Projections of Production and Price of Pecans In the United States to 1975

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Objectives and Procedure

The Oklahoma pecan industry is characterized by two conditions highly favorable for substantial expansion in the next 10 to 20 years. First, there are large numbers of pecan trees of nonbearing age. Second, production from trees that are now bearing could be increased substantially by applying known and recommended cultural practices.

These two conditions suggest further that the increased production could be obtained with a minimum investment for the development of unimproved groves and improvements in production practices. However, because of the long-term nature of the investment, the decision to invest in pecan production must be based on long-range considerations. The profitability of the investment depends largely on the long-term trend in pecan prices. The long-term price outlook depends, in turn, on expected trends in the market demand for and total supply of pecans. Therefore it is important that facts relating to basic trends and economic relationships affecting the pecan industry be brought together, analyzed, and interpreted.

This report describes and analyzes historical trends in demand, price, and supply relationships for pecans, and projects the probable trends in supply and price to the year 1975. Projections are made for United States prices only, because prices received by Oklahoma farmers and the United States average farm price for all pecans are closely correlated.

These projections are not to be viewed as forecasts. They simply indicate the trends in price and production that would be expected if specific assumptions are realized. Clearly, no one can forecast exactly what the supply of pecans will be in the years centering on 1975. Nor can anyone foresee the exact rate of growth in the total economy which will have an important effect on the demand outlook for pecans. Thus,

Research reported herein was done under Oklahoma Station Project No. 977.

while no precise estimates or forecasts of future trends are possible, we can make some carefully considered projections that may serve as useful guides to the course of future events.

The research procedure followed in this study was as follows: First, some basic trends in the pecan industry since 1920 were reviewed. Second, a statistical relationship was derived which relates prices received by farmers for all pecans to principal determining variables. Third, pecan production was projected to 1975 based on present and past trends. Fourth, projections were made of population and disposable real income per capita. These, along with total production of pecans, are the major factors influencing pecan prices. Finally, the projections of price determining variables were used in the price estimating equation to project the general level of prices received by farmers for pecans.[1]

Review of Basic Trends

Production and Population

Figure 1 shows the production of all pecans[2] in the United States, and U. S. population for the period 1919 to 1957. The chart emphasizes two facts. First, although production has fluctuated sharply from year to year, the trend in production has been steadily upward. Second, production has increased faster than population. As a result, there has been a pronounced upward trend in production per capita (Figure 2).

The relative magnitude of these changes is illustrated by the following data. Between 1924 and 1954, average annual production of all pecans increased from 45.5 million pounds to 153.6 million pounds (calculated from the trend line), or by 238 percent. Over the same period, the nation's population increased some 42 percent, from 114 million persons in 1924 to 162 million in 1954. This relatively greater expansion in pecan production than in population caused per capita production to increase from 0.43 pounds in 1924 to 1.00 pound in 1954 (calculated from the trend line), an increase of about 133 percent.

Production of pecans by type is shown in Figure 3. The six-year average production of improved pecans increased from about 10 million pounds in 1924 to about 73 million pounds in 1954. Over the same

[1]This is basically the same procedure used by B. C. French in *The Long-term Price and Production Outlook for Apples in the United States and Michigan* (Michigan Agri. Exp. Sta. Tech. Bul. 255; April, 1956). However, the models used in this study to project price and production are less refined than those used by French.

[2]There are two broad types of pecans. Seedling or native pecans, are those produced from unimproved pecan trees. Improved pecans are those produced on trees that have been budded, grafted, or top-worked with stock from named varieties of pecans.

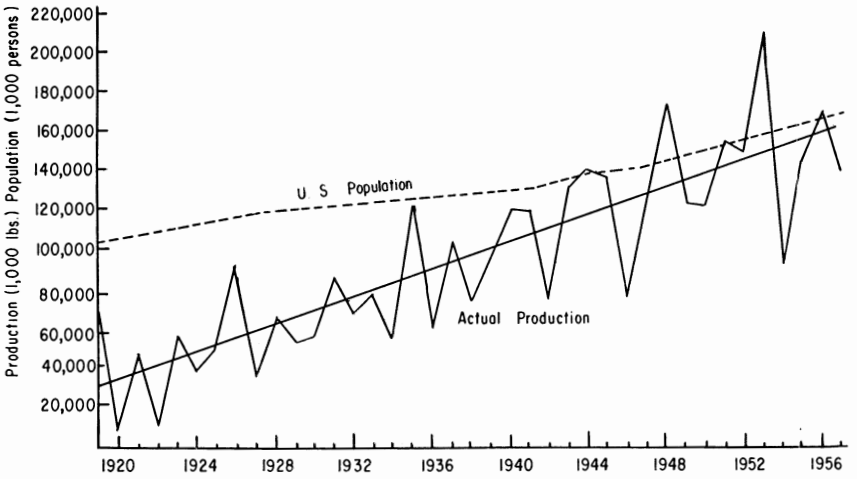

Figure 1.—Population; and production of all pecans. United States, 1919-1957. Source of data: Appendix Table I.

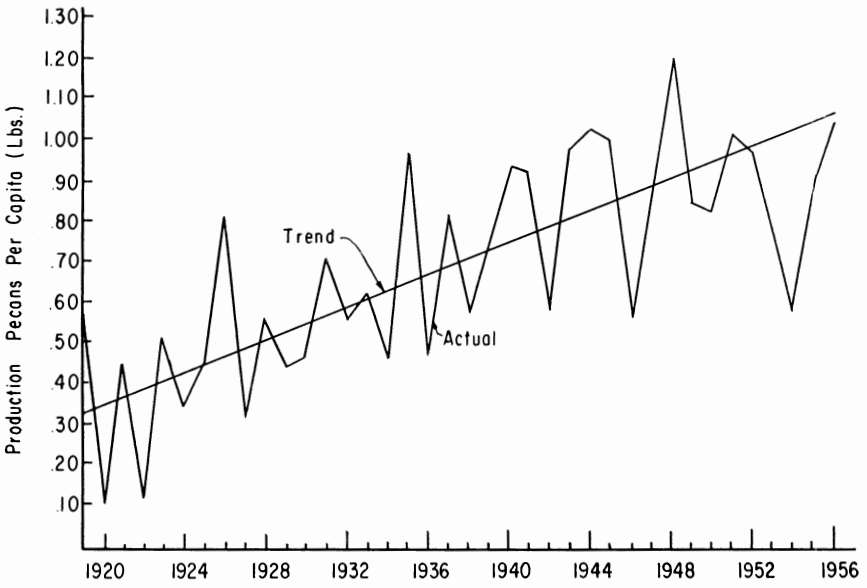

Figure 2.—Per capita production of all pecans. United States, 1920-1956. Source of data: Computed from Appendix Table I.

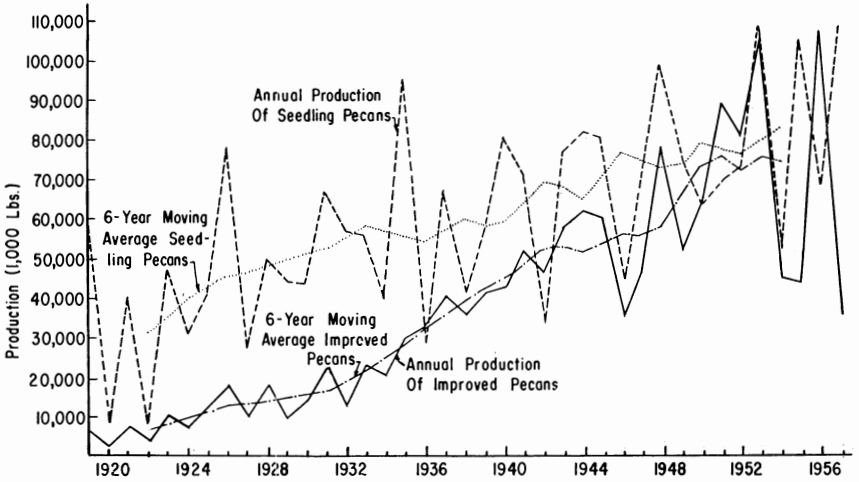

Figure 3.—Production of pecans, by types. United States, 1919-1957. Source of data: Appendix Table II.

period, the average production of seedling pecans increased from about 40 million pounds annually to about 82 million pounds. This represented more than a sevenfold increase in the production of improved pecans, but only about a twofold increase in the production of seedlings. Consequently, while improved pecans represented only about 20 percent of total United States production in 1924, they now account for about 47 percent of the total.

Net Exports

Although imports of pecans were substantial in some years during the early 1920's, they have seldom accounted for as much as 1.0 percent of domestic production since 1927. Between 1940 and 1954, imports varied from 1.2 to less than 0.05 percent of domestic production annually, and averaged only 0.6 percent (Table I).

Exports have exceeded 4.0 percent of domestic production in only one year since 1935, the first year for which export data are available. Between 1940 and 1954, they varied from 3.9 to less than 0.05 percent of production, and averaged only 1.7 percent. Thus net exports (exports minus imports) averaged only 1.1 percent of domestic production between 1940 and 1954.

Prices

Oklahoma and national average annual prices received by growers

for pecans are shown in Figure 4.[3] This figure also shows the actual United States price divided by the Bureau of Labor Statistics' Consumers Price Index (1947-49=100). This deflated price is a rough measure of the trend in the price of pecans relative to the general price level.

In the absence of counterbalancing forces, the steady increase in the per capita supply of pecans since the 1920's would have resulted in increasing downward pressure on pecan prices relative to the general price level. Actually, however, while production per capita increased 133 percent between 1924 and 1954, the average annual price received by growers (deflated by the consumer price index) decreased only 12 percent—from 22.7 to 19.1 cents per pound--between 1926-29 and 1950-54.

