ABSTRACT

ECONOMIC ASPECTS OF APPLE MARKETING IN THE UNITED STATES

by Dana G. Dalrymple

In recent years there has been increased interest in industry-wide marketing programs for apples. This requires economic knowledge of apple marketing on a broad level. Such information has been lacking. It was, therefore, the purpose of this dissertation to construct a comprehensive and systematic body of knowledge about the economics of apple marketing on the national level. The study incorporates, wherever relevant, information from the field of horticulture and gives particular attention to the relationships between fresh and processed apples.

It is hoped that this study will be of value to the leaders of regional and national apple organizations and agricultural economists specializing in fruit marketing. While the dissertation was intended to provide background information for these individuals to adapt to specific problems, it does shed light on two important and current national issues: the regional impact of the divergent trends in production and consumption of fresh and processed apples,

and the economic rationale behind centralized marketing programs such as bargaining and diversion.

Three main steps were followed in conducting the analysis. The first involved study of all previous investigations on the economic aspects of apple marketing for their potential contributions to a central body of knowledge. Secondly, all statistical data available on apples for the 1946-60 period were considered for the role they might play in filling out this body of knowledge. Finally, relevant economic studies and statistical material were integrated into the text of this dissertation. Where gaps were noted in the available economic information, this writer attempted to fill them. In this way, information was developed on such heretofore neglected, but related, areas as varieties, storage, processing, and retail prices and purchases.

The ensuing study is divided into six main chapters: production, utilization, consumption, prices, price analyses, and marketing policy.

The first five chapters attempt to present, in general terms, the body of knowledge which was developed with respect to the economics of apple marketing at the national level. More specifically, the study starts out by tracing changes in apple production by variety and region for the 1946-60 period

and presents information on projected future changes (which suggest that a sharp increase in production is likely within the next four years). The actual disposition of the crop is discussed next. Principal uses--the fresh market (including storage) and processing--are closely examined with respect to trends and technological changes. This leads into a detailed investigation of consumption patterns for fresh and processed apples. Prices for apples, both at the retail and farm levels for fresh and processed apples, are then studied, along with related information on marketing margins and farm values. A more specific analysis of the factors influencing the prices for apples follows. This is done through review of previous studies and investigations by this writer. Also, elasticities of demands for apples in fresh and processed forms, at retail and farm levels, are presented and analyzed for marketing implications.

In the last chapter, two areas of particular policy interest to the industry are developed. These concern the regional impact of the increasing production of fresh varieties as opposed to the decreasing consumption of fresh apples (with processed apples showing the opposite pattern), and the suggestions economic analysis of apple marketing has concerning the role of apple price bargaining associations and related controlled distribution programs.

In total then, the dissertation seeks to present a balanced picture of the economic factors involved in apple marketing at the national level and then attempts to relate some of these factors to two contemporary industry-wide problem areas.

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IN THE UNITED STATES

By

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CHAPTER I

INTRODUCTION

> It is of prime importance that the man who expects to grow fruit for sale shall understand the fruit market and its requirements.
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> --F. A. Waugh, 1901[1]

The Problem

The need for economic knowledge--always strong in marketing--has become acute in the apple industry in recent years. With heavy apple production and low prices in four of the last five years, and larger crops expected, growers have taken an increased interest in the economics of apple marketing. In particular, they have seen the need for tighter marketing organization on the regional and national level.

This is appropriate, for apples are very much a national--and occasionally an international--commodity. They are produced on a commercial scale in 35 states and are widely distributed: Washington Delicious apples flow to the northeastern market; New York McIntosh flow to Florida;

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[1] F. A. Waugh, Fruit Harvesting, Storing, Marketing, New York: Orange Judd Company, 1901, p. 1.

and for the first time in many years, Michigan apples--from Controlled Atmosphere storage--have started moving into California. In this context, what happens in one state or region may have considerable influence on the marketing of apples from other areas.

This interdependence is apt to grow for several reasons. The expansion of centralized selling in many areas has led to attempts to reach well beyond state boundaries for markets. There has been an increase in the use of marketing orders for apples and an upsurge of interest in apple bargaining associations. While the initial efforts with orders have been at the state level, it is possible that the future may find use of federal orders on a regional basis. The proponents of bargaining associations realize full well that to be successful it will be necessary to organize at least on a regional, and likely, on a national basis. There is likely to be, then, a definite growth towards a more national approach to marketing.

But as the marketing of apples takes on new and industry-wide forms, it is increasingly apparent that marketing knowledge has not kept pace. Current apple marketing information, in this broader context, is too insular; it suffers from geographic, professional and product parochialism.

There is relatively little research work that has been done with the economic problems of apple marketing on an industry-wide or national level. That work which is available is more likely the fortunate by-product of a specific study conducted for a specific area than it is of any study of broader scope. The result is a less than systematic body of economic knowledge on apple marketing at the national level.

A second problem is that the economic work which has been done, has generally given little attention to the horticultural phase of marketing, while the horticultural studies have given scant attention to economic aspects. The result is that some apple marketing problems may languish in a veritable no-man's land between the two disciplines--when each could be enhanced by greater knowledge of the other.

A third problem is that little attention is paid to the interrelationships between fresh and processed apples. Generally the studies consider apples as if they were a homogeneous entity or look at only one of the products.

Such deficiencies in the available research suggest the need for a more comprehensive body of economic knowledge of apple marketing on the national level--a knowledge that is enriched by contributions from horticulture and which considers the many forms of apples and apple products.

The Purpose

The purpose of this dissertation is to construct an orderly and comprehensive body of economic knowledge about apple marketing. The emphasis will be on relationships at the national level. Concurrently, the study incorporates information on horticultural aspects as they may temper economic factors. Special emphasis will be given to the interrelationships between fresh and processed apples at all levels in the marketing process.

Such a systematic and comprehensive treatment will enable the apple industry to better attack specific marketing problems. The dissertation is expected to be of particular interest to two groups: regional and national apple association managers and agricultural economists. The association managers may find that the study will help them place their empirical knowledge of apple marketing into a broader and more theoretical framework. The agricultural economists--in particular the price analysts--may gain a clearer picture of the structure of the industry and a broader knowledge of the economic studies completed to date. This could aid them in advising the industry and in formulating their own research projects.

While the dissertation was initiated to meet a need for a body of general economic knowledge, it is not without

application to several and important current industry problems. First, the industry tends to see only its immediate problems and often overlooks long-run problems of adjustment. Perhaps the most important of these concerns the balance between fresh and processing apples in terms of production and consumption. This point is covered implicitly in the text, and also explicitly in the chapter on marketing policy.

Secondly, both manager and economist currently face delicate questions concerning the economic problems associated with centralized marketing programs such as bargaining associations, marketing orders and diversion. While this study does not attempt to deal with details of their organization, it does provide information on utilization, consumption, prices, elasticities of demand, and price analyses which are basic to the enlightened operation of any such industry-wide programs. And because diversion and market control programs raise some basic economic questions they are also given special attention in the chapter on marketing policy.

