APPLE MARKETING

A REVIEW OF ECONOMIC RESEARCH 1945-1960

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PREFACE

This report is a digest of selected research publications dealing with the economics of apple marketing. Its purpose is to present a summary of current research information on three economic phases of apple marketing, and to suggest areas where additional research is needed.

The Marketing Costs and Margins section was prepared by Alfred J. Burns, Demand-Supply Relationships section by George R. Rockwell, Jr., and Merchandising and Promotion section by Elton Thigpen.

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The research publications covered in this digest are included in U. S. Department of Agriculture Miscellaneous Publication 866, "A Bibliography of Apple Marketing Research, 1945-60." Both the Bibliography and the digest of research information were requested by the Marketing Research Committee of the National Apple Institute to assist the industry, colleges and public agencies in planning future apple marketing research.

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APPLE MARKETING--A REVIEW OF ECONOMIC RESEARCH, 1945-1960

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INTRODUCTION

Apples are produced commercially in 34 States in the United States. The four main production areas are the Pacific Northwest, the Midwest, the New York-New England area, and the Appalachian area. The Pacific Northwest produces the largest volume and Washington State produces about one-fifth of the total commercial crop.

Commercial production of apples in the United States has been increasing in the postwar years, especially since the mid-1950's. Although the recent increases in production have been about in line with population growth, per capita consumption has been lower than in the years just before World War II, and down considerably from the levels of the 1920's. In addition, there has been a trend toward consuming a larger part of the crop in the form of canned apples and applesauce and less in fresh and dried forms. These developments have accentuated the problems of handling the apple crop and finding profitable markets for it.

The increased emphasis on research to improve economic efficiency in apple marketing has indicated the need for a review and digest of recent research on the economics of marketing apples. This digest covers three economic phases of marketing: (1) Demand-supply relationships, (2) merchandising and promotion, and (3) marketing costs and margins.

DEMAND--SUPPLY RELATIONSHIPS

Demand and supply analysis involves examination of past market experience to measure the effects of important factors which influence the price of a commodity and the amount produced and sold. In so far as these factors can be identified and their effects measured, and if market conditions do not differ widely from the past, results from such studies can be used in predicting what might be expected under current or probable future market conditions.

Demand and supply studies seek answers to a variety of questions, such as what is the price likely to be for a crop of a certain size; what part of the apple crop will be sold for the several processed uses and what part for fresh consumption; what is the relationship among prices of apples for these different uses; what is the expected price variation within a season? This last type of information would be helpful to growers in deciding when to sell apples.

Results from research studies made in recent years indicate that a number of factors affect prices and utilization of apples. Among these are the size of the apple crop, the volume of competing fruits available, and consumer income after taxes (disposable income). These factors affect price and utilization of apples in different ways. For instance, when the apple crop is heavy, prices tend to fall in order to move the larger crop, as long as other factors do not change. Prices tend to be higher when

crops are small. Changes in supplies of competing fruits have a similar effect--the price tending to be lower when large quantities of such fruits are available than when small quantities are on the market. Usually prices are less affected by the availability of substitutes than by the supply of the commodity itself, but this has not always been true for apples.

When incomes are up, consumers may be willing to buy more of many commodities at the same prices they were accustomed to paying, or they may be willing to pay higher prices for the same quantities they bought before their incomes went up. They may also buy more high quality products and reduce their consumption of lower priced products. When incomes rise, usually the price of agricultural products rises by a smaller percentage than the rise in income. The effect of a change in income is not the same for all commodities. For apples, results from several studies indicate that prices change in the same direction by almost the same percentage as the change in income. Apple prices, therefore, appear to be more sensitive to changes in income than the prices of most other agricultural commodities.

When a commodity has more than one use, such as apples used fresh and for processing, all uses may not be affected equally by a change in income. Shifts would then take place in the quantities going to the various uses.

Other factors that often are included in demand studies for a commodity are the general price level, changes in population, and gradual changes or trends that affect the consumption or use of the commodity. Some price change might be expected simply because most other prices have changed. This usually is not the kind of change that we want to measure in a demand analysis. Economists often try to eliminate this effect by adjusting prices and incomes for changes in the general price level.

Total consumption is also affected by population growth. To allow for changes in population, it is often desirable for statistical reasons to convert consumption and other data such as income to a per person basis.

When there is a relatively constant change in the consumption pattern of a commodity and this is not related directly to any of the other factors included in the study, more reliable results are sometimes obtained when this trend is allowed for in the statistical computations. For apples, such a trend has been an increase in canning in recent years, both in actual quantities, and in relation to quantities sold fresh.

Demand analyses must also consider the price-quantity interrelationships among the several end uses of apples. One of the studies made in recent years considered apples for fresh and for processing uses as having separate but related markets, since many growers have a choice of selling their crop for either or both uses. In such a situation, on-tree returns to producers for fresh and processing uses tend to be equal, with price differences between the two uses due to differences in handling costs. Price differences may also be due to differences in quality, uncertainties about market conditions, or special circumstances where the opportunity to sell in either market was not fully available to growers.

Supply analysis has to do with finding out what quantities of a commodity producers will sell at various prices under different sets of circumstances. Short-run or year-to-year variations in the supply of apples reflect mostly changes in weather. Longer-run changes in supply come about as farmers and fruit growers adjust the number and size of orchards to changed or expected market conditions.

In general, the entire crop of apples will be sold if the selling price is high enough to cover costs of harvesting and handling. In some years the price has been below this level in some areas and part of the crop was not harvested and sold, but this has not been a general problem with apples.

Decisions to plant trees depend upon growers' expectations of returns above costs during the commercial bearing life of the plantings. Growers' expectations doubtless are affected in part by past market experience. Little research has been done on the factors affecting the long-term supply of apples. Most studies have considered annual apple production as given, without taking into account how apple supply may be affected in the future by current and recent market conditions.

A number of research studies have provided tentative answers to specific questions about demand-supply relationships in the marketing of apples. Some have helped estimate prices of apples under a given set of conditions relating to size of crop, income and other price determining factors. These studies, therefore, can be used in making a variety of decisions, both for an immediate marketing situation and for longer-term plans. They may provide estimates for the whole marketing year or for separate parts of the marketing year. The latter type of estimates provide answers to questions such as how many apples to sell at harvest time and how many to store for later sale.

These studies may also be helpful in making longer-run decisions such as deciding whether to replace an orchard that is nearing the end of its useful commercial life, or to enlarge or buy an orchard. Because of the increased difficulty of making estimates of crop sizes, income, and other factors far in the future, long-term estimates of apple prices are likely to be less accurate than estimates for the immediate future. However, few estimates are completely accurate, and it probably is better to base production and sales decisions on relationships measured by a research study than to make them without this guidance. One of the sources of error in estimates made from research results is the omission of important factors from the research study. Sometimes these influences can not be included because no statistical measure of them is available, or these factors may have an influence only occasionally or under special circumstances and therefore are not effectively represented in the statistical results of the study. In addition, the data used in research often are not completely accurate and contain an unknown amount of error. Changes in market conditions in the period for which estimates are being made compared with conditions at the time the research study was made are another source of error.

What Is Known About Apple Demand-Supply Relationships

Studies by Fox in 1953 (33) and French in 1956 (35) based on annual observations indicate that with a given percentage change in the size of the apple crop, the percentage change in apple prices tends to be in the opposite direction and about eight-tenths as much. 1/ Both studies showed that apple prices moved in the same direction as changes in consumer income, and by almost the same percentage. French also considered the effects on apple prices of changes in supply of competing products and showed that changes in the combined production of oranges, pears, and banana imports affected apple prices by about the same percentage but in the opposite direction. The variables used in both of these studies explained 96 percent or more of the variation in apple prices. The Fox study was based on the years between the wars, 1922-1941, while the French study related to 1930-53, omitting the war years.

1/ Underscored figures in parentheses refer to items in Literature Cited, page 30.

A study by Brandow in 1956 (9) using somewhat different methods, considered the fresh and processed markets separately but took into account their effects on each other. On the demand side, prices for both fresh market and for processing were found to be inversely related to quantities sold. On the supply side, growers tended to sell more apples in the fresh market when the fresh price was up and to sell less fresh when the processing price was up. They also tended to sell more apples for processing when the processing price was up and less when the fresh price was up. Eighty-six percent of the year-to-year variation in fresh apple prices was explained by the variables used in the study and 93 percent of the variation in the amount of apples sold fresh was explained. For apples used in processing, 90 percent of the variation in price and 88 percent of the variation in amount of apples processed were explained.

Studies made by Pubols in 1954 (63) and by Boger in 1952 (8) were concerned primarily with the pattern of prices from month to month during the marketing season. One of the principal uses for this information is in deciding when to buy or sell apples.

Pubols showed that it was possible to estimate apple prices for several months ahead in the season from the estimates of size of the apple crop and disposable income. Beginning with the October crop estimate, estimates made for each succeeding month explained more than 80 percent of the year-to-year variation in price for several months ahead up to January. By January, cold storage stocks of apples took on more importance in relation to apple prices. Better estimates of prices for the months from January to the end of the season generally were obtained when cold storage stocks rather than estimates of the crop were used as explanatory variables in the regression analysis. About 75 percent of the variation in price for each month through March was explained by this method, and somewhat less for April and May. The study also developed a method of estimating the volume of cold storage holdings on December 1 in relation to the size of the crop and apple prices on October 15.

