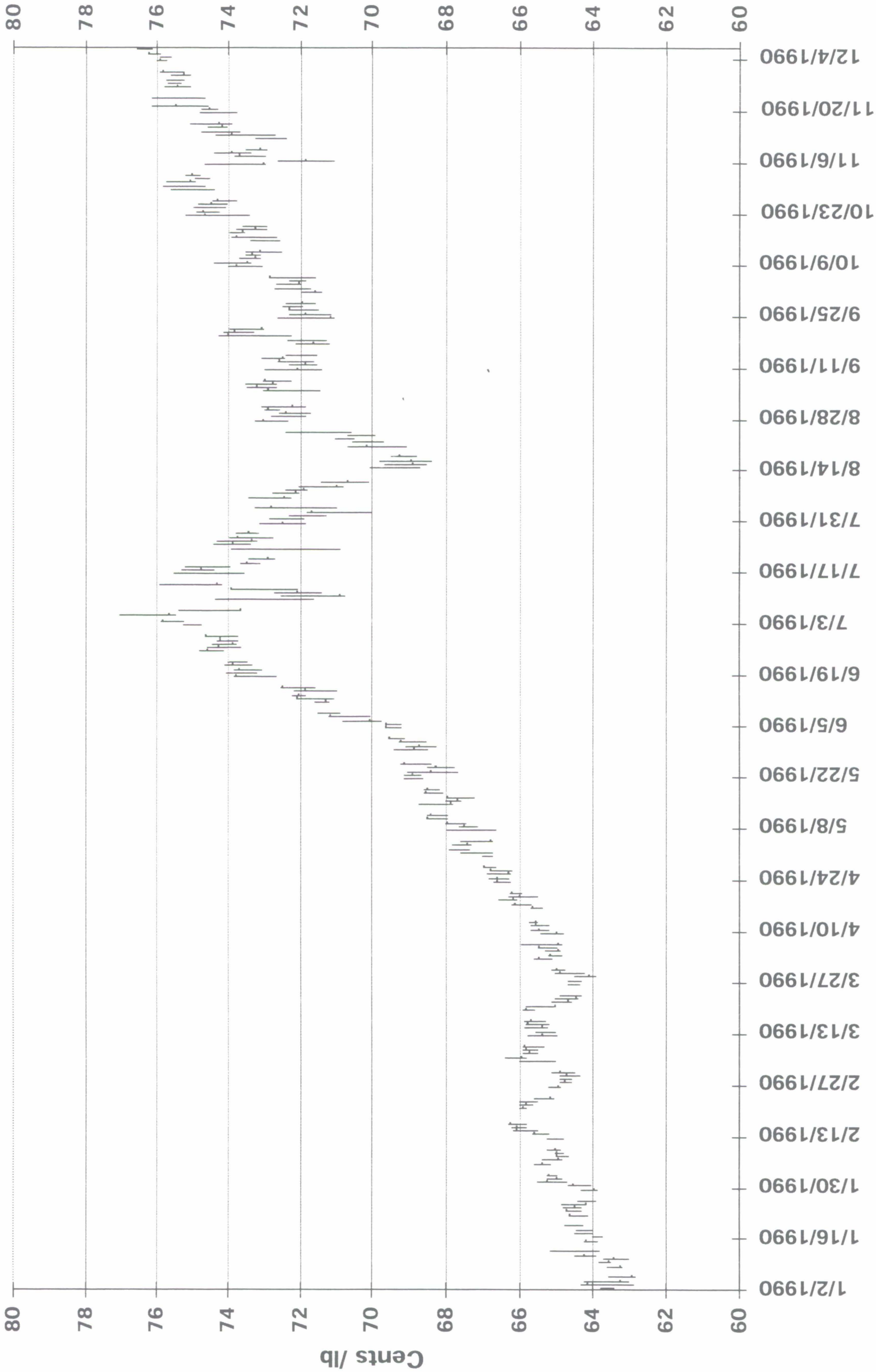
December 1992 Cotton Futures





December 1991 Cotton Futures
Cents/lb
78
76
74
72
70
68
66
64
62
60
58
56
54
1/2/1991
1/16/1991
1/30/1991
2/13/1991
2/27/1991
3/13/1991
3/27/1991
4/10/1991
4/24/1991
5/8/1991
5/22/1991
6/5/1991
6/19/1991
7/3/1991
7/17/1991
7/31/1991
8/14/1991
8/28/1991
9/11/1991
9/25/1991
10/9/1991
10/23/1991
11/6/1991
11/20/1991
12/4/1991