This paper then attempts to present a balanced picture of the economic aspects of apple marketing on a national level, giving attention to pertinent horticultural data and to both fresh and processed apples. At the same time, it sheds light on economic factors pertaining to two current problem areas--the relationship between fresh and processed and

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apples, and centralized marketing.

A greater knowledge of these economic aspects should in turn lead to a more efficient marketing process. The producer may benefit from a more stable, and perhaps higher seasonal price for his product, and the consumer may benefit from a higher quality product at a lower price.

The Method

With these purposes in mind, three main steps were utilized in this study. First, all the literature available pertaining to the economic aspects of apple marketing was analyzed. While there has been no shortage of research on the physical aspects of apple marketing, useful economic studies on apples are considerably more limited in number. Even so, there are a number of investigations which have contributions to make to a central body of economic knowledge of apple marketing. Secondly, all the available postwar statistics pertaining to apple marketing were studied. This included data from both public and semi-private organizations. Those that appeared to be most useful on the national level were recorded, summarized and analyzed. Finally, both economic studies and economic data were structured and synthesized into the text of this dissertation.

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The result is a study which analyzes the present state of economic knowledge of apple marketing on a broad national level. It also rounds out the picture by exploring into a number of rather neglected areas such as varieties, storage, processing, and retail prices and purchases. Much of the statistical material on these points is presented here for the first time.

The analysis itself is presented in seven chapters: (1) production, (2) utilization, (3) consumption, (4) prices, (5) price analysis, and (6) marketing policy. The first five chapters are more general in nature than the last, which specifically treats the divergent trends in the production and consumption of fresh and processed apples, and the economic rationale behind such centralized marketing programs as bargaining and diversion.

CHAPTER II

PRODUCTION

Postwar Changes in Production

In this study attention will be focused on the post-war period. This includes the 15 crop years from 1946 to 1960. A crop year is considered to extend from July 1 to June 30.[1]

Total Production

During the 15-year period under study, commercial apple production in the United States, as reported by the Department of Agriculture, averaged 111,532,000 bushels--ranging from a low of 86,869,000 bushels to a high of 134,309,000 bushels.[2] Production by years is presented

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[1]Unless indicated otherwise, the statistics presented in this and following sections were either taken from, or calculated from, data issued by the Crop Reporting Board, Statistical Reporting Service, U.S. Department of Agriculture (USDA). Specific listings of the USDA and other reports are found in part E of the References section.

[2]The Department of Agriculture reports production only in "commercial" states. Production in "all" states is reported only every five years by the Census of Agriculture.

in Table 1.

Table 1. U.S. commercial apple production (in thousands of bushels).

Crop Year	Production	Crop Year	Production
1946*	115,765	1954	111,878
1947*	109,044	1955	106,263
1948*	86,869	1956	101,315
1949	134,309	1957	119,258
1950	123,769	1958	127,485
1951	111,799	1959	126,847
1952	94,085	1960	108,515
1953	95,778		

*These are not official figures, but are estimates prepared by the author from USDA data in accordance with the method followed by the Department of Agriculture in revising its 1949-60 estimates. See Appendix A for detail.

Source: Crop Reporting Board, USDA.

Production fluctuated quite violently early in the period, particularly in 1948 and 1949,[3] but has evened out since then. The over-all trend in production for the period appears to have been up. Calculation of a trend line indicated that production increased at the rate of about 0.44% per year.[4]

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[3]A study of crop yields per harvested acre for leading crops from 1909 to 1949 indicated that the greatest instability was in apple production (T. W. Schultz, <u>The Economic Organization of Agriculture</u>, New York: McGraw-Hill, 1953, p. 205).

[4]This figure was obtained through regression analysis. That is, the regression coefficient for the period was divided by the average production for the period to give the average change in production by year.

To aid later analysis, the 15-year period was broken down into three five-year periods--those for small, medium and large crop years. The small crop years included those in which production ranged from 86 to 107 million bushels, the medium crop years incorporated a production range of 108 to 116 million bushels, and the large crop years ranged from 117 to 135 million bushels. In this way it may be seen that the small crop years included 1948, 1952, 1953, 1955 and 1956; the medium crop years included 1946, 1947, 1951, 1954 and 1960; and the large crop years 1949, 1950, 1957, 1958 and 1959. The small crop years, it will be noted, were concentrated near the middle of the period, while the large crop years were found near the beginning and the end of the period.

Geographic Location

The Department of Agriculture has grouped U.S. apple production into three main regions, and in turn reports production in 35 states.

Regions

The three main apple regions are classified as the east, the central states, and the west. Over the 1946 to 1960 period, production averaged as follows: the east, 50,683,000 bushels (45.3% of the U.S. average); the central states,

21,403,000 bushels (19.1%); the west, 39,445,000 bushels (35.5%). (See Appendix C, Table 1 for detail.)

Production trends varied between the areas. In the eastern states production increased at the rate of about 1.65% per year, while in the central states production increased by about 0.97% per year. In the western states, on the other hand, production decreased at the rate of about 1.7% per year.

Fluctuations in production, however, were wider in the eastern and central states than they were in the western states.[5]

States

While apples are produced in nearly every state, commercial production is reported only for the 35 most important states.[6] Of this total, the 16 most important states for the period under study are indicated in Table 2.

The degree of concentration of production is indicated by the facts that 38% of the crop was produced in two states

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[5]This point was also noted by Cecil N. Smith in "An Economic Analysis of the Eastern Apple Industry," University of California, Department of Agricultural Economics, Ph.D. thesis, June, 1957, p. 52.

[6]There is one exception. Production in Georgia is now greater than several of the lowest states in the commercial listing.

and over 75% was produced in eight states.

Table 2. Apple production by state, 1946-60.

Rank	State	Proportion of Production	Rank	State	Proportion of Production
1.	Washington	22.8%	10.	Illinois	2.4
2.	New York	15.2	11.	Massachusetts	2.3
3.	Michigan	8.7	12.	Oregon	2.1
4.	Virginia	8.6	13.	Indiana	1.5
5.	California	7.3	14.	Idaho	1.3
6.	Pennsylvania	6.1	15.	North Carolina	1.3
7.	West Virginia	4.0	16.	Connecticut	1.2
8.	Ohio	2.9		Other	9.9
9.	New Jersey	2.4			
				Total	100.0%

Source: Computed from Crop Reporting Board statistics.

Varietal Breakdown

Information is available on production by varieties--which in turn can be grouped into production by major use classification.

Specific Varieties

There are many varieties of apples (over 1800 named) but few of commercial importance.[7] The eight most important varieties over the 15-year period are indicated in Table 3.[8]

[7] R. M. Smock and A. M. Neubert, Apples and Apple Products, New York: Interscience Publishers, 1950, p. 9.