Boger's study provided a method of estimating Michigan apple prices by months in relation to size of the crop and income. A comparison of estimated prices with current prices early in the season could be used by growers in deciding whether to sell or store apples, and later in the season as a guide for selling apples from storage.

In addition to these two types of studies, Evans made two studies in 1957 (28, 29) dealing primarily with the degree of competition in the apple market in the Applachian area.

Summary of Selected Apple Demand-Supply Studies

Studies Relating to Whole-Season Marketing Experience

In 1956 Brandow (9) made a study of how prices of apples are determined both in the fresh market and for processing, and what determines the amount sold fresh and the amount processed from the total apple crop.

The study was made in such a way as to take into account the effects on the fresh market of what was happening in processing by way of prices paid and quantities of apples processed, while at the same time considering the effects on processing of what was happening in the fresh market. The data used were from the crop years 1934 through 1953, except for the wartime period of 1942-46 when unusual forces were operating in the market.

On the demand side, the study showed that the quantity of apples bought fresh was inversely related to fresh apple prices. On the average when the price of fresh apples was up 1 percent, the quantity bought fresh was down 0.73 percent.

Other influences considered in the study were the amount of apples used for canning and the price paid for them, wholesale food prices, fresh apples exported, orange production, apple production in the eastern States, apple production in other States, military purchases and exports of canned apples, and packers' stocks of canned apples at the beginning of the canning season. In most demand studies consumer disposable income is used as a factor affecting demand. It was found in this study, however, that changes in wholesale food prices and in income followed similar patterns. Statistical computation procedures are not well adapted for handling situations of this kind. Consequently, only the wholesale food price series was included in this study. In a sense this factor reflects the effects on the apple market of changes in consumer disposable income as well.

With respect to apples for fresh market, a rise of 1 percent in wholesale food prices was associated, on the average, with a rise of 0.86 percent in fresh apple prices. Demand for fresh market was improved by an increase in export demand and perhaps reduced by larger production of oranges.

Changes in wholesale food prices and in size of the crop together accounted for 86 percent of the year-to-year variation in fresh apple prices.

Prices and utilization of apples for canning were also inversely related, but the quantity-price relations were not as close as for the fresh market. On the average, quantity of apples canned was down 0.21 percent when the price of apples for canning was up 1 percent. Demand for canning increased when the index of wholesale food prices rose, and decreased when there was a gain in carryover stocks from the previous year. Higher exports and military purchases also increased demand for apple canning.

Ninety percent of the year-to-year variation in prices of apples for processing was explained by wholesale food prices, size of the eastern crop, military purchases and exports, and packer carryover stocks.

On the supply side, the study showed that the portion of a given crop sold by growers in the fresh market depended to some extent on the price for fresh use and to a lesser extent on the price for canning. Quantities sold by growers in the fresh market rose on the average by 0.08 percent when the fresh market price rose 1 percent, and were down 0.02 percent when the canning price was up 1 percent. An increase of 1 million bushels in the size of the crop in the eastern States resulted in less of an increase in fresh utilization than did an equivalent increase in other States.

Three factors, the size of the crop in eastern States, the crop in other States, and packer carryover stocks of canned apples explained 93 percent of the year-to-year variation in the amount of apples utilized fresh.

The portion of a given crop sold by growers for canning also was influenced by fresh and processing prices. Quantities sold to processors were up 0.58 percent when the canning price was up 1 percent, and were down 0.71 percent when the fresh price rose 1 percent. Size of the crop outside the eastern States had little effect on utilization by processors, except indirectly through fresh apple prices.

Eighty-eight percent of the year-to-year variance in amount of apples canned was accounted for by size of the eastern crop, military purchases and exports, and packer carryover stocks.

In a study in 1956 French (35) found that, on the average, a 1 percent change in U. S. apple production was associated with a 0.84 percent change in price in the opposite direction.

These results were obtained from least squares regression analyses based on data in logarithms for the 20-year period 1930-53, excluding the war years 1943-46. Separate analyses were run using prices and disposable income per person in current dollars, and these same variables deflated by the Consumer Price Index to allow for changes in the price level. Results were not substantially different.

Prices were average annual farm prices for apples by all methods of sale. All figures were expressed on a crop year basis beginning in July. Apple production figures were for the total crop, rather than for commercial productions as reported by the U. S. Department of Agriculture.

Following a 1 percent change in the supply of competing fruits, apple prices moved 1 percent in the opposite direction. 2/ Variations in income affected apple prices by the same proportion and in the same direction.

About 94 percent of the change in apple prices was associated with changes in the three variables used in the study.

The study also analyzed the supply-demand situation for Michigan apples. It showed that the average annual farm price of Michigan apples changed in the opposite direction by about one-half of 1 percent when Michigan apple production increased or decreased 1 percent. Michigan prices changed in the opposite direction by almost two-thirds of 1 percent when apple production in other States changed 1 percent. A given percentage change in income was reflected by a change in Michigan apple prices of about three-fourths as much in the same direction, and a change in production of competing products was reflected by an opposite price change of about nine-tenths as much. Michigan apple prices were less affected by changes in income or by competing products than were U. S. average prices, since Michigan apples sell for somewhat lower than average prices.

French related the annual production of apples to average farm prices of apples and a measure of farm costs during a period 10 to 14 years in the past. For example, the expected production of apples in 1938 was related to average prices and costs from 1924 to 1928.

Data were arranged in this way because an apple producer bases his expectations of the future, and thus his planting decisions, on the profitability of apple growing and the profitability of alternative enterprises for several years just prior to planting. Eight to 12 years are then required before the fruit begins to reach the market in significant quantities.

Attempts to introduce some index of relative profitability of alternative exterprises were not sucessful. Because there are wide differences in the alternatives from one

2/ The competing fruit variable was the per capita production of oranges and pears, and per capita consumption of bananas.

area to another, this omission may not be serious, since to some extent these variations may tend to cancel out.

Ratios of apple prices to an index of costs were used to measure the profitability of apple production. The cost index used was the U. S. Department of Agriculture index of prices paid by farmers for commodities used in production and family living, including interest, wages and taxes, but excluding prices for feed and livestock.

A 10-year lag of 5-year averages gave the most significant statistical results and also appeared most reasonable in terms of what is known of usual growth rates of apple trees.

To reduce the cyclical effect due to the tendency for small apple crops to follow large crops, total apple production was expressed as a 4-year moving average. If not removed, the cyclical variation in yields would make it difficult to measure apple production in relation to expected profits.

About 72 percent of the variation in U. S. apple production was explained by the ratio of apple prices to the index of prices paid by farmers. The production estimated from this relationship would be, in effect, an average annual production during a 4-year period. Therefore, the regression equation as formulated is useful for estimating long-run trends, but is not designed for predicting year-to-year changes in production because of the tendency for small crops to follow large crops and because of the importance of weather.

French computed the supply relationship for Michigan apples in the same way as for the United States, substituting Michigan prices and production, and lagging the ratio of apple prices to prices paid for commodities used in production and family living by 11 instead of 10 years. The longer lag gave better statistical results and seemed reasonable because a slightly lower than average growth rate for apple trees might be expected in the northerly Michigan climate.

This relationship explained only about 40 percent of the variation in Michigan apple supplies. Although the study explained only a small part of the variation it showed a significant long-term relation between production and lagged prices and costs. Michigan apple production had remained at a relatively uniform level for a number of years, with most of the year-to-year variations due to weather influences.

In an analysis of demand for farm products for the years 1922-41, Fox (33, pp. 64-66) found that a 1 percent year-to-year change in apple production was associated with a price change in the opposite direction of 0.79 percent. This average measure was relatively stable, since about two-thirds of the time the actual price change associated with a 1 percent change in production ranged from 0.75 percent to 0.83 percent in the opposite direction, after allowing for changes in income.

The study showed that apple prices changed in the same direction as changes in personal disposable income. With a 1 percent change in income, apple prices tended to change about 1.04 percent, after allowing for changes in production. Two-thirds of the time the actual price change ranged from 0.92 percent to 1.16 percent. Year-to-year changes in production and income together explained 96 percent of the year-to-year change in apple prices during these years.

Fox pointed out that the methods used seemed to be appropriate for the demand-supply conditions during the period studied, since most apples were used fresh at that time and processing was relatively unimportant. The report stated that when an

agricultural product is used in more than one way, or when storage stocks or substantial exports affect the market, consideration should be given to using other statistical methods which allow for the different demand and supply conditions of the various uses. Since apple processing, particularly canning, has grown so much in recent years, some consideration should be given to these changed conditions. 3/

Studies Relating to Within-Season Marketing Experience

Studies by Pubols in 1954 (63) and by Boger in 1952 (8) dealt with changes in apple prices within a single season. They provide means for estimating whether prices might be expected to be higher or lower later in the season. They are, therefore, useful to growers in making decisions early in the marketing season whether to store apples or sell them as they are harvested. They also provide information that helps in deciding when to sell apples from storage. These studies also can be used by processors in determining their rates of operation through the season.

