# An Analysis of Substitution Relationships Among Different Staple Lengths of Cotton

By Louis Glass

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# AN ANALYSIS OF SUBSTITUTION RELATIONSHIPS AMONG DIFFERENT STAPLE LENGTHS OF COTTON

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# INTRODUCTION

## Problem Statement

Production and disappearance of United States Upland cotton, on an average annual basis, was approximately the same through the mid 1960's as in the 1930's (see tables in appendix for sources of data). Within this aggregate, however, there have been substantial changes in the relative importance of different staple lengths. For example, annual average production of cotton stapling less than one-inch[1] in the period 1938-41, was 5,075,000 bales (44% of total production), whereas annual average production of short staple cotton in the period 1962-66, was 3,801,000 bales (27% of total production). Annual average disappearance of short staple cotton has decreased from 5,555,000 bales in the 1938-41 period (48% of total disappearance) to 2,831,000 bales in the 1962-66 period (22% of total disappearance).

This situation is of particular concern to Texas cotton producers where, in recent years, an average of 70% of annual production is short staple cotton, and to Texas High Plains producers (crop reporting districts 1-N and 1-S), where an average of 96% of annual production is short staple cotton.

Production of agricultural commodities, including cotton, tends to vary considerably from one year to another because of adverse weather, disease, etc. This causes prices of these commodities to be high in

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[1] Throughout this report, unless otherwise specified, cotton stapling less than one-inch will be referred to as "short staple cotton." Upland cotton with a staple length of one-inch or greater will be referred to as "long staple cotton."

years of short crops and low in years of bumper crops. In order to provide for more uniform pricing, the Commodity Credit Corporation (CCC) was established by the Federal government in 1933 to support prices of agricultural commodities. In the case of most storable commodities, such as cotton, this was done by use of the "nonrecourse loan." Under this system, if the market price of a commodity is lower than the support price, the farmer places his product in acceptable storage and receives a loan reflecting the amount of the support price. If the market price rises above the loan rate, before a specified date, the farmer may sell his product and repay the loan plus storage costs. Otherwise, the commodity is delivered to the government and the farmer keeps the loan. The CCC may dispose of its acquired stocks whenever market prices exceed release prices or at times through non-competing outlets.

Prices for cotton, administered under this setup, have apparently been higher than they otherwise would have been. Production has tended to exceed offtake at support prices. Excessive accumulations of total CCC stocks have made special sales programs necessary to reduce the surplus.

Also, support prices for short staple cotton, relative to long staple cotton, have apparently been higher than the demand for short staple relative to the demand for all cotton would justify, especially in recent years. For example, on August 1, 1961, there was practically no short staple cotton in CCC stocks (approximately 3,000 bales). On August 1, 1966 there was a record high of 4,814,000 bales of short staple cotton in CCC stocks. This represented 40% of total CCC stocks, while annual average production of short staple cotton from August 1, 1962 through August 1, 1966 was only 27% of total production.

Objectives

The general objective of this report was to develop and analyze trends associated with technological and economic factors which may have important implications for determining the demand for short staple cotton. More specifically, the objectives were:

1. To develop and analyze trends in the supply and disappearance of different staple lengths of cotton.

2. To estimate statistically the influence of government price supports and various demand and supply factors and time on relative prices of short and long staple cotton.

3. To estimate statistically the effects of changes in relative prices of cotton on relative disappearance and supply and changes or shifts in relative demand, over time.

Review of Literature

There have been numerous publications concerning the demand and substitution interrelationships between various agricultural commodities. Schultz[2] developed the theoretical basis for several tests of demand interrelationships between different commodities. Hoos[3] investigated the demand relations of pears to plums, peaches, and oranges. Rudd and Shuffet[4]

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[2] Henry Schultz, The Theory and Measurement of Demand (Chicago, University of Chicago Press, 1938), pp. 569-654.

[3] Sidney Hoos, "An Investigation on Complementary Relations Between Fresh Fruits: A Rejoinder," Journal of Farm Economics, Vol. 24 (May 1942), pp. 528-529.

[4] Robert W. Rudd and D. Milton Shuffet, Demand Interrelationships Among Domestic Cigarette Tobaccos, Bulletin 633 (Lexington, June, 1955).

used disappearance and price ratios to explain the demand interrelationships between different kinds of cigarette tobacco in the United States. Meinken, Rojko and King[5] used various measurements of demand interrelationships to analyze the competitive relationships between beef and pork in Canada. Thuroczy[6] analyzed the demand relationships between long and medium grain rice.

The works of these authors, though not directly related to the demand interrelationships between different staple lengths of cotton, were of great assistance in providing guidelines for the theoretical and organizational format of this report.

CONCEPTUAL FRAMEWORK

Nonrecourse loan prices, administered through the Commodity Credit Corporation, are established by a system of premiums and discounts added to or subtracted from the price of a base quality and staple length of cotton (middling one-inch since 1955). The base price and premiums and discounts are set by the Secretary of Agriculture, in accordance with the legislation establishing the program. These support prices, when in effect, are the minimum market prices for all specified qualities of cotton. This is because the Federal government stands ready to take all eligible qualities of cotton which the farmer cannot sell on the market at loan prices or better.

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5 K. W. Meinken, A. S. Rojko and G. A. King, "Measurement of Substitution in Demand From Time Series Data - A Synthesis of Three Approaches," Journal of Farm Economics, Vol. 38 (August, 1956), pp. 711-735.

6 Nicholas M. Thuroczy, Marketing Long-and-Medium-Grain Rice, United States Department of Agriculture, Marketing Research Report No. 251)Washington, D.C.: Government Printing Office, July, 1958).

These are several ways in which the price and disappearance relationships between short and long staple cotton are affected by a price support program. In years when there is excess production of both short and long staple cotton, relative to the demand for cotton at support prices, the average market price ratio of short to long staple cotton is determined by the support price ratio. When the production of both short and long staple cotton is relatively low, market price ratios will be determined by the supply and demand situation, instead of price support ratios.

A low level of production of short or long staple cotton relative to all cotton production, will have the effect of widening the difference between price support ratios and average market price ratios. Net additions of all qualities of cotton to CCC stocks means price support ratios establish average market ratios, and the absence of net additions of all qualities to CCC stocks indicates that the supply and demand situation determines average market price ratios.

In the absence of price support programs, relative prices of different staple lengths would be determined by their relative supplies and demand, and excess production would move into domestic consumption, exports or private storage instead of CCC stocks. This would mean greater variations in the price of any one staple length relative to the prices of other staple lengths and smaller carryover stocks of various qualities relative to production from one year to another, since the demand for cotton is fairly stable.

The demand for a commodity may be defined as the quantity of that commodity which will be taken per unit of time at all possible alternative prices, other relevant factors held constant.[7] There are two separate but related groups of "other relevant factors" which do not stay constant and, therefore, affect the demand for an intermediate product [8] such as raw cotton. Both groups of factors have a significant influence on the demand for a raw product.

The first group may be classified under the broad heading of technology. Changes in technology include changes in machinery, labor, structure of the final product, and many other factors which have a direct effect on the manufacturing process itself. A change in any one of these factors can have important implications concerning raw product use.

The speed at which newer, more advanced, textile machinery is operated has increased significantly in recent years. For example, spindle speed has increased from 9,200 RPM in 1950 to 14,000 RPM in 1965 - a 52% increase in fifteen years.[9] Fiber quality tests conducted by the United States Department of Agriculture have shown that "... the longer staples are usually finer and stronger than the shorter staples ...,"[10] therefore, downtime, caused by thread breakage, is more frequent with the use of short staple cotton instead of the stronger, long staple cotton. This

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7 Richard H. Leftwich, The Price System and Resource Allocation, Third Edition (New York, Holt, Rinehart and Winston, 1966), p. 25.

8 An intermediate product is one which requires further processing before sale to the final consumer.

9 W. A. Turner, "Reaching Toward a Push-Button Era," The Cotton Trade Journal - 33rd International Edition, 1966, p. 23.

10 United States Department of Agriculture, The Classification of Cotton, Miscellaneous Publication No. 310, BAE, USDA (Washington, D.C.: Government Printing Office, May, 1938), p. 33.

increases fixed cost per unit of production, which, together with rising labor costs, sometimes makes the cost of using short staple cotton prohibitive.

Another change in the textile industry has been the increased production of blends of cotton and man-made fibers. This has also affected the demand for short staple cotton relative to all cotton since most of these blends are made using long staple cotton.[11]

Although technological changes in the textile industry have been important factors affecting the relative demand for short staple cotton, the second group of factors, which could be labeled as social standards of living and working, have also had important implications. One of these factors is rising per capita income. The demand for higher quality goods generally increases as incomes rise, and the production of higher quality cotton products usually requires longer staple cotton.[12]

Also, increased urbanization and the increase in the number of "white collar" workers relative to the number of "blue collar" workers has increased the demand for higher quality products.

Mathematically, the demand for short staple relative to the demand for long staple cotton can be expressed as:

$$R_Q = F(R_p/T, C, I)$$

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11 South Carolina Agricultural Experiment Station, Clemson University, Department of Agricultural Economics, Factors Affecting Use of Southeastern Cotton and Competing Fibers, Bulletin 532, February, 1967.

12 Walter V. Woodworth, Guest Editorial, The Cotton Digest International, February 17, 1968, p. 6.

where $R_Q$ = ratio of the quantities taken of the two commodities

$R_P$ = ratio of the price per unit of the two commodities

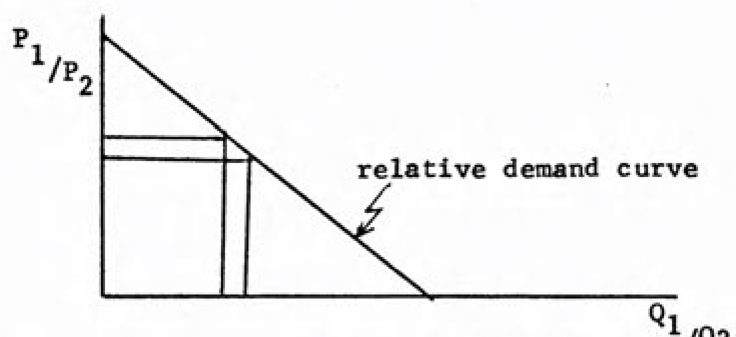
T = technology

C = consumer tastes and preferences

I = per capita income

The vertical bar denotes that all remaining variables are held constant, including time.

Graphically, the theoretical demand function for short staple relative to long staple cotton, at a given point in time, is illustrated in the following diagram:

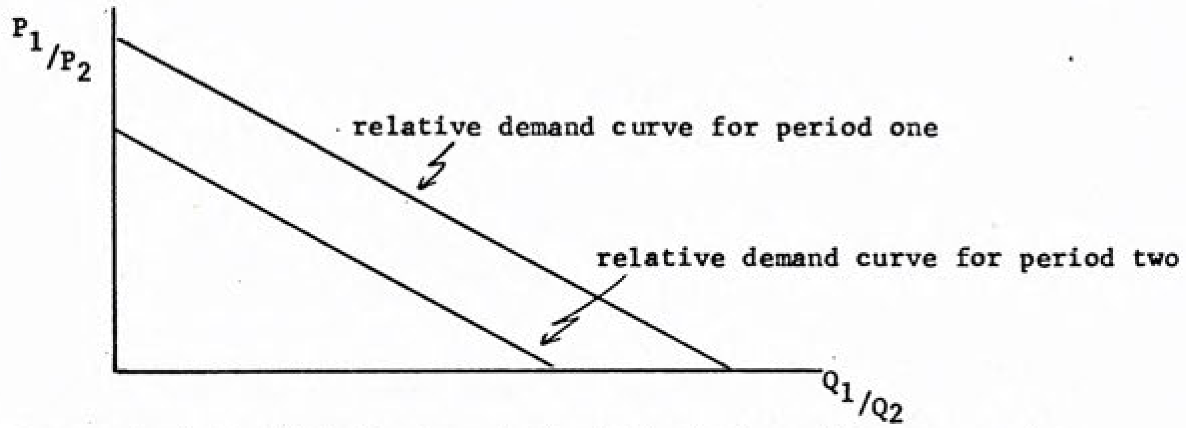



where: $P_1/P_2$ = price of short staple ($P_1$) relative to the price of long staple cotton ($P_2$) represented in this report by the price of middling 15/16" and middling 1 1/16" staple lengths cotton, respectively

$Q_1/Q_2$ = disappearance ratio of short staple to long staple cotton

The slope of the relative demand curve is the change in the price ratio associated with a point change in the disappearance ratio. Expressed as a logarithmic relationship between the price and quantity ratios, the slope of the relative demand curve is "the elasticity of substitution"[13] between short and long staple cotton.

Changes in the demand for short staple relative to long staple cotton over a long period of time, as discussed in the previous section, are illustrated in the following graph.




The above graph shows that the amount of short staple cotton consumed relative to the amount of long staple consumed, at all possible price relationships between the two, has decreased in the second period of time. This change occurred as a result of changes in standards of living and working, and changes in technology.

The demand for raw cotton by textile mills is determined by its spinning and weaving properties, quality of the finished product, etc. The quality of cotton yarn (thread), the end product of spinning, is classified under a number system. Smaller numbers represent coarse or thick yarn and the higher numbers represent the finer, higher quality yarns.

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13 Percent change in the quantity-ratio associated with a one-percent change in the price ratio (see page 17 for further discussion of the elasticity of substitution).

Shorter staple lengths are generally associated with lower yarn counts and longer staple lengths with higher yarn counts (see Table 1).

The uses or end products which can be made from different yarn counts vary from mill to mill. A mill with exceptionally good equipment and skillful operators can produce a given quality cloth with a lower quality of cotton. The staple length of cotton used in the production of ounce duck ranges from 13/16" to 1 1/32" (nearly 1/4" difference). There are several measures of the performance of manufactured cotton products. One of these measurements is yarn strength (in lbs. per sq. in.). As the lower end of the range of staple lengths is increased, yarn strength also increases (see Table 2), however, the subsequent increases are small, making it necessary to use a much greater staple length of cotton to increase the strength of the product significantly.

Waste decreases as the length of the staple increases, however, after leaving the shorter staple lengths (app. 13/16" or less), a large increase in the length of staple used would be necessary to make any significant changes in the amount of waste.

There is no current data available which specifies exactly what product a mill can produce, given a certain grade and staple length of cotton. Estimates of ranges of staple lengths used in the manufacture of various cotton products and the yarn count which may be expected from the different staple lengths, such as is presented in Table 3, is about as close to estimating the range of technical substitution between different staple lengths of cotton in the production of various end products as is possible with the information currently available.

Table 1 - Approximate Maximum Yarn Counts for Warp Yarns

Spun from Cotton of Specified Staple Lengths

| Staple Length of Cotton (inches) | Approximate Maximum Yarn Count |
|---|---|
| 7/8 | 16s |
| 29/32 | 20s |
| 15/16 | 24s |
| 31/32 | 28s |
| 1 | 32s |
| 1 1/32 | 36s |
| 1 1/16 | 40s |
| 1 3/32 | 44s |
| 1 1/8 | 50s |
| 1 3/16 - 1 1/4 | 60s |

Source: Qualities of Cotton Used in the United States of America to Produce Principal Fabrics, Anderson, Clayton, & Company, Fiber and Spinning Laboratory, Houston, Texas, 1956. p. 1.

Table 2 - Cottons Used in Mfg. of Various Fabrics, by

Yarn and Staple Length Classification

| Range of Staple Length | Average Staple Length | Yarn Strength (lbs.) | Product Produced | Yarn Count |
|---|---|---|---|---|
| 13/16 - 1 1/16 | 15/16 | 92-97 | Ounce Duck<br>Osnaburg<br>Blankets | 12s - 40s |
| 7/8 - 1 1/16 | $\frac{31.7}{32}$ | 102-108 | Warrow sheeting<br>Denim | 16s - 40s |
| 15/16 - 1 1/16 | $\frac{32.4}{32}$ | 103-108 | Chafer Fabric<br>Flannel | 24s - 40s |
| 31/32 - 1 1/16 | $\frac{32.4}{32}$ | 98-109 | Wide Sheeting<br>Woven Terry<br>Toweling<br>Jacquard Woven | 28s - 40s |

Source: "Cotton Fiber Table, 1958 Revision," <u>Textile World</u>, June, 1958.

Table 3 - Use of American Upland Cotton in U.S.

Textile Mills, by Yarn Classification, 1966

| Yarn Count | Total Number of Bales of Cotton Used | Number of Bales of Short staple Cotton Used | Short staple Cotton Used as a Percent of Total Cotton Used | Distribution of Short Staple Cotton Used in Textile Mills, by Yarn Classification |
|---|---|---|---|---|
| 8s - 12s | 35,500 | 30,999 | 87.32 | Coarse Yarn - 54,005 bales 23.04% of short staple cotton used by textile mills |
| 13s - 16s | 309,225 | 23,006 | 7.44 | |
| 17s - 19s | 287,951 | 77,544 | 26.97 | Medium yarn - 127,356 bales 54.34% of short staple cotton used by textile mills |
| 20s - 25s | 878,520 | 49,812 | 5.67 | |
| 26s - 31s | 838,383 | 52,996 | 6.32 | Fine yarn - 52,996 bales 22.61% of short staple cotton used by textile mills |

Source: Factors Affecting Use of Southeastern Cotton and Competing Fibers, Bulletin 532, Dept. of Ag. Eco., South Carolina Experimental Station, Clemson University, Clemson, South Carolina, February, 1967, p. 40.

Given the range of possible technical substitution between short staple and long staple cotton in the production of some end product, technology, tastes, and preferences held constant at some level, there will be some point at which the price differential between short and long staple cotton will be great enough that, even though processing costs using short staple cotton are higher, the lower price of the raw product will enable the textile mill to maximize profits by substituting short staple for long staple cotton.

A relatively lower price for short staple cotton, given technology, tastes and preferences, on the other hand, might enable the textile mill to maximize profits by producing a lower quality product with the now lower price raw product.

## METHODS AND PROCEDURES

The data used in the report was mostly secondary, coming primarily from U.S.D.A. publications. Some of the information concerning textile mills was taken from various textile journals and magazines. The period of analysis was 1938-66.

The first objective of this report was accomplished by tabulating the production, supply and disappearance of short and long staple cotton for each of the years in the analysis. Production, supply and disappearance ratios (percentages) of short staple to long staple cotton were computed for each year. Annual average market and government support price ratios of short staple to long staple cotton, represented by yearly average market and support prices of 15/16" and 1 1/16" staple length cotton, respectively, were also computed.

Linear least squares regression equations were used to accomplish the second and third objectives. A regression equation shows the functional relationship that exists between some dependent variable and one or more independent variables. This relationship may be expressed mathematically as:

$$Y = a + b_1X_1 + b_2X_2 + \cdots + b_iX_i$$

where: $Y$ = dependent variable

$a$ = regression constant term

$b_i$ = regression coefficients

$X_i$ = independent variables

$(i = 1, 2, 3, \ldots, k)$

This equation expresses the functional relationship that exists between the dependent variable Y and each of the independent variables, other relevant factors held constant. The absolute value of each of the regression coefficients ($b_i$) shows the change in the dependent variable as the result of a one-unit change in one of the independent variables, other variables held constant at a given level. The signs of the b-values indicate the kind of relationship (negative or positive) that exists between the dependent variables and each of the independent variables.