The sale of these larger per capita supplies with only a moderate decrease in the price of pecans relative to the general price level can be explained largely by three main factors. First, disposable real income per capita increased from $834 in 1924 to $1,378 in 1954, an increase of about 62 percent. Since the demand for pecans is elastic with respect to income, the quantity of pecans that would be purchased at a given price would increase by a greater percentage than did income with other factors affecting demand remaining unchanged.[4]

A second factor that helps explain the large increase in per capita production with only a moderate decrease in relative prices is that the demand for pecans is also elastic with respect to price. This means that a given percentage increase (or decrease) in production (or quantity taken) will result in a *smaller* percentage decrease (increase) in price. The elasticity of demand was estimated to be —1.4 in this study.

A third factor that has helped to maintain prices in the face of continuously increasing per capita supplies is technological improvements in processing and distribution. The major technological advancements have been improvements in cracking and shelling equipment, in refrigerated storage, and in consumer packaging. This has made it possible to provide consumers, both household and institutional, with a dependable supply of a high quality product throughout the year. Undoubtedly, this has tended to increase the demand for pecans by those already using them and to expand the market to consumers who had not previously used pecans to any significant extent.

It will be noted that the United States average farm price for all

[3]The price for all pecans was computed by weighting prices for improved and seedling pecans by quantities sold in each year.

[4]In this study the income elasticity of demand was estimated to be 2.9 based on annual data and calculated at the mean of the time series used in the analysis (see page 18). The statement in the text ignores the question of possible differences in income elasticity over various time periods.

Table I.—Exports and Imports of Edible Tree Nuts and Percentages of Production, United States, 1940 to 1954[1]

Year	Almonds				Filberts			
	Exports[2]	Imports	Exports as a Per Cent of Production	Imports as a Per Cent of Production	Exports[2]	Imports	Exports as a Per Cent of Production	Imports as a Per Cent of Production
	(tons)	(tons)	(Per Cent)	(Per Cent)	(tons)	(tons)	(Per Cent)	(Per Cent)
1940	--	3,309	--	22.1	--	1,672	--	52.1
1941	—	6,205	--	65.3	--	92	--	1.6
1942	27	1,686	0.1	5.4	11	66	0.3	1.5
1943	82	18,876	.4	92.1	215	1,173	3.1	16.7
1944	148	37,577	.5	118.5	249	8,072	3.8	123.8
1945	160	30,465	.5	95.2	158	11,089	3.0	208.4
1946	552	15,082	1.2	32.0	232	13,451	2.7	159.2
1947	378	19,714	1.1	55.2	522	4,664	5.9	53.0
1948	103	17,156	.3	47.0	195	8,627	3.1	135.2
1949	210	2,428	.5	5.6	235	7,217	2.1	65.5
1950	110	20,854	.3	55.3	339	6,190	5.1	92.7
1951	876	6,054	2.1	14.2	359	8,814	5.2	127.4
1952	2,594	11,260	7.1	30.9	487	6,591	4.0	53.8
1953	6,799	11,528	17.6	29.9	250	6,894	5.8	160.3
1954	8,624	2,204	20.0	5.1	950	8,684	11.0	100.2
Average	1,590	13,627	4.0	44.9	323	6,220	4.2	90.1
	Pecans				Walnuts			
1940	506	179	0.8	0.3	1,948	5,447	3.8	10.7
1941	282	2	.5	*	2,006	3,322	2.9	4.7
1942	38	4	*	*	360	302	.6	.5
1943	603	419	.9	.6	1,174	2	1.8	*
1944	1,976	216	2.8	.3	1,990	26	2.8	*
1945	2,104	425	3.0	.6	3,502	455	4.9	.6
1946	1,501	330	3.9	.9	2,826	998	3.9	1.4
1947	300	692	.5	1.2	2,706	716	4.2	1.1
1948	826	238	.9	.3	1,377	3,088	1.9	4.3
1949	1,704	136	2.7	.2	2,063	7,514	2.3	8.5
1950	880	661	1.4	1.1	1,911	7,726	3.0	12.0
1951	909	736	1.2	1.0	1,499	8,175	1.9	10.6
1952	1,150	471	1.6	.6	1,628	8,030	1.9	9.6
1953	1,486	290	1.4	.3	1,680	8,682	2.8	14.7
1954	1,630	420	3.6	.9	5,147	9,509	6.8	12.6
Average	1,060	348	1.7	.6	2,121	4,266	3.3	6.1

[1]Production, crop year; foreign trade, year beginning July 1. Figures on an unshelled basis; shelled converted to unshelled basis at ratios of:
Almonds: 1 to 3.33
Filberts: 1 to 2.22 through 1949; in subsequent years at 1 to 2.5
Pecans: exports at 1 to 2.5; imports at 1 to 2.63
Walnuts: 1 to 2.38.
[2]Separately classified into exports and imports basis on following dates:
Almonds: January 1, 1942
Filberts: January 1, 1943
Pecans: 1935
Walnuts: July 1, 1935.
*Less than 0.05 per cent.
Source: *Foreign Agricultural Trade, Statistical Handbook*, FAS, USDA, Statistical Bulletin No. 179, (Washington: Government Printing Office, August 1956) pp. 130-137.

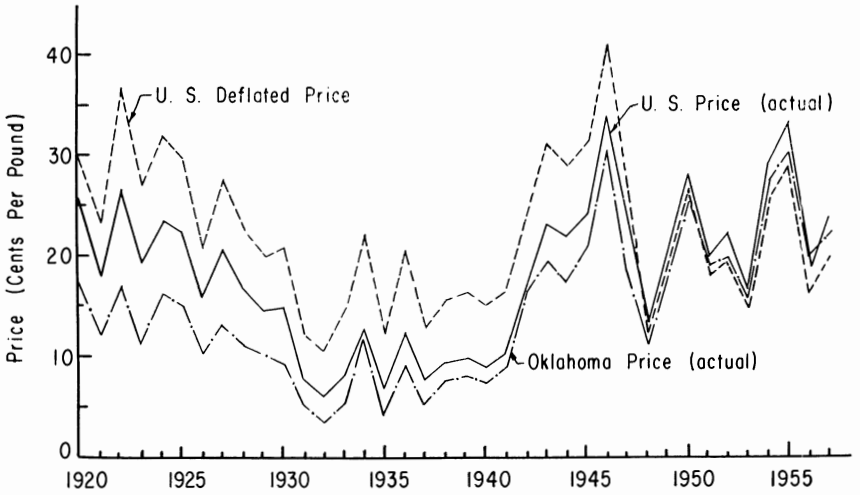

Figure 4.—United States and Oklahoma farm price of all pecans; and the United State's price deflated by the Consumers' Price Index. 1920-1957. Source of data: Appendix Tables I and II.

pecans was higher than the corresponding price in Oklahoma in all years except 1956. This was a result primarily of the fact that seedling pecans represent a larger percentage of total production in Oklahoma than in the nation at large. But it is clear from Figure 4 that the difference between the Oklahoma and United States farm price has become quite small in recent years. This was a result of the smaller price differential between the two types of pecans resulting from the increased national production of improved relative to seedling pecans.[5] When compared by type, Oklahoma and national average farm prices were approximately equal.

Competing Nuts

Pecans are only one of a group of edible tree nuts. While the individual nuts may be best suited for specific uses, most of the nuts can be and are used for many of the same purposes. Consequently, it is commonly believed that the demands for the various edible tree nuts are closely interrelated; that is, they are readily substituted one for the other in response to changes in relative prices.

The nuts which are produced domestically, in addition to pecans, are walnuts, almonds, and filberts. The nondomestic-type nuts included in import data are brazil nuts, cashews, chestnuts, pignolia, pistachio,

[5]See Appendix Table II.

and miscellaneous tree nuts. These nuts are usually grouped together and called "other nuts" in the various available statistical compilations.

The total domestic supply of edible tree nuts for any given marketing year is composed of domestic production, imports of domestic-type and nondomestic-type tree nuts, and stocks of nuts carried over from previous seasons. Distribution of the total supply may be divided into domestic consumption, exports, and carryover. Each classification may be further divided into its more important utilization components or by individual nuts.

Imports of domestic-type nuts, except pecans, are important components of the supply of the individual nuts (Table I). Imports of nondomestic-type nuts are an important component of the total supply of all edible tree nuts. As pointed out earlier, however, imports of pecans are of minor importance in the supply picture. On the other hand, the volume of exports of tree nuts is relatively unimportant in distribution, although in some years substantial quantities of some nuts are exported (Table I). Data on carryover stocks are fragmentary and of questionable validity.

Because of the importance of foreign trade in domestic supply and utilization of tree nuts other than pecans, apparent[6] per capita consumption data are used to indicate trends in the relative importance of the individual nuts and for all tree nuts combined. These data are shown in Table II. It seems unlikely that consumption per capita actually varies to the extent indicated by these data. The rather wide changes from year to year can be traced primarily to annual variations in production, and to the lack of data on carryover stocks. Changes in carryover stocks, moreover, will tend to average out over a period of several years. Thus the data probably indicate per capita consumption rather accurately when averaged over periods of several years duration.

In any event, interest at this point is not directed to the details of particular years but to an overall appraisal of significant developments in relative consumption of tree nuts over time. For this purpose, six-year averages for two selected periods are used. Table III shows the changes which occurred between 1930-35 and 1949-54.

Between these two periods, per capita consumption of all tree nuts on a shelled basis increased from 1.06 pounds to 1.61 pounds, an increase of 52 percent. The consumption of pecans increased about 52 percent, accounting for about 22 percent of total tree nut consumption in both

[6]Apparent in the sense that the data reflect estimates of production, imports and exports but not estimates of carryover stocks. The data are on a shelled basis.