[8] When the USDA estimates reported here were checked against International Apple Association estimates, the rankings for 1949-60 were the same and the percentages differed by less than 1%.

Table 3. U.S. apple production by variety, 1946-60.

Rank	Variety	Proportion of Production	Rank	Variety	Proportion of Production
1.	Delicious	21.0%	6.	York	5.0
2.	McIntosh	11.4	7.	Stayman	4.7
3.	Winesap	9.4	8.	Golden Delicious	3.8
4.	Jonathan	6.8			
5.	Rome	6.6	9.	Other	31.3
				Total	100.0%

Source: Computed from Crop Reporting Board statistics.

Concentration of production into a few varieties is indicated by the fact that two varieties accounted for nearly a third of the crop while the top four varieties accounted for nearly 50% of total production.

There was some change in the variety "mix" over the 1946-60 period. The largest increases were registered by McIntosh and Golden Delicious, followed by more modest increases in Red Delicious and Stayman. The strongest decrease was registered by Winesap.

The importance of the specific varieties varied by region. A variety important in one area of the country often was of minor importance in other areas. Only a few were of comparable importance in each area. This is illustrated in Table 4.

Table 4. Varietal production by region, 1946-60.

Variety	Region East	Central	West
Red Delicious	9.5%	10.2%	41.1%
McIntosh	20.2	11.2	0.3
Winesap	3.3	1.5	21.6
Jonathan	2.2	24.1	6.0
Rome	7.5	5.1	6.4
York	10.8	0.7	---
Stayman	8.3	4.1	0.5
Golden Delicious	3.3	7.5	2.6
Other	34.9	35.6	21.5
Total	100.0%	100.0%	100.0%

Source: Computed from Crop Reporting Board statistics.

This table also indicates that two or three varieties are easily most important in each of the regions.

In terms of total variety production, 70% of the Red Delicious were produced in the west, 80% of the McIntosh in the east, 81% of the Winesap in the west, 54% of the Jonathan in the central states and 52% of the Stayman in the east. Only Golden Delicious were fairly evenly distributed through the three areas.

Major Use Classification

Apple varieties are often classified by their major use. Hence, some are known as "fresh" varieties, others as "processing" varieties and some as "dual purpose." The

particular category a variety falls in depends to some degree on the region. While the four most important varieties (Red Delicious, McIntosh, Winesap, Jonathan) are classified as "fresh" in all areas,[9] many of the other varieties differ: Romes and Stayman are classified as "dual purpose" in the east and west and "fresh" in the central area; Yorks are a "processing" variety in the east, and "dual purpose" in the central states; Golden Delicious is "dual purpose" in the east, "fresh to dual purpose" in the central states, and "fresh" in the west; and so on.

In an attempt to determine what changes have taken place in the production of these groupings, the production for each area for each year was classified by variety, totaled for the period, and then added to provide an aggregate figure for the U.S. The results showed surprisingly little variation over the 15-year period (see Appendix C, Table 2 for detail). "Fresh" apple production averaged 57.9% of the total and varied from 54.4 to 62.1%. "Processing" varieties averaged 10.1% and varied from 8.6 to 11.9%. "Dual purpose" varieties averaged 32.0% and varied from 28.9 to 34.5%. The trend over the period seemed to be up slightly for "fresh," down slightly

[9]This classification was made up by the Apple Marketing Clinic which meets every year in Washington, D. C. See Appendix C, Table 3.

for "dual purpose," and about steady for "processing."[10]

Table 5. Production by use classification, 1946-60.

Region	Use Classification: Fresh	Dual Purpose	Processing	Total
East	41.9%	40.5%	17.5%	100.0%
Central	68.2	31.8	---	100.0%
West	72.6	21.4	6.1	100.0%
United States	57.9%	32.0%	10.1%	100.0%

Source: Computed from Crop Reporting Board statistics arranged according to Apple Marketing Clinic varietal classification.

This table will become particularly interesting when actual utilization by region is considered. Suffice it now to note the low proportion of production represented by processing varieties in the east and west and the absence of processing varieties in the central states.

The data cited so far have been developed from final government crop estimates. This material is not available until a year or more following the crop year. During any crop year the industry has to rely on monthly crop estimates.

[10] The relatively small variation in the production of processing varieties was noted by W. W. Hunt in "The Future in Growing Processing Apples," Virginia Fruit (Proceedings of the Annual Meeting of the Virginia State Horticultural Society), February, 1961, p. 60.

Periodic Crop Estimates

Crop estimates are prepared by three groups. Estimates of the crop size by states (but not by variety) are released every month from July to December by the U.S. Department of Agriculture. In addition, the International Apple Association releases crop estimates in August and September, and the National Apple Institute prepares a "Guesstimate" in June. Only the "Guesstimate" is broken down by variety, and this is done later in the summer.

U.S. Department of Agriculture

The six monthly USDA reports are followed by a semi-final estimate released a year after the last monthly report. These estimates are in turn subject to revision in light of data obtained in the Census of Agriculture every five years.[11]

In this section, the monthly estimates shall be considered in light of the semi-final estimate (t+1) released a year after the final monthly estimate. Computing the monthly estimates as a percent of the t+1 estimate reveals the wide variations of the individual monthly estimates (Table 6).

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[11] And, during the summer of 1960, even this data was revised on the basis of different container weights for fresh apples in the northwest. See Appendix A.

Table 6. Deviations of U.S. monthly crop estimates from estimates on following December (t+1).

	Crop Estimate*					
Year	July	Aug.	Sept.	Oct.	Nov.	Dec.
1946	-11.9%	- 7.4%	- 2.3%	+1.0%	+1.7%	+1.8%
1947	- 1.7	+ 0.5	0	-0.1	-0.5	-0.5
1948	+13.2	+13.6	+13.7	+8.9	+2.1	+2.1
1949	- 9.5	- 4.4	- 3.2	-1.2	-0.3	-0.4
1950	- 3.2	- 4.0	- 3.3	-2.5	-2.1	-2.1
1951	+10.2	+ 9.6	+ 8.3	+6.2	+2.4	+2.1
1952	+10.0	+ 6.1	+ 6.0	+3.8	+0.2	+0.2
1953	+ 9.7	+ 7.6	+ 6.8	+4.2	+0.8	-0.8
1954	- 7.2	- 7.6	- 6.9	-6.4	-5.6	-5.5
1955	- 0.7	+ 1.0	- 1.7	+0.9	-1.5	-1.0
1956	-11.3	-10.1	- 7.1	-5.6	-4.5	-3.5
1957	- 4.8	- 2.5	- 6.1	-4.4	-1.9	-1.0
1958	- 2.2	- 0.5	+ 0.2	-1.0	-1.5	-1.5
1959	- 2.2	- 2.5	- 2.9	-4.9	-3.3	-2.9
1960	- 1.5	+ 0.8	+ 0.6	-0.7	-1.1	-2.0
Avg.	- 0.87%	+ 0.01%	+0.13%	-0.12%	-1.01%	-0.87%
S**	± 7.83%	± 5.60%	± 5.85%	±4.31%	±2.67%	±2.45%

*Monthly estimates in bushels are provided in Appendix C, Table 4.