A logarithmic regression equation expresses the relationship between the dependent and the independent variables in percentage instead of absolute terms. The general form of a logarithmic regression equation is:

$$\log Y = a + b_1 \log X1 + b_2 \log X2 \ldots + b_i \log X_i$$

where: $y$ = logarithm of the dependent variable

$a$ = regression constant term

$b_i$ = regression coefficients

$\log X_i$ = logarithms of the independent variables

$(i = 1, 2, 3, \ldots, k)$

A one percent change in the independent variable $X_1$ will result in a $b_1$ percent change in Y , all other relevant variables held constant at a given level. The value of $b_1$, therefore, is the elasticity of demand for Y , if Y and $X_1$ represent quantity consumed per unit of time and price per unit of some product, respectively. The value of $b_1$ is the "elasticity of substitution" between two products if Y = quantity ratio and $X_1$ = price ratio of the two products.

There are many procedures used to test the closeness of the "fit" of a least squares estimating equation. Generally, several descriptive constants are examined at the same time to determine the validity of the estimating equation. One of these constants is the coefficient of determination ($R^2$), which is the percent of total variation of the dependent variable explained by the independent variables in the estimating equation. $R^2$ is not always necessarily a reliable measure of the "goodness of fit" for an estimating equation, however, such as when two or more of the independent variables are highly correlated.

Students' "t" test is a test of the significance of each of the independent variables in explaining variation of the dependent variable. Computed t's were compared to the tabulated t's in Table A.3 of Steel and Torrie[14] for levels of significance.

The regression equations and all related tests of significance were programmed and run on the Texas Tech IBM 7040 and IBM 360/40 computers.[15]

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[14] Robert G. Steele and James H. Torrie, Principles and Procedures of Statistics, (New York, McGraw-Hill Book Company, Inc. 1960).

[15] Programs were designed by Dr. H. Y. Lee of the Department of Agricultural Economics, Texas Technological College, Lubbock, Texas.

Elasticity of Substitution

The elasticity of substitution, using the price and quantity ratios of two commodities, is an indication of the kind of relationship which exists between the two commodities. A negative elasticity coefficient denotes substitution and a positive coefficient denotes complementarity. The magnitude of the coefficient indicates the degree of substitution. The elasticity of substitution may be defined as the percentage change in the quantity (disappearance) ratio of two commodities associated with a change of one percent in the price ratio of the two commodities, other factors held constant.[16] Mathematically, the elasticity of substitution is:

$$Es = \frac{\%\Delta Q_R}{\%\Delta P_R} = \frac{\Delta Q_R}{\Delta P_R} \cdot \frac{P_R}{Q_R} = \frac{\Delta X_1}{\Delta X_2} \cdot \frac{\bar{X}_2}{\bar{X}_1} = \frac{1}{b_1} \cdot \frac{\bar{X}_2}{\bar{X}_1}$$

where: Es = elasticity of substitution

$\Delta Q_R$ = change in the quantity ratio

$\Delta P_R$ = change in the price ratio

$\bar{X}_1$ = mean of the quantity ratios

$\bar{X}_2$ = mean of the price ratios

[16]K. W. Meinken, A. S. Rojko and G. A. King, "Measurement of Substitution in Demand from Time Series Data-A Sythesis of Three Approaches," Journal of Farm Economics, Vol. 38 (August, 1956), pp. 711-735.

# FINDINGS

## Trends and Developments in the Supply and Disappearance of Short Staple Cotton in the United States

### Production

#### U. S.

In 1938, 49% of the cotton produced in the United States had a staple length of less than one inch (short staple cotton). Production of 15/16" and 31/32" staple length cotton accounted for 55% of the short staple cotton produced. On the average, production of short staple cotton declined, both absolutely and relative to the production of all cotton in the period from 1938-1956. Production of short staple cotton dropped to a low, for the period of analysis, of 21% of total production in 1956. Since that time, the number of bales of short staple cotton produced per year has varied considerably, but the percentage of short staple to all cotton production has averaged approximately 25% of total production from 1956 to 1966. Production of 15/16" and 31/32" staple length cotton has increased relative to the production of all short staple cotton from 55% in 1938 to a high of 90% in 1960, but then decreased to 71% in 1966.

#### Texas

In 1940, 77% of the Texas cotton crop was short staple cotton.[17] The relative amounts of short staple and long staple cotton produced in Texas have varied from 83% in 1944 to 62% in 1957, averaging

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[17] 1940 is the first year in which production by staple lengths is available for Texas.

approximately 74% from 1940 - 1966.

The production of 15/16" and 31/32" staple length cotton has increased slightly, relative to the production of all short staple cotton, from 53% in 1940 to 69% in 1966. 89% of the short staple cotton produced in Texas in 1960 was 15/16" and 31/32" staple length, but this figure has decreased since then to 69% in 1966.

The production of short staple relative to long staple cotton has decreased during the period of analysis in the U. S., but has remained fairly constant in Texas. This means that the production of short staple cotton in Texas has increased relative to the production of short staple cotton in the United States. The production of 15/16" and 31/32" staple length cotton relative to the production of all short staple cotton has increased during the period in the United States and in Texas, but there has been a relatively greater increase in the U. S. This means that the production ratio of 15/16" and 31/32" staple length cotton to all short staple cotton in Texas has decreased relative to the production ratio of 15/16" and 31/32" in the United States.

High Plains

In 1940, 96% of the cotton produced on the High Plains of Texas (crop reporting districts 1-N and 1-S) had less than one inch staple length.[18] Production of 15/16" and 31/32" staple length cotton accounted for only 21% of the short staple cotton produced. The production of short staple cotton on the High Plains relative to the production of long staple has ranged from a high for the period of 98% in 1943 to a

[18] Earliest that production by staple lengths is available.

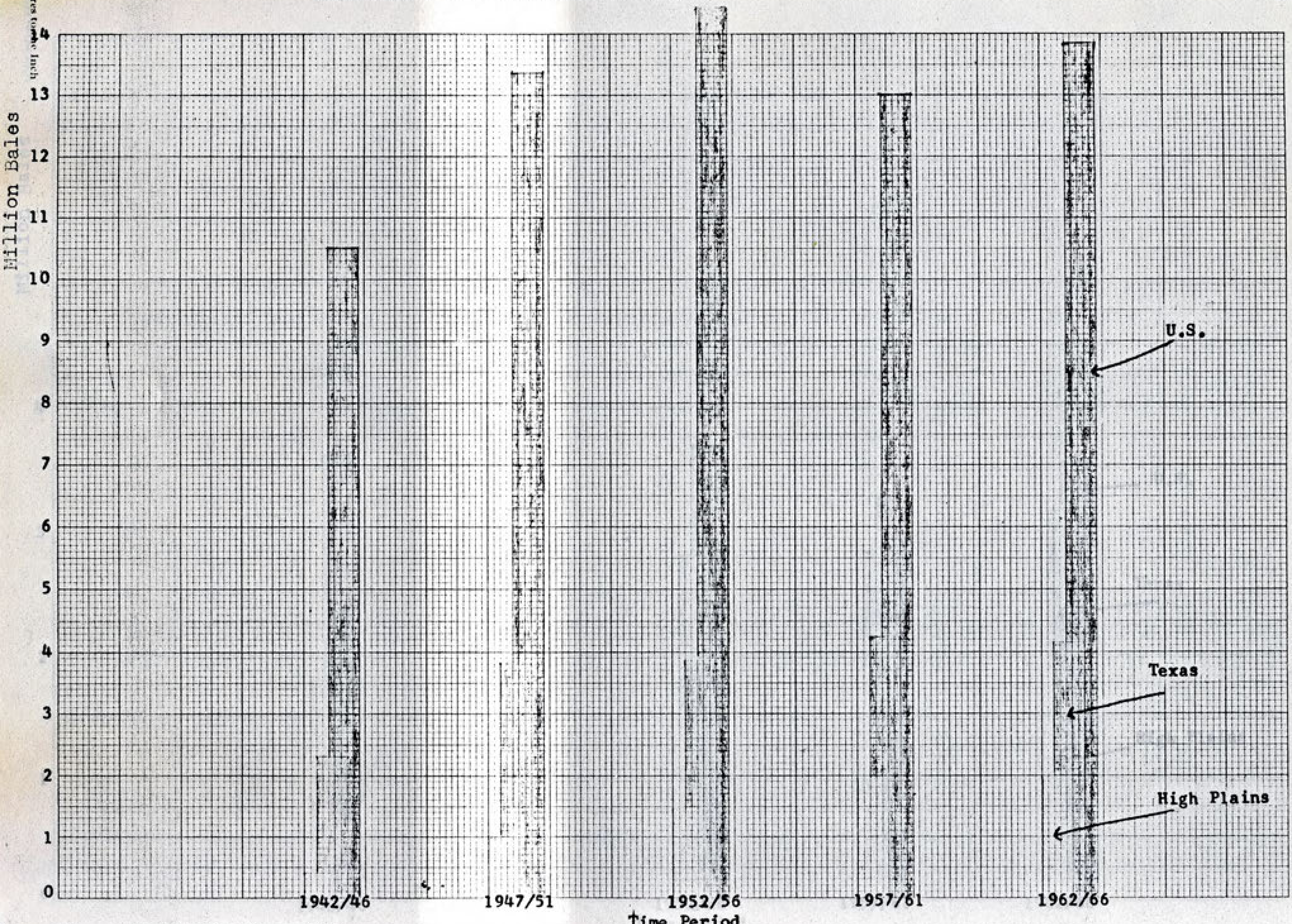
low of 71% in 1956. 88% of the 1966 High Plains' cotton crop was short staple cotton, however, 79% of the short staple crop was 15/16" and 31/32" staple length cotton.

The amount of short staple cotton produced on the High Plains relative to the amount of long staple production has remained fairly constant during the period, averaging around 90%. The amount of 15/16" and 31/32" staple length cotton produced, relative to the total amount of short staple cotton production, has increased significantly from 21% in 1940 to 79% in 1966. This means that the production of short staple cotton on the High Plains has remained about the same relative to the production of short staple cotton in Texas, and has increased relative to the production of short staple cotton in the U. S. The production ratio of 15/16" and 31/32" staple length cotton to the production of all short staple cotton has increased relatively more on the High Plains than in Texas and the United States.

## Summary of Production Trends in the U. S., Texas, and High Plains

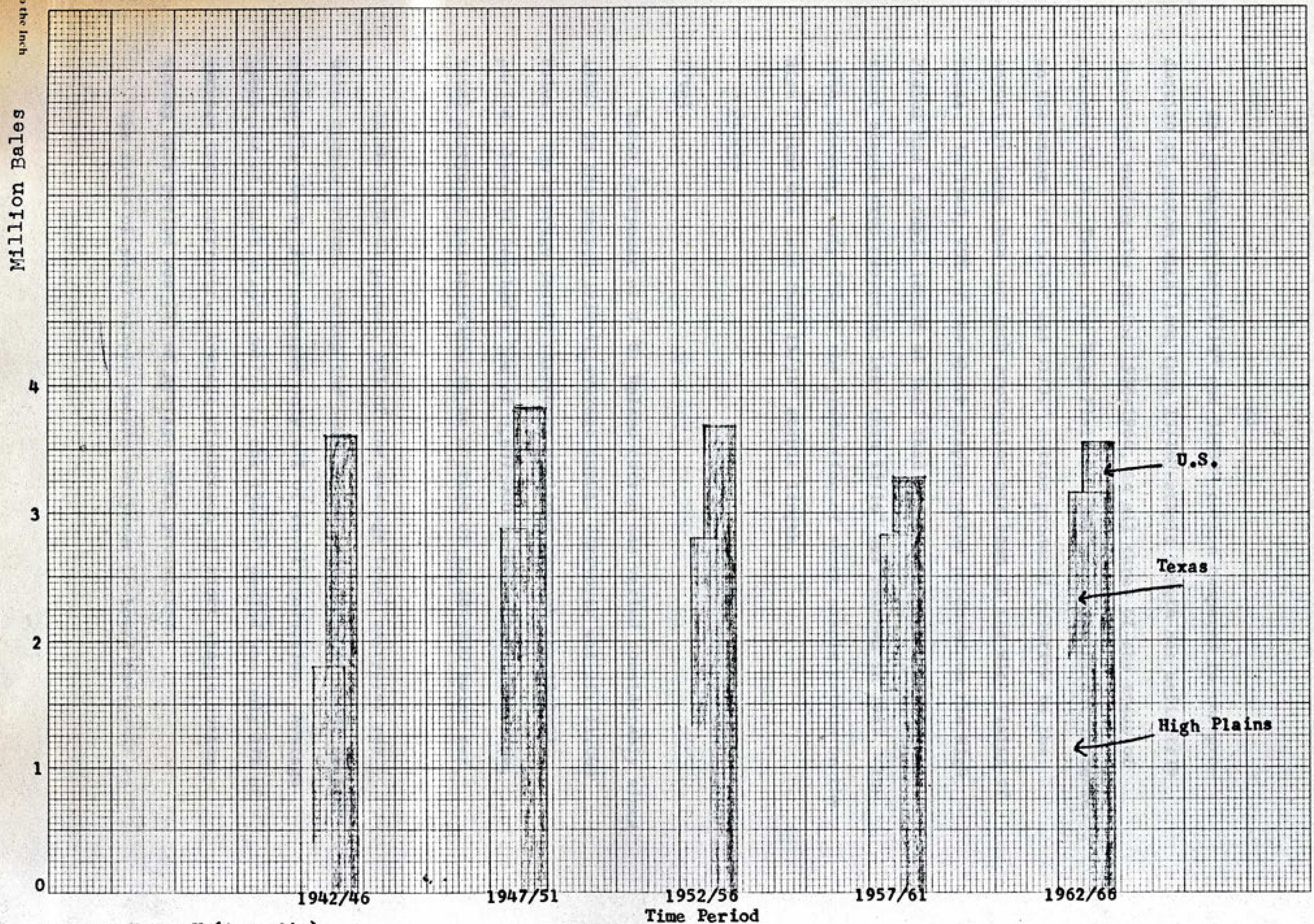
The amount of short staple cotton (less than one inch) produced in the United States has decreased from 49% of total production in 1938 to 27% in 1966. Texas' production of short staple cotton compared to the production of long staple cotton has remained fairly constant over the period. 77% of the 1940 Texas cotton crop was short staple cotton, compared with 75% in 1966. The High Plains has had a slight decrease in the production of short staple cotton compared to the production of long staple cotton. 96% of the 1940 High Plains crop was short staple cotton, decreasing to 88% in 1966 (See Figures 1 & 2).

Figure 1. Production of U.S. Upland cotton, United States, Texas, and High Plains, 1942-1966(5-year averages)




Source: Table IV (Appendix)

Figure 2. Production of <1" U.S. Upland cotton, United States, Texas, and High Plains, 1942-66, (5-year averages)




Source: Table V (Appendix)

The production of 15/16" and 31/32" cotton compared to the production of cotton with less than 15/16" staple length has definitely increased during the period 1938-1966, in all three of the areas of concern (U. S., Texas, and High Plains). The most significant increase in the amount of 15/16" and 31/32" cotton produced relative to the amount of less than one inch production has been in the High Plains of Texas. In 1940, 79% of the short staple cotton produced on the High Plains had a staple length of less than 15/16". A high of 97% of the short staple crop measuring less than 15/16" was reached in 1943. In 1966, however, only 21% of the production of short staple cotton on the High Plains was less than 15/16" staple length.

## Stocks

### Total

Total carryover of U. S. Upland cotton has varied considerably since 1938. In the period 1938-41 average annual carryover was 11,711,000 bales. The average yearly carryover declined through the 1947-51 period, where it reached a low of 3,897,000 bales. Since that time, total carryover has increased to an average of 12,284,000 bales per year in the 1962-66 period.

In the 1938-41 period, 61% of the average total carryover was short staple cotton. During the same period production of short staple cotton (in the U. S.) averaged only 44% of total production. Average carryover of short staple cotton in the 1947-51 period was only 17% of average total carryover. Average production of short staple cotton during this period was 28% of average total production.

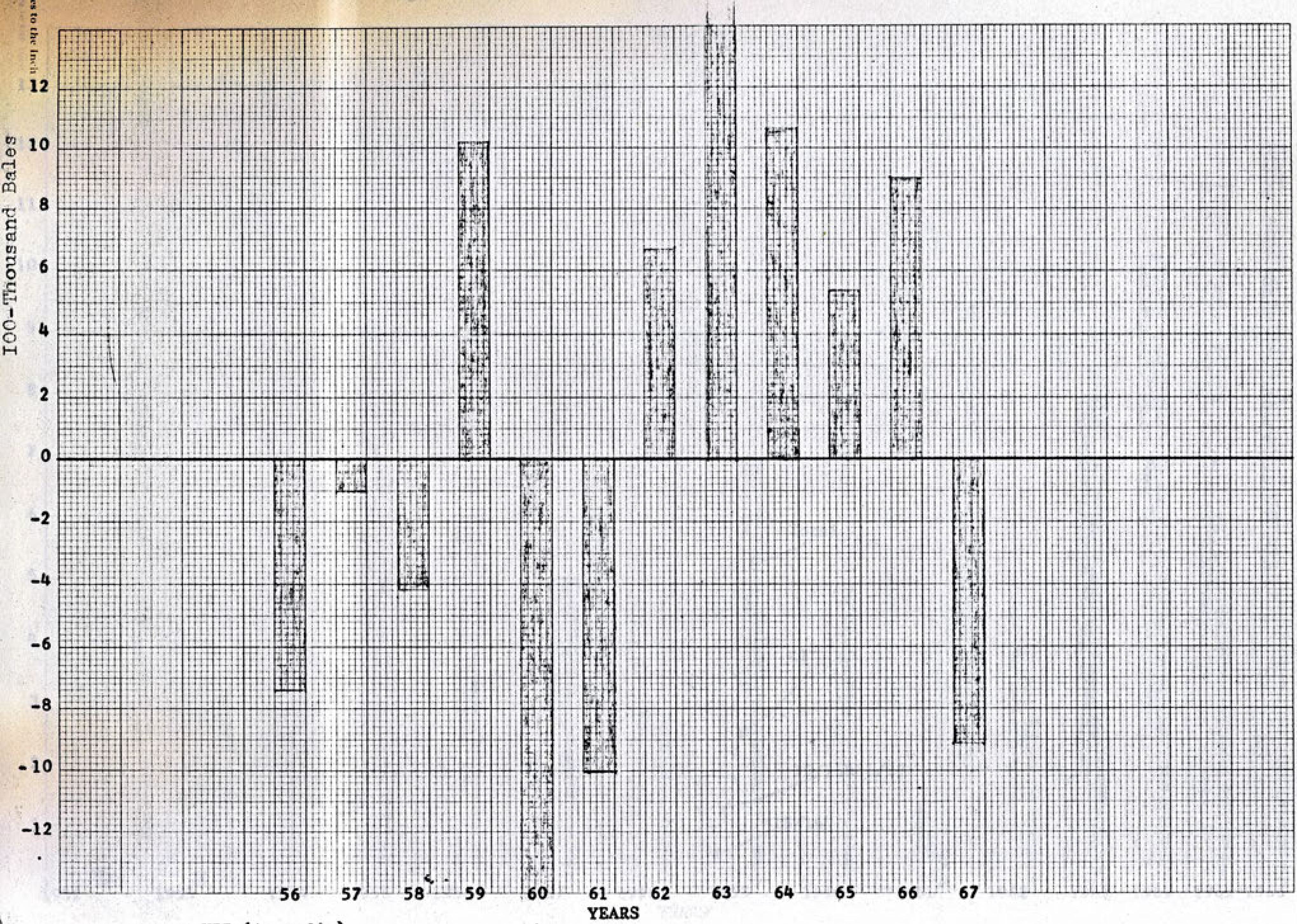
The ratio of short staple cotton carryover to total carryover as compared with the ratio of short staple production to total production has remained about the same beginning with the 1952-56 period (see Table 8). Short staple carryover has averaged from 30 to 32 percent of total carryover and short staple production has averaged from 24 to 26 percent of total production.