Pubols' study estimated apple prices in future months of the season from estimates of the size of the apple crop and size of cold storage holdings. In both estimating procedures personal disposable income was taken into account, and in one case the price of oranges also was considered.

The study showed that increasingly accurate estimates of the size of the crop can be made as the season progresses. The official government crop estimates made in August and in October were used to estimate apple prices in the following months.

Only 66 percent of the year-to-year change in the September price was explained by the August production estimate and by income. It appeared that the supplies of summer apples still exert considerable influence on price as late as September.

This method, using the October production estimate, did not explain apple prices in January quite as well as in November and December. It is probable that January prices are influenced more by the December estimate of total production and the December 1 estimate of cold storage stocks.

To measure the influence of cold storage stocks on price after the first of the year, the price of apples for January through May, each month in turn, was related to stocks the first of the preceding month and to disposable consumer income for the current quarter, for the 1941-50 crops. This part of the study made allowances for changes in population. These analyses showed that approximately three-fourths of the year-to-year changes in price for January, February, and March, and more than three-fifths of the price change for April and May were associated with year-to-year changes in stocks and disposable income. The smaller percentage effect of a 1 percent change in stocks during April and May reflects the smaller quantities of apples in storage during these months. It is probable that a 1 million bushel change in stocks would have nearly the same effect on price in each month.

This study also included an analysis of the annual changes in volume of apples in cold storage on December 1 in relation to apple prices and size of the crop on October 15. Eighty-seven percent of the year-to-year change in cold storage stocks on December 1 was explained by these two variables. With each percentage change in the October crop estimate for the years 1942-51, cold storage stocks changed on

3/ For a discussion of trends in apple use and consumption, see Pubols (64).

the average by somewhat more than 1 percent in the same direction. Price of apples have a small effect on cold storage stocks.

In addition to the analyses of prices for individual months, analyses were made relating the average price of apples in the 5-month period of January-May to disposable income and to the October and December estimates of apple production. In the latter case, price of oranges also was included. Another analysis substituted cold storage stocks on December 1 for production and included disposable income and price of oranges. In these analyses figures on production, stocks, and income were adjusted for population growth. Separate analyses were made for the 20 years, 1921-40, the 10 years, 1941-50, and the two periods combined.

For the whole period of 1921-50, about three fourths of the year-to-year change in apple prices during the January-May period was explained by the independent factors. On the average, a 1 percent change in the December estimate of production resulted in a change of about 0.6 percent in price in the opposite direction. Similarly, when the October estimate of production was used, the change in price associated with a 1-percent change in production was 0.7 percent, and when stocks were used the change in price was 0.8 percent. The effect of a 1-percent change in income on price was a little more than 1 percent in the same direction when the October production estimate was used, and about 1 percent when the December estimate or December 1 stocks were used. Price of oranges did not have a strong effect on the price of apples in any of these analyses.

Boger (8) outlined a method for estimating Michigan apple prices for future months, using two variables--size of crop and income of persons in the United States. He found that about three-fourths of apple price fluctuations by months could be explained by this method. The estimated prices for future months can then be compared with current prices to determine whether to sell or to store apples.

For the 23 years included in the study, the conclusions that a grower would have drawn using the method outlined by the study would have been to sell apples at harvest in 10 of the years and to store in 13 years. These conclusions would have been correct in all years except two, 1935 and 1947. In both of these years the analysis indicated that apples should be stored but it actually would have been more profitable to sell at harvest.

The study showed that on the average for each month, from September through April, a change of 1 percent in the U. S. apple crop was reflected by a change of about 1 percent in the opposite direction in Michigan apple prices. A 1-percent change in income was reflected in Michigan apple prices by a change in the same direction of from 0.8 to 1 percent.

The study called attention to some other factors that probably affect Michigan apple prices but which were not included in the statistical computations. Among these were size of cold storage stocks; rate of movement of apples out of storage; differences from year-to-year in the relative part of the apple crop accounted for by varieties that traditionally sell for more than the average price, or by varieties that keep exceptionally well in storage; and changes in the proportion of the crop processed.

Competition Among Apple Processors

Two studies by Evans in 1957 (28, 29) dealt primarily with the degree of competition in the marketing of apples in the Appalachian area. They are included in this summary

of the findings of studies relating to demand and supply of apples because competitive conditions can affect prices and utilization of a commodity.

Evans noted that sales of apples to processors were increasing, both in the United States and in the Appalachian area. The Appalachian area produced about one-fifth of the commercial apple crop and accounted for about half of the national production of canned applesauce and slices. In the years just before the reports were published, about half of the crop in the Appalachian area was sold for processing.

Six processors did most of the apple processing in the area. The reports stated that one firm generally announced an opening price for apples and other firms followed with similar if not identical prices. This situation, considered alone, suggested the possibility of more profits for processors and less output than would be the case under perfect competition. The reports analyzed the apple demand and supply conditions in the area and came to the conclusion that competition among processors was strong and that there was little opportunity for excess profits over a period of time.

The reports showed that apple growers had a choice between marketing their crops for fresh or for processed use and, therefore, the amount going to processors depended on the processor price relative to the price paid for fresh apples.

Processing costs per unit did not seem to vary within the range of processor capacities. A processor cooperative in the area returned to its patrons all receipts over costs of operations and other processors met this competition by paying bonuses to their suppliers. Implicit price deals were widely used. These added returns encouraged growers to sell more apples to processors.

In view of these considerations the studies concluded that there was little opportunity for processors to make excess profits over a period of time, and that the processor price was efficient in the allocation of apples between fresh and processor outlets.

Evans also stated in support of his conclusion that apple processing in the Appalachian area was relatively free of monpolistic conditions and that between 1939 and 1957 three processors had entered the field and were doing from a quarter to a third of the processing in the area.

Apple Use and Consumption

A good discussion of the trends in apple use and consumption, from 1935 through 1959, is given by Pubols in the August 1960 issue of "The Fruit Situation" (64). Apple production had dropped somewhat from 1935 to 1960 and on a per capita basis had declined noticeably. During this 25-year period the volume of apples processed increased rather sharply, while fresh use decreased, and per capita consumption of fresh and processed apples combined declined.

During 1935-39, fresh use of apples, including use in households of farms where grown, averaged about 91 million bushels (including exports of 9 million), 72 percent of production. By 1955-59 fresh use had declined to 77 million bushels (including exports of 3 million), 67 percent of production.

These trends were shown more sharply in terms of consumption per person. Per capita consumption of fresh and processed apples on a fresh equivalent basis decreased from more than 35 pounds in 1935 to about 26 pounds in 1957. It was about

30 pounds in 1958 and 29 pounds in 1959. The decrease over the years was in fresh consumption, from about 33 pounds in 1935 to a low of 19 pounds in 1956 and 1957. In contrast, per capita consumption of all processed apples (fresh basis) increased from 2.5 pounds in 1935 to more than 7 pounds in 1959. Most of the increase was in canned apples and applesauce. Per capita consumption of canned apple juice also increased, but that of dried apples decreased.

Utilization of apples in the various processed forms--canned, dried, frozen, and otherwise processed (mostly crushed for vinegar, cider, and juice)--followed varied trends during 1935-59. The volume canned increased from about 8 million bushels in the early years to about 20 million in the late years. Use for freezing attained considerable importance during 1943-46, although the volume was well under that of other processed forms. It then declined, but beginning in 1951 trended slowly upward to exceed slightly the peak of 2.4 million bushels in 1945. Over the 25-year period studied, use for drying trended downward, decreasing to about half the beginning volume. Apples processed for vinegar, cider, and juice showed no market trend, through they fluctuated greatly from year to year. In 1955-59 an average of 18.1 million bushels were canned, 50 percent of the apples processed; 10 percent of the apples processed were dried, 3.8 million bushels; 8 percent were frozen, 2.8 million bushels; 11.9 million bushels were processed in other forms, accounting for 32 percent of the processed total.

In the later years covered by the study, the heaviest producing apple State was Washington, followed by New York, Michigan, Virginia, California, Pennsylvania, and West Virginia. Most Washington apples were sold for fresh use, although in some years substantial quantities were processed. The other 6 States accounted for most of the apples processed, especially canned, as well as for large fresh sales.

In all of the leading apple producing areas where an important part of the crop is used for processing, the percentage of sales for fresh use declined over the years as the percentage processed increased. This was true for the Appalachian area of Pennsylvania, Virginia, and West Virginia as well as for New York, Michigan, and California. Except in Michigan, increases in processing were due to strong upward trends in canning. In Michigan, use for canning trended only gently upward after World War II, while other types of processing continued to predominate. In New York and the Appalachian area, canning was the principal use of apples processed in the later years of the study. But apples otherwise processed continued to take a substantial percentage of production. The percentage of apple production dried in California shrunk in half over the 25-year period covered by the study while the percentages canned and otherwise processed combined increased more than the decrease in dried.