Table II.—Apparent Per Capita Consumption of Tree Nuts (Shelled Basis), United States, Crop Years, 1919-57[1]

Crop Year	Almonds	Filberts	Pecans	Walnuts	Other[2]	Total	Pecans as a Per Cent of Total
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Per Cent
1919	.33	.15	.24	.49	.23	1.4	17.14
1920	.20	.07	.04	.31	.36	1.0	4.00
1921	.31	.11	.16	.49	.36	1.4	11.43
1922	.29	.11	.05	.44	.34	1.2	4.17
1923	.30	.12	.19	.42	.39	1.4	13.57
1924	.26	.07	.13	.48	.35	1.3	10.00
1925	.23	.10	.17	.51	.29	1.3	13.08
1926	.26	.08	.30	.37	.35	1.4	21.43
1927	.24	.10	.11	.51	.14	1.1	10.00
1928	.26	.09	.21	.38	.30	1.2	17.50
1929	.20	.06	.16	.44	.23	1.1	14.55
1930	.21	.05	.17	.33	.29	1.1	15.45
1931	.17	.04	.26	.32	.33	1.1	23.64
1932	.14	.05	.20	.36	.27	1.0	20.00
1933	.12	.03	.23	.26	.25	.9	25.56
1934	.11	.03	.17	.33	.35	1.0	17.00
1935	.17	.04	.36	.34	.44	1.4	25.71
1936	.16	.05	.17	.28	.47	1.1	15.45
1937	.19	.03	.30	.38	.46	1.4	21.43
1938	.14	.03	.21	.32	.49	1.2	17.50
1939	.21	.05	.27	.38	.46	1.4	19.29
1940	.12	.03	.34	.32	.54	1.4	24.29
1941	.09	.04	.34	.44	.40	1.3	26.15
1942	.22	.03	.23	.35	.14	1.0	23.00
1943	.23	.05	.38	.37	.07	1.1	34.55
1944	.36	.10	.41	.41	.16	1.4	29.29
1945	.34	.10	.37	.38	.24	1.4	26.43
1946	.36	.13	.20	.38	.40	1.5	13.33
1947	.30	.08	.31	.33	.45	1.5	20.67
1948	.29	.09	.44	.38	.49	1.7	25.88
1949	.27	.10	.31	.41	.53	1.6	19.38
1950	.33	.06	.31	.36	.56	1.6	19.38
1951	.29	.08	.38	.42	.48	1.7	22.35
1952	.26	.09	.36	.42	.49	1.6	22.50
1953	.24	.06	.50	.32	.49	1.6	31.25
1954	.22	.08	.21	.38	.57	1.5	14.00
1955	.20	.07	.33	.42	.58	1.6	20.63
1956	.26	.04	.40	.35	.49	1.5	26.67
1957	.19	.09	.24	.31	.56	1.4	17.14

[1]Crop year beginning July of year indicated for tree nuts. Civilian per capita consumption beginning 1941.

[2]Includes the following nuts: Brazil, pignolia, pistache, chestnuts, cashews, and miscellaneous tree nuts.

Source: 1919-55: *Supplement for 1956 to Consumption of Food in the United States, 1909-56,* Agriculture Handbook No. 62 USDA, AMS, Washington, D. C., September 1957, p. 30.

1956-57: *Supplement for 1957 to Consumption of Food in the United States, 1909-52; Supplement for 1957 to Agriculture Handbook No. 62,* USDA, AMS, Washington, D. C., August 1958, p. 9.

Table III.—Edible Tree Nuts: Per Capita Consumption and Percentage Change Between the Periods 1930-35 and 1949-54, (Six-Year Averages)

Period	Almonds	Filberts	Pecans	Walnuts	Other	Total
1930-35						
Pounds per capita	.15	.04	.23	.32	.32	1.06
Percent of total	14.2	3.7	21.7	30.2	30.2	100.0
1949-54						
Pounds per capita	.27	.08	.35	.39	.52	1.61
Percent of total	16.8	4.9	21.6	24.2	32.5	100.0
Percentage increase	80.0	100.0	52.2	21.9	62.5	51.9

Source: Computed from Table II

periods. The largest percentage increase in consumption occurred in filberts, although they still represented only four percent of total consumption in 1949-54. Consumption of "other nuts" increased about 62 percent and thus accounted for a slightly larger percentage of total consumption in 1949-54 than in 1930-35. Consumption of almonds increased 80 percent and thereby increased their share of the total market from 14 to 17 percent. Consumption of walnuts decreased 22 percent and accounted for only 24 percent of total consumption in 1949-54 compared with 30 percent in 1930-35.

In summary, these data show that pecans have maintained their same percentage share of a larger total market between the two periods under consideration, while almonds, filberts, and "other nuts" have increased their share at the expense of walnuts. At the same time, prices of pecans increased relative to walnuts and filberts and remained virtually unchanged relative to almonds. Data on prices of nondomestic-type nuts are not available. Thus the substantial increases in per capita supplies of pecans during the past three decades have been marketed with only a moderate decrease in the price of pecans relative to the general price level, but apparently with a moderate price increase relative to prices of other tree nuts.

Statistical Analysis of Factors Affecting Pecan Prices

Pecan prices are determined in a market that for all practical purposes is characterized by conditions approximating those of pure competition. Under such conditions prices are determined by the interaction of the market demand for and supply of pecans. In order to project future trends in pecan prices it is necessary to (1) identify the major factors and forces affecting demand and supply, (2) measure their interrelationships, and (3) parcel out the net effect of each factor on price. In

this section a statistical analysis of the factors affecting pecan prices is presented, and the way in which the analysis can be used to guage the price outlook in the years ahead is illustrated.

The supply of pecans in any given year consists of production, carryover stocks, and net imports (which may be negative). Each of the components of supply is influenced by different forces or to a different degree depending upon the length of time under consideration.

Production is the most important component of supply. In any given year, production is determined by yields, and year-to-year changes in production are caused primarily by changes in yields. As is well known, pecan yields follow a pronounced two-year cycle usually referred to as alternate-year bearing. Although little is known of the basic causes for this phenomenon, it is clearly not related to current or lagged economic variables.

Year-to-year changes in carryover stocks may have an important influence on available supplies in any given year, but they do not influence supplies over a period of several years. The same is true for imports and exports in the absence of long-term trends in one or the other, or both.

Hence, over the longpull, the supply of pecans consists largely of production. The average level of production over time is influenced by such factors as cultural practices, disease and insect control, development of better yielding varieties, and a larger production base.[7]

The demand[8] for pecans is determined by four major factors: (1) population, (2) tastes and preferences of consumers, (3) the level and distribution of consumer incomes, and (4) the availability or prices of substitute commodities. These are the factors that form the environment that conditions and determines the level and shape of the demand curve or schedule, and changes in these factors manifest themselves in shifts in the demand curve and possibly also in its shape.

In this study, the factors found to be of primary importance in explaining variations in annual prices received by farmers for all pecans

[7]In the case of improved pecans planted in groves, a larger production base is likely to mean increased numbers of trees. In the case of native pecans, where a large percentage of the crop is produced under noncultivated grove conditions, there may be an inverse relationship between the number of trees and total production. The total production may be increased substantially by thinning existing trees. Even in this case, however, after some level of total production from existing trees is achieved, increased production will require an increase in the total number of trees.

[8]The term demand as used here refers to a schedule or curve or function showing the relation between alternative prices of pecans and the corresponding quantities of pecans that will be purchased at each alternative price. The prices and quantities defining the schedule refer to a specific market area and a specific time period, with all other factors affecting demand remaining unchanged. Statistically, it is the net relation between price and quantity with the influence of other major factors affecting demand being measured and parcelled out. The terms demand schedule, demand curve, and demand function are used interchangeably in this report.

in the United States were (1) the supply of pecans per capita, (2) disposable national income per capita, and (3) a linear trend.

Although it was expected that pecan prices would be influenced by supplies of other tree nuts, several analyses failed to yield any statistically significant relations between supplies of competing nuts and pecan prices.

Method Used

The single equation method of least squares regression was used to estimate the coefficients connecting the variables. As is well known, this procedure yields unbiased estimates of structural parameters only if all explanatory (independent) variables are predetermined. This raises a number of questions with respect to the supply variable used in this analysis.

As defined in this study, supply is equal to harvested production plus imports minus exports. It seems clear that actual production in the current season as contrasted to the quantity harvested, is not influenced by prices prevailing during the season and is, therefore, predetermined. The actual quantity harvested, however, may be affected to some extent by prices prevailing during the harvesting season. That is, when pecan prices are relatively high, a more thorough job of harvesting may be accomplished than when prices are relatively depressed, especially in the native pecan growing areas. Since data on quantities produced but not harvested are not available, it was impossible to explore this problem further.

A second problem involved in the definition of supply concerns carryover stocks from production in previous years as a component of market supply in the current year. The quantity carried over in any given year and changes in carryover from year to year may be influenced significantly by current price. Unfortunately, adequate data on carryover stocks of pecans are not available and could not be taken into account in the study. However, since the major objective of this study is long-term projection rather than year-to-year prediction, this does not appear to be a serious shortcoming. The effects of excluding stocks from the supply variable will be reflected in the unexplained residuals and the coefficient of multiple determination. This will affect the standard error of estimate but not necessarily the coefficient connecting price and supply. To the extent that changes in the level of carryover stocks are predominantly random variations, uninfluenced by current price and independent of other explanatory variables, the coefficient will be unbiased.

In any event, variations in stocks do not influence the level of supplies over a period of several years. Thus, even if the coefficient connecting price and supply based on annual data is biased in the technical sense, the bias will be of little significance in projecting long-term trends in prices.