<u>CCC</u>

Data for CCC stocks by staple lengths is not available prior to 1952, and because of the lack of reliable data, the 1952-56 period was omitted from the analysis. In the 1957-61 period, an average of 1,572,000 bales of short staple cotton were in CCC stocks as of August 1, of each year. This represented about 32% of total CCC stocks and 83% of the average carryover of short staple cotton. There was only one year (1959) in this period in which there were net additions of short staple cotton to CCC stocks.

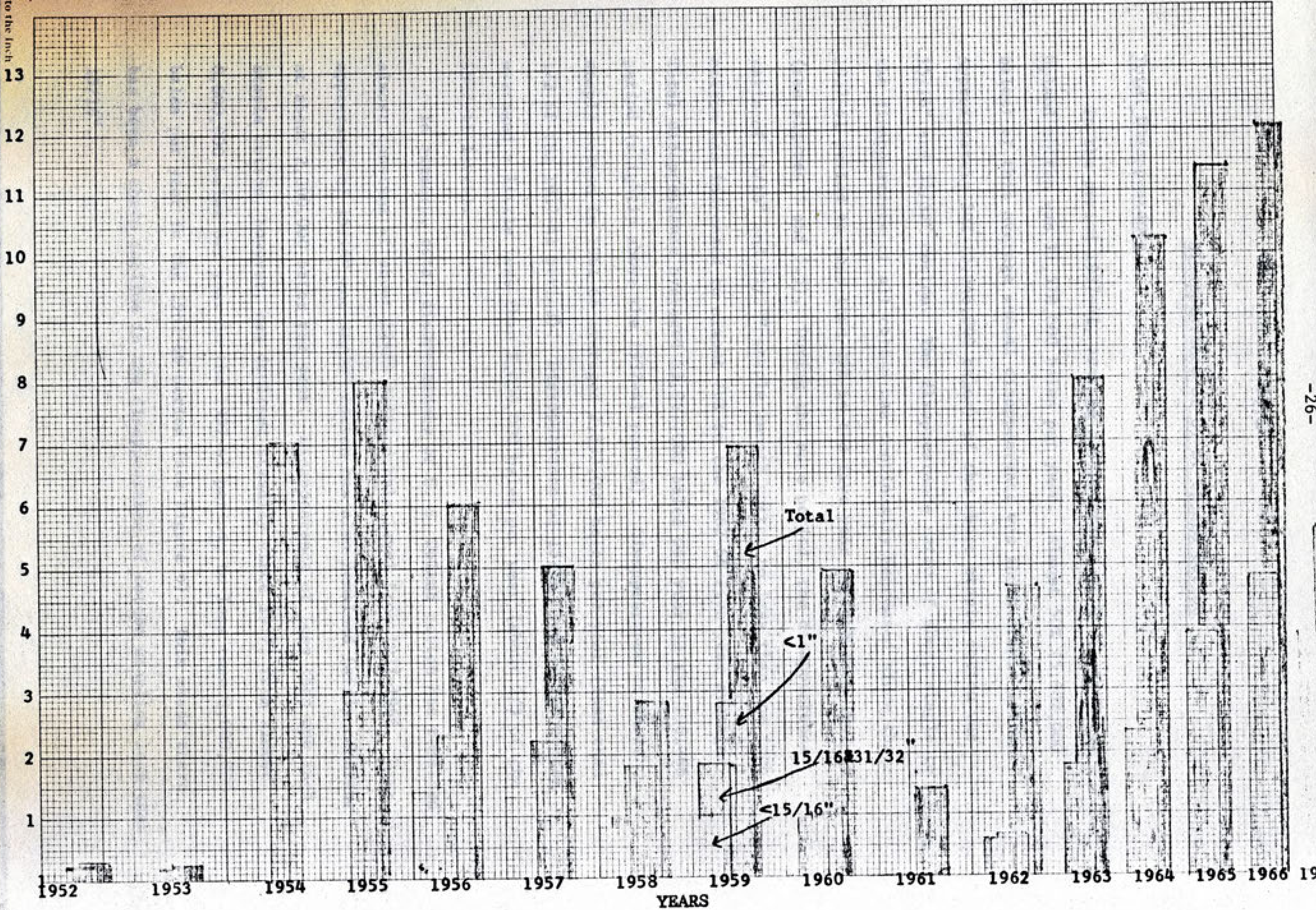
This situation quickly changed in the 1962-66 period where there was an average of 3,012,000 bales of short staple cotton in CCC stocks as of August 1, of each year. Although this represented only about 32% of total CCC stocks, compared to 37% in the previous period, net additions of short staple cotton to CCC stocks averaged 25% of the short staple cotton produced annually. Net additions of short staple cotton to CCC stocks averaged only 7% of short staple production in the previous 5-year period. Also, 83% of the annual average carryover of short staple cotton in 1962-66 went into CCC stocks, compared to only 59% in the last period (see Figures 3 and 4).

Figure 3. Net changes in <1" U.S. Upland cotton in CCC stocks during the year beginning August 1, United States, 1956-67




Source: Table VII (Appendix)

Figure 4. U.S. Upland cotton in CCC stocks, by staple lengths, as of August 1, 1952-67




20 Squares to the Inch

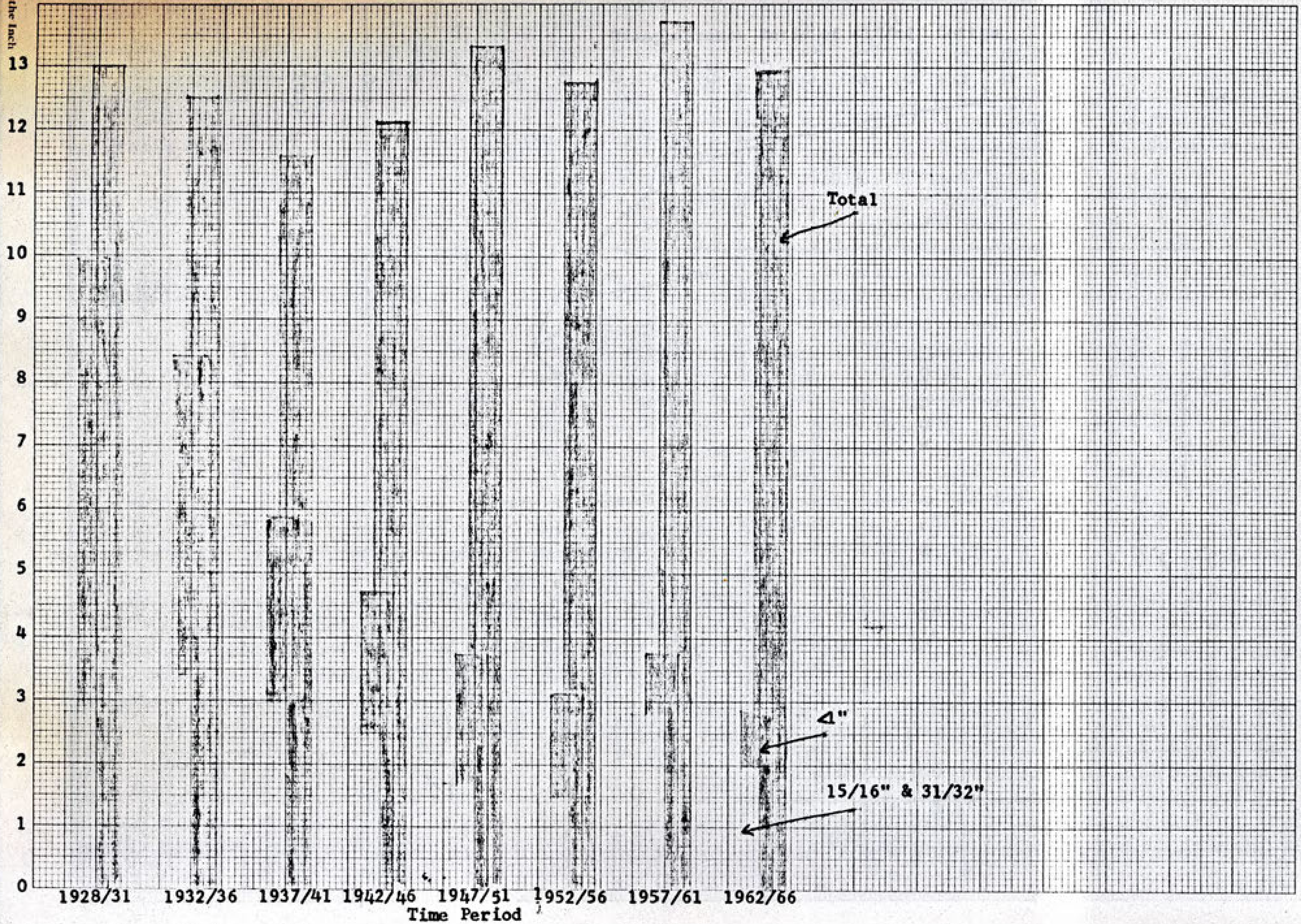
## Disappearance of U. S. Upland Cotton

### Total Disappearance

In the period 1937-41, average disappearance of U. S. produced Upland cotton was 11,578,000 bales per year. Almost 50% (5,902,000 bales) of this average annual disappearance was short staple cotton. Approximately 50% (2,946,000 bales) of the short staple cotton was 15/16" and 31/32" cotton. The disappearance ratio of short staple to the disappearance of all cotton has continually decreased since the 1937-41 period to less than 25% in the five year average from 1962-66 (see Figures 5 and 5.5). During the same period, the disappearance ratio of 15/16" and 31/32" staple length cotton to less than one inch cotton has increased to almost 70% in the 1962-66 five year average. Total disappearance averaged 12,961,000 bales per year in the 1961-66 period (slightly above the 1937-41 period). Disappearance of short staple cotton in 1961-66 averaged 2,833,000 bales per year (less than 1/2 of the 1937-41 period). Disappearance of 15/16" and 31/32" cotton averaged a little less than 2,000,000 bales per year (about 2/3 of the 1937-41 level).

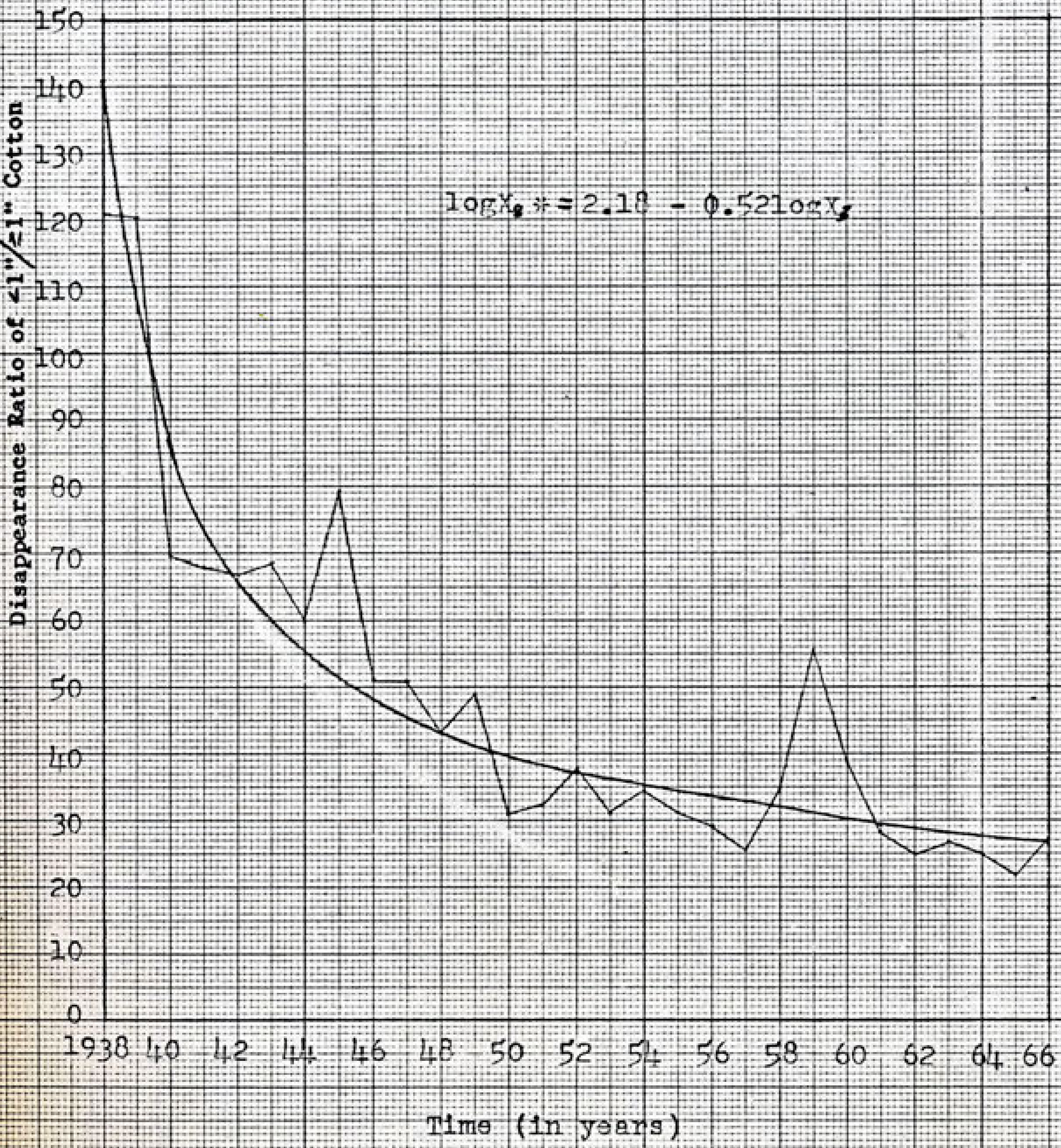
In summary, total disappearance of U. S. Upland cotton has remained almost constant at about 12-13 million bale level from 1937-1966. Disappearance of 15/16" and 31/32" cotton has also remained fairly constant at about 2,000,000 bales per year. Disappearance of less than one inch staple cotton, however, has declined steadily since 1937, from almost 6,000,000 bales per year in the 1937-41 period, to less than 3,000,000 bales per year in the 1962-66 period (see Figure 6). This means there has been a sharp decline in the disappearance of cotton stapling less than 15/16".

**Figure 5. Disappearance of U.S. [illegible]and cotton, by staple lengths, 1928-66 (5-year averages, except 1928-31)**



cotton as a function of time, average market price ratio of <1" to≥1" staple length cotton held constant at the mean, 1938-'66






Source: Equation(14),p. 55.

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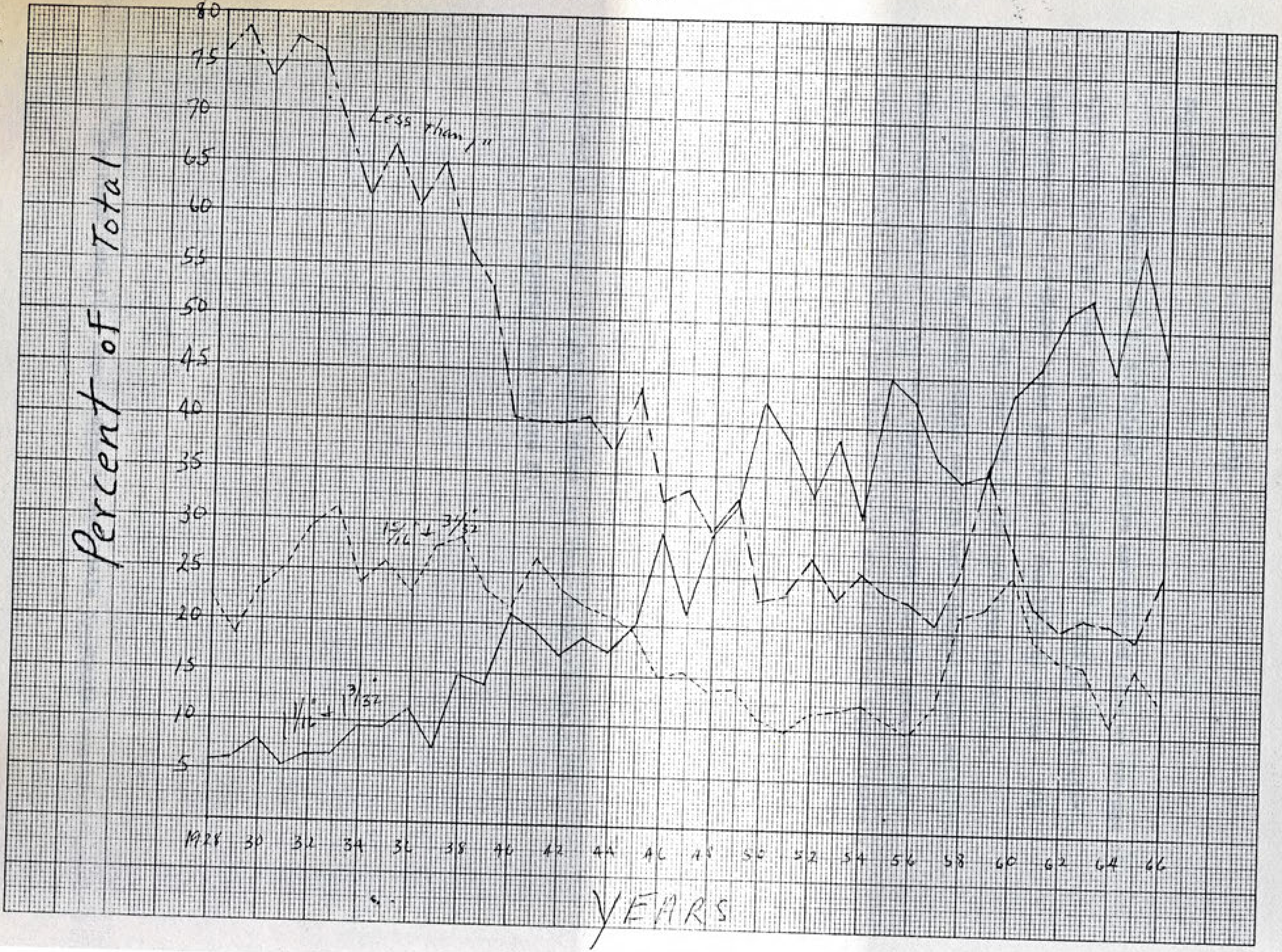
Figure 6. Disappearance of U.S. Upland cotton, by staple lengths, 1928-66