Growth in output of both canned (bottled) apple juice and frozen apples was erratic during the last 2 decades of the study. The pack of canned apple juice increased from less than 20 million pounds in 1940 to about 60 million in 1941, then fluctuated widely around this level for several years. It rose sharply in 1949 and 1950 to about 100 million pounds, then remained near this level for several years. After 1955 it increased sharply, and in 1959 approached 200 million pounds. Output of frozen apples increased from about 4 million pounds in 1940 to a high of 93 million in 1945, then declined to a level of about 40 million. It increased substantially in the middle 1950's but never quite reached the former high mark--it was 72 million pounds in 1959. The 1959 pack of dried apples was about 11,000 tons, dried weight, about half as large as the 1935 pack. Comparable figures on output of other apple products were not available.

Tables 1 and 2 of this report show per capita consumption of apples and principal apple products on product weight and fresh-weight equivalent bases. These consumption figures are brought up to date annually in the August issue of "The Fruit Situation."

Table 1.--Apples: Per Capita consumption, fresh-weight equivalent, 1910-62 1/

Year	Fresh 2/	Canned	Canned juice	Frozen	Dried	Total
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
1910	59.4	1.0	---	---	1.8	62.2
1911	73.5	1.0	---	---	2.0	76.5
1912	74.6	1.0	---	---	2.4	78.0
1913	59.3	1.0	---	---	2.5	62.8
1914	71.8	.8	---	---	1.6	74.2
1915	69.0	1.0	---	---	1.8	71.8
1916	63.9	1.1	---	---	3.6	68.6
1917	56.1	1.9	---	---	3.8	61.8
1918	56.9	2.2	---	---	3.5	62.6
1919	45.2	1.8	---	---	3.3	50.3
1920	63.0	1.6	---	---	3.0	67.6
1921	36.1	1.4	---	---	1.6	39.1
1922	57.5	1.4	---	---	1.7	60.6
1923	54.7	1.4	---	---	2.0	58.1
1924	54.1	1.6	---	---	1.1	56.8
1925	46.3	1.4	---	---	1.7	49.4
1926	62.3	1.5	---	---	1.2	65.0
1927	37.4	1.4	---	---	1.1	39.9
1928	48.9	1.4	---	---	1.0	51.3
1929	39.7	1.6	---	---	1.4	42.7
1930	42.1	1.7	---	---	1.5	45.3
1931	51.7	1.2	---	---	.8	53.7
1932	39.2	1.2	---	---	.7	41.1
1933	40.0	1.4	---	---	.7	42.1
1934	2/25.3	1.5	---	---	.9	27.7
1935	32.9	1.5	---	---	1.0	35.4
1936	27.6	1.6	---	---	1.2	30.4
1937	33.6	2.0	---	3/	1.3	36.9
1938	28.2	1.8	---	0.1	1.2	31.3
1939	30.7	1.9	0.1	3/	.9	33.6
1940	29.7	2.2	.2	3/	1.7	33.8
1941	31.7	2.5	.3	.1	.8	35.4
1942	28.1	2.6	.6	.1	.3	31.7
1943	24.9	2.3	.7	.2	.1	28.2
1944	25.5	1.4	1.0	.5	.4	28 8
1945	22.9	1.7	.4	.8	.8	26.6
1946	23.0	1.9	.5	1.0	1.5	27.9
1947	25.4	2.4	.4	.6	1.3	30.1
1948	26.3	2.8	.3	.6	1.3	31.3
1949	24.7	2.9	.7	.5	1.1	29.9
1950	22.7	3.5	.9	.5	1.3	28.9
1951	25.7	3.4	.8	.4	1.2	31.5
1952	21.6	4.0	.8	.5	1.0	27.9
1953	20.9	3.5	.8	.4	.9	26.5
1954	20.0	3.6	1.1	.5	.9	26.1
1955	19.6	4.1	.8	.7	.9	26.1
1956	18.9	4.4	1.0	.9	.8	26.0
1957	19.3	4.4	1.0	.6	.7	26.0
1958	22.6	4.7	1.2	.7	.7	29.9

Table 1.--Apples: Per Capita consumption, fresh weight equivalent, 1910-62 1/--Continued

Year	Fresh 2/	Canned	Canned juice	Frozen	Dried	Total
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
1959	23.0	4.5	1.5	.7	.8	30.5
1960	20.1	4.9	1.4	.7	.7	27.8
1961	18.6	5.1	1.5	.6	.7	26.5
1962 4/	19.5	4.9	1.6	.5	.7	27.2

1/ Excludes quantities consumed as baby food. Fresh-weight equivalent derived using contant conversion factors for individual products except juice, for which factors have been adjusted since 1948 to allow for increased yield. Unless otherwise noted, data represented a calendar year (adjustments to a calendar year, when necessary, were made by combining proportional parts of each pack year involved. Civilian consumption only, beginning 1941.

2/ Beginning 1934 includes only apples grown in commerical areas.

3/ Less than 0.05 pound.

4/ Preliminary

Table 2.--Processed apples: Per capita consumption, product weight, 1909-62 1/

Year	Canned apples and applesauce 2/	Canned apple juice 3/	Frozen apples and applesauce 3/	Dried apples 4/
	Pounds	Pounds	Pounds	Pounds
1909	0.7	---	---	0.2
1910	.7	---	---	.3
1911	.6	---	---	.3
1912	.7	---	---	.4
1913	.5	---	---	.2
1914	.7	---	---	.1
1915	.5	---	---	.4
1916	1.1	---	---	.5
1917	1.5	---	---	.4
1918	1.2	---	---	.4
1919	1.1	---	---	.4
1920	.9	---	---	.2
1921	1.0	---	---	.1
1922	.8	---	---	.3
1923	1.1	---	---	.1
1924	.9	---	---	.2
1925	.9	---	---	.1
1926	.9	---	---	.1
1927	.8	---	---	.1
1928	1.0	---	---	.1

Table 2.--Processed apples: Per capita consumption, product weight, 1909-62 1/--Continued

Year	Canned apples and applesauce 2/	Canned apple juice 3/	Frozen apples and applesauce 3/	Dried apples 4/
	Pounds	Pounds	Pounds	Pounds
1929	1.1	---	---	.2
1930	.8	---	---	.1
1931	.7	---	---	.1
1932	.8	---	---	.1
1933	.9	---	---	.1
1934	1.0	---	---	.1
1935	1.0	---	---	.1
1936	1.2	---	---	.2
1937	1.0	---	0.01	.2
1938	1.1	---	.04	.1
1939	1.2	0.05	.01	.3
1940	1.5	.10	.02	.1
1941	1.4	.20	.04	5/
1942	1.7	.37	.07	0
1943	1.6	.44	.12	.1
1944	1.0	.62	.30	.1
1945	1.1	.26	.49	.2
1946	1.4	.35	.60	.2
1947	1.7	.26	.34	.2
1948	1.9	.20	.33	.1
1949	2.1	.47	.28	.2
1950	2.4	.56	.29	.1
1951	2.3	.50	.21	.2
1952	2.7	.54	.28	.1
1953	2.4	.51	.24	.1
1954	2.5	.71	.31	.1
1955	2.8	.54	.41	.1
1956	3.1	.66	.51	.1
1957	3.1	.68	.34	.1
1958	3.3	.77	.39	.1
1959	3.2	.97	.39	.1
1960	3.4	.90	.40	.1
1961	3.6	.95	.37	.1
1962 6/	3.4	1.05	.32	.1

1/ Civilian per capita consumption only, 1941 to date.
2/ Data 1909-42 on pack year, beginning in early June; beginning 1943 on calendar-year basis.
3/ Calendar-year basis.
4/ Production begins midyear.
5/ Less than 0.05 pound.
6/ Preliminary.

MERCHANDISING AND PROMOTION

Merchandising may be viewed as the practices and conditions under which apples are offered for sale. These include package type and size, display location and fixtures, pricing unit, product quality, space allocation, store layout and promotional materials used. Research on merchandising, therefore, is concerned with evaluating the influence of these conditions on the sales of apples at the consumer level. Merchandising research provides information on those methods which will have the greatest impact on maintaining or expanding the market for apples.

Merchandising research has become increasingly important with the emergence of self-service, mass merchandising in food supermarkets. This review briefly describes the results of major fresh apple merchandising studies during the period 1945 to 1960. The principal areas covered are prepackaging, displaying, quality, advertising and promotion, color, pricing, and consumer preferences for apples.

Prepackaging

An early study of consumer preference for prepackaged Maine apples was made by Merchant in 1946 (53). Housewives in Portland indicated they would accept apples in consumer packages because they liked the convenience of prepackaged apples, the apples were uniform quality and the packages kept apples in good sanitary condition. Consumers, however, were critical of the small size of some packages offered during this study (4 or 5 apples per cellophane wrapped carton). They reported the cello bag was difficult to handle and resulted in excessive bruising.