**Standard error.

Source: Computed from Crop Reporting Board statistics.

Despite the fact that estimates for individual years and period groupings may vary fairly widely from the actual crop, the average of these aberrations has been remarkably close to the actual crop. The greatest error was found in July, and then strangely in November and December. The average August, September and November estimates were almost

identical to the semi-final estimate. It must be recongized, however, that the 15-year average is rather like the man who has one arm in an oven and one arm in a refrigerator, and who is on the average comfortable.

When the monthly variations from year to year are examined and standard errors computed, it is apparent that the variance of the estimates was reduced as the season progressed, with the exception of a slight jump in September.

It is often felt that crop estimates err most with crop size. Grouping of the estimates into years of small, medium and large crops suggests that this is so--though individual years may vary rather widely (Table 7). In the small crop years the crop appeared to be overestimated early in the season; while in the large crop years, production appeared to be underestimated. In other words, there did not seem to be sufficient flexibility in the estimates to fully accommodate large or small crops. By November the actual magnitude of the crops seemed to be more fully recognized and the range of the estimates narrowed. In the medium-sized crop year, the estimate was low in July but within 1% the rest of the season.

Has there been an improvement in the estimates over the period? The answer would seem to be "not perceptibly." It is difficult to be certain though, for the most recent five-year period contained three years of large crops, which as indicated above, seem to lead to underestimates.

Table 7. Deviations of U.S. monthly crop estimates from final crop estimates, by crop size, 1946-60.

	Crop Size		
Month	Small	Medium	Large
July	+4.2%	-2.6%	-4.4%
August	+3.6	-0.8	-2.8
September	+3.5	+0.7	-3.1
October	+2.4	0	-2.8
November	-0.6	-0.6	-1.8
December	+0.6	-0.8	-1.6

Source: Computed from Crop Reporting Board statistics.

International Apple Association

This organization releases crop estimates in August and September, based on a survey of its members. At the same time it revises its figures for the previous years.

The International Apple Association (IAA) does not try to align its estimates with the USDA, but maintains its own estimates of the total crop. From 1946 to 1960, its final estimates place the crop at an average of 1.53% higher than the USDA estimates. Since 1950, the yearly estimates have ranged from 0.3 to 6.1% higher.

Thus, in the first instance, the IAA monthly estimates should be compared with the IAA final estimate. This is done

in Table 8.

Table 8. Deviations of August and September IAA crop estimates for U.S. from final IAA crop estimates, by crop size, 1946-60.

	Crop Size			
Month	Small	Medium	Large	All
August	+0.8%	-0.4%	-4.4%	-1.29%
September	+-.3	-1.6	-5.1	-2.26

Source: Computed from International Apple Association statistics.

If these results are next compared with the August and September USDA estimates (in Table 7), the IAA estimates appear to have been more accurate (i.e., showed less variation) in small crop years but were less accurate in the large years. Over the period, the average error of the IAA estimates was greater than the USDA estimates (which as has been indicated, were very close for these two months).

Lastly, the IAA monthly estimates are compared with the semi-final USDA estimates. On this basis the results are not very much different from the preceeding classification except that the IAA estimates erred about 1% more in the large crop years. The over-all averages were very similar in August (a difference of only 0.14%) and slightly wider in September (0.80%). Individual years, however, varied

enough so that one might hesitate before substituting one estimate for another in a particular year. The USDA estimates appeared to run closer in the first half of the period, while the IAA was closer during the second half.

National Apple Institute

At their annual meeting in June, members of the National Apple Institute (NAI) make up a crop "Guesstimate." The estimate differs from that of the IAA in that the NAI uses the USDA crop estimates for pervious years as a base.

Comparison of the NAI estimate with the July 1 USDA estimate reveals that the NAI estimate was more accurate in years of small crops (+1.9% vs. 4.2%), but further off in years of medium (-5.0% vs. -2.6%) and large crops (-8.6% vs. -4.4%). The average error of -4.1% was considerably more than the USDA error of -0.87%. The USDA estimate, in fact, was closer in 12 out of the 15 years.

The NAI estimates in revised form have also been used by the Apple Marketing Clinic in August as the basis for estimating the breakdown of the forthcoming crop by variety. These are then combined with the "fresh," "dual purpose" and "processing" breakdown as have been noted earlier. For the 1953-60 period, the "fresh" and "dual purpose" estimates have been within 10% of "acutal" utilization

(as later reported by USDA), while the "processing" category has varied from +20% to -48%, and is generally low. This is rather peculiar in view of the previously noted greater stability of "processing" production.

Implications

Crop estimates have been examined in some detail because they may play a very important role in the planning of marketing programs. Since neither the grower nor any one else knows the actual crop size, they can only turn to the best guess then available--the crop estimates. And if the estimate is in error, the consequent marketing policy may also be in error. Therefore it is important that careful attention be given to improving estimates in the future. There are weather factors which are impossible to account for in advance, but there are, at the same time, areas such as varieties into which the reports might well be extended.

Horticultural Considerations

Weather can influence apple production through its effects on quantity, quality and timing of the crop.

Quantity

Unlike many farm crops, the production of apples in any one year cannot be adjusted by the farmer. By their

nature, apple trees require approximately five years to bring into bearing, and at least a dozen years before they reach maximum yield. Hence, there is little a grower can do from year to year to adjust yields, short of pulling an orchard out (an expensive process). True, he can modify the yield a little bit by cultural practices,[12] but the process is apt to be expensive and the results minimal. Consequently, apple production in any one year or over a couple of years is essentially predetermined.

But as has been noted, production can and does fluctuate widely from year to year. This is largely due to the influence of the weather. A severe frost can kill the fruit buds; a hail storm can wipe out the crop of an entire area; a dry year can result in a smaller yield; etc.

Quality

Not only can weather influence crop size, but it also has a very important influence on quality. Too much rain can increase the incidence of disease and lead to soft, less flavorful fruit; but lack of rain can result in undersized fruit. Warm nights during the harvest season can hinder the development of red color, but cold days during the growing

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[12] See W. V. Longley, "The Relation of Price to Apple Production," Journal of Farm Economics, October, 1930, pp. 618-20.

season can lead to a low sugar level, and so on. The result is that, unlike many agricultural products such as soybeans or milk apples can vary widely in quality.[13] The effects of such conditions can be of considerable importance to the grower. As F. V. Waugh put it in 1930:

> In the case of many farm products, the variation in quality is so great as to be more important than variations in supply and demand conditions from time to time.[14]

Unfortunately, there is no commonly accepted objective measure of quality that can be applied on a crop-wide basis. One can only deal in subjective terms. And even here there is no well recorded series. One New York investigator attempted to approach this problem for the postwar period by writing to state pomologists and asking them for their remembrances of quality. Replies indicated that the crops of 1946, '56, and '60 were above average in quality while those of 1947, '57, and '59 were below average.[15] Another approach

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[13]A further complication is that quality may also vary with region. For instance, northern New England is often thought to be able to grow a harder McIntosh than New York, and it may be that New York grows a harder McIntosh than Michigan.