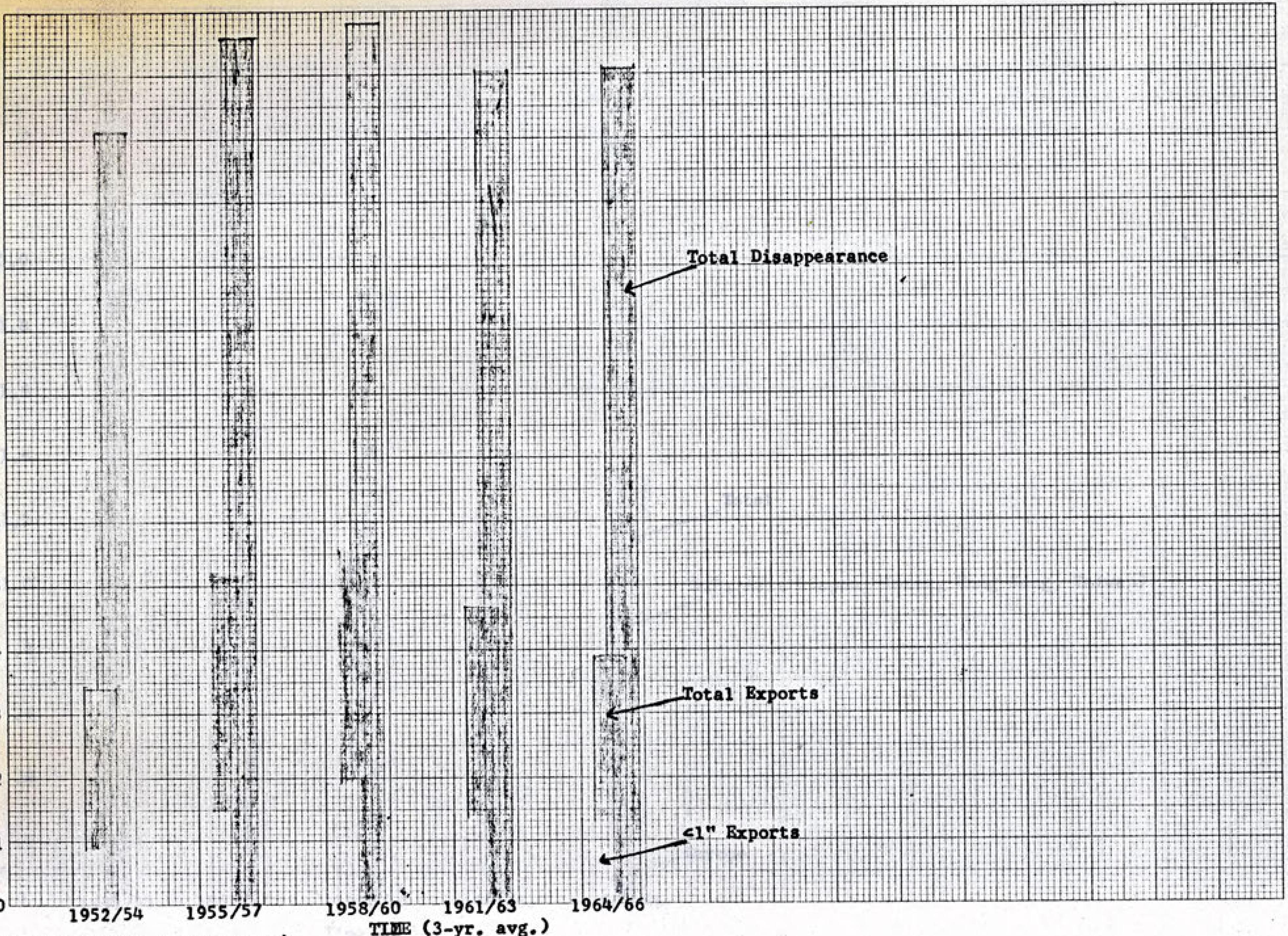
Exports

Total exports of U. S. Upland cotton have varied from an average of 4,013,000 bales per year in the 1952-56 period[19] (31% of total disappearance) to 5,448,000 bales per year in the 1962-66 period - 27% in 1952-56, 32% in 1957-61, and 32% in 1962-66 (see Figure 7).

Destinations of short staple exports have changed drastically since 1952. In the three year period, 1952-54, Europe received an average of 253,000 bales per year of short staple cotton (approximately 30% of short staple exports). In the same period, Southeast Asia (Japan, Korea, Hong Kong, and Taiwan) received an average of 440,000 bales per year (51% of short staple exports). There has been a continuous shift of short staple exports from Europe to Southeast Asia since that time. In the 1964-66 period, Europe received an average of 131,000 bales per year (19% of short staple exports) and Southeast Asia received an average of 1,038,000 bales per year--approximately 70% of short staple exports (see Figure 8).

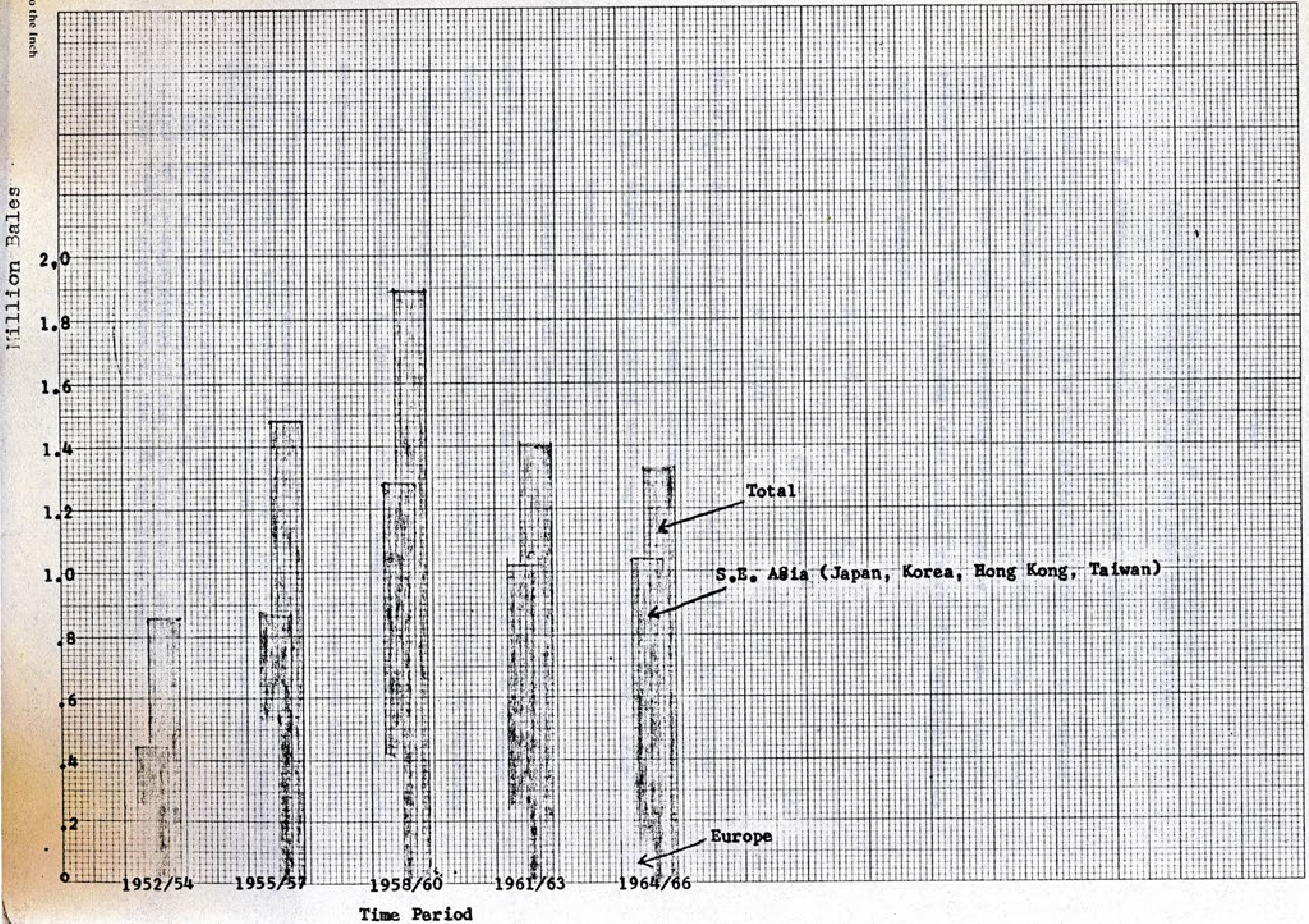
[19] Earliest date that export data is available by staple lengths.

Figure 7. Total disappearance, total exports, and 1" exports, U.S. Upland cotton, 1952-66




Source: Table XI (Appendix)

Figure 8. Destinations of 1" exports of U.S. Upland cotton, 1952-66, (3-year averages)



## STATISTICAL ANALYSIS OF THE SUBSTITUTION INTERRELATIONSHIP OF SHORT AND LONG STAPLE COTTON

### I. Average Market Price Ratio as the Dependent Variable

The first hypothesis to be statistically tested was that market price relationships for short and long staple cotton during the period 1943 - 1966, have been predominantly determined by government support prices on cotton. The following least square regression equation shows the empirical results.

$$X_1 = -6.07 + 1.06\,X_2 \qquad (1)$$
$$(7.2732^{***})$$

[20]

$$R^2 = 0.70$$

Where $X_1$ = average market price ratio of middling 15/16" to middling 1 1/16" staple length cotton

$X_2$ = support price ratio of middling 15/16" to middling 1 1/16" staple length cotton

The coefficient of the support price ratio has the expected sign and is significant at the 95% confidence level. The $R^2$ of 0.70 means that 70% of the variation in the average market price ratio is explained by the support price ratio.

The coefficient of $X_2$ indicates that a change of one-percentage point in the support price ratio will result in a change in the same direction

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[20] The number in parentheses below the coefficients in all least square equations in this report are t-values. The *'s beside the t-values indicate the significance of the coefficient under which the t-value appears as follows:

(a) No * = insignificant at the 90% confidence level
(b) * = significant at the 90% confidence level
(c) ** = significant at the 95% confidence level
(d) *** = significant at the 99% confidence level

in the average market price ratio of 1.06 percentage points, other relevant factors held constant. This means that the average market price ratio of short and long staple cotton changes in an approximate one to one ratio with the support price ratio short and long staple cotton (see Figure 9).

The "t" test in equation (1) indicates that the coefficient of the support price ratio is significantly different from zero. The hypothesis that the coefficient of the price ratio is equal to one was also tested by the following "t" test.

$$t = \frac{b-B}{Sb} = \frac{1.0629-1.0}{0.14614} = 0.4304$$

where: b = the estimated value of the coefficient of the support price ratio.

B = the hypothesized value of the coefficient of the support price ratio.

Sb = sample standard deviation of the estimated value of the coefficient of the support price ratio.

On the basis of the above t-tests, the hypothesis that the average market price ratio is dependent on the support price ratio in a 1:1 relationship is not rejected.

The addition of time to equation number one yielded the following least square estimating equation:

$$X_1 = 0.91 + 1.00\, X_2 - 0.09\, X_3 \qquad (2)$$

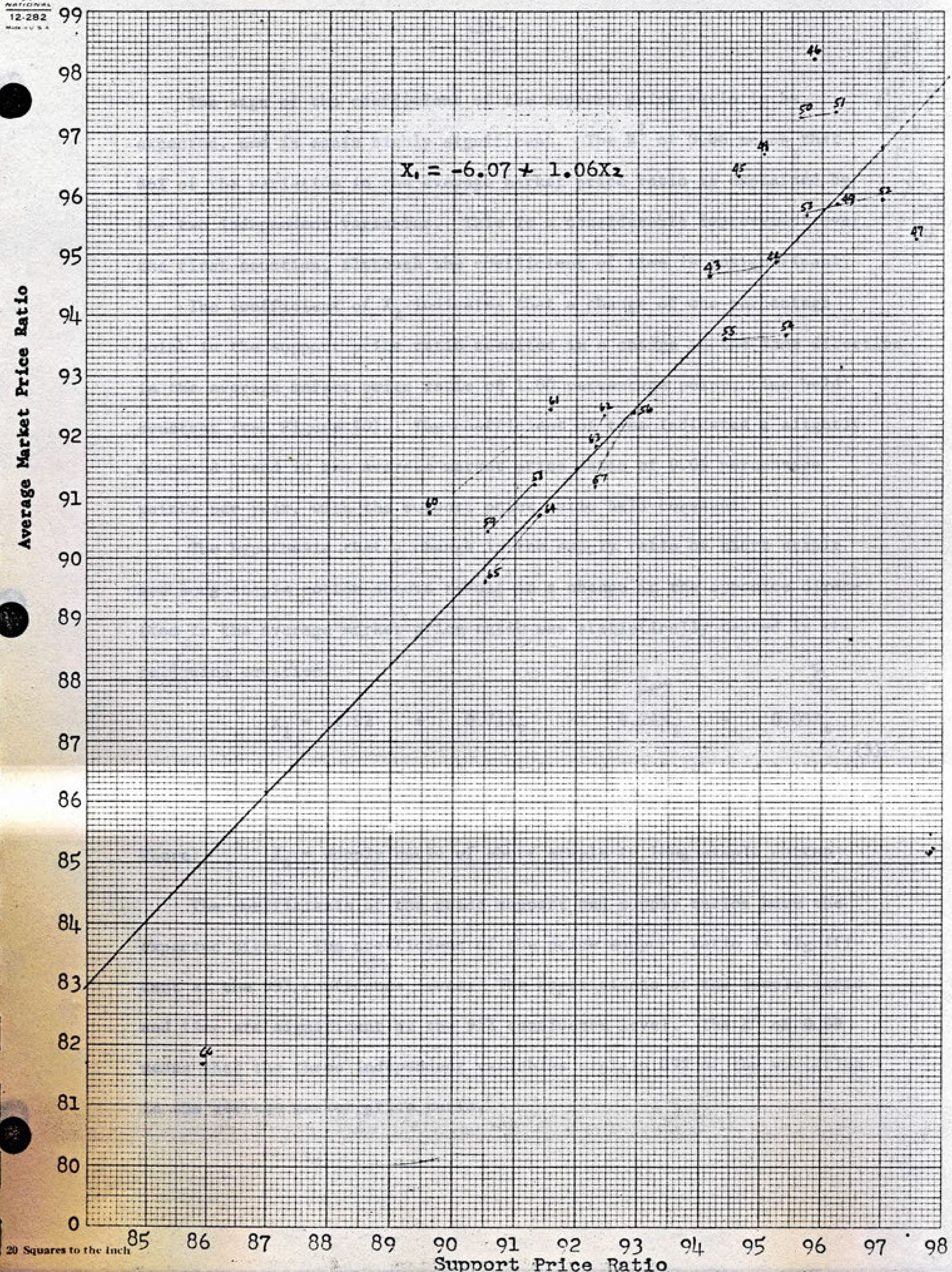
$$(5.8616^{***}) \qquad (-1.2846)$$

$$R^2 = 0.86$$

where: $X_3$ = time, in years (1943 = 1)

Figure 9. Average market price ratio as a function of government support price ratio, U.S. Upland cotton, 1943-'66





The sign of the coefficient of the support price ratio is as expected, and is again highly significant. The $R^2$ of 0.86 means that 86% of the variation in the average market price ratio is explained by the two independent variables. This is a considerable improvement over the first equation, although the coefficient of time is insignificant.

The coefficient of $X_2$ indicates that a change of one-percentage point in the support price ratio resulted in a change in the same direction in the average market price ratio of 1.00 percentage point, time held constant (see Figure 10). The coefficient of time indicates a slightly downward trend in the average market price ratio of 0.09 percentage points per year, with the support price ratio held constant.

The hypothesis that a change in the supply ratio of short staple and long staple cotton should result in a change in the opposite direction in the average market price ratio was statistically tested in the following equation.

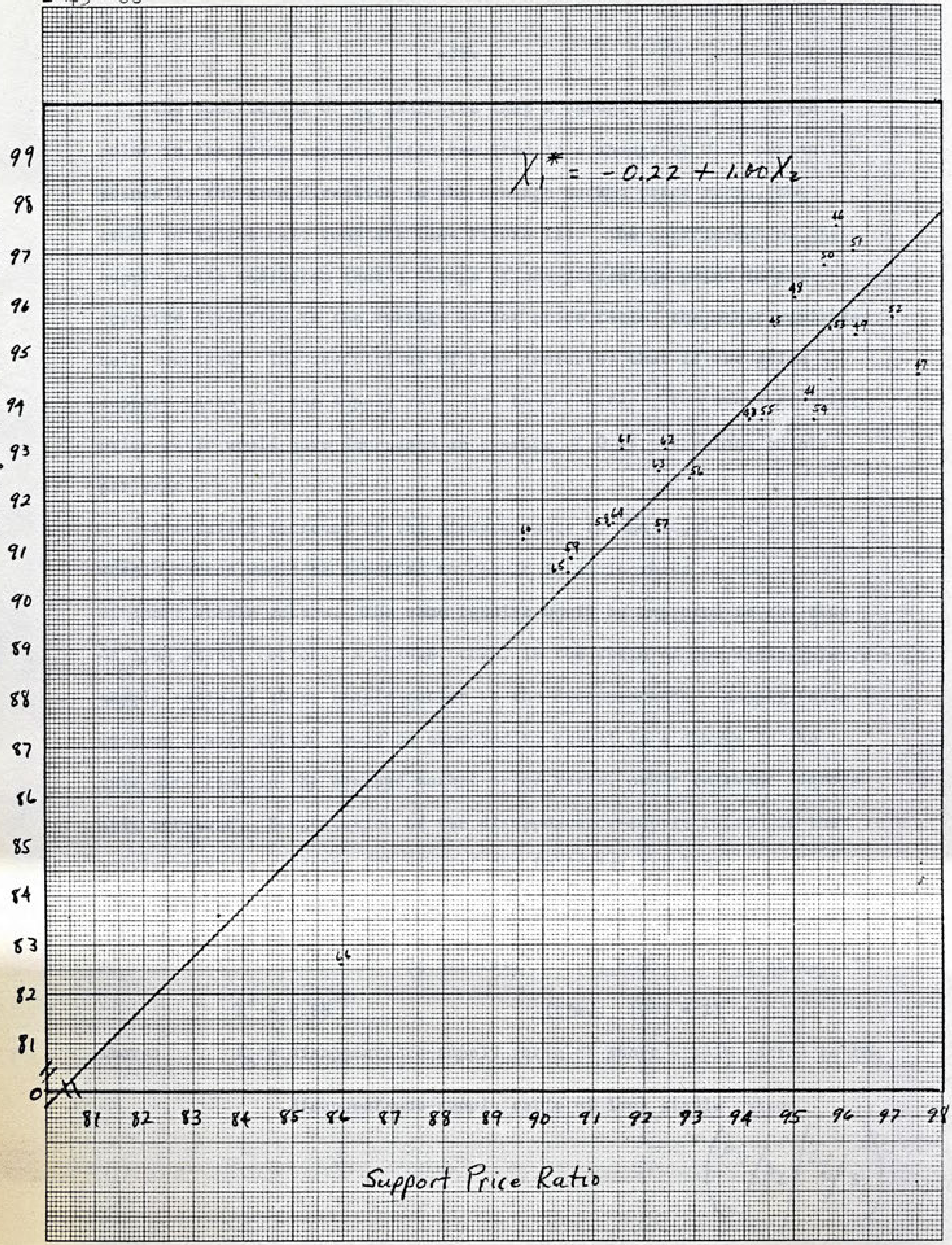
$$X_1 = 31.92 + \underset{(3.4848^{***})}{0.71X_2} - \underset{(-2.5622^{**})}{0.24X_3} - \underset{(-2.1742^{**})}{0.05X_4} \quad (3)$$

$R^2 - 0.89$ (time: 1943 = 1)

Where: $X_4$ = supply ratio of short staple to long staple cotton

The coefficients of the price support and supply ratios have the expected signs. The coefficient of the price support ratio is significant at the 99% confidence level. The coefficients of the supply ratio and time are significant at the 95% confidence level. The $R^2$ of 0.89 means that the three independent variables explain 89% of the variation in the average market price ratio.