Research to find ways to move more apples into consumption was begun at Cornell University in 1948. Initial research was devoted to developing and testing procedures for measuring the effect of bruising on the sale of apples in retail stores under actual operating conditions. Van Waes (82) found no significant difference in the retail sales of apples that had been picked, hand packed in the orchard, and carefully handled in all subsequent stages of distribution compared with apples that were picked, graded, packed, and handled in the usual manner.

Tests were repeated in the fall and winter of 1949-50 with bruise free apples which had been mechanically bruised to three levels of bruising (83). The first level of mechanical bruising was more severe than the average of apples handled in the usual way. While sales of the bruise free apples were 11 percent greater than those of the first two levels of bruising, this would not pay for the additional cost of the extra care and handling over the usual methods.

Van Waes observed during these studies that sales in stores offering apples for sales in combination bulk and packaged displays seemed to sell greater volumes than other stores. This observation led to further apple merchandising research the following year.

A study by Dominick (27) showed that apple sales were increased when offered in combination displays of prepackaged and bulk fruit with the fruit packaged in 4 and 6-pound units. The display featuring 6-pound packages had sales 40 percent greater than the display with 4-pound packages.

Henderson (42) in 1951 sought to determine what kind of package, size of package, and pricing unit gives the best sales results. He used five combination package and bulk displays, using 5-pounds packages and pricing units in which five different package

materials were evaluated. These were compared with a display of bulk apples priced in 5-pound units. The package materials tested were red mesh, paper window bag, pliofilm, purple mesh, and polyethylene. All combination displays had higher sales than the bulk display. Sales from polyethylene display were higher than all others except purple mesh. Sales were about 40 percent greater for the 6-pound unit than for 4, 5, 8, and 10-pound packages and pricing units. Additional studies of prepackaging by Davis (26) and Buckman (15) also found similar increased sales from combination packaged and bulk displays.

In recent years prepackaging of apples has become a widespread practice. Rasmussen (65) in 1949 found that during the 1949-50 season about 9.6 percent of the fresh apples sold by individual, cooperative, and private country shipping points were prepackaged. Packaged sales were greatest in Eastern apple regions and lowest in the Western area. There were 17 different types and 26 sizes of packages being used indicating considerable experimentation at that time. Several varieties of apples were sold in packaged form. They included: Red Delicious, McIntosh, Jonathan, York Imperial, Stayman, and Rome Beauty. Fancy and Extra Fancy grades in 2 1/4 and 2 1/2-inch sizes were the predominant sizes prepackaged.

Subsequent reports by Rasmussen cited increased prepackaging of apples and the acceptance of more standardized packaging units. During the 1954-55 season the polyethylene bag was used for 61 to 92 percent of the prepackaged volume in different producing areas. Package sizes also had become more standardized with the 3, 4 and 5-pound bags most widely used.

Chainstores were the predominant sales outlet for prepackaged apples sold by packers in 1953-54. They handled about 56 percent of the total volume surveyed by Rasmussen, followed by brokers with 25 percent, individual retail stores with 7 percent, and merchant-truckers with 7 percent.

Advantages of prepackaged apples reported in the various studies include reduced spoilage because of faster turnover, extended shelf life, good grading, less customer handling, less labor required in retail stores to maintain display, customer selection time reduced about one-half, increased sales volume and more profit on prepacked apples than on bulk.

The disadvantages recorded by Rasmussen were: Too expensive, not enough price advantage, difficulty in obtaining efficient help, lack of proper machinery to pack, cost of packages, difficulties in weighing each package accurately, and too many different sizes of packages. Some customers resisted packaged apples because of past experiences of buying poor quality packaged apples. Brunk and Dominick (13) pointed out that practices which indicate a lack of interest in good marketing result in reduced sales.

Display of Apples

Until about 1950, apples were sold almost exclusively from bulk displays, Brunk (12). In small stores, apples usually were displayed in containers placed on the floor while in larger stores apples were placed on counters, tables, or bins. There were no cooled display counters or cases. Special lighting was observed only in large stores. Customers made their selection from bulk displays sometimes of mixed sizes.

The size of apple display was found to be associated with sales volume by Cravens (24), Henderson (43), and Blum (7). Cravens found that a 10 percent increase in display space increased sales volume by 6 percent and the value by 4 percent.

Brunk (12), Dominick (27), Henderson (42), and Davis (25) found that a combination display of 6-pound polyethylene packages with a bulk display was more effective in stimulating sales than either a bulk or packaged display alone. Henderson found the best display location for apples to be at the end of the display table near the most used entrance to the produce department. Neither apple nor orange sales were affected when these two fruits were displayed side by side, but the sales of both apples and oranges decreased when displayed beside bananas.

A sales increase of over 60 percent was observed in Portland, Me. stores when carryout cartons and polyethylene bags were added to bulk displays. Merchant, Underwood and McDonald (54) gave the following reasons for this increase: (1) Additional items displayed increased sales; (2) some hurried shoppers pick up consumer packages; (3) some consumers prefer to know the exact cost of an item immediately; (4) a greater number of customers are satisfied by the choice of either bulk or packaged apples; (5) location may have played a role.

The following relationship between various displays and sales per 100 customers was observed by Smith (79) in small New York State towns and Pittsburgh.

Display	Sales per 100 customers (lbs.)
5-lb mesh bag with bulk (5-lb. pricing unit)	20.0
5-lb. poly bag with bulk	19.0
3-lb. poly bag with bulk (3-lb. pricing unit)	16.5
Bulk alone (3-lb. pricing unit)	12.0

Quality

An analysis of the effects of quality on the price of apples at auction and retail was made by Blanch (5). Quality defects observed at auctions consisted mainly of bruising, apple scab, stem punctures, and codling moth stings. Color and bruising appeared to have the greatest effect on the price of apples. The most seriously bruised apples were discounted 28 cents per bushel from the price of the least bruised; apples with scab were discounted 23 cents per bushel from apples free of the fungus; apples most severely damaged by codling moth were discounted 21 cents per bushel from those free of this defect. Blanch concluded that discounts caused by quality defects generally exceeded the cost of spraying or other practices that produce a better quality of apple for the market.

Carlsen (20) recognized the need for accurate measures of quality throughout the marketing system to reflect consumer preferences back to producers.

Cravens (24) found apples competing with 8 to 10 major fruits and that appearance and color were important factors that affected price and rate of sale "Bright apples" sold more rapidly than "dull" ones.

Scott and Leed (73) observed in Ohio that retailers paid too little attention to quality when pricing apples. In some stores, primarily independents, both high and low quality apples sold at or near the same prices despite the fact that retailers paid less for the low quality fruit.

Advertising and Promotion

Advertising and promotion programs have been used by many groups of apple growers since the 1930's attempting to increase sales and profits. According to Garman (37) such programs were financed by a State tax in five States in the late 1940's. These States represented about 45 percent of U. S. commerical apple production. Except for the State of Washington, funds collected from advertising taxes were small.

Apple growers in New York were reported by Garman to have considered the following possibilities in 1949 when deciding how to finance advertising and what media and methods to use: (a) Free publicity from growers, home State newspaper; (b) a 1 cent per bushel tax on apples; (c) whether advertising would raise apple sales and grower profits; (d) whether marketing low-grade apples near big cities would interfere with an advertising program that should be coordinated with high quality apples; (e) retailer's ability to move large quantities of apples; (f) grower's knowledge regarding the division of advertising funds between radio, newspaper and magazine media.

It was suggested that some of the money should be spent to educate apple handlers in how to maintain the quality of apples in transit. The problem of administration of advertising funds and the possibility of coordinating New York apple advertising with other State programs were dealt with. Solutions in these problem areas were considered to be a practical necessity before any group of growers could consider advertising apples.

Advertising commissions with past operating experience are concerned with improving the effectiveness of their present programs. It was suggested to Washington State apple growers by Johnson (48) that emphasis should be placed on growing conditions and better care and handling rather than on general themes which apply to apples from every State. Washington growers were also told by Johnson that television was the most effective advertising medium for their apples.

Michigan apple growers were advised by Cravens (24) that their apples should be advertised as the lowest priced item in the fresh fruit field. Therefore, the slogan, "To get more for your money buy Michigan apples," should be used. Cravens also advised Michigan apple growers that campaigns such as National Apple Week should be managed in close cooperation with trade groups. Such cooperation offers a chance for the promotion of good merchandising practices, improving quality, displays, and turnover.

Apple advertising campaigns conducted by the Virginia State Apple Commission were found by Henderson (44) to have measurable and sometimes substantial sales effect. A sharp increase in the volume of apples sold was observed following the campaigns.

Window displays of apples were the most effective promotional practice tested by Dominick (27). Display markers also had a considerable effect on sales, especially where they were sufficiently concentrated.

Henderson, et al. (45) found that sales of Washington-grown apples in a 4-week period were 32 percent higher for the "apple use" promotion theme (emphasizing use of the fruit in salads, pies, and other dishes), and 21 percent greater for the "health" promotional theme than when no promotion was used.

Sales of all apples were 20 percent greater when the apple-use theme was used than when there was no promotion, and 9 percent greater for the health theme. Advertising based on either theme for a 4-week test period did not affect sales of apples in the succeeding 4-week period.