A third problem involves treating the quantity of pecans imported and exported as predetermined. In a free market the quantity of exports and imports and average farm prices would be determined simultaneously. This would imply the need for a system of equations to be solved simultaneously. Actually, however, the quantity of imports and exports of pecans are influenced importantly by various trade restrictions.[9] Moreover, they are relatively unimportant quantitative components of the total market supply of pecans. To treat imports and exports as predetermined appears in the main to be satisfactory. To do so implies that exporting a given quantity of pecans will, by removing that quantity from the domestic market, have the same effect on price as an equivalent *decrease* in production. Conversely, it implies that a given quantity imported, by adding to the domestic market supply, will have the same effect on price as an equivalent *increase* in production.

Clearly, national disposable income is predetermined. Time is included as a shift variable to represent the combined influence of omitted variables that cause the demand for pecans to change smoothly and slowly over time. In this analysis the coefficient on the time variable may reflect to some extent effects of increasing supplies of other edible tree nuts over the period analyzed. But this causes no difficulty, since for all practical purposes supplies of competing nuts are predetermined also.

The Algebraic Form of the Equation

In this study, an equation linear in the variables was used because it implies that the price elasticity of demand varies with price in such a way that the higher is price the more elastic is demand with respect to price. The form also permits, within limits and under certain conditions, the elasticity of demand with respect to income to decrease as income increases.[10]

The Basic Data and Time Period Used

The statistical analysis was based on annual data for the years 1922 through 1956, omitting the war years 1942-45.

The price and supply data refer to the average United States price

received by producers for and the net supply (harvested production plus imports minus exports) of all pecans on a crop-year basis. The income series is the Department of Commerce's series of total national disposable income on a calendar-year basis converted to an index (1947-49=100). To adjust for the influence of changes in the general price level, the price and income series were deflated by the Bureau of Labor Statistics' Consumer Price Index (1947-49=100). To adjust for changes in population, the income and supply data were deflated by total population in the United States on July 1, including Armed Forces overseas. Table IV shows the variables used and the computed annual average prices based on this analysis.

The Empirical Results

The least square regression equation derived from these data for 1922-1956 (omitting 1942-45) is:

$$X_1 = 2.6549 - \underset{(6.0896)}{21.6350}\, X_2 + \underset{(6.6005)}{0.5400}\, X_3 - \underset{(3.6226)}{0.5989}\, X_4$$

$$R^2 = 0.782 \qquad d = 1.62$$

where: X_1=U. S. average farm price of pecans (cents per pound), deflated by the CPI (1947-49=100)
X_2=U. S. net supply of pecans (pounds per capita)
X_3=index of per capita disposable income (1947-49=100), deflated by the CPI (1947-49=100)
X_4=time (1922=1).

The figures in parentheses below the coefficients are t-ratios. The coefficients on supply and income have the expected sign. All coefficients are significantly different from zero at the one percent probability

[9]For example, see Foreign Agriculture Service, USDA, *Prospects for Foreign Trade in Fruits, Vegetables and Tree Nuts*, January, 1959.

[10]If the constant term in the net statistical relation between quantity and income is negative, demand with respect to income is elastic and will decrease as income increases and approach unitary elasticity as a limit as income becomes larger and larger. On the other hand, if the constant term is positive, demand with respect to income is inelastic and will increase as income increases but will again approach unitary elasticity as income becomes larger and larger. By using the net statistical relation between consumption and income, this can be demonstrated as follows: $C = a^* + bI$, where C is consumption, I is income, b is net effect of I on C, and a^* is the constant term adjusted for the level of other variables. Then the income elasticity of demand is given by:

$$C_I = \frac{\partial C}{\partial I} \cdot \frac{I}{C} = b\frac{I}{C}. \text{ Substituting for C we obtain: } C_I = \frac{bI}{a^* + bI}$$

The above statements follow from this expression. The first statement is limited, of course, to those levels of income such that $/a^*/ < bI$.

Table IV.—All Pecans, United States: Actual and Computed Annual Average Price Received by Farmers and Related Variables, 1922-56 Omitting 1942-45

Crop Year	Season Average Price Per Pound		Supply Per Capita[3]	Index of Disposable Income Per Capita[4] (1947-49=100)	Time
	Actual[1]	Computed[2] (X_1)	(X_2)	(X_3)	(X_4)
	cents	*cents*	*pounds*	*percent*	
1922	37.01	32.66	.13	61.7	1
1923	26.47	25.90	.53	66.3	2
1924	32.01	30.08	.36	68.4	3
1925	29.47	26.94	.46	67.9	4
1926	20.63	19.48	.83	69.8	5
1927	27.76	30.13	.31	69.9	6
1928	22.65	25.43	.57	72.9	7
1929	20.05	28.28	.44	74.1	8
1930	20.87	23.75	.47	67.8	9
1931	12.00	15.61	.72	63.8	10
1932	10.27	14.86	.55	56.7	11
1933	14.47	11.96	.63	55.9	12
1934	22.03	17.64	.45	60.3	13
1935	11.58	7.17	.98	63.2	14
1936	20.91	21.17	.45	69.1	15
1937	12.54	13.93	.82	71.3	16
1938	15.59	18.03	.55	69.2	17
1939	16.33	15.52	.73	72.9	18
1940	14.86	12.35	.93	76.1	19
1941	16.38	15.25	.91	81.9	20
1946	40.53	32.87	.52	104.6	25
1947	23.66	23.45	.84	100.8	26
1948	11.96	14.25	1.19	99.2	27
1949	18.57	22.12	.82	100.0	28
1950	28.02	24.21	.82	104.9	29
1951	17.84	18.17	1.01	102.6	30
1952	19.47	19.24	.96	103.4	31
1953	14.25	12.45	1.33	106.8	32
1954	24.91	28.39	.57	107.1	33
1955	28.73	24.50	.89	113.8	34
1956	15.92	21.96	1.02	115.6	35

[1]Deflated by the CPI.
[2]Computed from the equation given in the text.
[3]Production plus imports minus exports divided by July 1 population (Appendix Table I).
[4]Index of disposable income per capita (1947-49=100) deflated by the CPI (1947-49=100). (Appendix Table I).

level. The R^2 of 0.78 indicates that the three independent variables explained 78 percent of the annual variation in pecan prices. While not exceptionally high, this is satisfactory for the purposes of this analysis.

The Durbin-Watson statistic, d, of 1.62 indicates that the hypothesis of no serial correlation in the unexplained residuals is accepted.[11] Other statistical coefficients relating to this equation are shown below.[12]

[11]J. Durbin and G. S. Watson, "Testing for Serial Correlation in Least Squares Regression, II," *Biometrika*, Vol. 38 (1951), pp. 159-178.
[12]$S_{1\cdot234}=3.73$; $r^2_{12\cdot34}=0.579$; $r^2_{13\cdot24}=0.617$; $r^2_{14\cdot23}=0.327$.

The coefficient attached to the supply variable indicates that a change of 0.1 pound per capita in the supply of pecans results in an average change in the opposite direction of 2.16 cents per pound in the farm price of all pecans (with the other factors held constant). The average effect of a change of one point in the index of real disposable income per capita (with the other factors included in the analysis held constant) was a change in the same direction of about 0.5 cent per pound in the farm price of pecans. The coefficient on X_4 indicates that with no change in per capita supply and income the farm price of pecans decreased an average of about 0.6 cent per pound per year.

Coefficients of *price flexibility* and *elasticity of demand* were calculated at the means of the series. The flexibility of price with respect to supply is —0.727. Thus a 10 percent change in per capita supply was associated with a seven percent change in price in the opposite direction. The flexibility of price with respect to income is 2.099, indicating that a one percent change in the income index was associated with a two percent change in farm prices in the same direction. The inverse of the coefficient of price flexibility with respect to supply provides an estimate of the price elasticity of demand of —1.376. The income elasticity implied by the equation is 2.892.[13]

Graphic Representation

Figure 5 shows graphically the average net statistical relations between price and each of the independent variables. Panel A shows the relationship between price and per capita supply after allowing for changes in the level of real disposable income per capita and the estimated trend in the demand for pecans. Panel B shows the relationship between prices and the index of disposable income per capita in 1947-49 dollars after adjusting prices for changes in per capita supply and estimated trend. Panel C shows the estimated trend in demand over time after allowing for changes in per capita income and supply. The points plotted about the lines of average net relationships are the differences between the actual price and the price estimated from the equation for the indicated years. Panel D shows actual prices and prices estimated from the regression equation for the years included in the analysis.

[13]These estimates of price and income elasticities are almost identical to those obtained by Lerner in a detailed, unpublished study based on the simultaneous equation estimating procedure and using both arithmetic and logarithmic equations. Elliott B. Lerner, "An Econometric Analysis of the Demand for Pecans with Special Reference to Demand Interrelationships Among Domestic Tree Nuts," unpublished master's thesis, Oklahoma State University, August, 1959.

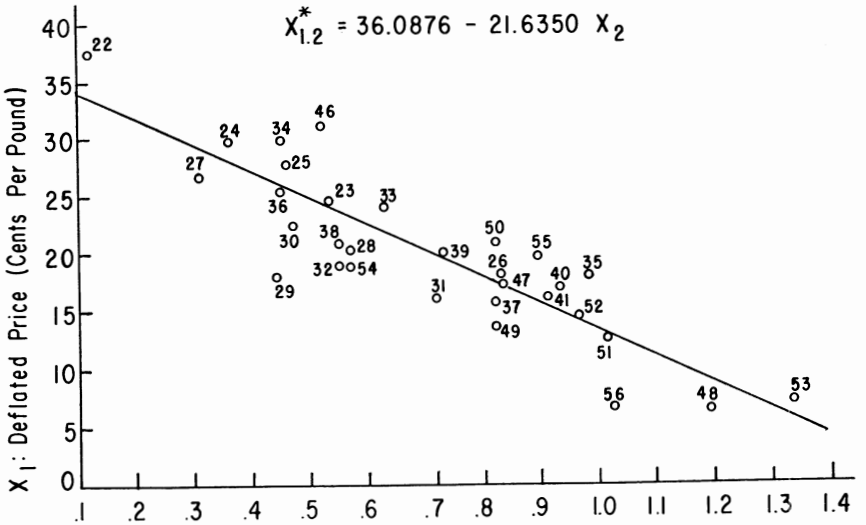

Figure 5 (A)—X_2—U. S. supply of all pecans (pounds per capita).