December 1990 Cotton Futures



APPENDIX B: FORMULAS AND DATA

Table B1. Price and ES% Data

Page 4. Price Equation with ES% only

Price = 131.64 –22.886 Ln(ES%)

Marketing Year	Price	ES%
	Cents/lb	%
90/91	68.2	14.2
91/92	58.1	22.8
92/93	54.9	30.2
93/94	58.4	20.4
94/95	72.0	12.9
95/96	76.5	14.2
96/97	70.5	22.1
97/98	66.2	20.6
98/99	60.2	26.7
99/00	45.0	23.1
00/01	55.1	29.3

Table B2. Yield Data

Page 8: Yield Equation

Yield = 440.99 + 7.899 Trend

Year	Yield	Trend
	lbs/harvested acre	
1970	438	1
1971	438	2
1972	507	3
1973	520	4
1974	442	5
1975	453	6
1976	465	7
1977	520	8
1978	420	9
1979	547	10
1980	404	11
1981	542	12
1982	590	13
1983	508	14
1984	600	15
1985	630	16
1986	552	17
1987	706	18
1988	619	19
1989	614	20
1990	634	21
1991	652	22
1992	700	23
1993	606	24
1994	708	25
1995	537	26
1996	705	27
1997	673	28
1998	625	29
1999	607	30
2000	631	31

Table B3. Mill Use Data

Page 10: Mill Use Equation

MillUse = 1,597+ 0.089 USProd + 0.70 MillUse(-1)

Year	Mill Use	Production	MillUse(-1)
	-----------------1,000 bales----------------		
1985	6,413	13,432	5,538
1986	7,452	9,731	6,413
1987	7,617	14,760	7,452
1988	7,782	15,411	7,617
1989	8,759	12,196	7,782
1990	8,657	15,505	8,759
1991	9,613	17,614	8,657
1992	10,250	16,218	9,613
1993	10,418	16,134	10,250
1994	11,198	19,662	10,418
1995	10,647	17,900	11,198
1996	11,126	18,942	10,647
1997	11,349	18,793	11,126
1998	10,401	13,918	11,349
1999	10,240	16,970	10,401
2000	9,500	17,220	10,240

Table B4. Export Data

Page 12: Export Equation

Exports = 11,94134 + 0.4258 USProd – 0.1763 ForProd(-1)

Year	Exports	Production	ForProd(-1)
	-----------------1,000 bales---------------		
1990	7,793	15,505	67,500
1991	6,646	17,614	71,600
1992	5,201	16,218	78,100
1993	6,862	16,134	66,300
1994	9,402	19,662	60,900
1995	7,675	17,900	66,200
1996	6,865	18,942	75,200
1997	7,500	18,793	70,600
1998	4,344	13,918	72,800
1999	6,750	16,970	70,960
2000	6,900	17,220	70,240

Table B5. Price, ES%, A-Index, and China Data

Page 13: Price Equation, all variables

Price = 77.52 – 9.16 Ln(ES%) + 0.151 A-Index(-1) – 0.002 China(X-1)

Year	Price	ES%	A-Index(-1)	China(X-1)
	¢/lb	%	¢/lb	1,000 bales
90/91	68.2	14.2	82.34	-1,277
91/92	58.1	22.8	82.87	-1,028
92/93	54.9	30.2	62.90	442
93/94	58.4	20.4	56.87	-59
94/95	72.0	12.9	70.75	-3,877
95/96	76.5	14.2	92.66	-3,024
96/97	70.5	22.1	58.61	-3,603
97/98	66.2	20.6	78.66	-1,800
98/99	60.2	26.7	72.11	322
99/00	45.0	23.1	58.97	1,580
00/01	55.1	29.3	52.85	0

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