Color

Color was found by Blanch (6) to be the most important single characteristic explaining higher prices and faster sales of some lots of apples from the 1942 New York crop. Blanch (5) also found that color had an appreciable effect on the auction price of apples. Highly colored fruit commanded a premium of 30 cents per bushel over poorly colored fruit.

Dominick (27) reported that sales from a lot of well colored apples (75 percent red) were 69 percent greater than sales from a control lot of less well colored apples (50 percent red). Cravens (24) found that all red varieties showed an increasing rate of sale as the percentage of red color increased. For McIntosh, the rate of sale increased rapidly when the percentage of red color increased from about 25 to 55 percent, remained about the same until the percentage reached 75, and then declined due to overmaturity, bruising, and other unfavorable characteristics.

Retailers asked by Scott and Leed (73) to name the most significant consideration when buying apples, stated that color was by far the most important factor.

A study by Evans and Marsh (30) confirmed that fresh apple sales respond to good color. In two West Virginia cities sales increased an average of about 75 percent as the area of solid red color on the surface of the apples increased from 15 to 50 percent.

Retail customers were found by Smith (78) to prefer Red Delicious apples that had a high percentage of good red color to apples of partial red color. Sales were 33 percent less for partial red fruit (50-75 percent red) and 14 percent less for combination displays of red and partial red fruit than for red fruit (75 to 100 percent red).

Pricing

References to pricing policies have been made by various researchers. Weaknesses that have been pointed out include: (1) Insufficient price differences among various qualities to stimulate grower interest in producing quality apples; (2) pricing of good and poor quality apples about the same at retail stores slows total sales of apples and; (3) better quality measures are needed for basing price differences.

Bruns (14) found enough differences in prices being paid for the same apples in the fresh market and in the processed market to suggest that it may pay producers to be aware of the value of their apples in each market before selling.

Carlsen (20) observed many retailers selling poor quality apples at practically the same price as better fruit. This poor merchandising technique slowed the rate of apple sales. This slowing of sales had a detrimental effect on the entire industry, in Carlsen's opinion, because of the importance of movement in the orderly marketing of apples.

Consumer Preferences

Consumer preferences for apples as to variety, kind of pack, grade, and buying season were studied by Maxton, et al., in the East in 1948 (52). They found that consumer level groups and many retailers did not know fruit and vegetable varieties, packs, and grade well enough to provide the desired information. Therefore, the experiences of chainstore buyers and cooperative retail organizations were used to reflect consumer preferences.

On a weighted basis, consumer preferences for varieties placed red strains of Delicious first, closely followed by Winesap. These two varieties made up nearly 40 percent of the variety preference demand for apples. The Stayman variety ranked third and was followed by Jonathan, Rome Beauty, and Grimes Golden in that order. These four varieties made up approximately the second 40 percent of the variety preference.

The kind of container preferred varied greatly with varieties. In total, 49 percent preferred a consumer pack, 30 percent the bushel box, and 21 percent the bushel basket. For all varieties, consumer preferences were expressed for one-third U. S. Fancy and two-thirds U. S. No. 1 grade. The proportions of volume consumed by seasons were: 31 percent in the fall, 30 percent in winter, 25 percent in spring, and 14 percent in summer.

During December 1950 and January 1951 New and Scott (57) interviewed 934 consumers in Columbus, Ohio grocery stores to determine the extent to which consumers were familiar with different apple varieties, their use of apples in the home, and their apple purchasing habits.

About 70 percent of the consumers identified the Western Delicious variety correctly indicating that advertising had been used to advantage in familiarizing consumers with this variety. Of the local apples, 25 percent identified the Golden Delicious, 17 percent the Stayman Winesap, 15 percent Ohio Delicious, and 12 percent the Rome Beauty.

About 86 percent of the customers who purchased apples indicated they intended to eat some out-of-hand. About one-third of the apple purchasers indicated that the variety they bought would be used for both eating and cooking.

The younger age groups (under 40 years) indicated a larger proportion of their purchases would be eaten out-of-hand than the older groups did. Older people planned to use more for pies and cooking.

Customers reared on farms and in small towns indicated they purchased more apples for cooking and making pies while city reared customers intended to use more apples for baking and in salads.

Over one-half of the customers interviewed indicated that they buy apples once a week and 90 percent at least once a month. Customers in low and medium-income area stores purchases apples more frequently than shoppers in high-income area stores. In general, shoppers for larger families purchase apples more frequently than shoppers for smaller families.

Each customer interviewed was asked to indicate the three most common uses for apples in their homes. Of the total interviewed 90 percent indicated out-of-hand eating, 67 percent pies, 55 percent sauce, 27 percent baked apples, and 15 percent salads. Less than 5 percent indicated other uses.

About 80 percent of all homemakers surveyed by USDA researchers in 1949 (81) said they preferred one fruit above all others. Among these, one out of three preferred apples.

MARKETING COSTS AND MARGINS

In 1961 over three billion pounds of fresh apples were consumed in the United States, approximately 18.6 pounds per capita. The retail value of fresh apples consumed was slightly under $500 million, or about $2.50 per consumer.

What happens to the consumer's apple dollar? How much of the apple dollar goes to the producer? How much is absorbed by the various agencies performing marketing functions such as retailing, wholesaling, transportation, storage, and other marketing services? What services are provided by these agencies, and what are the costs of providing them? These questions are important in evaluating the performance of the apple marketing system.

This section of the report is a digest of the principal results of marketing costs and margins research since 1945 showing areas of agreement or conflict in these results.

Definitions

The farm-retail price spread or marketing margin is the difference between the price per pound the consumer pays for apples at retail and the farm value or payment the farmer receivers for an equivalent quantity of apples. The expenses of providing the services of one or more marketing functions are marketing costs.

Marketing margins may be expressed in several ways. In this report percentage margins refer to percentage of retail price and actual margins refer to dollars per unit. Marketing margins usually are calculated by functions for retailing, wholesaling, transportation, and combined functions performed at the shipping point. Functions performed at the shipping point are handling, sorting, washing, grading, packing, storage, and selling.

Retail Costs and Margins

The retail margin is that portion of the consumer's dollar retailers keep as payment for the services they provide. Retail costs to be covered by the margin normally include charges for receiving, handling, storing, displaying, merchandising, and selling apples; charges for losses from shrinkage in weight and spoilage; and return on invested capital. Some retailers provide additional services such as credit and delivery and their margins should cover the costs of these services.

Most research on apple marketing margins in the past 16 years was conducted during 1947 to 1951. Research indicates that retail margins varied considerably among retail outlets during this period. Retail margins for apples in some cases were as little as 25 cents of the consumers' apple dollar and in other cases as much as 50 cents. The size of margin received by retailers may be influenced by type of retail outlet,

method of merchandising, price variation and pricing policy, area of production, and variety of apple.

Type of Retail Outlet

Past research indicates that type of outlet may be an important influence on the size of retail margins taken on apples. Retail outlets may be classified as (1) chains, (2) independents, and (3) fruit and vegetable speciality stores.

Studies in 1949-50 and 1950-51 in Pennsylvania (4, 49) and Ohio (72, 73) found that chainstores had smaller average retail margins than did independent stores on both local and Western apples. However, most independent stores provided services such as credit and delivery not provided by chainstores.

In contrast, a study in Denver, Colo. in 1948-49 (84) found no consistent differences in the size of margins taken on Washington apples by different types of retail stores. Nor were there consistent differences in size of margins taken between stores with different volumes of business.

According to most margin studies independent retailers had larger margins than chainstores, but there was no evidence that apple retailing costs were proportionally higher in independent stores.

Method of Merchandising

A study in Chicago and Los Angeles in 1950 (23) found retailers' margins on prepackaged Northwest apples smaller than on bulk apples. Retail margins in Chicago averaged 30 percent of the retail price on bulk apples, 26 percent on 4-pound bags, and 24 percent on 3-pound bags. Margins in Los Angeles averaged 31 percent on bulk apples, 26 percent on 4-pound bags, and 23 percent on 3-pound bags.

Several studies found that direct costs of retailing prepackaged apples are considerably smaller than for bulk apples (1, 2, 18, 19, 23). In merchandising prepackaged apples less in-store labor was required to build and maintain displays, weighing time was reduced, spoilage losses were less, and savings were made on bag costs.

Price Variation and Pricing Policy

At any given time not all retailers take the same margin on apples. In addition to differences in services provided and costs of providing services, the pricing policy of the firm is important in determining margins. An important part of the pricing policy is the decision to maintain a fixed selling price or to adjust selling price in relation to purchase price changes.

Studies made in 1948-49 and 1949-50 indicate that apple pricing policies vary considerably among retail firms. In Pittsburgh (4), although most retail firms studied did not have a consistent price policy, retailers had greater average actual margins as the apple marketing season progressed. Increasing monthly wholesale prices plus increasing dollar margins resulted in higher monthly average retail prices and relatively stable percentage margins. In Denver (84) most retailers studied followed a flexible selling price policy. Retailers took a relatively constant actual margin

regradless of changes in cost of apples purchased, resulting in changing percentage margins as purchase price changed. In the Canton-Youngstown area of Ohio, Scott (72) found that chains reduced both average actual and percentage margins on local and western apples as the season progressed, while fruit and vegetable specialty stores increased margins.