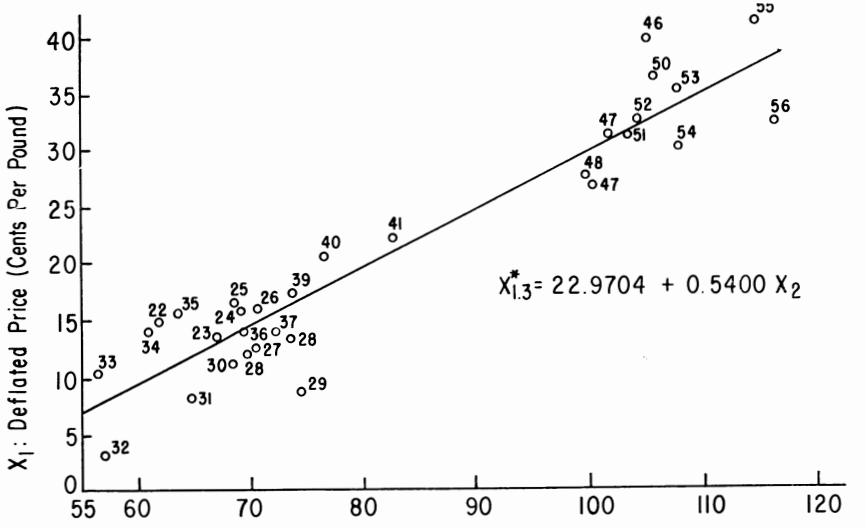

Figure 5 (B)—X_3—Index of real disposable income per capita 1947-49=100).

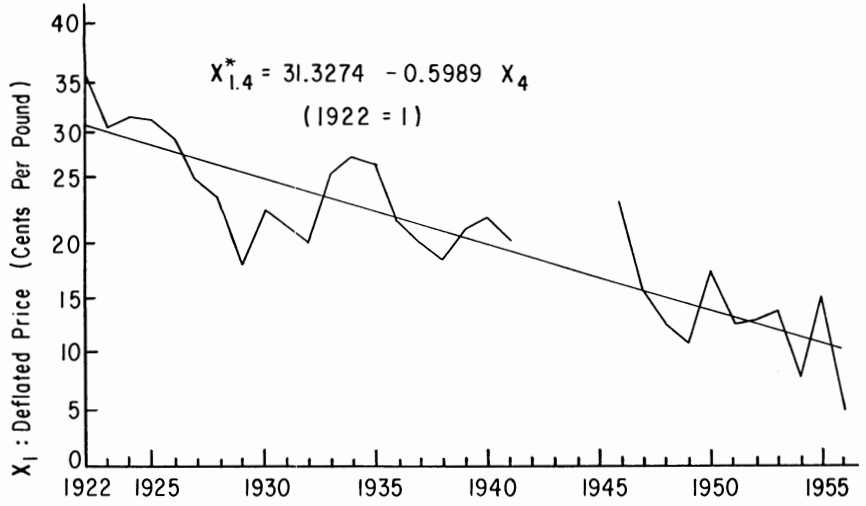

Figure 5 (C)—X_1—Time (in years)

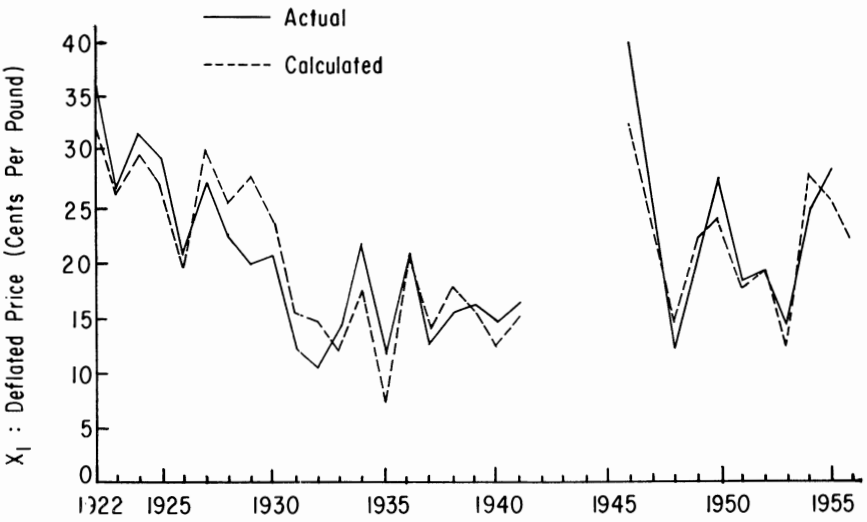

Figure 5 (D)—Year.

Graphic Illustration of Shifts in the Demand Curve and Its Use in Estimating Price

The concept of a demand curve, the implications of shifts in the curve in response to a change in one or more of its determinants, and the analytical usefulness of statistical estimates of demand relationships are illustrated in Figure 6. The figure is constructed on the basis of the price-estimating equation discussed above and using actual numerical information for the years 1950 and 1959.

The average annual United States price received by farmers for all pecans, expressed in cents per pound and in terms of the 1947-49 price level, is measured on the vertical axis. Production of all pecans in the United States, in millions of pounds and adjusted for net foreign

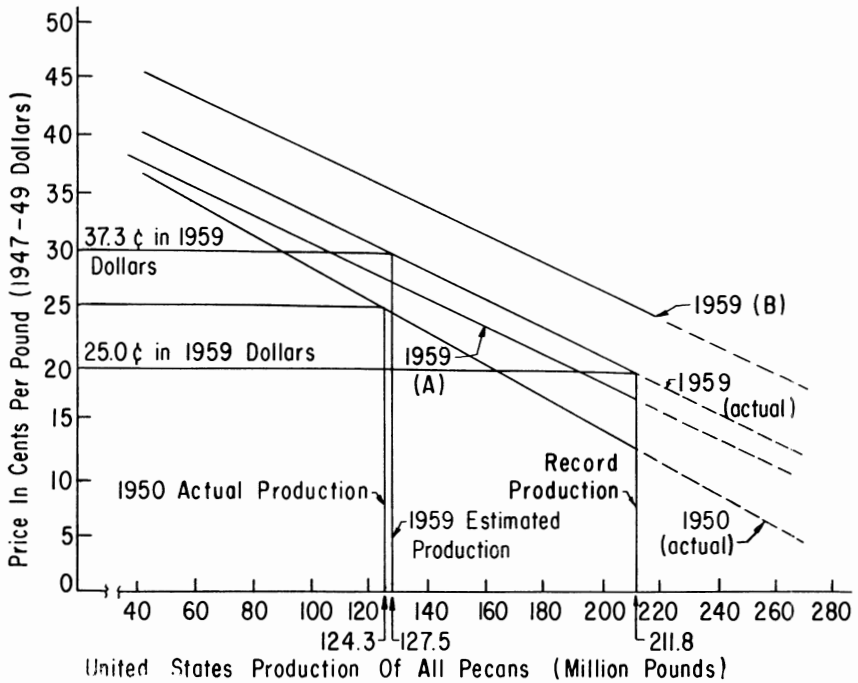

Figure 6—The 1950 and 1959 demand curves for pecans and the effect of changes in shift variables.*

*Extreme caution must be used in estimating the probable value of the dependent variable (price) for combinations of values of the independent variables outside the range of these used in estimating the regression equation. For example, Figure 6, and the equation upon which it is based, cannot be interpreted as meaning that price would be reduced to zero if actual production were sufficiently large that the appropriate demand curve in the figure would decline to zero if extended. Such a value for production in combination with observed values of income, population, and the general price level is clearly outside the range of values used in estimating the equation. See, Mordecai Ezekiel, *Methods of Correlation Analysis*; second ed. (New York: John Wiley & Sons, Inc., 1941), pp. 347-349.

trade, is shown on the horizontal axis. Thus, the demand curves illustrated here refer to the United States domestic market with the unit of time being one year.

The demand curves in the diagram have the following meaning: The curve designated 1950 (actual) is the estimated net relationship between price and quantity adjusted to the 1950 level of income, population, and estimated trend. Between 1950 and 1959 the nation's population increased from 151.7 million to 176.8 million. The 1959 (A) demand curve shows how the 1950 curve shifts when adjusted to the 1959 population assuming no changes in other factors affecting demand. However, the index of real disposable income per capita (1947-49=100) increased from 106.7 in 1950 to 121.8 in 1959. The 1959 (B) demand curve shows the 1950 curve adjusted both for the change in population and the change in income per capita. Finally, the 1959 (Actual) demand curve is the 1950 curve adjusted for the estimated downward trend in demand from 1950 to 1959 as well as for the 1959 level of population and income. The 1959 (Actual) demand curve is the relevant curve from which to estimate expected farm prices in 1959 corresponding to crops of various sizes.

The use of the demand curves shown in the diagram may be illustrated in the following way: Actual net supply of all pecans in 1950 was 124.3 million pounds, or 0.82 pounds per capita. Given the 1950 (Actual) demand curve, this quantity of pecans would have resulted in an expected farm price in 1947-49 dollars of 25.2 cents per pound.[14] The actual farm price in 1950 in terms of the 1947-49 price level was 28.0 cents per pound.