Figure 10. Average market price ratio as a function of government price ratio, time held constant at the mean, U.S. Upland cotton, 1943-166 



The coefficient of $X_2$ indicates that a change of one-percentage point in the price support ratio resulted in a change of 0.71 percentage points in the same direction in the average market price ratio, the other variables held constant (see Figure 11). The coefficient of the supply ratio indicates that a change of one-percentage point in the opposite direction in the average market price ratio, the other variables held constant. The coefficient of time indicates that if the price support ratio and the supply ratio are held constant, the average market price ratio would have decreased an average of 0.24 percentage points per year.

A relative increase in the disappearance to the supply of short staple cotton would be expected to result in an increase in the price of short staple cotton. The same results would be expected in the case of long staple cotton. A change, then, in the ratio of the disappearance - supply ratio of short staple cotton to the disappearance - supply ratio of long staple cotton would be expected to result in a change in the same direction in the average market price ratio, other relevant factors held constant. Substitution of the disappearance-supply ratio for the supply ratio in equation (3) yielded the following results:

$$X_1 = 2.12 + 1.01X_2 - 0.06X_3 + 0.02X_5 \quad (4)$$

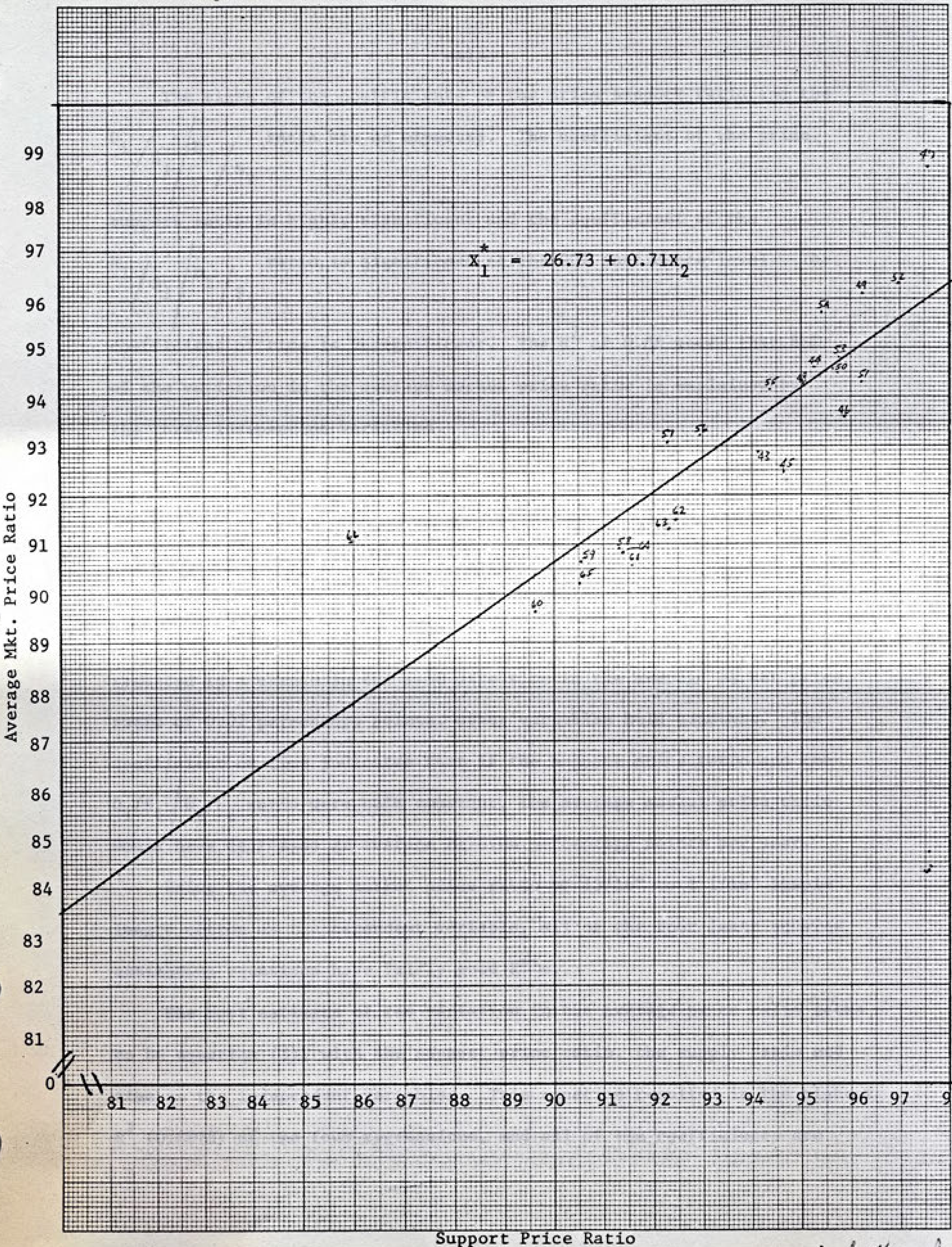
$$(6.3443^{***}) \quad (-1.0082) \quad (2.0578^{*})$$

$$R^2 = 0.88 \qquad \text{(time: } 1943 = 1)$$

where: $X_5$ = disappearance-supply ratio of short staple cotton to the disappearance-supply ratio of long staple cotton

$$\left( \frac{D_1 / S_1}{D_2 / S_2} \right)$$

ratio, supply and time ratios held constant at their means, U. S. Upland cotton, 1943 - '66.






Check on '66 [illegible]

The signs of the coefficients of the price support ratio and the $D_1/S_1 / D_2/S_2$ ratio are as expected. The coefficient of the price support ratio is highly significant and the coefficient of the $D_1/S_1 / D_2/S_2$ ratio is significant at the 90% confidence level. The coefficient of time is insignificant. The $R^2$ of 0.88 means that 88% of the variation in the average market price ratio is explained by the three independent variables.

The coefficient of $X_2$ indicates that a change of one-percentage point in the price support ratio resulted in a change in the same direction of 1.01 percentage point in the average market price ratio, other variables held constant (see Figure 12). The coefficient of $X_5$ indicates that a change of one-percentage point in the $D_1/S_1 / D_2/S_2$ ratio resulted in a change in the same direction in the average market price ratio of 0.02 percentage points, other variables held constant. The coefficient of time indicates that if the support price ratio and the $D_1/S_1 / D_2/S_2$ ratio were held constant, the average market price ratio would have decreased an average of 0.06 percentage points per year.

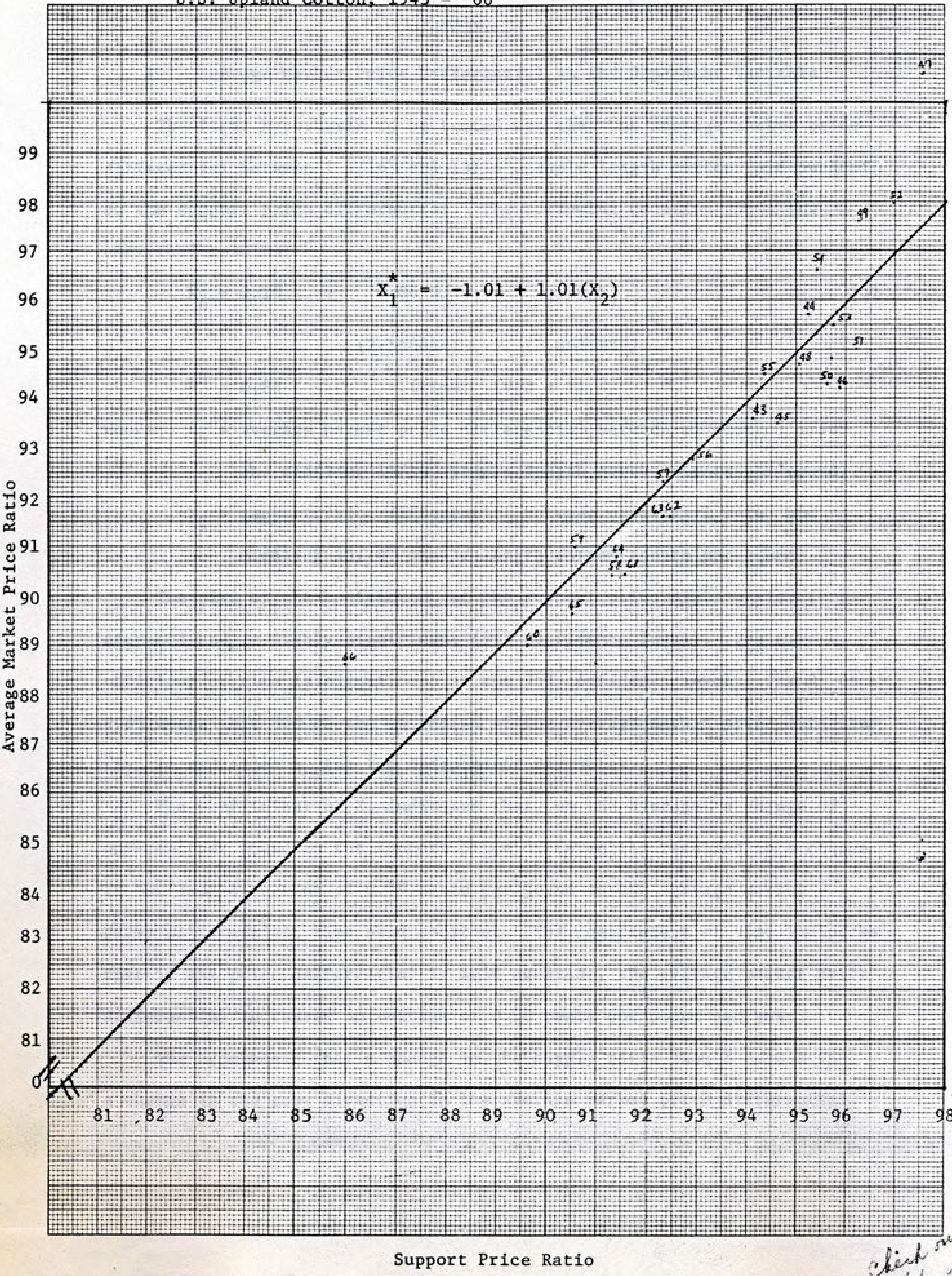
Using the average market price ratio of 15/16" to 1 1/16" staple length cotton as the dependent variable, all of the four least squares estimating equations have fairly good $R^2$'s.

The best estimate of the variation in the average price ratio seems to be equation (3), with the support price ratio, the supply ratio and time as the independent variables. This equation resulted in the highest $R^2$ (0.8875) of the four regressions, and all of the coefficients are significant at the 95% confidence level. The signs of the support price and supply ratios are as expected.

Equation (4) yielded an $R^2$ (0.8843) which is almost as good as equation (3). The signs of the support price and the $D_1/S_1 \big/ D_2/S_2$ ratios are as expected, but the coefficient of the $D_1/S_1 \big/ D_2/S_2$ ratio is not significant at the 95% confidence level.

Figure 12. Average Market Price Ratio as a function of government support price ratio, $D_1/S_1 / D_2/S_2$ ratio and time held constant at their means, U.S. Upland Cotton, 1943 - '66





## II. Average Market Price Differential as the Dependent Variable

The first hypothesis to be tested was that the average market price differential between 1 1/16" and 15/16" staple length cotton is dependent on the support price differential. The following equation shows the empirical results:

$$X_6 = 0.20 + 0.06\,X_3 + 0.59\,X_7 \qquad (5)$$

$$(2.5588^{**}) \qquad (2.8673^{***})$$

$$R^2 = 0.86 \qquad (\text{time: } 1943 = 1)$$

Where: $X_6$ = average market price differential between middling 1 1/16" and middling 15/16" staple length cotton (cents per pound).

$X_7$ = support price differential between middling 1 1/16" and middling 15/16" staple length cotton (cents per pound).

The sign of the coefficient of the support price differential is as expected and is highly significant (99% confidence level). The coefficient of time is significant at the 95% confidence level. The $R^2$ of 0.86 means that 86% of the variation of the average market price differential is explained by the two independent variables.

The coefficient of $X_7$ indicates that, on the average, a change of one-cent per pound in the support price differential resulted in a change in the same direction of 0.59 cents per pound in the average market price differential, time held constant. The coefficient of time indicates that if the price differential is held constant, the average market price differential increased an average of 0.06 cents per pound per year.

The hypothesis that a change in the supply ratio should result in a change in the same direction in the average market price differential was tested in the following equation:

$$X_6 = -0.48 + \underset{(3.7149^{***})}{0.10X_3} + \underset{(2.4375^{**})}{0.01X_4} + \underset{(2.1051^{**})}{0.42X_7} \quad (6)$$

$$R^2 = 89 \qquad \text{(time: } 1943 = 1)$$

The signs of the coefficients of the support price differential and the supply ratio are as expected. The coefficients of all three independent variables are significant at the 95% confidence level. The $R^2$ of 0.89 means that 89% of the variation in the market price ratio is explained by the three independent variables.

The coefficient of $X_7$ indicates that a change of one-cent in the support price differential resulted in a change in the same direction in the average market price differential of 0.42 cents per pound, other variables held constant. The coefficient of $X_4$ indicates that a change of one-percentage point in the supply ratio resulted in a change in the same direction in the average market price differential of 0.01 cents per pound, other variables held constant. The coefficient of $X_3$ indicates that if the support price differential and the supply ratio were held constant, the market price differential would have increased an average of 0.10 cents per year.

The disappearance - supply ratio of short staple cotton to the disappearance - supply ratio of long staple cotton was substituted for the supply ratio in equation (6). The following equation shows the results:

$$X_6 = 0.78 + \underset{(2.1264^{**})}{0.05X_3} - \underset{(-1.7176)}{0.006X_5} + \underset{(3.248^{***})}{0.65X_7} \quad (7)$$

$$R^2 = 0.88 \qquad \text{(time: } 1943 = 1)$$

The signs of the coefficients of the support price differential and the $D_1/S_1 \big/ D_2/S_2$ ratio are as expected. The coefficient of $X_7$ is highly significant (99% confidence level). The coefficient of $X_5$ is not significant and the coefficient of $X_3$ is significant at the 95% confidence level. The $R^2$ of 0.88 means that 88% of the variation in the average market price differential is explained by the three independent variables.

The coefficient of $X_7$ indicates that a change of one-cent per pound in the support price differential resulted in a change of 0.65 cents per pound in the same direction in the average market price differential, other variables held constant. The coefficient of $X_5$ indicates that a change of one-percentage point in the $D_1/S_1 \big/ D_2/S_2$ ratio resulted in a change of 0.006 cents in the opposite direction in the average market price differential, other variables held constant. The coefficient of $X_3$ indicates that if the support price differential and the $D_1/S_1 \big/ D_2/S_2$ ratio were held constant, the average market price differential would have increased an average of 0.05 cents per year.

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## III. Disappearance Ratio of Short to Long Staple Cotton As the Dependent Variable

The least squares estimating equations using the disappearance ratio of short staple to long staple cotton, generally were not as satisfactory as the equations with the average market price ratios and the average market price differentials as the dependent variables.

The first hypothesis to be tested was that the disappearance ratio is a function of the average market price ratio of 15/15" to 1 1/16" staple length cotton and time. The following equation shows the empirical results:

$$X_8 = 515.60 - 4.41\ X_1 - 3.61\ X_3 \qquad (8)$$

$$(-3.8408^{***}) \qquad (-8.0556^{***})$$

$$R^2 = 0.74 \qquad \text{(time: 1938 = 1)}$$

The sign of the coefficient of the average market price ratio is as expected. The coefficients of both of the independent variables are highly significant. The $R^2$ of 0.74 means that 74% of the variation in the disappearance ratio is explained by the two independent variables.

The coefficient of $X_1$ indicates that a change of one-percentage point in the average market price ratio resulted in a change in the opposite direction in the disappearance ratio of 4.41 percentage points, with time held constant. The coefficient of $X_3$ indicates that if the average market price ratio had been held constant, the disappearance ratio would have decreased an average of 3.61 percentage points per year.

The average market price ratio, lag one year, was added to equation (8) to test the hypothesis that a time lapse is necessary for the disappearance ratio to adjust to changes in the average market price ratio. The resulting regression equation was:

$$X_8 = 661.90 - 1.18X_1 - 3.41X_3 - 4.85X_9 \qquad (9)$$

$$(-1.0989) \qquad (-8.993^{***}) \qquad (-3.3015^{***})$$

$$R^2 = 0.80 \qquad \text{(time: 1939 = 1)}$$

where $X_9$ = average market price ratio of middling 15/16" to middling 1 1/16" staple length cotton, lagged one year.

The signs of the coefficients of the average market price ratio and the average market price ratio, lag one year, are as expected. The coefficient of the average market price ratio is not significant, but the coefficient of the average market price ratio, lag one year, is highly significant. This would tend to verify the hypothesis that the disappearance ratio of short to long staple cotton is dependent on the average market price ratio of the two commodities when time is sufficient for adjustments to be made. The $R^2$ of 0.80 means that 80% of the variation in the disappearance ratio is explained by the three independent variables.

The coefficient of $X_1$, indicates that a change of one-percentage point in the average market price ratio would have resulted in a change in the opposite direction in the disappearance ratio of 1.18 percentage points, other variables held constant. The coefficient of $X_9$ indicates that a change of one-percentage point in the average market price ratio, lag one year, resulted in a change in the opposite direction in the disappearance ratio of 4.85 percentage points, other variables held constant. The coefficient of $X_3$ indicates that if the average market price ratio and the average market price ratio, lag one year, were held constant, the disappearance ratio would have decreased an average of 3.41 percentage points per year.