[14]F. V. Waugh, "The Relation of Quality to the Price of Farm Products," Proceedings of the Second International Conference of Agricultural Economists, Menasha: George Banta Co., 1930, p. 776. (A summary of Quality as a Determinant of Vegetable Prices, New York: Columbia University Press, 1929).

[15]Teckle N. Skinner, "Industry Processes in Appraising Price-Making Factors For Apples," Cornell University, Department of Agricultural Economics, M.S. thesis, June, 1962, p. 71.

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that might be tried is to examine the grading slips of lots of apples examined by the Federal-State inspection service. This would not take into account such considerations as flavor, etc., but at least would be a start.

Timing

A third area where weather may have influence is the timing of the crop. That is, in some seasons the crop may not be ready for harvest until two weeks or more after average, or vice versa. If the crop is delayed, this means that the peak fall marketing period is shortened--throwing a heavier load on the rest of the season.

* * *

If, then, the quantity, quality and timing of production in the short run is mostly influenced by weather, what of the long run?

Long Run Changes in Production

Production Cycles

While apple growers can do little about production in the short run, they can and do alter their plantings over

the long run. Since it takes several years[16] before apple trees begin to bear and a dozen or more years to reach maximum production, apple production is apt to vary over rather long cylces. This was recognized some time ago.

Early Studies

Two publications issued in 1927, referred to the apple production cycle.

Davis, Waugh and McCarthy, after studying U.S. apple production from 1889 to 1926, stated:

> . . . the cycles are fourteen years in length from one low point to the next low point. Orchards are planted in periods of low production and high prices and come into full production about fourteen years later, which begins a new cycle of over production.[17]

They pointed out that Baldwin apple prices in Boston reflected this cycle.

Warren went on to suggest that:

> . . . It would appear to be the part of wisdom for a farmer to start planting or buying orchards about the middle of the low-price period when everyone is

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[16] And a considerable investment--about $630/acre according to one study. (Lynn A. Stanton, Costs of Growing Orchards and Vineyards to Bearing Age, Cornell University, Department of Agricultural Economics, A.E. Res. 51, November, 1960, p. 10.)

[17] I. V. Davis, F. V. Waugh, and Harold McCarthy, The Connectucut Apple Industry, University of Connecticut, Agricultural Experiment Station, Bulletin 145, May, 1927, p. 61. [Underlining added.]

> discouraged, and to stop planting at the time when prices are so high that everyone is planting.[18]

If either observation were ever widely noticed, there is no sign of it in the literature.

More Recent Studies

Little additional work was done on the potentialities of using production cycles until 1941 when Clawson, Heising and Hurd conducted a study which indicated that it is possible to make forecasts of production of fruits and nuts for 10 to 20 years. They observed that planting rates appear to have been influenced by prices of the very recent past and current date. A general method for predicting production on a normal basis was then described which would utilize information on tree planting by ages.[19]

In 1959, Cravens reported that high-priced periods were ". . . about 10-12 years from peak to peak." He went on to state:

> It is likely that these years of alternately low and high-priced apples are caused by periods of over and under planting with about 8-10 years required

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[18] G. F. Warren, Farm Management, New York: Macmillan, 1927, p. 86.

[19] Marion Clawson, Carl Heisig, and Edgar Hurd, "Long Term Forecasting of Fruit and Nut Production," Journal of Farm Economics, August, 1941, pp. 551, 559, 560.

for the trees to affect production.[20]

Cravens also reported that nursery sales of apple trees appeared to be highly correlated to apple prices:

> On the average of 10% increase in the two-year average price of apples has meant about a 10% increase in tree plantings a year later, or a 10% price decrease has meant a 10% decline in plantings.[21]

The concepts introduced in these studies have, to some extent, been used in several production projections.

Crop Projections

Crop projections have been made for all apples, and in several instances for specific varieties.

Total Production

The most sophisticated projection of production was made by French in 1955, while two other somewhat more informal projections have been made more recently. In the former case past prices are utilized, while for the latter two tree planting information and market "feel" are used to a greater extent.

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[20] M. E. Cravens, A Brief Review of Selected Studies of Apple Prices, Ohio State University, Department of Agricultural Economics, A.E. 303, March, 1959, p. 8. (Also see M. E. Cravens and R. L. Bere, Trends in the Ohio Apple Industry, Ohio Agricultural Experiment Station, Research Bulletin 756, February, 1955, p. 9.)

[21] Ibid., p. 12.

French. Owing to the fragmentary nature of the fruit tree surveys completed through 1955, French elected to base his production estimates on the economic relationships existing in a previous period, reasoning that ". . . an apple producer bases his expectations of the future, and thus his planting decisions on the profitability of apple growing . . . for several years just prior to planting."[22] To do this, he set up an algebraic function ". . . relating the production of apples forthcoming in any year to average farm prices of apples and a measure of farm costs during a period 10 to 14 years in the past."[23] The ratio of prices to costs was used as a measure of the profitability of apple production. The ratios were averaged over five years and then lagged 10 to 14 years (the exact number varying because of the intrusion of the war years). Over the period covered, the equations developed from these relationships explained 72% of the variation in production.[24]

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[22] B. C. French, The Long Term Price and Production Outlook for Apples in the United States and Michigan, Michigan State University, Agricultural Experiment Station, Technical Bulletin No. 225, April, 1956, p. 13.

[23] Ibid. The length of the time period was very close to the cycle length of 14 years noted in 1927 by Davis, Waugh and McCarthy. It might be decreased as plantings of dwarf trees, which come into bearing sooner, increase.

[24] Ibid., pp. 13, 15. A similar equation developed for Michigan explained only 40% of the variations in production (p. 17).

This equation was then used to project production until 1975. The estimates were made for the period beginning in 1955. One estimate was made for each year until 1964. From then on, various economic relationships (disposable income, competing fruits, population) are allowed for, providing four possible paths for production to take. While one must wait to verify most of these estimates, it is possible to check his predictions through 1961.[25] When this was done, it was found that his estimates were within +12% to -9% of actual production. Since there are no other studies with which to compare these figures, they are difficult to assess. But when plotted, his estimates seem to have reflected the general trend of actual production.