In 1959, the December estimate of total production was 127.5 million pounds. Assume that imports and exports are equal. According to the 1959 (Actual) demand curve, the expected farm price is 30.1 cents per pound in 1947-49 dollars. This is equivalent to 37.3 cents per pound in terms of the 1959 price level.[15]

Consider a final example. The largest crop of pecans on record was that of 1953 when 214.2 million pounds of all pecans were harvested. The net supply was 211.8 million pounds. The average farm price was

[14]The expected price in this and the following examples is found as follows: Draw a line from the point on the quantity axis corresponding to 124.3 million pounds. This line will intersect the 1950 (Actual) demand curve at point A. From point A draw a horizontal line to the vertical (price) axis. This line intersects the price axis at 25.2 cents (allowing for minor inaccuracies in the construction of the diagram.)

[15]Since 1937, the preliminary estimate of production issued in December has averaged about six million pounds less than the final estimate of production issued in the following July. The demand curves are estimated using the final estimate of production. In addition, exports have exceeded imports by about one percent on the average. If these adjustments were taken into account, the expected farm price would be reduced by about 1.0 cent, from 37.3 to 36.3 cents per pound in terms of the 1959 price level.

16.3 cents per pound, or 14.3 cents per pound in terms of 1947-49 dollars. What would be the expected farm price of a crop of this size in 1959? Assume that imports and exports were the same as they were in 1953, that is, that the net supply was 211.8 million pounds. Then the expected farm price would be almost 20.0 cents per pound in terms of the 1947-49 price level or almost 25.0 cents in terms of the 1959 price level.

Projection of Production and Other Exogenous Variables

In the price estimating equation, production and net exports of pecans, population, the general price level, and disposable national income were taken to be independent of pecan prices. These exogenous variables, or combinations of them, must be projected sparately before pecan prices can be projected.

Population

The U. S. Bureau of the Census makes periodic projections of population based on alternative sets of assumptions regarding birth and death rates and net migration. One such set of projections is shown in Table V.[16] The uncertainty of these projections is suggested by the wide range between the highest and lowest projection for 1975. Although there is considerable difficulty in choosing the most reasonable projection, the projections given by Series AA and Series A were used in this study.[17] Estimates for individual years were obtained by linear interpolation.

Disposable Real Income Per Capita

Figure 7 shows the index of United States disposable income per

Table V.—Census Bureau Projections of Total United States Population (Including Armed Forces Overseas)

Year (July 1)	Series AA	Series A	Series B	Series C
		- - - 1,000 - - -		
1960	179,358	177,840	177,840	176,452
1965	193,346	190,296	190,296	186,291
1970	209,380	204,620	202,984	196,370
1975	228,463	221,522	214,580	205,907

Source: U. S. Bureau of the Census, *Current Population Reports*, Series P-25, No. 123, October 20, 1955.

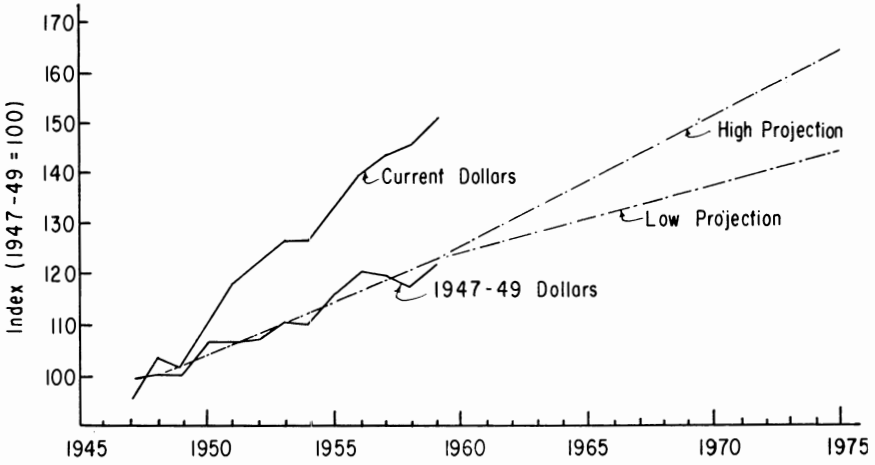

Figure 7.—Postwar United States disposable income per capita projected to 1975 in 1947-49 dollars.

capita (1947-49=100) for the postwar years both in current dollars and in constant 1947-49 dollars. The index of per capita income is projected to 1975 in terms of the 1947-49 price level. Two projections are made: the "high" projection is represented by the equation:

$$\log X_3 = 1.9874 + 0.007895\ (t)\ ,$$

where X_3 is the index of disposable income per capita (1947-49=100) deflated by the CPI (1947-49=100), and t is time in years (1947=1). The parameters are estimated from annual data for the 13 years 1947 through 1959. This equation implies an annual increase of about 1.9 percent in the index of real per capita income or an increase of about 30 percent between 1959 and 1975.

The "low" projection was chosen arbitrarily to reflect an annual increase of 1.0 percent in the index of income. It is represented by the equation:

$$\log X_3 = 1.9874 + 0.00432\ (t)\ .$$

This implies an increase in real disposable income per capita of about 16 percent between 1959 and 1975.

[16]For a discussion of the various assumptions underlying these projections, see U. S. Bureau of the Census, *Current Population Reports*, Series P-25: No. 123 (October 20, 1955) and No. 78 (August 21, 1953).

[17]Actually, the projections shown in Table IV have since been revised upward. The revised projections range from a low of 216 million to a high of 244 million in 1975. Nevertheless, Series AA and Series A were used in this study for two reasons. First, Series AA projection for 1975 is about midway between the highest and lowest projection for 1975 contained in the revision. Second, and of a more pragmatic nature, certain calculations required to use the projections in this study had previously been made for use in another study. Because of the uncertainty attached to the separate projections, it was not considered worthwhile to make the additional calculations. It should be noted, however, that current estimates of population—180.5 million for July, 1960—are slightly above those implied by the Series AA projection. See U. S. Bureau of the Census, *Current Population Reports*, Series P-25, No. 187 (December 10, 1958) for the revised projections.

This is, of course, an exceedingly simple model for projecting an economic variable that is determined by so many complex and interrelated factors. Of itself, however, simplicity does not necessarily detract from the usefulness or validity of the projections. At least two points may be made in defense of the model. From the pragmatic point of view, the equation describes the 1947-59 data quite satisfactorily. More importantly, however, the projections are in essential agreement with those made by other analysts based on highly refined and detailed considerations of the complex forces underlying the determination of national income.[18]

Net Exports

During the 1950's, net exports (exports minus imports) of pecans have averaged a little more than one million pounds annually.[19] This represented a little less than one percent of domestic production. It was arbitrarily assumed that net exports of pecans would continue to average one percent of domestic production per year through 1975.

Since total production is increasing, a slowly increasing quantity of exports is anticipated by this model. It might be argued that a more realistic estimate would be a continuation of the current level of exports. However, except for an estimated production of about five million pounds in Mexico, the United States is the only producer of pecans. Hence, with generally rising real incomes and living standards abroad, the increase in exports implied here may not be unreasonable.

Production

Figure 8 shows annual production of all pecans in the United States for the years 1925 to 1957 and two alternative projections of production to 1975. Projection 1 was based on a linear trend in total production calculated from annual data for the years 1920 through 1957. The trend line is represented by the following equation:

$$P=27{,}463.6+3{,}604.5\,(t)\,,$$

where P represents total United States production of all pecans (1,000 pounds), and t represents time in years (1920=1).

[18]See, for example, Rex F. Daley, "The Long-Run Demand for Farm Products," *Agricultural Economics Research*, Vol. VIII, No. 3 (July, 1956), pp. 73-91; Norman R. Collins and George L. Mehren, "Demand Functions and Prospects"; Chap. 4 in Earl O. Heady, *et. al.* (Ed.), *Agricultural Adjustment Problems in a Growing Economy* (Ames: Iowa State College Press, 1958).
[19]Appendix Table I.

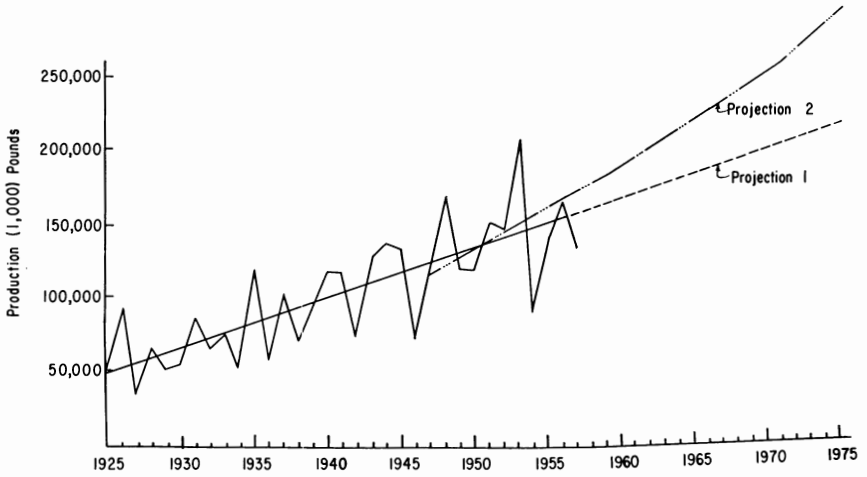

Figure 8.—United States production of all pecans 1925-1957, with projections to 1975.