A two-year time lag in the average market price ratio was then added to the estimating equation, with the following results.

$$X_8 = 572.90 - \underset{(-1.8972^{*})}{1.52X_1} - \underset{(9.3841^{***})}{2.91X_3} - \underset{(-0.7697)}{1.12X_9} - \underset{(-2.1208^{**})}{2.58X_{10}} \quad (10)$$

$R^2 = 0.83$ (time: 1943 = 1)

Where: $X_{10}$ = average market price ratio of middling 15/16" to middling 1 1/16" staple length cotton, lag two years.

The sign of the coefficients of the ratios are as expected. The coefficient of the average market price ratio, lag one year, is insignificant. The coefficient of the average market price ratio is only significant at the 90% confidence level. The coefficient of the average market price ratio, lag two years, is significant at the 95% confidence level, and the coefficient of time is significant at the 99% confidence level. The $R^2$ of 0.83 means that 83% of the variation in the disappearance ratio is explained by the three independent variables.

The coefficient of $X_1$ indicates that a change of one-percentage point in the average market price ratio resulted in a change in the opposite direction in the disappearance ratio of 1.52 percentage points, other variables held constant. The coefficient of $X_9$ indicates that a change of one-percentage point in the average market price ratio, lag one year, resulted in a change in the opposite direction in the disappearance ratio of 1.12 percentage points, other variables held constant. The coefficient of $X_{10}$ indicates that a change of one-percentage point in the average market price ratio, lag two years, resulted in a change in the opposite direction in the disappearance ratio of 2.58 percentage points, other variables held constant. The coefficient of $X_3$ indicates that if the average market price ratios remained constant, the disappearance ratio would have decreased an average of 2.91 percentage points per year.

The hypothesis that the disappearance ratio of short to long staple cotton will change in the same direction as the average market price differential was tested in the following equation:

$$X_8 = 80.94 \quad - \quad \underset{(-4.4704^{***})}{4.10\ X_3} \quad + \quad \underset{(2.0735^{**})}{14.89\ X_6} \qquad (11)$$

$R^2 = 0.65$ (time: 1938 = 1)

The sign of the coefficient of the average market price differential is as expected. The coefficients of both independent variables are significant. The $R^2$ of 0.65 means that 65% of the variation in the disappearance ratio is explained by the two independent variables.

The coefficient of $X_6$ indicates that a change of one-cent per pound in the market price differential resulted in a change in the same direction of 14.89 percentage points in the disappearance ratio, time held constant. The coefficient of $X_3$ indicates that if the average market price differential is held constant, the disappearance ratio would have decreased an average of 4.1 percentage points per year.

The average market price differential between 1 1/16" and 15/16" staple length cotton, lag one year, was added to the estimating equation. The following equation shows the results:

$$X_8 = 69.31 \quad - \quad \underset{(-4.5986^{***})}{3.95\, X_3} \quad + \quad \underset{(1.0825)}{7.08\, X_6} \quad + \quad \underset{(1.4257)}{10.44\, X_{11}} \qquad (12)$$

$$R^2 = 0.68 \qquad\qquad (\text{time: } 1939 = 1)$$

Where: $X_{11}$ = average market price differential between middling 1 1/16" and middling 15/16" staple length cotton, lag one year (cents per pound).

The signs of the average market price differentials are as expected, however, neither of the coefficients are significant. The coefficient of time is significant at the 99% confidence level. The $R^2$ of 0.68 means that 68% of the variation in the disappearance ratio is explained by the three independent variables.

The coefficient of $X_6$ indicates that a change of one-cent per pound in the average market price differential resulted in a change in the same direction in the disappearance ratio of 7.08 percentage points, other variables held constant. The coefficient of $X_{11}$ indicates that a change of one-cent per pound in the average market price differential, lag one year, resulted in a change in the same direction in the disappearance ratio of 10.44 percentage points, other variables held constant. The coefficient of $X_3$ indicates that if the average market price differentials were held constant, the disappearance ratio would have decreased an average of 3.95 percentage points per year.

A time lag of two years in the average market price differential was added to the previous equation to test the hypothesis that a two year lapse is required for a significant adjustment in the disa-ppearance ratio as a result of a change in the average market price differential. The following equation shows the results:

$$X_8 = 59.21 \quad - \quad \underset{(-6.238^{***})}{3.92\, X_3} \quad + \quad \underset{(1.8364^{*})}{8.09\, X_6} \quad + \quad \underset{(0.074)}{0.42\, X_{11}} \quad + \quad \underset{(2.3109^{**})}{11.90\, X_{12}} \qquad (13)$$

$R^2 = 0.78$ (time: 1940 = 1)

Where: $X_{12}$ = average market price differential between middling 1 1/16" and middling 15/16" staple length cotton, lag two years (cents per pound).

The signs of the coefficients of the average market price differentials are as expected. The coefficient of the average market price differential is significant at the 90% level of confidence. The co-efficient of the average market price differential, lag one year, is not significant. The coefficient of the average market price differential, lag two years, is significant at the 95% confidence level and the co-efficient of time is significant at the 99% confidence level. The $R^2$ of 0.78 means that 78% of the variation in the disappearance ratio is explained by the four independent variables.

The coefficient of $X_6$ indicates that a change of one-cent per pound in the average market price differential resulted in a change in the same direction in the disappearance ratio of 8.09 percentage points, other variables held constant. The coefficient of $X_{11}$ indicates that a change of one-cent per pound in the average market price differential, lag one year, resulted in a change in the same direction in the disappearance ratio of 0.42 percentage points, other variables held constant. The coefficient of $X_{12}$ indicates that a change of one-cent per pound in the average market price differential, lag two years, resulted in a change in the same direction in the disappearance ratio of 11.90 percentage points, other variables held constant. The coefficient of $X_3$ indicates that if the average market price differentials were held constant, the disappearance ratio would have decreased an average of 3.92 percentage points per year.

There were only two regression equations in which 80% or more of the variation in the disappearance ratio of short staple to long staple cotton was explained by the independent variables. These were equations (9) and (10) where the $R^2$'s were .80 and .83, respectively. A time lag in the average market price ratio of short staple to long staple cotton was used in both of these equations. This would tend to substantiate the hypothesis that a time lapse is necessary for a change in the average market price ratio to have a substantial effect on the disappearance ratio.

The equations with the lowest $R^2$'s are those with the average market price differentials as independent variables. This would tend to indicate that variation in the disappearance ratio of short to long staple cotton can be more adequately estimated by using percentages rather than absolute values.

Elasticity of Substitution

The elasticity of substitution (Es), which has been defined as the percentage change in the quantity (disappearance) ratio of two factors of production associated with a change of one percent in the price ratios of the two factors, other variables held constant, was computed for short and long staple cotton. The elasticity of substitution was computed from two different regression equations used in this report. From equation (8), the result was:

$$Es = \frac{1}{b_1} \cdot \frac{\bar{X}_1}{\bar{X}_8}$$

$$= \frac{1}{-4.41} \cdot \frac{93.69}{47.99}$$

$$= -0.2268\ (1.9523)$$

$$Es = -0.4428$$

This indicates that a change of one percent in the price ratio of short to long staple cotton will result in a change in the opposite direction of 0.44 percent in the disappearance ratio of short to long staple cotton, other factors held constant.

From equation (9), the result was:

$$Es = \frac{1}{b_9} \cdot \frac{\bar{X}_9}{\bar{X}_8}$$

$$= \frac{1}{-4.85} \cdot \frac{94.12}{45.02}$$

$$= -0.2062\ (2.0906)$$

$$Es = -0.4311$$

The elasticities of substitution of short staple for long staple cotton, computed from equations (8) (using average market price ratio) and (9) (using average market price ratio, lagged one year) are almost identical. According to these estimates, the substitution interrelationships between short and long staple cotton is highly inelastic. This means that a decrease in the price of short staple relative to the price of long staple cotton will result in a relatively smaller increase in the amount of short staple cotton consumed relative to the amount of long staple consumed.

## IV. Logarithmic Regression Equations

The underlying assumption in the preceding regression equations is that the disappearance ratios of short staple to long staple cotton are related to the average market price ratios (present year and one year lag) and the average market price differentials (present year and one year lag) of the two commodities in absolute terms. These relationships might be more adequately explained in constant percentage terms, where the coefficient of the average market price ratio would be the elasticity of substitution between short and long staple cotton. This type of relationship can be expressed easily by using logarithmic regression equations instead of arithmetic equations, which is done in the next four regression equations.

Equation (14) was used to test the relationship between the same variables used in equation (8). The hypothesis being tested was that a change in the average market price ratio of short to long staple cotton will result in a change in the opposite direction in the disappearance ratio of the two commodities. The empirical results were:

$$\log X_8 = 5.67 - 1.77 \log X_1 - 0.52 \log X_3 \qquad (14)$$

$$(-1.5324) \qquad (-10.0878^{***})$$

$$R^2 = 0.82 \qquad (\text{time: } 1938 = 1)$$

The sign of the coefficient of the average market price ratio is as expected. The coefficient of the average market price ratio, however, is insignificant. The coefficient of time is highly significant. The $R^2$ of 0.82 means that 82% of the variation in the disappearance ratio is explained by the two independent variables.

The coefficient of $X_1$ indicates that a change of one-percent in the average market price ratio resulted in a change in the opposite direction in the disappearance ratio of 1.77 percent, time held constant. The coefficient of $X_3$ indicates that if the average market price ratio had been held constant, the disappearance ratio would have decreased an average of 0.52 percent per year.

The average market price ratio, lag one year was added to equation (14) to test the significance of the effects of a time lag in the average market price ratio on the disappearance ratio. The variables used in equation (15) are the same as those used in equation (9). The results were:

$$\log X_8 = 6.14 - 1.35 \log X_1 - 0.46 \log X_3 - 0.70 \log X_9 \qquad (15)$$

$$(-0.682) \qquad (-7.9667^{***}) \qquad (-0.264)$$

$$R^2 = 0.77 \qquad (\text{time: } 1939 = 1)$$

The signs of the coefficients of the average market price ratios are as expected. The coefficients of both of these variables, however, are insignificant. The coefficient of time is highly significant. The

$R^2$ of 0.77 means that 77% of the variation in the disappearance ratio is explained by the three independent variables. The decrease in the $R^2$ in equation (15) can be attributed to the fact that when a variable with a one year time lag is added to an equation, the first year of the original analysis must be dropped. This has the effect of fitting the regression to a different set of data.

The coefficient of $X_1$ indicates that a change of one-percent in the average market price ratio resulted in a change in the opposite in the disappearance ratio of 1.35 percent, other variables held constant. The coefficient of $X_2$ indicates that a change of one-percent in the average market price ratio, lag one year, resulted in a change in the opposite direction in the disappearance ratio of 0.7 percent, other variables held constant. The coefficient of $X_3$ indicates that if the other variables were held constant, the disappearance ratio would have decreased an average of 0.46 percent per year.

The average market price differential between 1 1/16" and 15/16" staple length cotton was substituted for the average market price ratio of 15/16" to 1 1/16" staple length cotton. The variables used in the following logarithmic equation are the same as those used in equation (11). The results were:

$$\text{Log } X_8 = 2.24 - \underset{(-6.1012^{***})}{0.61 \log X_3} + \underset{(1.4418)}{0.18 \log X_6} \qquad (16)$$

$$R^2 = 0.82 \qquad \text{(time: } 1938 = 1\text{)}$$

The coefficient of the average market price differential has the expected sign, but is not significant. The coefficient of time is significant at the 99% confidence level. The $R^2$ of 0.82 means that 82%

of the variation in the disappearance ratio is explained by the two independent variables.

The coefficient of $X_6$ indicates that a change of one-percent in the average market price differential resulted in a change in the same direction in the disappearance ratio of 0.18 percent, time held constant. The coefficient of $X_3$ indicates that if the average market price differential had been held constant, the disappearance ratio would have decreased an average of 0.61 percent per year.

In the following equation, the average market price differential, lag one year, was added to equation (16) to test the effects of a time lapse in the average market price differential on the disappearance ratio. The variables used in the following logarithmic equation are the same as those used in equation (12). The results were:

$$\log X_8 = 2.21 - \underset{(-5.04^{***})}{0.62 \log X_3} + \underset{(1.1651)}{0.19 \log X_6} + \underset{(0.7906)}{0.12 \log X_{11}} \qquad (17)$$

$R^2 = 0.78$ (time: 1939 = 1)

Both coefficients of the average market price differentials have the expected signs, however, neither are significant. The coefficient of time is again highly significant. The $R^2$ of 0.78 means that 78% of the variation in the disappearance ratio is explained by the three independent variables. The lower $R^2$, after the addition of another independent variable to the regression equation is probably due to the same reason as was explained in equation (15).

The coefficient of $X_6$ indicates that a change of one-percent in the average market price differential resulted in a change in the same direction in the disappearance ratio of 0.19 percent, other variables held constant. The coefficient of $X_{11}$ indicates that if the average market price differential, lag one year, changed one percent, the disappearance ratio changed in the same direction by 0.12 percent, other variables held constant. The coefficient of $X_3$ indicates that if $X_1$ and $X_2$ were held constant, the disappearance ratio would have decreased an average of 0.62 percent per year.

## Elasticities of Substitution

It was pointed out earlier that the coefficient of the price ratios of two commodities in a logarithmic regression equation, with the disappearance ratio of the two commodities as the dependent variables, is the elasticity of substitution between the two commodities. According to the results of equation (14), the elasticity of substitution between short staple and long staple cotton is -1.77. This indicates that a change of one percent in the average market price ratio will result in a change in the opposite direction in the disappearance ratio of short to long staple cotton of 1.77 percent, other factors constant.

The results of equation (15) show the elasticity of substitution between short staple and long staple cotton to be -0.70, using the coefficient of the average market price ratio, lag one year, or -1.35, using the average market price ratio with no time lag.

The elasticities of substitution, from the logarithmic equations, are far more elastic than those computed from the arithmetic equations (-0.43 and -0.44). Since time was highly significant and the average market price ratios were not significant in either logarithmic equation, the coefficients of these variables probably have little meaning. The market price ratios in the arithmetic equations, though, were highly significant. Taking all these factors into consideration, the elasticity of substitution between short and long staple cotton, as computed from the arithmetic equations, is probably more realistic, although possibly a little low.

V. Production Ratio as the Dependent Variable

out

Equation (18) tests the hypothesis that the production ratio of short to long staple cotton is dependent on the average market price ratio, lag one year.

$$X_{13} = 425.92 - 228\,X_3 - 3.71\,X_9 \qquad (18)$$

$$(-5.5949^{***}) \quad (-2.6969^{**})$$

$$R^2 = 0.60 \qquad (1939 = 1)$$

The sign of the coefficient of the average market price ratio, lag one year, is not as expected. The expected result of a change in the average market price ratio is a change in the production ratio in the same direction. The coefficient of the average market price ratio, lag one year, is significant at the 95% confidence level. The coefficient of time is significant at the 99% confidence level. The $R^2$ of 0.60 means that 60% of the variation in the production ratio is explained by the two independent variables.

The coefficient of $X_9$ indicates that a change of one-percentage point in the average market price ratio, lag one year, resulted in a change of 3.72 percentage points in the production ratio, other variables held constant. The coefficient of $X_3$ means that if the average market price ratio, lag one year, had been held constant the production ratio would have decreased an average of 2.28 percentage points per year.

The addition of the average market price ratio, lag two years, was added to equation (18) with the following result:

$$X_{13} = 305.89 - 1.66\, X_3 - 0.41\, X_9 - 2.15\, X_{10} \qquad (19)$$

$$(-4.3781^{***}) \quad (-0.2499) \quad (-1.3917)$$

$$R^2 = 0.55$$

The signs of the coefficients of the average market price ratios, lag one year ($X_9$) and lag two years ($X_{10}$) are not as expected. Neither of the coefficients are significant. The coefficient of time is highly significant. The $R^2$ of 0.55 means that only 55 percent of the variation in the production ratio is explained by the three independent variables.

The coefficient of $X_9$ indicates that a change of one-percentage point in the average market price ratio, lag one year, resulted in a change in the opposite direction in the production ratio of 0.41 percentage points, other variables held constant. The coefficient of $X_{10}$ indicates that a change of one-percentage point in the average market price ratio, lag two years, resulted in a change in the opposite direction in the production ratio of 2.15 percentage points, other variables held constant. The coefficient of $X_3$ indicates that if the average market price ratios were held constant, the production ratio would have decreased an average of 1.66 percentage points per year.

The unexpected results of the regression equations used to test the hypothesis that the production ratio of short to long staple cotton is positively dependent on the average market price ratio, lagged in time, can probably be attributed to acreage controls by government programs and the concentration of certain varieties of cotton in different cotton producing areas. For example, producers on the High Plains of Texas are somewhat limited in their choice of cotton varieties due to the relatively short growing season. Producers in areas where the longer stapled varieties are grown are reluctant to shift to other varieties because of the uncertainty of future price relationships between different staple lengths of cotton and the extra expenses involved in changing from the production of one commodity to that of another.

## SUMMARY AND CONCLUSIONS

Production of U. S. Upland cotton in the United States and Texas has remained fairly constant since the 1930's. There has been a gradual increase in production on the High Plains of Texas. The production of short staple cotton has decreased in the United States, remained about the same in Texas, and has increased in absolute amounts produced, on the High Plains. There has been a definite decrease in the production of cotton stapling less than 15/16", in absolute quantities and relative to all short staple cotton produced, in the United States, Texas, and the High Plains.

Carryover of short staple cotton from one year to another has varied considerably since the 1930's. Average carryover of short staple cotton, relative to carryover of all cotton, has been less than average production of short staple relative to all cotton produced in only one period of the analysis (1947-51).

The amount of short staple cotton in CCC stocks has also varied considerably, following a trend of buildup and decline. However, since 1961, at which time there was virtually no short staple cotton in CCC stocks, there has been a continuous buildup of short staple cotton in CCC stocks.

Disappearance of U. S. Upland cotton in the United States has followed the same general pattern as production, with respect to total amount consumed and consumption of different staple lengths. Exports have accounted for an average of 34% of annual disappearance of all cotton since 1952. Short staple cotton exports, relative to total disappearance of short staple cotton, have increased from an annual average of 35% in 1952-56 to 47% in 1962-66.

There has been a marked change in the destination of exports of short staple cotton since 1952. Europe received an average of 30% and Southeast Asia received 51% of the short staple exports in 1952-54. In 1964-66, Europe received only 10%, while Southeast Asia received approximately 70% of the short staple exports.

The results of the regression analysis indicates that relative prices of short and long staple cotton are primarily determined by government support prices on short and long staple cotton, but that the supply of short staple relative to the supply of long staple cotton is also a significant factor in determining their relative prices. Time is also an important factor because by holding the support price and supply relationships constant, the results of the regression analysis show that the price of short staple relative to the price of long staple cotton has decreased over time.

Results of the regression analysis also indicate that the disappearance ratio of short to long staple cotton is significantly influenced by their price relationships. This supports the hypothesis that the consumption of short staple cotton can be influenced by a change in its price relationship with long staple cotton. Time is, again, an important factor. Results of the regression analysis indicate that, with the relative price ratios of short to long staple cotton held constant, the disappearance of short staple, relative to long staple cotton, will decrease over time.