The trend that French saw for the years beyond 1961 was for an increase in production from 1961 to 1966, when production might reach 148 to 149 million bushels, and then for production to drop off through 1975.[26]

Brush. A different method of projection was used in 1958 by Brush, an employee of the National Apple Institute. Instead of using past cost-price relationships, he examined

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[25] This is complicated by his use of a total, not just commercial production figure. To counter this, adjustments have been made back into commercial crop figures.

[26] French, op. cit., p. 26.

the tree planting surveys that had been conducted in many states. His estimate of average total production for 1965 on this basis was 135 million bushels.[27] (French's estimate for this period appeared to be about 144 million bushels).[28]

Burrows. In 1962, Burrows, Executive Vice President of the International Apple Association, utilizing "available data," projected an average crop of 132.5 million bushels by 1967.[29] (French's approximate estimate for this period appeared to be again about 144 million bushels).[30]

* * *

In total, all three estimates suggest that the United States is about to face sharp increases in apple production. Estimates for 1965 range from 135 to 144 million bushels. The peak may be reached in 1966, with moderate declines after that. The problems for marketing therefore, would seem to be

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[27] Ray Brush, Trends in Apple Production, National Apple Institute, Washington, D.C.), Bulletin 408, November, 1958, p. 1. Magness feels that even this estimate is too high and suggests that the trend will be stable to slightly upward (John R. Magness, "The Present Status and the Future of the Apple Industry," Eastern Fruit Grower, September-October, 1960, pp. 8, 10).

[28] French, op. cit., p. 26.

[29] Fred Burrows, Production Trends in Apples in the U.S., International Apple Association (Washington, D.C.), Special Letter, February 2, 1962.

[30] French, op. cit., p. 26.

most severe from 1962 to 1966.

Production by Varieties

While French's study did not take changes in the potential varietal mix into consideration, this point was covered by both Brush and Burrows.

Their projections, by major varieties, are listed in Table 9. Varieties are listed in terms of proportion of total anticipated production.

Table 9. Average and projected U.S. apple production by variety.

Variety	Average Production 1959-60 (USDA)	Projected Production 1965 (NAI)	Projected Production 1967 (IAA)
Red Delicious	21.7%	25.2%	27.2%
McIntosh	13.6	9.9	11.7
Winesap	7.4	8.5	9.1
Rome	7.0	7.8	7.9
Jonathan	6.8	6.7	7.6
Golden Delicious	6.1	6.3	7.6
Stayman	5.8	3.9	4.5
York	5.4	4.6	4.9
Others	26.2	27.1	19.5
Total	100.0%	100.0%	100.0%
Crop size (million bu.)	117.7	135	132.5

Source: Computed from: Crop Reporting Board statistics; Trends in Apple Production, National Apple Institute (1958); and Production Trends in Apples in the U.S., International Apple Association (1962).

The table suggests that, compared to the 1959-60 average, varieties increasing in relative importance will be Red Delicious, Winesap,[31] Rome, and Golden Delicious; while those decreasing will be McIntosh, Stayman and York.[32] The position of Jonathan is unclear.

If "use" pattern is now considered, it may be observed that of the four varieties slated to increase in importance, none are presently being used in large quantity for processing (though the Golden Delicious could be). On the other hand, of the three varieties decreasing in importance, two (Stayman and York) are important processing varieties.[33]

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The suggestion then is that the industry is likely to face an increase in production of what are presently fresh varieties while the relative proportion of processing varieties may decrease. The true significance of this variety switch will become clear when it is realized that the trend in fresh

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[31] Magness (op. cit., p. 10) and this writer feel that Winesap will decline rather than increase.

[32] This is not necessarily to say that these varieties will decrease in absolute production; only that their relative position is lowered as production of other varieties increases.

[33] Two dual purpose varieties often used for processing, Newtown Pippin and Baldwin, are also slated to decrease.

and processing utilization and consumption is in the other direction, from fresh to processing. Thus, future problems may not only be those of increased production, but increased production of the wrong varieties.

CHAPTER III

UTILIZATION

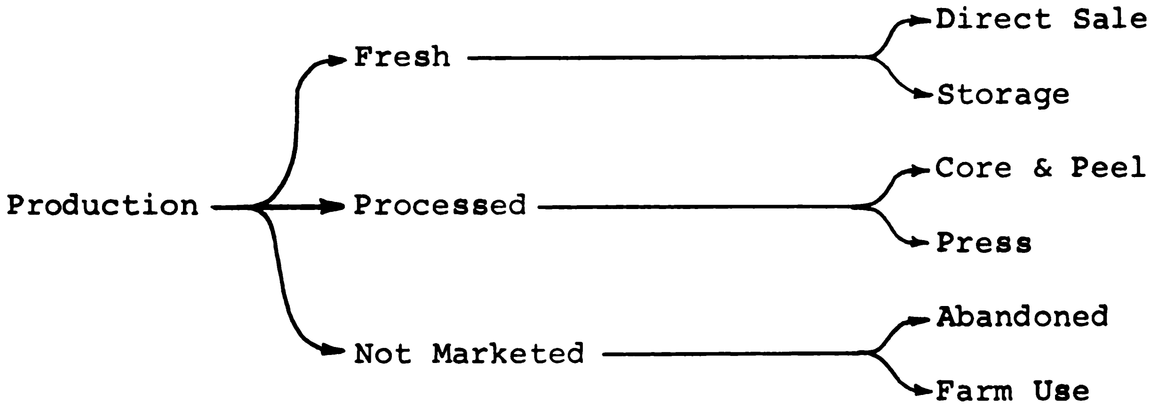
Types of Outlets

Given a certain quantity of apple production, the grower faces a choice of three major ways of disposing of production. These are (1) the fresh market, (2) the processed market, and (3) the non-marketed sphere. The principal outlets are, of course, the first two.

The fresh market is in turn broken down into two main sections; (a) the market for apples which move directly into consumption, and (b) that portion of apples which move into storage to be sold at a later date on the fresh market.

The processed market also has two main sectors: (a) the market for apples to be cored and peeled and prepared into apple slices or apple sauce, and (b) the market for apples to be ground and pressed into juice.

The non-marketed sphere consists of dissimilar sectors: (a) that portion which is abandoned by the grower because of low prices, and (b) that portion which is consumed by the farmer and his family. The following diagram may clarify the presentation.



Fresh apples are not the only ones stored. A small portion of processing apples are not used immediately but are placed into storage for use through the season. Consequently, there might be a "Direct Use" and "Storage" breakdown just after the "Processed" classification.

Volume in Fresh and Processing Outlets

In this section a quantitative picture of the fresh and processing outlets is presented on a national and then a regional and state basis.[1]

United States

Utilization estimates for the United States will be broken down into three categories: the period average, yearly

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[1]Unless otherwise noted, the statistics presented in this and following sections were computed from data issued by the Crop Reporting Board, Statistical Reporting Service, U.S. Department of Agriculture. See Reference section, part E, for further detail.

variability and seasonal variability.