The linear trend seems to be quite reasonable for projection over the relatively short period of 15 years to 1975. It results in a projection of total production of 193, 211, and 230 million pounds in 1965, 1970 and 1975, respectively. From the pragmatic point of view, the trend adequately describes historical changes in production. Between 1920 and 1957 there is no observable tendency toward nonlinearity or of change in the direction of trend. Theoretically, there are no apparent reasons why the basic causes of the past and present trend should cease to operate as before over the years covered by the projections. Thus, neither the empirical evidence nor logical reasons indicate that either the rate or direction of trend are likely to change over the period under consideration.

Nevertheless, the linear projection of production and projections of population based on Series AA and A imply a rather abrupt slowing down of the historical increase in per capita supply. Projection 2 was made, therefore, to investigate the probable effect on price should *per capita supply* continue to increase up to 1975 as it did between 1920 and 1957.

Projection 2 was based on the linear trend in per capita production calculated from annual data for the years 1920 through 1957 and projected population. The trend in per capita production is represented by the following equation:

$$P = .3136 + 0.0190\,(t)\,,$$

where P is per capita production of all pecans in pounds, and t is time in years (1919=1). Projection 2 was then obtained by multiplying the

estimated per capita production and population projection "A" for each year. This results in a projection of a total production of 310 million pounds of pecans in 1975, and a per capita production of 1.4 pounds.

Since there appear to be logical limits to per capita consumption of pecans, it would seem to be somewhat unreasonable to expect per capita supply to continue to increase by a constant amount each year. Moreover, close examination of Figure 3, which shows the trend in per capita production from 1919 to 1957, indicates that increases in per capita production may be slowing down to some extent. Thus, a curve that at some point increases at a decreasing rate and approaches some saturation or maximum level may reflect more accurately the future trend in per capita production than does the linear equation. Certainly, it has a more solid theoretical basis.

Nevertheless, for reasons that will be discussed more fully below, the projections based on the linear trend in per capita production will be used in some of the price projections.

Figure 9 shows the actual per capita supply of all pecans in the United States for the postwar years, and projections to 1975 based on alternative assumptions.

The upper projection was based on the linear trend in per capita production between 1920 and 1957. It underlies projection 2 in total

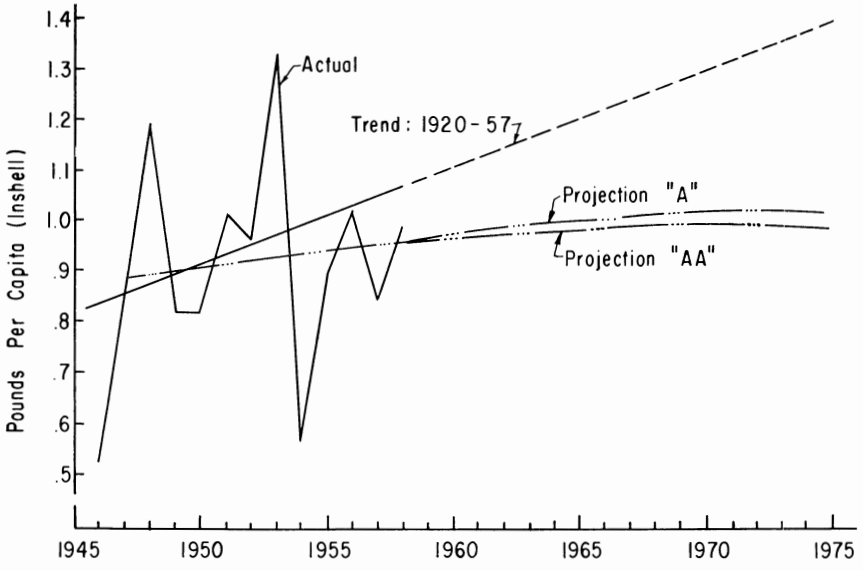

Figure 9.—Per capita supply of all pecans projected to 1975.

production (Figure 9). No allowance was made for imports and exports. Projection "A" was calculated from the linear projection of total production—projection 1, Figure 9—adjusted for estimated net exports and projected population based on Series A. Projection "AA" was calculated from the same supply projection as was "A" but using the higher population projection based on Series AA.

Projection of Pecan Prices to 1975

For the purpose of projecting pecan prices, all explanatory variables in the price estimating equation are assumed to be exogenous. That is, future pecan prices depend upon the values of factors that are not, in turn, influenced by pecan prices. Alternative projections of the exogenous variables were described in the preceding section. Because of the uncertainty attached to these projections, the long-term trend in prices was estimated for several combinations of projections of exogenous variables. This makes it possible to evaluate the probable effect of situations not specifically analyzed.

Six specific projections of price were made. The projections of exogenous variables upon which each of the price projections was made are as follows:

Situation 1
Disposable income (real, per capita): High projection (Figure 7)
Population: Series AA (Table IV)
Production (per capita): Projection "AA" (Figure 9)

Situation 2
Disposable income (real, per capita): Low projection (Figure 7)
Population: Series AA (Table IV)
Production (per capita): Projection "AA" (Figure 9)

Situation 3
Disposable income (real, per capita): High projection (Figure 7)
Population: Series AA (Table IV)
Production (per capita): Projection "A" (Figure 9)

Situation 4
Disposable income (real, per capita): Low projection (Figure 7)
Population: Series A (Table IV)
Production (per capita): Projection "A" (Figure 9)

Situation 5
Disposable income (real, per capita): High projection (Figure 7)

Production (per capita): Linear trend (Figure 9)

Situation 6

Disposable income (real, per capita): Low projection (Figure 7)
Production (per capita): Linear trend (Figure 9)

Summary of Price Projections

Projections based on four of these six situations are shown in Figure 10. The number attached to each projection refers to the situation of the same number underlying the projections. Projections are made in terms of the 1959 price level. It is assumed that any change in the general price level will be accompanied by a similar change in the actual price of pecans. Thus, if the general price level continues to rise, actual prices in current dollars will probably be higher than those projected. Sharp inflation or prolonged depression may invalidate this assumption.

It should be emphasized that these projections are based on average annual supply as represented by the projections of supply. Hence, the projections of price represent the long-term trend in the average level of prices. Actual production will, of course, fluctuate from year to year —and fluctuate widely. Moreover, there will be year-to-year changes in carryover stocks and net foreign trade that will influence actual annual supply. Similar year-to-year variations in income will occur and influence

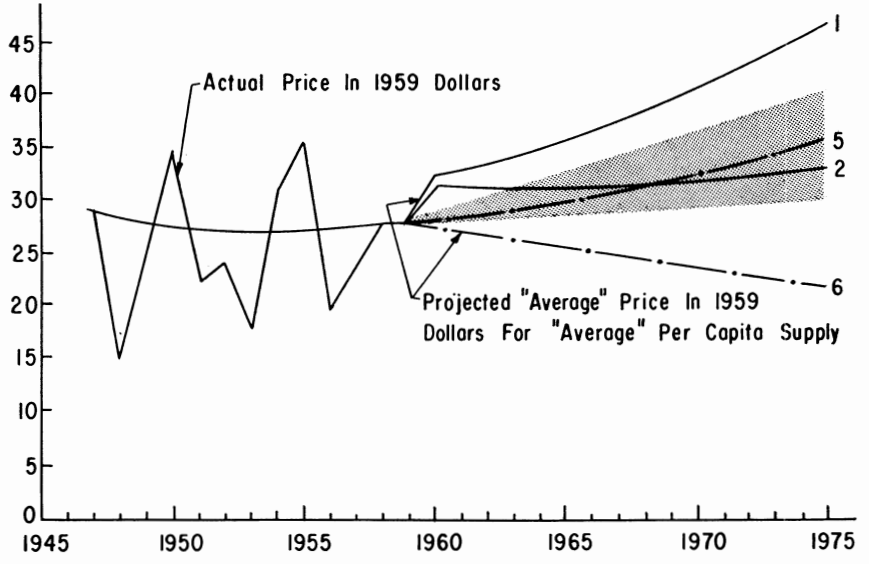

Figure 10.—United States average farm price of all pecans in 1959 dollars for a crop of average size, projected to 1975.

annual demand. Such changes are not reflected in these projections. In response to these changes, actual annual prices will fluctuate around the projected level (Figure 10).

Evaluation of Price Projections

Situation 1 reflects a very favorable outlook for pecan prices. In fact, the liklihood of the simultaneous realization of the set of conditions underlying projection 1 seems small. Hence, projection 1 probably represents the upper boundary of any realistic projection of future prices. There are at least two reasons for this, even if real income continues to increase at the relatively high postwar annual rate. First, if pecan prices actually increase in line with projection 1, it seems reasonable to assume that production may increase somewhat faster than that indicated by the linear production in Figure 8. Thus, per capita supplies would be larger than indicated for situation 1, resulting in a downward pressure on prices. Second, if population should increase at a somewhat slower rate, supply per capita could be larger and prices lower. Another reason for believing that projection 1 may be somewhat optimistic is that such an increase in pecan prices may result in larger supplies of competing nuts. This could result in a more pronounced downward shift in the demand for pecans than that indicated by the coefficient on the trend variable.

Situation 6 seems to represent an excessively pessimistic set of conditions. Projection 6, therefore, probably represents the lower limit of any realistic projection of future prices. As a matter of fact, the set of conditions underlying situation 6 would appear to be even less likely to occur than those underlying situation 1. The belief that projection 6 has a very low probability is based primarily on the assumption that a linear trend in per capita production is unrealistic. It will be recalled, moreover, that no allowance was made for exports in defining net per capita supply in this case. Another reason for believing that projection 6 may be too low is that for this projection it was assumed that real per capita income would increase at only about one-half its postwar rate.