As a result of these tests, there can be little doubt that the demand for short staple cotton relative to the demand for long staple cotton has decreased during the period of this analysis. Changes in technology and social standards of living and working seem to be the primary causes of this downward shift in the demand for short staple relative to long staple cotton.

Tests of the substitution interrelationship between short and long staple cotton indicate, however, that within a given range of possible physical substitution, short staple cotton can be an economically satisfactory substitute for long staple cotton if the price differential between the two is great enough. The main problem here is that as the consumer demand for higher quality end products keeps increasing, the range of possible physical substitution of short staple for long staple cotton keeps decreasing. Textile industry specialists have indicated, however, that higher qualities and more uniform short staple cotton would help in preventing further losses in the market for short staple cotton.

Mr. Robert M. Vance, president of Clinton Mills, Clinton, South Carolina, expressed what seems to be the general consensus of those in the textile industry, concerning the demand for cotton in the United States, in the following excert from a recent talk to the South Atlantic Cotton Shippers:

> "... So we need fiber that will produce strong, even yarn and won't cause repeated downtime on our machinery by breaking under stress. In 1 1/16" and longer of course, we are able to draft at higher speeds and thus improve our production costs.
>
> So the medium and longer staple lengths have been in great demand. But whether we buy 29/32" or 1 3/32" or 1 9/16" cotton, we are increasingly demanding that it be strong, quality fiber, and that it be uniform in length."[21]

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[21] Robert M. Vance, Remarks before South Atlantic Cotton Shippers, Savannah, Georgia, March 29, 1968, The Cotton Digest International, April 27, 1968, p. 47.

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# APPENDIX

## SOURCES OF DATA

The following is a list of all the sources of data used in the tables. Sources for each table will be referred to this list by the number in parenthesis. Other pertinent information such as dates and volume numbers will appear with the number in parenthesis with each table.

(1) United States Department of Agriculture, Agricultural Marketing Service, Statistics on Cotton and Related Data, 1920-1956, Statistical Bulletin No. 99 (Revised February, 1957) (Washington, D. C.).

(2) _______________, Economic Research Service, Economic and Statistical Analysis Division, Statistics on Cotton and Related Data, 1925-1962, Statistic-l Bulletin 329 (Washington, D. C., April, 1963).

(3) _______________, Economic Research Service, Statistics on Cotton and Related Data, 1925-1962, Supplement for 1966 to Statistical Bulletin 329 (Washington, D. C., 1966).

(4) _______________, Economic Research Service, Statistics on Cotton and Related Data, 1930-1967, Statistical Bulletin No. 417 (Washington, D. C., March, 1968).

(5) _______________, Agricultural Marketing Service, Cotton Division, Cotton Quality, (Memphis, Tennessee).

(6) _______________, Agricultural Marketing Service, Cotton Division, Cotton Quality Statistics, Statistical Bulletin (Washington, D. C.).

(7) _______________, Economic Research Service, Cotton Situation (Washington, D. C.).

(8) _______________, Consumer and Marketing Service, Cotton Division, Vol. 48, No. 13.

TABLE I

Production of U. S. Upland Cotton by staple lengths,
United States 1937-66 (1,000 running bales)

| Year (beg Aug. 1) | Total | < 1" | < 1" % of Total | 15/16" & 31/32 | 15/16" & 31/32" AS % OF < 1" | < 15/16" | < 15/16" as % of < 1" |
|---|---|---|---|---|---|---|---|
| 1937 | 18,237 | 12,108 | 66 | 5038 | 42 | 7070 | 58 |
| 1938 | 11,598 | 5,640 | 49 | 3124 | 55 | 2516 | 45 |
| 1939 | 11,452 | 5,804 | 51 | 2780 | 48 | 3024 | 52 |
| 1940 | 12,261 | 4,924 | 40 | 2999 | 61 | 1925 | 39 |
| 1941 | 10,434 | 3,930 | 38 | 2265 | 58 | 1665 | 42 |
| 1942 | 12,363 | 4,785 | 39 | 2586 | 54 | 2199 | 46 |
| 1943 | 11,069 | 4,708 | 43 | 2593 | 55 | 2115 | 45 |
| 1944 | 11,831 | 4,068 | 44 | 2188 | 54 | 1880 | 46 |
| 1945 | 8,809 | 2,608 | 30 | 1697 | 65 | 911 | 35 |
| 1946 | 8,515 | 1,896 | 22 | 1108 | 58 | 788 | 42 |
| 1947 | 11,556 | 3,850 | 33 | 1774 | 46 | 2076 | 54 |
| 1948 | 14,577 | 3,462 | 24 | 1663 | 48 | 1799 | 52 |
| 1949 | 15,905 | 5,484 | 34 | 2376 | 43 | 3108 | 57 |
| 1950 | 9,846 | 2,342 | 24 | 1092 | 47 | 1250 | 53 |
| 1951 | 15,026 | 3,993 | 27 | 1625 | 41 | 2368 | 59 |
| 1952 | 14,858 | 4,102 | 28 | 1714 | 42 | 2388 | 58 |
| 1953 | 16,253 | 3,951 | 24 | 2172 | 55 | 1779 | 45 |
| 1954 | 13,577 | 3,938 | 29 | 1918 | 49 | 2020 | 51 |
| 1955 | 14,501 | 3,616 | 25 | 1561 | 43 | 2055 | 57 |
| 1956 | 13,102 | 2,791 | 21 | 1580 | 57 | 1211 | 43 |
| 1957 | 10,801 | 2,759 | 26 | 1866 | 68 | 893 | 32 |
| 1958 | 11,354 | 2,984 | 26 | 2466 | 83 | 518 | 17 |
| 1959 | 14,446 | 3,447 | 24 | 2596 | 75 | 851 | 25 |
| 1960 | 14,199 | 3,373 | 24 | 3031 | 90 | 342 | 10 |
| 1961 | 14,263 | 3,854 | 27 | 3261 | 85 | 593 | 15 |
| 1962 | 14,754 | 3,842 | 26 | 3061 | 80 | 781 | 20 |
| 1963 | 15,129 | 3,872 | 26 | 2436 | 63 | 1436 | 37 |
| 1964 | 15,032 | 3,439 | 23 | 2194 | 64 | 1245 | 36 |
| 1965 | 14,831 | 3,995 | 27 | 2944 | 74 | 1051 | 26 |
| 1966 | 9,491 | 2,556 | 27 | 1814 | 71 | | 29 |

Sources of Data: 1937-58: (2), p.101
1959-60: (5), 1966-67, Vol. 40, No. 8, p.9
1961-65: (3), p.64
1966: (7), January, 1968, CS-234, p.6

TABLE II

Production of U. S. Upland Cotton by staple lengths,
Texas, 1940-66 (1,000 running bales)

| Year (beg. Aug. 1) | Total | <1" | <1" as a % of Total | 15/16" & 31/32" | 15/16" & 31/32" as a % of <1" | 15/16" | 15/16" as a % of <1" |
|---|---|---|---|---|---|---|---|
| 1940 | 3108 | 2380 | 77 | 1256 | 53 | 1124 | 47 |
| 1941 | 2549 | 2073 | 81 | 995 | 48 | 1078 | 52 |
| 1942 | 2906 | 2374 | 82 | 882 | 37 | 1492 | 63 |
| 1943 | 2687 | 2117 | 79 | 665 | 31 | 1452 | 69 |
| 1944 | 2557 | 2110 | 83 | 694 | 33 | 1415 | 67 |
| 1945 | 1749 | 1260 | 72 | 684 | 54 | 576 | 46 |
| 1946 | 1634 | 1115 | 68 | 537 | 48 | 578 | 52 |
| 1947 | 3313 | 2566 | 77 | 886 | 35 | 1680 | 65 |
| 1948 | 3060 | 2264 | 74 | 817 | 36 | 1447 | 64 |
| 1949 | 5858 | 4560 | 78 | 1817 | 40 | 2742 | 60 |
| 1950 | 2858 | 1939 | 68 | 834 | 43 | 1105 | 57 |
| 1951 | 4032 | 3064 | 76 | 1079 | 35 | 1985 | 65 |
| 1952 | 3702 | 2928 | 79 | 849 | 29 | 2079 | 71 |
| 1953 | 4231 | 3175 | 75 | 1647 | 52 | 1529 | 48 |
| 1954 | 3849 | 2818 | 73 | 1104 | 39 | 1714 | 61 |
| 1955 | 3942 | 2888 | 73 | 1187 | 41 | 1702 | 59 |
| 1956 | 3537 | 2223 | 63 | 1206 | 54 | 1017 | 46 |
| 1957 | 3573 | 2231 | 62 | 1447 | 65 | 784 | 35 |
| 1958 | 4210 | 2630 | 62 | 2174 | 83 | 456 | 17 |
| 1959 | 4373 | 2875 | 66 | 2115 | 74 | 760 | 26 |
| 1960 | 4318 | 2937 | 68 | 2620 | 89 | 317 | 11 |
| 1961 | 4774 | 3402 | 71 | 2840 | 83 | 562 | 17 |
| 1962 | 4694 | 3442 | 73 | 2707 | 79 | 734 | 21 |
| 1963 | 4350 | 3435 | 79 | 2124 | 62 | 1311 | 38 |
| 1964 | 4033 | 3055 | 76 | 1927 | 63 | 1127 | 37 |
| 1965 | 4599 | 3541 | 77 | 2555 | 72 | 985 | 28 |
| 1966 | 3125 | 2329 | 75 | 1617 | 69 | 711 | 31 |

Sources of Data: 1940-59: (6) 1941-60
1960-66: (5) 1961-67, Vols. 34-40, No. 11 and 7

TABLE III

Production of U. S. Upland Cotton by Staple Lengths
High Plains of Texas (Crop Reporting Districts 1-S & 1-N), 1940-66 (1000 running bales)

| Year (Beg.Aug.1) | Total | < 1" | < 1" % of Total | 15/16" & 31/32" | 15/16" & 31/32" as % of < 1" | < 15/16" | 15/16" as a % of < 1" |
|---|---|---|---|---|---|---|---|
| 1940 | 440 | 422 | 96 | 89 | 21 | 332 | 79 |
| 1941 | 563 | 546 | 97 | 68 | 12 | 478 | 88 |
| 1942 | 625 | 615 | 98 | 67 | 11 | 547 | 89 |
| 1943 | 515 | 513 | 99.7 | 13 | 3 | 500 | 97 |
| 1944 | 572 | 562 | 98 | 41 | 7 | 522 | 93 |
| 1945 | 119 | 118 | 99 | 10 | 8 | 108 | 92 |
| 1946 | 230 | 219 | 95 | 30 | 14 | 190 | 86 |
| 1947 | 1,022 | 1,012 | 99 | 59 | 6 | 953 | 94 |
| 1948 | 663 | 649 | 98 | 65 | 10 | 584 | 90 |
| 1949 | 1,761 | 1,738 | 99 | 195 | 11 | 1,542 | 89 |
| 1950 | 796 | 789 | 99 | 98 | 12 | 691 | 88 |
| 1951 | 1,271 | 1,233 | 97 | 333 | 27 | 901 | 73 |
| 1952 | 1,436 | 1,423 | 99 | 163 | 11 | 1,260 | 89 |
| 1953 | 1,370 | 1,312 | 96 | 473 | 36 | 838 | 64 |
| 1954 | 1,581 | 1,428 | 90 | 546 | 38 | 882 | 62 |
| 1955 | 1,392 | 1,313 | 94 | 404 | 31 | 909 | 69 |
| 1956 | 1,655 | 1,173 | 71 | 832 | 71 | 340 | 29 |
| 1957 | 1,577 | 1,174 | 75 | 774 | 66 | 400 | 34 |
| 1958 | 1,998 | 1,451 | 73 | 1,285 | 89 | 166 | 11 |
| 1959 | 1,897 | 1,509 | 80 | 1,076 | 71 | 433 | 29 |
| 1960 | 1,955 | 1,589 | 81 | 1,445 | 91 | 144 | 9 |
| 1961 | 2,380 | 2,181 | 92 | 1,732 | 79 | 449 | 21 |
| 1962 | 2,321 | 2,211 | 95 | 1,733 | 78 | 478 | 22 |
| 1963 | 2,112 | 2,053 | 97 | 1,389 | 68 | 664 | 32 |
| 1964 | 1,901 | 1,793 | 94 | 1,413 | 79 | 380 | 21 |
| 1965 | 2,239 | 2,118 | 95 | 1,591 | 75 | 527 | 25 |
| 1966 | 1,333 | 1,168 | 88 | 925 | 79 | 243 | 21 |

Sources of Data: 1940-59: (6) 1941-60
1960-66: (5) 1961-67

TABLE IV

Production of U.S. Upland Cotton, 5-Year Averages
United States, Texas & High Plains, 1942-66

| Years (Beg.Aug.1) | U.S. | Texas | Texas as a % of U.S. | High Plains | High Plains as a % of Texas |
|---|---|---|---|---|---|
| 1942-46 | 10,517 | 2,306 | 22 | 412 | 18 |
| 1947-51 | 13,382 | 2,824 | 29 | 1,103 | 29 |
| 1952-56 | 14,458 | 3,852 | 27 | 1,487 | 39 |
| 1957-61 | 13,013 | 4,250 | 33 | 1,960 | 46 |
| 1962-66 | 13,847 | 4,160 | 30 | 1,981 | 48 |

See Tables I-III for sources.

TABLE V

**Production of <1" staple length U.S. Upland Cotton, 5-Year Averages**
**United States, Texas, & High Plains, 1942-66**

| Years (Beg. Aug.1) | U.S. | Texas | Texas as a % of U.S. | High Plains | High Plains as a % of Texas |
|---|---|---|---|---|---|
| 1942-46 | 3,613 | 1,795 | 50 | 405 | 23 |
| 1947-51 | 3,826 | 2,879 | 75 | 1,084 | 38 |
| 1952-56 | 3,680 | 2,806 | 76 | 1,330 | 47 |
| 1957-61 | 3,283 | 2,815 | 86 | 1,581 | 56 |
| 1962-66 | 3,541 | 3,160 | 89 | 1,869 | 59 |

See Tables I-IV for sources.

TABLE VI
Annual Carryover of U.S. Upland Cotton, United States
1937-66 (1,000 running bales)

| Year (Beg.Aug.1) | Total | <1" | <1" as a % of Total | < 1" Carryover as a % of < 1" Production In Previous Years | ◄ 1" | < 1% as a % of Total | < 1" Carryover as a % of < 1" Production In Previous Years |
|---|---|---|---|---|---|---|---|
| 1937 | 4,382 | 3,065 | 69.9 | 44.3 | 1,317 | 30.1 | 25.3 |
| 1938 | 11,436 | 7,882 | 68.9 | 65.1 | 3,554 | 31.1 | 58.0 |
| 1939 | 12,943 | 7,798 | 60.2 | 138.3 | 5,145 | 39.8 | 86.4 |
| 1940 | 10,453 | 6,191 | 59.2 | 106.7 | 4,262 | 40.8 | 75.5 |
| 1941 | 12,011 | 6,812 | 56.7 | 138.3 | 5,199 | 43.3 | 70.9 |
| 1942 | 10,475 | 5,962 | 56.9 | 151.7 | 4,513 | 43.1 | 69.4 |
| 1943 | 10,530 | 5,826 | 55.3 | 121.8 | 4,704 | 44.7 | 62.1 |
| 1944 | 10,559 | 6,060 | 57.4 | 128.7 | 4,499 | 42.6 | 70.7 |
| 1945 | 11,006 | 5,869 | 53.3 | 142.8 | 5,137 | 46.7 | 66.2 |
| 1946 | 7,165 | 2,962 | 41.3 | 113.6 | 4,203 | 58.7 | 67.8 |
| 1947 | 2,392 | 532 | 22.2 | 28.1 | 1,860 | 77.8 | 28.1 |
| 1948 | 2,988 | 693 | 23.2 | 18.0 | 2,295 | 76.8 | 30.0 |
| 1949 | 5,216 | 501 | 9.6 | 14.5 | 4,715 | 90.3 | 42.4 |
| 1950 | 6,745 | 1,270 | 18.8 | 23.2 | 5,475 | 91.2 | 52.5 |
| 1951 | 2,144 | 310 | 14.5 | 13.2 | 1,834 | 85.5 | 24.4 |
| 1952 | 2,709 | 909 | 33.6 | 22.8 | 1,800 | 66.4 | 16.3 |
| 1953 | 5,478 | 1,755 | 32.0 | 42.8 | 3,723 | 68.0 | 34.6 |
| 1954 | 9,550 | 2,889 | 30.3 | 73.1 | 6,661 | 69.7 | 54.1 |
| 1955 | 10,999 | 3,722 | 33.8 | 94.5 | 7,277 | 66.2 | 75.5 |
| 1956 | 14,382 | 4,697 | 32.7 | 129.9 | 9,685 | 67.3 | 89.0 |
| 1957 | 11,251 | 3,773 | 33.5 | 135.2 | 7,478 | 66.5 | 72.5 |
| 1958 | 8,592 | 3,712 | 43.2 | 134.5 | 4,880 | 56.8 | 60.7 |
| 1959 | 8,718 | 3,722 | 42.7 | 124.7 | 4,996 | 57.3 | 59.7 |
| 1960 | 7,390 | 1,430 | 19.4 | 41.5 | 5,960 | 80.6 | 54.2 |
| 1961 | 7,078 | 598 | 8.4 | 17.7 | 6,480 | 91.6 | 59.9 |
| 1962 | 7,725 | 1,378 | 17.8 | 35.8 | 6,347 | 82.2 | 61.0 |
| 1963 | 11,005 | 2,855 | 25.9 | 74.3 | 8,150 | 74.1 | 74.7 |
| 1964 | 12,110 | 3,686 | 30.4 | 95.2 | 8,424 | 69.6 | 74.8 |
| 1965 | 14,018 | 4,339 | 31.0 | 126.2 | 9,679 | 69.0 | 83.5 |
| 1966 | 16,565 | 5,933 | 35.8 | 148.4 | 10,632 | 64.2 | 98.0 |

Sources of Data:
All Data - 1961-66, "Cotton Situation," Jan. 1968, p. 6.
Carryover - "Statistics on Cotton & Related Data, 1925-62."
CCC - 1952-66, "Cotton Quality," U.S.D.A.