Area of Production

Although the area in which apples are produced may influence retail margins, research in the 1949-50 and 1950-51 marketing seasons does not show consistently larger retail margins on apples from any one area.

In the Canton-Youngstown area of Ohio in 1949-50, chainstores had larger average percentage margins on Western apples than on Ohio apples while independent stores had greater margins on local fruit (72). A year later this same relationship existed in Cleveland. In the Canton-Youngstown area, however, both chains and independents had larger percentage margins on Ohio apples (73). Retailers' average percentage margins in Indianapolis in 1949-50, were about the same for both Western and Midwestern apples (58), while Pittsburgh retailers (both chains and independents) had larger percentage margins on Eastern apples than on Western apples in both 1949-50 and 1950-51 (4, 49).

Variety of Apples

In the 1948-49 season, Denver retailers tended to mark-up all varieties of Washington apples a similar absolute amount, thus taking greater percentage margins on the lower priced apples (84). On Standard Delicious, Red Delicious, and Winesaps retail margins averaged 26-28 percent and on Staymans and Johnathans 37-40 percent. A year later Los Angeles retailers took about 10 percent more of the consumer's apple dollar for Washington Delicious than for lower priced Jonathan and Rome Beauty varieties (70). At the same time, Indianapolis retailers' average margins were about the same for all major Midwestern and Western varieties (58).

Wholesale Costs and Margins

The difference between the shipping point price plus transportation charges, and the price the retail firm pays for apples is the wholesale price spread, or margin. The costs encountered by wholesale firms in providing the wholesale function are the costs to be covered by this margin. These costs may include receiving, handling, inspecting, repacking, selling, delivering, credit, and a return on investment.

In Pittsburgh in 1949-50 wholesale margins averaged 9 percent of the consumer's dollar for both Eastern and Western apples (4). Absolute margins averaged 33 cents per 48 lb. bushel for Eastern apples and 40 cents per 44 lb. box for Western apples.

In Pittsburgh, Eastern apples were handled by initial carlot receivers who sold either directly to retailers or to secondary handlers (4). Initial receivers' charges averaged 25 cents per bushel regardless of whether they sold to retail firms or to secondary handlers. Secondary handlers charged an additional 29 cents per bushel for distributing Eastern apples to retail stores. Thus, for apples moving directly from initial receiver to retail stores the absolute margin was less than half of the margin for apples moving through a secondary handler.

For Western apples the auction market was used in Pittsburgh in addition to the initial carlot receiver, whose margin averaged 38 cents per box, and the secondary handler, whose margin averaged 40 cents per box (4). The average wholesale margin including auction charges for firms using the auction was 36 cents per box.

In 1948-49, Zahn (84) found that few marketing channels were used in moving Washington apples to Denver consumers. Some apples moved from shipper directly to chains and some moved from shipper to trucker to wholesaler to retailer. For the season actual wholesale margins averaged 99 cents per box; 14 percent of the consumer's apple dollar.

Denver wholesalers' margins showed two definite patterns: (1) Apples purchased 1 month were sometimes sold over a period of several months and percentage mark-up increased for each succeeding month after the apples were purchased, (2) approximately the same absolute wholesale margin was taken on each variety of Washington apples, thus percentage margins tended to be greater for lower priced apples.

Transportation Costs and Margins

Transportation costs include charges for all services performed for packed apples from the time they are placed in the freight car or motor truck at the shipping point until they are unloaded at the terminal market. In addition to the normal service of transporting the apples from shipping point to consuming center, special services to minimize the effects of changing temperatures during transit may be utilized. These special services are particularly useful in long hauls, as from Western shipping points to Eastern consuming centers.

The few studies made on apple transportation costs and margins during the past 16 years were limited to a three season period, 1947-48 through 1949-50. During this period most apples shipped from Washington State moved by rail. Rail rates from Washington to Chicago increased during the period, yet the transportation margin remained fairly stable at about 14 percent of the Chicago consumer's apple dollar (68, 70).

In 1948, transportation accounted for 10 percent of the Denver consumer's Washington apple dollar (84). The following season transportation was 9 percent of the Los Angeles retail price, 17 to 19 percent in New York, and 21 percent in Pittsburgh (4, 70).

Shipping-point Costs and Margins

Shipping-point costs include charges for all service performed on apples from the time the loosely-packed orchard-run fruit is received at the packing-house door until it is loaded on a carrier for shipment to a market. Shipping-point services may include washing, sorting, grading, packing, packaging, warehousing, storing, handling, and selling. Average shipping-point charges for a box of Washington apples were $1.17 in 1947, $1.24 in 1948 and $1.17 in 1949; a fairly constant 20 percent during the 3-year period (70). In 1948, 19 percent of the Denver consumer's Washington apple dollar went for shipping-point charges, while the following season shipping-point charges for Washington apples took 23 percent from New York and Los Angeles consumers. The same season shipping-point charges in the Appalachian area took 30 percent of the Pittsburgh consumer's apple dollar (4).

Packing Costs

Packing costs usually include charges for: (1) Dumping, washing, sorting, grading, packing, lidding, stamping, and labeling; (2) supervision; (3) materials used such as containers, paper wraps, and liners; and (4) overhead expenses such as depreciation on packing quipment, heat, power, and rent.

Packing costs are a major part of shipping-point expenses, in some cases averaging over two-thirds of total shipping-point charges and as much as one-fifth of the consumer's dollar spent on apples (68, 69).

Considerable variation has been found in packing costs among areas of production, among packers in a given area, and among different packing methods in a given plant.

Many factors affect packing costs, such as: Type of container, amount and type of packing equipment, size and organization of the packing crew, size of the packing operation, and size and quality of fruit being packed.

Type of Container

Many advances have been made in apple packaging materials in the past decade. The tray-packed fiberboard carton and various retail packages have become increasingly important with declining use of the northwestern wooden box and the tub-type bushel basket.

Comparisons of total labor and material costs for different hand-packed commerical size containers found the northwestern wooden box usually most expensive to pack, followed by the tray-packed carton, with the bushel basket least expensive (3, 31, 41, 50, 61, 62, 69). Most of the cost difference between the northwestern box and the tray-packed carton was in material cost, but average labor cost for packing the northwest box was greater in several cases (31, 41, 62).

Studies in Ohio in 1950, 1951, and 1954 and Pennsylvania in 1954 found total variable costs of hand-packing apples in 3-, 4-, or 5-polyethylene bags more expensive than packing in bushel baskets, tray-packed cartons or jumble-filled cartons (3, 41, 75, 76, 77). However, a later study in the Appalachian area found packing in 4- or 5-pound polyethylene bags less expensive than hand-packing tray-packed cartons (62). When semiautomatic bagging machines and semiautomatic tray-packers were used the estimated total cost of tray-packed cartons was less than for 4-pound bags but more than for 5-pound bags (61).

Studies in the Appalachian area in 1955 and 1959 found smaller average total labor and material costs for hand-packing 4- or 5-pound polyethylene bags than for packing in the northwestern box (41, 62). In the Pacific Northwest in 1950 direct labor and material cost were greater for packing 3- or 4-pound pliofilm bags than for packing in the northwest box, regardless of the method of bagging (23).

Comparisons of packing costs for different type retail packages in 1959 and 1960 found jumble-packed polyethylene bags least expensive (59, 60). The major disadvantage of the package is that apples are easily damaged. Packaging in modified polyethylene bags containing cell inserts or in molded pulp-board trays overwrapped with cellophane allowed less fruit damage and increased packing costs about one cent per pound of fruit.

Comparing labor and material costs of packaging apple in 3-,4-, and 5-pound bags, several studies in the mid and late 1950's found that costs decreased as bag size increased (3, 23, 41, 60, 61, 62, 66, 67). Essentially the same motions are necessary in filling each size bag, resulting in only a small cost difference per bag. As more smaller-size bags must be filled for a carton, labor cost is greater. Usually the difference in price of bags relative to their size is not great. Thus, total labor and material cost per pound of fruit packaged is usually greater in 3-pound bags than in 5-pound bags.

Amount and Type of Packing Equipment

Packinghouse operations vary considerably in amount and type of mechanical equipment used in grading, sorting, packing, and packaging apples. Hand-packing operations in most packinghouses have been replaced by homemade mechanical devices, semiautomatic, automatic, or other improved equipment for operating a packing line more efficiently. Packing labor and equipment costs have been affected by these changes in mechanization. Most studies of apple packing costs recognized that a large part of the differences in costs among packers is due to differing amounts of mechanization (11, 17, 23, 31, 32, 38, 40, 41, 47, 51, 55, 61, 62, 66, 80).

The introduction of mechanical equipment in a packinghouse does not necessarily mean that packing costs will be reduced. In some cases the use of mechanical equipment resulted in combined labor and equipment costs as high or higher than for hand operations (3, 51, 76, 77). Generally, use of mechanical equipment results in lower labor requirements, which on an hourly pay base means a reduction in labor costs (11, 16, 17, 23, 32, 38, 41, 47, 55, 61).