Period Average

Over the 15-year period from 1946 to 1960, U.S. Department of Agriculture (USDA) estimates indicate that 64.6% of the apple crop was sold to fresh outlets, 30.0% to processing outlets, and 5.4% was not marketed.

Data from grower organizations place the proportion going to fresh markets slightly lower and that going to processing outlets correspondingly higher. Specifically, the International Apple Association estimates would place the fresh figure at 62.9%, the processed figure at 31.9%, and the non-marketed portion at 5.9%.

The breakdown of the processing figure will be discussed later and little will be said about it here, except to report that USDA figures suggest that canning and freezing uses took about 19% of the crop, while by-product usage accounted for about 11%.

The non-marketed portion of the crop (5.4% by USDA estimates), was broken down as follows: no value 2.3% and farm use 3.1%.

If the non-marketed portion is dropped out and only the sales figure is studied, it is found that 68.5% went to fresh outlets and 31.5% went to processing outlets.

Yearly Variability

Variability in utilization may be viewed in terms of (1) production and (2) sales.

Utilization of Production.[2] During the 15-year period studied, the proportion used for fresh, according to USDA statistics, ranged from a high of 71.9% to a low of 59.6%, while that used for processing varied from a high of 35% to a low of 22.4%. The non-marketed proportion peaked at a high of 12.9%, and dropped to a low of 2.1%.

The fluctuations in proportions going to these three areas were widest during the first half of the period; during the second half utilization was comparatively more stable.

When the yearly data were plotted and trend lines calculated, it appeared that the proportion going to the fresh market was declining very slightly (-0.08% per year) while that going to processing was increasing gradually (+0.53% per year), with most of the increase represented by canned sauce. The proportion not marketed was highest in 1949 and 1951 when the "no value" proportion was particularly high; otherwise, the proportion going to the farm use sector has been declining gradually (about 0.22% per year). It

[2] Further detail is provided in Appendix C, Table 5.

seems likely that the processing sphere has taken over some of the apples which were formerly of "no value."

The utilization of production varied somewhat with the crop size. The proportion sold fresh was higher in the small crop years (67.2%) and lower in the large crop years (62.8%). The proportion sold for processing showed the opposite pattern, averaging lower in the small crop years (28.7%) and higher in the large crop years (31.2%).[3] This suggests a greater relative stability in the quantity of apples placed on the fresh market. This would be expected if it is assumed that the growers consider the fresh market to be more profitable--that is, they supply the fresh market first, and then the processing market.[4] The reasons for this will be discussed in greater detail later.

Utilization of Sales. If the non-marketed portion of the crop is dropped out, it is possible to look at only the portion of the crop sold. The results are very similar to the utilization of production.

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[3]That is, as the crop increased from small to large, the proportion going into the fresh market decreased, while the proportion going to the processed market increased.

[4]It must be remembered that a large portion of the processed apple market is composed of salvage or by-product juice outlets. The reference to "relative stability" is to percentage changes; because of their greater magnitude, the absolute changes in fresh sales in terms of bushels would probably be greater.

During the period studied the proportion sold for fresh ranged from a high of 77.5% to a low of 63.9%, while that used for processing varied from a high of 36.1% to a low of 22.5%. Again, the fluctuations in the proportions going to these outlets appeared widest during the first half of the period.

Over the period, the proportion of sales going to the fresh market decreased gradually (-0.45% per year) while that going to the processed market increased by a corresponding amount.

The proportion of the crop sold on the fresh market was highest in small crop years (averaging 70.4%) and lowest in large crop years (averaging 66.8%). Processing apples showed just the opposite trend.

If the approach is changed and yearly utilization is computed as a proportion of the period average (rather than adding the yearly averages) for that item, it is possible to gain a little better idea of the comparative fluctuations in sales to fresh and processing outlets.

This method reveals that the fresh sales fluctuated much less (in relation to their period average) than did processing sales. Fresh sales ranged from a low of 88.0% of the period average to a high of 114.5%, while processed sales ranged from a low of 57.9% of the period average to a

high of 127.9%.[5]

Grouping in terms of crop size also emphasized the greater relative variability of processing sales. Fresh apples sales ranged from 90.5% of the period average in the small crop years to 110.2% in the large crop years, while processed apple sales had a corresponding range of from 83.3% to 117.3%.

Since the relative stability in production of "processing" apples has been noted, the variability must have come through fluctuations in the sales of "dual purpose" apples for processing.

Seasonal Variability

The figures examined so far have been for utilization estimates for a full year. The International Apple Association has prepared data that provides an idea of utilization within the season.

The IAA makes annual estimates of utilization before and after December 1. Over the 1946-60 period, of the apples marketed before December 1 (approximately 60% of the crop), 47% went fresh, 45% went to processing, and 8% were not marketed. On the other hand, of the apples marketed after

[5] The fluctuations in sales for canning were even wider; from 52.0% to 129.6%.

December 1 (approximately 40% of the crop), 89.2% went fresh, 10.4% went to processing, and 0.4% were not marketed.

Viewed a different way, this means that about half of the apples sold fresh moved off the farm or out of storage before December 1 and about half moved after. Concurrently, approximately 90% of the processing apples moved before December 1[6] and about 10% moved after (the latter movement was probably largely of apples to by-product outlets, principally juice).

Clearly, U.S. processing sales are concentrated early in the season.

Regions

In this section, both utilization of production and of sales will be considered on a regional basis.

Utilization of Production

Two sets of estimates of utilization of production by region are available: those of the U.S. Department of Agriculture (USDA), and those of the International Apple Association (IAA). Since the latter combines the eastern and central states, the same is done with the USDA data.

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[6] And though they may "move" before December 1, they are not necessarily processed before then, but may be held for short periods.

This process indicates the breakdown presented in Table 10.

Table 10. Utilization of apple production, 1946-1960.

Region	Utilization			Total
	Fresh	Processed	Not Mktd.	
East and Central				
USDA	59.8%	33.2%	7.1%	100.0%
IAA	57.6	35.9	6.5	100.0
West				
USDA	73.0	24.4	2.6	100.0
IAA	71.4	25.7	2.9	100.0
United States				
USDA	64.6%	30.0%	5.4%	100.0%
IAA	62.9	31.9	5.2	100.0%

Source: Computed from Crop Reporting Board and International Apple Association statistics.

In line with the national estimates, the IAA regional estimates place the proportion sold fresh at one to two percent less than the USDA, and the proportion sold processed at one to three percent higher.

In either case, it is quite clear that the proportion sold for fresh purposes is higher in the west (by roughly 13 to 14%) than in the eastern and central states, while the proportion sold for processing is lower (by roughly 9 to 10%), and the proportion not marketed is lower (by 3.5 to 4.5%).