Some insights regarding the effects on the projections of price of modifications in the conditions underlying the projections can be obtained by analyzing the conditions underlying the intermediate price projections and comparing them with situations 1 and 6. Projections 3 and 4 are not shown in Figure 10. If plotted on the graph, however, projection 3 would be parallel to and lie about 0.5 cent per pound below projection 1, and projection 4 would be parallel to and lie about

0.5 cent per pound below projection 2.

The only difference in the conditions underlying projections 1 and 2 is that the high income projection is assumed for 1 and the lower projection for 2 (Figure 7). The same is true for projections 5 and 6. Consequently, if income increases at an intermediate rate, projection 1 would be lower and projection 6 would be higher. Also, if production increases more rapidly than indicated by the linear trend in total production but less rapidly than indicated by the linear trend in per capita production (Figure 8), price projection 1 would be lower and price projection 6 would be higher. It seems reasonable to assume that either income or production or both are likely to increase at some rate intermediate between the projections shown in Figures 7 and 8. Any of these eventualities would cause estimated long-term average prices to converge on projections 2 and 5 (Figure 10).

Based on the foregoing subjective evaluation, price projections 2 and 5 would seem to have the greatest likelihood of being realized and the probability that the trend in prices will be somewhat above these projections is greater than the probability that it will be below these projections. Hence, the analysis suggests that future pecan prices are likely to center in the central or upper portion of the range indicated by the shaded area in Figure 10.

Summary and Conclusions

The purpose of this study was to summarize some past trends in the pecan industry and to project total production and average farm prices of all pecans in the United States to the year 1975. Two separate projections of total production and six separate projections of prices were made. These projections are not to be viewed as forecasts, but as estimates based on reasonable alternative sets of assumptions. Obviously, no objective probability statements can be attached to the projections. It is believed, however, that the projections demarcate the most likely range of trends in production and price between 1960 and 1975. The projections of price are in terms of the 1959 price level.

The projections indicate that trends in total production and net supply of all pecans will continue upward and will probably range between 230 and 310 million pounds annually by 1975. Compared with the average production of about 155 million pounds in the mid-1950's, this would represent an increase of between 50 and 100 percent by 1975.

Census Bureau projections of population used in this study indicate

that we will have between 222 and 228 million people in the United States in 1975. This represents an increase of about 25 to 27 percent over the 179 million population in January, 1960. If these projections of population and production materialize, the per capita supply of pecans will range between .95 and 1.40 in 1975.

The index of per capita disposable income (1947-49=100) in terms of the 1947-49 price level is projected to range between 144 and 165 in 1975 compared with an index of 122 in 1959. This represents an increase of between 18 and 34 percent over 1959.

If the projections summarized here are approximately realized and there are no substantial changes in the influence of the explanatory variables on pecan prices, the trend in pecan price is expected to range between 46 cents per pound under the most favorable circumstances and 22 cents under the most pessimistic circumstances. While no objective probabilities can be attached to the individual projections, they are not believed to be equally likely. The analysis suggests that the trend in price is most likely to center between the middle and higher range of the projections. This would indicate an average price of perhaps 35 to 40 cents per pound in terms of the 1959 price level by 1975.

Appendix Table I—Production, Average Farm Price, Imports and Exports of All Pecans, Population and the Consumers Price Index, United States, 1922-58

Year	Production	Price[1]	Imports[2]	Exports[2]	Population	CPI Index
	1,000 Pounds	cents	1,000 Pounds	1,000 Pounds	million	1947-49=100
	(1)	(2)	(3)	(4)	(5)	(6)
1920	10,375	25.7	2,195		106.5	85.7
1921	48,155	17.6	1,082		108.5	76.4
1922	11,355	26.5	2,469		110.1	71.6
1923	58,030	19.3	784		112.0	72.9
1924	37,998	23.4	2,718		114.1	73.1
1925	52,463	22.1	1,013		115.8	75.0
1926	95,861	15.6	1,119		117.4	75.6
1927	36,504	20.6	260		119.0	74.2
1928	68,550	16.6	541		120.5	73.3
1929	53,340	14.7	731		121.8	73.3
1930	57,135	14.9	503		123.1	71.4
1931	88,463	7.8	461		124.0	65.0
1932	68,234	6.0	24		124.8	58.4
1933	78,812	8.0	711		125.6	55.3
1934	56,172	12.6	1,035		126.4	57.2
1935	124,485	6.8	699	365	127.2	58.7
1936	59,787	12.4	122	1,086	128.1	59.3
1937	107,190	7.7	465	2,614	128.8	61.4
1938	74,323	9.4	386	3,853	129.8	60.3
1939	97,060	9.7	563	2,488	130.9	59.4
1940	122,884	8.9	358	1,012	132.1	59.9
1941	121,781	10.3	4	563	133.4	62.9
1942	77,374	17.1	7	75	134.9	69.7
1943	133,042	23.0	838	1,206	136.7	74.0
1944	142,104	21.6	432	3,953	138.4	75.2
1945	138,854	23.9	850	4,208	139.9	76.9
1946	76,225	33.8	660	3,001	141.4	83.4
1947	119,602	22.6	1,384	600	144.1	95.5
1948	176,043	12.3	477	1,652	146.6	102.8
1949	125,690	18.9	286	3,407	149.2	101.8
1950	124,630	28.8	1,397	1,761	151.7	102.8
1951	156,735	19.8	1,556	1,818	154.4	111.0
1952	151,436	22.1	994	2,298	157.0	113.5
1953	214,170	16.3	615	2,973	159.6	114.4
1954	94,600	28.6	885	2,859	162.4	114.8
1955	146,860	32.9	2,027	1,830	165.3	114.5
1956	173,700	18.5	919	2,298	168.2	116.2
1957	141,350	23.7	991	2,624	171.2	120.2
1958	174,750	28.0			174.1	123.5

[1]1922, Nov. 1 price; 1923-36, Dec. 1 price.

[2]Exports of shelled nuts converted to in-the-shell basis at ratio of 1 to 2.5. Imports of shelled nuts converted at ratio of 1 to 2.63.

Source of Data:

Columns 1, 2, 3 and 4—1920-56: USDA, *Agricultural Statistics*, 1957, p. 319. 1957-58: Agricultural Marketing Service, USDA, *Tree Nuts by States, 1957 and 1958: Production, Use, Value*, August, 1959.

Columns 5 and 6—Agricultural Marketing Service, USDA, *Supplement to 1958 to Consumption of Food in the United States, 1909-52* (Agricultural Handbook No. 62), September, 1959, p. 36.

Appendix Table II—Production and Prices Received by Farmers for Pecans by Types, United States, and Price Received by Farmers in Oklahoma for All Pecans, 1922-1958

Year	Production		Price Per Pound		
	Improved	Seedling	Improved[1]	Seedling[1]	All Pecans[2] Oklahoma
	1,000 *pounds*	1,000 *pounds*	*cents*	*cents*	*cents*
1922	3,448	7,907	44.5	18.7	17.1
1923	10,514	47,516	42.5	14.1	11.1
1924	7,150	30,848	43.8	18.6	16.1
1925	12,316	40,147	37.6	17.3	15.1
1926	17,535	78,326	32.5	11.8	10.1
1927	9,540	26,964	35.4	15.4	13.1
1928	18,005	50,545	29.6	12.0	11.1
1929	8,839	44,501	31.7	11.4	10.3
1930	13,875	43,260	27.7	10.8	9.2
1931	22,002	66,461	13.9	5.8	5.1
1932	11,813	56,421	13.5	4.4	3.6
1933	22,941	55,871	13.0	6.0	5.6
1934	19,468	36,704	15.5	11.0	11.9
1935	29,464	95,021	12.4	5.0	4.2
1936	32,257	27,530	14.7	9.6	9.2
1937	40,026	67,164	10.9	5.8	5.5
1938	35,291	39,032	11.8	7.2	7.6
1939	40,944	56,116	12.2	7.8	8.1
1940	42,126	80,758	12.8	6.9	7.1
1941	51,452	70,329	12.8	8.5	8.8
1942	45,383	31,991	18.9	14.6	16.5
1943	57,173	75,869	28.5	19.0	19.6
1944	61,188	80,916	27.7	16.9	17.1
1945	59,236	79,618	29.2	20.0	20.6
1946	33,492	42,733	40.2	28.8	30.7
1947	45,193	74,409	29.4	18.3	18.4
1948	77,532	98,511	15.2	10.0	11.5
1949	50,105	75,585	21.8	17.0	18.7
1950	62,788	61,842	31.8	25.7	26.9
1951	88,600	68,135	21.7	17.2	18.6
1952	79,570	71,866	25.2	18.8	19.7
1953	106,215	107,955	17.8	14.7	15.5
1954	43,800	50,800	32.7	25.2	27.2
1955	42,400	104,460	40.9	29.6	30.3
1956	106,310	67,390	19.2	17.4	19.5
1957	34,110	107,240	31.1	21.6	22.1
1958	105,500	69,250	29.2	26.2	28.4

[1]1922, November 1 price; 1923-36, December 1 price.
[2]December 1 price 1919-1936. Prices computed by weighting prices for improved and seedling pecans by quantities sold.
Source of Data: U. S. production and price by types: 1922-56: USDA, *Agricultural Statistics*, 1957, p. 319. 1957-58: USDA, AMS, *Tree Nuts by States, 1957 and 1958: Production Use, Value*, August, 1959.
Oklahoma prices: 1922-43: *Tree Nuts: Acreage, Production, Farm Disposition, Value and Utilization of Sales, 1909-45*, USDA, BAE, October, 1947, pp. 23-25. 1944-48: *Ibid.*, August, 1952, pp. 7-10. 1949-55: *Tree Nuts by States, 1949-55*, Revised Estimates, USDA, AMS (Statistical Bul. No. 195), October, 1956, p. 11. 1956-58: Office of Agricultural Statistician, USDA, AMS, Oklahoma City.

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