TABLE VII

U.S. Upland Cotton in C C C Stocks,
United States, 1957-66 (1000 running bales)

| Year (Beg. Aug. 1) | Total | <1" | <1" as a % of Total | Net Additions | <1" Net Additions | <1" Net Additions as a % of <1" Production |
|---|---|---|---|---|---|---|
| 1957 | 5,108.9 | 2,221.9 | 43 | -912.2 | -105.0 | ---- |
| 1958 | 2,850.4 | 1,801.2 | 63 | -2,258.5 | -420.7 | ---- |
| 1959 | 6,940.2 | 2,818.6 | 41 | 4,089.8 | 1,017.4 | 34 |
| 1960 | 4,965.1 | 1,014.3 | 20 | -1,975.1 | -1,804.3 | ---- |
| 1961 | 1,446 | 3 | -- | -3,518.9 | -1,011.3 | ---- |
| 1962 | 4,688 | 678 | 14 | 3,242 | 675 | 18 |
| 1963 | 8,017 | 2,300 | 29 | 3,329 | 1,622 | 42 |
| 1964 | 10,232 | 3,362 | 33 | 2,215 | 1,062 | 27 |
| 1965 | 11,397 | 3,904 | 34 | 1,165 | 542 | 16 |
| 1966 | 12,077 | 4,814 | 40 | 680 | 910 | 23 |

Sources:

1957-60 : (5), 1958-61, Vols. 31-34, No. 11

1961-66 : (7), January, 1968, p.6

TABLE VIII

Comparison of CCC Stocks With Annual Carryover and Production
U.S. Upland Cotton, United States, 1957-66

| Year (Beg.Aug.1) | ∠1" CCC Stocks as a % of ∠1" Carryover | ∠1" CCC Stocks as a % of ∠1" Prev. Year's Production | Net Additions to CCC as a % of ∠1" Prev. Year's Production | ≥1" CCC Stocks* | ≥1" CCC Stocks as a % of ≥1" Carryover | ≥1" CCC Stocks as a % of ≥1" Prev. Year's Production |
|---|---|---|---|---|---|---|
| 1957 | 58.9 | 79.6 | -37.6 | 2,887 | 38.6 | 28.0 |
| 1958 | 48.5 | 65.3 | -15.2 | 1,049.2 | 21.5 | 13.0 |
| 1959 | 75.7 | 94.5 | 34.1 | 4,121.6 | 82.5 | 49.2 |
| 1960 | 70.9 | 29.4 | -52.3 | 3,950.8 | 66.3 | 35.9 |
| 1961 | .5 | .09 | -30.0 | 1,443 | 22.3 | 59.9 |
| 1962 | 49 | 17.6 | 17.5 | 4,010 | 63.2 | 38.5 |
| 1963 | 80.6 | 59.9 | 42.2 | 5,716 | 70.1 | 74.7 |
| 1964 | 91.2 | 86.8 | 27.4 | 6,870 | 81.6 | 61.0 |
| 1965 | 90.0 | 113.5 | 15.8 | 7,493 | 77.4 | 64.6 |
| 1966 | 81.1 | 120.4 | 22.8 | 7,263 | 68.3 | 67.0 |

* 1,000 Running Bales

Sources: See Tables VI and VII.

TABLE IX

Disappearance of U. S. Upland Cotton by staple lengths,
United States 1937-66 (1,000 running bales)

| Year (beg Aug. 1) | Total | ≥ 1" | < 1" | < 1" as a % of total | 15/16" and 31/32" | 15/16" and 31/32" as a % of < 1" |
|---|---|---|---|---|---|---|
| 1937 | 11,183 | 3,892 | 7,291 | 65.20 | 3,083 | 42.29 |
| 1938 | 10,091 | 4,367 | 5,724 | 56.72 | 2,869 | 50.12 |
| 1939 | 13,942 | 6,531 | 7,411 | 53.16 | 3,266 | 44.07 |
| 1940 | 10,703 | 6,400 | 4,303 | 40.20 | 2,328 | 54.10 |
| 1941 | 11,970 | 7,190 | 4,780 | 39.93 | 3,184 | 66.61 |
| 1942 | 12,308 | 7,387 | 4,921 | 39.98 | 2,881 | 58.55 |
| 1943 | 11,040 | 6,566 | 4,474 | 40.53 | 2,425 | 54.20 |
| 1944 | 11,384 | 7,125 | 4,259 | 37.41 | 2,386 | 56.02 |
| 1945 | 12,650 | 7,135 | 5,515 | 43.60 | 2,479 | 44.95 |
| 1946 | 13,288 | 8,962 | 4,326 | 32.56 | 1,993 | 46.07 |
| 1947 | 10,960 | 7,271 | 3,689 | 33.66 | 1,719 | 46.60 |
| 1948 | 12,349 | 8,695 | 3,654 | 29.59 | 1,705 | 46.66 |
| 1949 | 14,376 | 9,661 | 4,715 | 32.80 | 2,028 | 43.01 |
| 1950 | 14,447 | 11,145 | 3,302 | 22.86 | 1,605 | 48.61 |
| 1951 | 14,461 | 11,067 | 3,394 | 23.47 | 1,432 | 42.19 |
| 1952 | 12,089 | 8,833 | 3,256 | 26.93 | 1,417 | 43.52 |
| 1953 | 12,181 | 9,364 | 2,817 | 23.13 | 1,477 | 52.43 |
| 1954 | 12,128 | 9,023 | 3,105 | 25.60 | 1,551 | 49.95 |
| 1955 | 11,118 | 8,477 | 2,641 | 23.75 | 1,258 | 47.63 |
| 1956 | 16,233 | 12,518 | 3,715 | 22.89 | 1,623 | 43.69 |
| 1957 | 13,459 | 10,639 | 2,820 | 20.95 | 1,712 | 60.71 |
| 1958 | 11,228 | 8,254 | 2,974 | 26.49 | 2,442 | 82.11 |
| 1959 | 15,774 | 10,037 | 5,737 | 36.37 | 3,539 | 61.67 |
| 1960 | 14,512 | 10,307 | 4,205 | 28.98 | 3,718 | 88.42 |
| 1961 | 13,616 | 10,540 | 3,076 | 22.59 | 2,637 | 85.73 |
| 1962 | 11,474 | 9,110 | 2,364 | 20.60 | 2,018 | 85.36 |
| 1963 | 14,023 | 10,981 | 3,042 | 21.69 | 2,383 | 78.34 |
| 1964 | 13,124 | 10,338 | 2,786 | 21.23 | 1,495 | 53.66 |
| 1965 | 12,300 | 9,894 | 2,406 | 19.56 | 2,087 | 86.74 |
| 1966 | 13,886 | 10,319 | 3,567 | 25.69 | 1,914 | 53.66 |

Sources of Data: 1937-58: (3), p. 100
1959-66: (5), 1967, Vol. 40, No. 8, p. 9

TABLE X

Exports of U.S. Upland Cotton - Total; Total Short Staple,
Short Staple by Principle Countries of Destination, 1952-66 (1,000 running bales)

| Year (Beg.Aug.1) | Total | <1" (Short Staple) | Europe | Japan | Korea | Hong Kong | Taiwan |
|---|---|---|---|---|---|---|---|
| 1952 | 3,048 | 819 | 260.18 | 358.55 | 39.33 | - | - |
| 1953 | 3,761 | 906 | 231.68 | 422.33 | 92.64 | 1.51 | - |
| 1954 | 3,446 | 845 | 266.54 | 236.99 | 162.57 | 4.91 | - |
| 1955 | 2,215 | 1,116 | 346.30 | 415.47 | 121.98 | 42.13 | 118.03 |
| 1956 | 7,593 | 1,743 | 681.42 | 571.26 | 179.19 | 78.4 | 140.06 |
| 1957 | 5,717 | 1,587 | 566.62 | 564.09 | 159.04 | 121.54 | 97.65 |
| 1958 | 2,789 | 1,314 | 305.76 | 457.66 | 183.61 | 112.57 | 165.38 |
| 1959 | 7,183 | 2,393 | 578.73 | 931.34 | 244.31 | 218.78 | 169.16 |
| 1960 | 6,634 | 1,966 | 364.13 | 884.97 | 171.15 | 188.59 | 122.64 |
| 1961 | 4,916 | 1,543 | 324.94 | 550.40 | 248.39 | 92.41 | 169.12 |
| 1962 | 3,352 | 1,155 | 147.78 | 528.78 | 194.71 | 58.74 | 122.62 |
| 1963 | 5,660 | 1,524 | 253.65 | 661.47 | 208.05 | 136.63 | 91.05 |
| 1964 | 4,060 | 1,244 | 133.77 | 550.66 | 152.07 | 121.12 | 142.13 |
| 1965 | 2,942 | 1,146 | 125.35 | 484.68 | 171.11 | 82.9 | 111.44 |
| 1966 | 4,669 | 1,618 | 133.60 | 731.78 | 183.12 | 163.21 | 220.36 |

Sources of Data:

1952: (7), Sept. 1953.
1953: (7), Oct. 1954.
1954-65: (7), Nov. 1955-66.
1966: (7), Sept. 1967.

TABLE XI

Average Exports of U.S. Upland Cotton, By Staple Lengths
1952-66 (1,000 running bales)

| Years (Beg.Aug.1) | Average Total Exports Per Year | <1" Average Exports Per Year | <1" Exports as a % of Total Exports | <1" Exports as a % of <1" Disappearance |
|---|---|---|---|---|
| 1952-54 | 3,418.59 | 856.67 | 25.06 | 28.0 |
| 1955-59 | 5,099.7 | 1,630.60 | 31.97 | 45.6 |
| 1960-64 | 4,924.18 | 1,486.40 | 30.19 | 48.0 |
| 1965 | 2,942.11 | 1,146.0 | 38.95 | 47.6 |
| 1966 | 4,668.85 | 1,618.0 | 34.66 | 45.4 |

Source:
See Tables IX & X.

TABLE XII

Average Exports of U.S. Upland Cotton, By Countries of Destination
1952-66 (1,000 running bales)

| (Beg.Aug.1) | Europe | % of <1" Exports | Korea | % of 1" Exports | Hong Kong | % of <1" Exports | Taiwan | % of <1" Exports | Japan | % of <1" Exports | Korea Hong-Kong, Taiwan, Japan | % of <1" Exports |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1952-54 | 252.8 | 29.5 | 98.18 | 11.5 | 2.14 | 0.25 | - | - | 339.29 | 39.6 | 439.61 | 51.3 |
| 1955-59 | 495.77 | 30.4 | 177.63 | 10.9 | 114.68 | 7.0 | 138.06 | 8.5 | 587.96 | 36.1 | 1,018.33 | 62.5 |
| 1960-64 | 244.85 | 16.5 | 194.87 | 13.1 | 119.50 | 8.0 | 129.51 | 8.7 | 635.26 | 42.7 | 904.80 | 60.9 |
| 1965 | 125.35 | 10.9 | 171.11 | 14.9 | 82.90 | 7.2 | 111.44 | 9.7 | 484.68 | 42.3 | 844.42 | 78.5 |
| 1966 | 133.60 | 8.3 | 183.12 | 11.3 | 163.21 | 10.1 | 220.36 | 13.6 | 731.78 | 45.2 | 1,298.47 | 80.3 |

Source:

See Table X.

TABLE XIII

Disappearance, Supply, and Production Ratios of <1" to ≥1" U. S. Upland Cotton, United States, 1937 - 1966

| Year Beginning Aug. 1 | Disappearance Ratios | Supply* Ratios | Production Ratios | < 1" Disappearance-Supply Ratios | ≥ 1" Disappearance-Supply Ratios | (D<1"/S<1") / (D≥1"/S≥1") |
|---|---|---|---|---|---|---|
| 1937 | 187.33 | 204.59 | 197.99 | 47.99 | 52.41 | 91.57 |
| 1938 | 131.07 | 142.16 | 94.66 | 42.33 | 45.91 | 92.20 |
| 1939 | 113.47 | 126.03 | 102.76 | 54.48 | 60.51 | 90.03 |
| 1940 | 67.23 | 95.83 | 67.11 | 38.71 | 55.18 | 70.15 |
| 1941 | 66.48 | 91.77 | 60.42 | 44.50 | 61.43 | 72.44 |
| 1942 | 66.62 | 88.88 | 63.14 | 45.79 | 61.10 | 74.94 |
| 1943 | 68.14 | 95.20 | 74.01 | 42.47 | 59.34 | 71.57 |
| 1944 | 59.78 | 82.60 | 52.40 | 42.05 | 58.11 | 72.36 |
| 1945 | 77.30 | 74.77 | 42.06 | 65.06 | 62.93 | 103.38 |
| 1946 | 48.27 | 44.89 | 28.64 | 89.05 | 82.81 | 107.54 |
| 1947 | 50.74 | 45.81 | 49.96 | 84.19 | 76.01 | 110.76 |
| 1948 | 42.02 | 30.98 | 31.15 | 87.94 | 64.84 | 135.63 |
| 1949 | 48.80 | 39.54 | 56.46 | 78.78 | 63.83 | 123.42 |
| 1950 | 29.63 | 27.83 | 31.21 | 91.42 | 85.87 | 106.46 |
| 1951 | 30.67 | 33.44 | 36.19 | 78.88 | 86.01 | 91.71 |
| 1952 | 36.86 | 39.91 | 38.14 | 64.98 | 70.35 | 92.37 |
| 1953 | 30.08 | 35.61 | 32.12 | 49.37 | 58.43 | 84.49 |
| 1954 | 34.41 | 41.88 | 40.85 | 45.48 | 55.36 | 82.15 |
| 1955 | 31.15 | 40.40 | 33.22 | 35.99 | 46.67 | 77.12 |
| 1956 | 29.68 | 32.45 | 27.07 | 49.61 | 62.60 | 79.25 |
| 1957 | 26.51 | 42.09 | 34.31 | 43.17 | 68.55 | 62.98 |
| 1958 | 36.03 | 50.54 | 35.65 | 44.41 | 62.29 | 71.30 |
| 1959 | 57.16 | 44.81 | 31.34 | 80.04 | 62.75 | 127.55 |
| 1960 | 40.80 | 28.62 | 31.16 | 87.53 | 61.41 | 142.53 |
| 1961 | 29.18 | 26.37 | 37.03 | 69.08 | 62.41 | 110.69 |
| 1962 | 25.95 | 30.24 | 35.21 | 45.30 | 52.78 | 85.83 |
| 1963 | 27.70 | 34.68 | 34.41 | 45.21 | 56.59 | 79.89 |
| 1964 | 26.95 | 35.60 | 29.66 | 39.10 | 51.65 | 75.70 |
| 1965 | 24.32 | 40.62 | 36.86 | 28.86 | 48.20 | 59.88 |
| 1966 | 34.57 | 48.32 | 36.86 | 42.02 | 58.74 | 71.54 |

*Production plus carryover
Sources: See Tables I, VI, and IX

# TABLE XIV

**Average Market Prices and Government Support Prices (per pound) for Middling 15/16" and 1 1/16" Staple Length, U. S. Upland Cotton, 1937-66.**

| Year Beginning Aug. 1 | Middling 15/16" Average Market Price | Middling 15/16" Support Price | Middling 1 1/16" Average Market Price | Middling 1 1/16" Support Price |
|---|---|---|---|---|
| 1937 | 9.09 | | 9.82 | |
| 1938 | 9.00 | | 9.56 | |
| 1939 | 10.09 | | 10.46 | |
| 1940 | 11.00 | | 11.46 | |
| 1941 | 18.31 | | 19.07 | |
| 1942 | 20.14 | | 21.28 | |
| 1943 | 20.65 | 19.26 | 21.82 | 20.46 |
| 1944 | 21.86 | 21.08 | 23.04 | 22.13 |
| 1945 | 25.96 | 21.09 | 26.96 | 22.29 |
| 1946 | 34.82 | 24.38 | 35.45 | 25.43 |
| 1947 | 34.58 | 27.94 | 36.31 | 28.64 |
| 1948 | 32.15 | 30.74 | 33.27 | 32.34 |
| 1949 | 31.83 | 29.43 | 33.22 | 30.58 |
| 1950 | 42.58 | 29.45 | 43.78 | 30.80 |
| 1951 | 39.42 | 31.71 | 40.49 | 32.96 |
| 1952 | 34.52 - 34.92 | 31.96 | 36.00 | 32.96 |
| 1953 | 33.55 | 32.70 | 35.08 | 34.15 |
| 1954 | 33.88 - ~~34.02~~ | 33.23 | 36.17 | 34.83 |
| 1955 | 34.38 | 33.50 | 36.72 | 35.50 |
| 1956 | 32.35 | 31.59 | 35.02 | 33.99 |
| 1957 | 32.93 | 31.16 | 36.12 | 33.76 |
| 1958 | 32.96 | 33.63 | 36.14 | 36.83 |
| 1959 | 30.26 - 30.27 | 29.74 | 33.46 | 32.84 |
| 1960 | 29.43 | 27.61 | 32.43 | 30.81 |
| 1961 | 32.43 | 31.49 | 35.08 | 34.39 |
| 1962 | 32.26 | 34.22 | 34.93 | 33.77 |
| 1963 | 31.85 | 31.22 | 34.68 | 33.82 |
| 1964 | 29.39 22.59 | 28.70 | 32.40 25.90 | 31.40 |
| 1965 | 28.19 22.44 | 27.65 | 31.46 25.71 | 30.55 |
| 1966 | 20.20 | 19.60 | 24.73 | 22.80 |

Sources: Columns 2 and 4 - 1937-48: (1), p. 158; 1949-58: (2), p. 131; 1959-66: (8), p. 5. Columns 3 and 5 - 1943-53: (5), 1944-54; 1954-66: (7), May, 1955-67

TABLE XV

Average Market and Support Price Ratios of <1" to ≥1" U. S. Upland Cotton and Market and Support Price Differentials, United States, 1937-66.

| Year Beginning Aug. 1 | Average Market Price Ratios | Price Support Ratios | Aver. Market Price Differentials | Price Support Differentials |
|---|---|---|---|---|
| 1937 | 92.57 | | .73 | |
| 1938 | 94.14 | | .56 | |
| 1939 | 96.46 | | .37 | |
| 1940 | 95.99 | | .46 | |
| 1941 | 96.01 | | .76 | |
| 1942 | 94.64 | | 1.14 | |
| 1943 | 94.64 | 94.13 | 1.17 | 1.20 |
| 1944 | 94.88 | 95.26 | 1.18 | 1.05 |
| 1945 | 96.29 | 94.62 | 1.00 | 1.20 |
| 1946 | 98.22 | 95.87 | .63 | 1.05 |
| 1947 | 95.24 | 97.56 | 1.73 | .70 |
| 1948 | 96.63 | 95.05 | 1.12 | 1.60 |
| 1949 | 95.82 | 96.24 | 1.39 | 1.15 |
| 1950 | 97.26 | 95.62 | 1.20 | 1.35 |
| 1951 | 97.36 | 96.21 | 1.07 | 1.25 |
| 1952 | 95.89 | 96.97 | 1.48 | 1.00 |
| 1953 | 95.64 | 95.75 | 1.53 | 1.45 |
| 1954 | 93.67 | 95.41 | 2.29 | 1.60 |
| 1955 | 93.63 | 94.37 | 2.34 | 2.00 |
| 1956 | 92.38 | 92.94 | 2.67 | 2.40 |
| 1957 | 91.17 | 92.30 | 3.19 | 2.60 |
| 1958 | 91.20 | 91.31 | 3.18 | 3.20 |
| 1959 | 90.44 | 90.56 | 3.20 | 3.10 |
| 1960 | 90.75 | 89.61 | 3.00 | 3.20 |
| 1961 | 92.45 | 91.57 | 2.65 | 2.90 |
| 1962 | 92.36 | 92.45 | 2.67 | 2.55 |
| 1963 | 91.84 | 92.31 | 2.83 | 2.60 |
| 1964 | 90.71 | 91.40 | 3.01 | 2.70 |
| 1965 | 89.61 | 90.51 | 3.27 | 2.90 |
| 1966 | 81.68 | 85.96 | 4.53 | 3.20 |

Sources: See Table XIV