The installation of equipment required a capital outlay which depreciates over the lifetime of the equipment, and increases fixed costs. These costs must be added to any additional operating expense cost (excluding labor) necessitated by the equipment. Equipment cost per unit of output is influenced greatly by volume of fruit handled. Per unit equipment cost must be more than offset by savings in per unit labor cost to make the added equipment profitable. Thus, the profitableness of adding equipment depends on reduction in labor cost, increase in equipment cost, and volume of apples to be handled. Several studies emphasize this. In a relatively efficient packinghouse in the Appalachian area where culls resulting from the packing operation were hand-packed in field crates, the installation of an automatic box filler for packing culls reduced labor requirements for the job from 0.78 man-minutes to 0.33 man-minutes per crate (32). It was estimated that this packing operation would need 28,000 crates per year for the automatic box filler before any net savings would be made by its installation. In a less efficient packinghouse requiring 2.3 man-minutes per crate to fill by hand, the break-even volume would be only 6,500 crates per year.

A study of packing equipment in the New York-New England area in 1959 using an improved mechanical packing line found that by increasing volume handled per season from 50,000 boxes (900 per day) to 150,000 boxes (1,200 per day) packing costs per dumped box were reduced from 22.3 cents to 15.3 cents (16). In the Appalachian area in plants hand-packing 50,000 tray-pack equivalent units in a 200-hour season a return flow belt system with semi-automatic tray-packing machines reduced estimated costs per tray-packed carton about 28 percent (61). Estimated savings were even greater in larger plants with greater volumes.

Size and Organization of Packing Line Crew

Size and organization of the packing crew are important determinants of packing cost differences. A poorly organized and supervised packing line is likely to operate inefficiently. Using an inadequate crew results in either operating the line quite slowly or stopping the flow at intervals to allow the performance of needed tasks; a costly operation in either case. This problem was found in several Michigan packinghouses in 1948 (38). Operating with too many workers on the packing line increases nonproductive time and is wasteful. Higher packing costs resulting from nonproductive labor were reported in Vermont in 1954 (55), California in 1952 (11,34), and in larger packinghouses in Michigan in 1957 (40). Nonproductive labor usually exists because of failure to adjust the packing crew to the volume of fruit being handled. In California this resulted from the uncertainty of management concerning future labor supply and future fruit volume and quality.

Size of Packing Operation

Few apple marketing studies have dealt with the effects of plant size on packing costs. By increasing volume, overhead costs are spread over more units resulting in lower fixed costs per unit of output. In most plants increased volume reduced packing costs. However, this research did not attempt to measure the rate at which costs were reduced, nor the volume necessary for least cost operation.

In one study in 1959 which attempted to measure economies of size in apple packinghouses in Michigan, increasing plant capacity from 50 to 800 field crates per hour reduced unit cost as much as 24 percent (36). Reductions in unit cost were least for certain types of packing, such as jumble packing in bushel cartons, and greatest for more costly operations such as packing ring-faced bushel baskets. Reductions in unit packing costs with increased length of season were substantial. For example, costs in plants of given capacity operating 400 hours were about 25 percent less than costs for the same plants operating 200 hours. Cost reductions accompanying increased length of season were least for operations involving greater amounts of labor.

Size of Fruit

Apples packed for fresh market are usually packed according to size of the fruit. Studies in California in 1952 (34) and the Appalachian area in 1959 (61) found that changes in size of fruit significantly affected rates of output. Increasing size (meaning fewer apples per container) generally increases output per packer hour. For example, in California increasing the size of fruit packed in standard boxes from 150 to 100 raised average output by four boxes per packer hour, a 29 percent increase. In the Appalachian area, the same increase in size packed in tray-pack cartons raised average output 2.9 cartons per packer hour, approximately a 25 percent increase.

Handling Costs

Handling operations in apple packinghouses include receiving the fruit at the packinghouse door, moving the fruit from the packinghouse door or from storage to the dumping area, putting packed apples into storage, and moving packed apples from storage or from the packing area to the rail car or truck trailer.

Most studies of handling costs in apple packinghouses agree that handling methods which use the unit load principal rather than handling individual containers require fewer man-hours of labor and are usually less costly. (17, 21, 22, 31, 46, 56, 71). The forklift truck and pallet method was found to be the most economical handling method in most cases. Using this method in the Appalachian area in 1960, labor and equipment costs per crate handled were reduced when annual volume was increased from 50,000 to 100,000 crates (17).

In 1958 in the Northwest the forklift truck and pallet method was most economical for handling an annual volume of 100,000 boxes, but when annual volume increased to 200,000 or 400,000 boxes the 36-box industrial clamplift truck method proved to be more economical (56). Although suitable for one-floor plants, neither the forklift truck nor the clamplift truck could be used alone in a two-floor plant. The 24-box industrial clamplift truck used with belt conveyors proved most economical in two-floor plants, with clamp type two- wheel handtrucks and belt conveyors being only slightly higher (56).

Determination of the most efficient type or combination of types of equipment must be made on an individual plant basis, as a handling method proving most economical for some plants may not be most economical for others. The industrial forklift truck was found to be most economical in newer plants built to utilize this type of equipment. Many older plants in the Northwest have low ceilings and closely spaced posts or columns in storage areas restricting stacking heights and interfering with stacking arragements. Thus, the ability of the industrial forklift truck to high-stack boxes in such plants cannot be fully realized and the industrial clamplift truck method, although slightly more expensive, is better adapted to many of these plants (22, 46).

Several factors have been suggested as important considerations in a wise selection of handling equipment for any given plant (56). Among these are: (1) Travel distances; (2) layout and design of plants; (3) necessary remodeling of plant, if any; (4) expected volume to be handled; (5) capital outlay for equipment; (6) maintenance of quality of fruit; and (7) available labor supply, particularly at the peak of the season.

Storage Costs

Storage includes the service performed on bulk or packed apples from the time they are moved into the storage room until they are moved into a vehicle for shipment (packed apples) or to the packing area (bulk apples). These services normally include receiving, moving, and stacking filled containers in the storage room and storage under controlled conditions.

Several studies during the 1940's found that most Eastern apples were stored in commercial facilities although storage in grower-owned houses was less expensive (69, 74, 80). In Michigan during the 1952-53 season commercial rates for a 6-month storage period ranged from 45 to 80 cents per crate while in grower-owned storage houses per crate costs averaged 34 cents in a 2,000-crate house and only 21 cents in a 25,000-crate house (39).

In the past decade controlled atmosphere storage has become important in the storage of apples, both in grower-owned facilities and commercial facilities, but cost data for such storage operations are not available.

Grower's Return

That portion of the consumer's apple dollar remaining after costs of retailing, wholesaling, transportation, and shipping-point service are deducted is the return to the grower. The grower's share of the consumer's apple dollar is payment for the services of producing, harvesting, and hauling the apples to the packinghouse.

For the 1947-48 season Washington apple growers' return averaged 26 percent of the consumer's dollar (10, 68). In 1948-49, a short crop pushed Washington growers' returns to 33 percent of the consumer's dollar, while in 1949-50 a heavy crop dropped farmers' return to 24 percent (4, 84).

During the decade of the 1950's research was not directed toward case studies of grower returns for apples.

RESEARCH NEEDS

Research has provided much useful information on the economics of apple marketing. Although continued economic research is needed in most areas of apple marketing, several areas stand out in need of additional research. Several developments in the apple industry in recent years have increased the importance of marketing problems in these areas.

One important development during the postwar period is the growth of controlled atmosphere storage. It has altered the seasonal marketing pattern of apples for fresh use by extending the fresh marketing season, especially for the more perishable varieties. Its effects on seasonal demand and supply of apples and the changes in marketing costs are largely unmeasured. Also, little is known about the effects of controlled atmosphere storage on competition among producing areas.

Although the fresh market is still the principal outlet for apples, it has declined in importance during the postwar period while the market for canned apples and applesauce has grown. These trends make it important to know more about the separate but related demands for fresh apples and processed apples and to evaluate the factors that bring about the utilization of the crop between these uses. Little is known about the long-range demand and supply of apples. Most research studies have dealt with annual data and have taken the supply of apples as given without considering long-term production adjustments that might take place in response to changes in the demand for apples. Likewise, little consideration has been given to long-term changes in the demand for apples that might come about with population growth and future trends in consumption of competing products. To investigate these questions an analytical framework should be developed that would take into account the various demand-supply relationships. It should be formulated to measure both short-and long-run relationships.

Additional information is needed on apple marketing margins to explain margin changes and their effects on producers, distributors, and consumers. Little research on apple marketing margins has been conducted since 1950. Changes have been made in the number and kinds of services provided by the marketing system and additional studies are needed to reflect fully these services and their effects, if any, on the distribution of the consumer's apple dollar.

Large amounts of money are spent each year by producer groups to promote and merchandize apples. Research is needed to determine how such funds might be spent most effectively. These research needs include measurement of sales response to such factors as: Selected promotional themes; specific forms or combinations of advertising, merchandising, and other related promotional activities, and varying levels of promotional expenditures.

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