The first two relationships are to be expected, but the sharp difference in the non-marketed sphere is a bit surprising. A break-down of the USDA data suggests that both "farm use" and "no value" utilization are lower in the west. The former is understandable in view of the more highly specialized fruit farms in the west, but it is not clear why the "no value" figure--which is essentially economic abandonment--is less in the west.

Utilization of Crop Sold

Turning back entirely to USDA data, the eastern, central and western areas are now compared for the 1946-60 period.

Of the apples sold on the fresh market, 39.2% came from the east, 20.4% from the central states, and 40.3% from the west. Of the processed apple sales, 58.1% came from the east, 13.6% from the central states[7] and 28.3% from the west. This breakdown clearly indicates the concentration of processing apples in the east.

If one sorts on the basis of utilization of sales by region, the east is found to have sold 59.3% of its apples

[7] It will be recalled that this area had no varieties which were classified as exclusively "processing." The apples which were processed came from the "dual purpose" category or as culls from the "fresh" category.

to the fresh market and 40.7% to processing, while the central and eastern states, oddly enough, both sold 75.8% on the fresh market and 24.2% to processing.

States

The concentration of production suggested in previous sections comes out even more clearly when utilization is considered on a state basis (Table 11).

Table 11. Fresh and processing apple sales by states, 1946-1960.

	Proportion of U.S. Sales		
State or Region	Total	Fresh	Processing
New England	6.4%	8.1%	2.6%
New York	15.0	11.3	23.0
Pennsylvania	6.0	4.5	9.1
Virginia	8.7	6.3	13.7
West Virginia	4.1	3.2	6.0
Michigan	8.6	8.5	8.8
Washington	23.6	30.0	9.5
Oregon	2.1	2.4	1.5
California	7.8	3.7	16.5
Other states	17.7	22.0	9.3
United States	100.0%	100.0%	100.0%

Source: Computed from Crop Reporting Board statistics.

The predominant processing states by this classification were New York, Pennsylvania, West Virginia and California--accounting for 68.3% of the total. Predominant fresh market areas were the New England states, Washington and "other" states.

Looking at it another way, New York and the Appalachian states noted above directed an average of 48.4% of their total sales to processing--exceeded only by California with 66.6%. At the other extreme, the New England states and Washington directed about 87% of their sales to the fresh market.

While processing is indeed concentrated in some areas, it is not a sufficiently large industry yet in any one state except California to claim an average of more than 50% of the crop. It would seem that processing production is, in this sense, not so highly concentrated as fresh production.

Deciding between Fresh and Processing Outlets

The question of whether to sell apples to the fresh or processing market is one that is predetermined for most farmers in any one season. But for some others, it is a choice of some magnitude.

Form of Farm Organization[8]

It should be recongized at the outset that some farmers

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[8] This breakdown was suggested by Ned Miller in "What Varieties Should I Plant," The Mountaineer Grower (Proceedings of West Virginia Horticultural Society), March, 1962, pp. 35-39.

produce primarily for only one outlet.

Fresh Only

This category consists primarily of small fruit farms, both within and outside of the principal fruit growing regions. Their principal marketing outlet is a roadside stand or some other local market. They may or may not have a packing area and a small storage. However, they are not exclusively "fresh" in that their cull apples may go to a cider mill. But they do not raise apples specifically for processing, and the processing outlet they utilize is the least remunerative.

Processing Only

The grower who raises apples only for the processing market is apt to represent quite a different form of farm organization. His is likely to be a much larger operation. Moreover, he is to be found in or near a major apple producing region which has processing facilities of a first run nature--canning and freezing. Unlike the fresh market grower, the processing grower generally does not have a packing area or cold storage, because he does not need them. His sales are made directly to the processor on a tree-run basis out of the orchard.

Fresh and Processing

Growers in this intermediate category comprise the large share of apple production. They may be divided into three main groups--all of which presume the availability of processing outlets.

Primarily Fresh. Growers in this bracket produce primarily for the fresh market but have made arrangements to sell their better packing table culls to processors for canning and freezing use. They are located in the larger fruit growing areas. They own or have access to packing and storage facilities and operate over a fairly long season. To gain access to the processing plant for their culls, they may also grow a few processing apples. These processing apples may serve as a valuable opening to the processing market in years of heavy production when the grower needs to divert more of his fresh market apples.

Fresh and Processing. This group includes growers who raise sizable proportions specifically for both markets--but are in a position to shift some of their production from one outlet to another. They have (or have access to) both packing and storage facilities, and processing outlets. While some of their output is committed to each outlet, they do have a considerably wider range of choice of outlet than

the other groups. It is this group and this decision which will be of most concern in the remainder of this section.

Primarily Processing. Some processing growers may also raise small quantities of fresh apples. This may be because they have some varieties which they cannot sell for processing, or have a small local demand for some fresh varieties.

* * *

Very closely connected with the type of farm organization is the type of varieties raised.

Varieties

The freedom that a grower has to choose between fresh and processing outlets is limited by the varieties planted on his farm--for these cannot be altered in the short run. Varieties are considered to fall in one of the three general classifications: fresh, processing, and dual purpose. The Apple Marketing Clinic classification will be followed here (see Appendix C, Table 3).

1. Fresh varieties are those which are grown for the fresh market and are generally used only incidentally for processing. These apples are not considered to be as well suited for processing (because of texture,

shape, etc.) as are some of the "harder" processing varieties. And since the fresh apple market generally seems more remunerative than the processing market (particularly since fresh varieties, as will be illustrated, are often discriminated against in setting a processing price), fresh apples do not generally find their way into this use.[9] Fresh varieties might generally be considered as including Red Delicious, McIntosh, Winesap and Jonathan. About 58% of production is represented by this category.

2. Processing varieties are those grown almost exclusively for commercial processing use. While many varieties are used for processing, comparatively few fall exclusively into this category on a nation-wide basis. More often, a variety will be considered a processing variety in one region and carry a different label in another area. For instance, Grimes Golden and Yorks are considered processing apples in the east where most are grown, but are classified dual purpose in the central states. On the other hand, Gravensteins are a processing variety in the west and a fresh

[9] There is, however, one important exception. This is the portion of processing apples purchased fresh for processing use in the home.

variety in the east. But in all cases, some apples are sold on the fresh market for home processing. About 10% of production is represented by the processing category.

3. Dual Purpose varieties because of their texture, shape, etc., are considered acceptable for either fresh market or processing use. As with processing varieties, the classification varies with the region. For the east the following varieties are considered dual purpose: Wealthy, Cortland, Stayman, Baldwin, Rome, Golden Delicious, Northern Spy, and Newtown Pippins. In the central states are found Grimes Golden, R.I. Greening, York, Baldwin, Northern Spy and Golden Delicious.[10] In the west, the group is smaller, including Stayman, Rome and Newtown Pippins. These varieties are mentioned in detail, because they represent about one-third of production and it is with them that the short-run decision to go to a fresh or a processing market lies most heavily.

The factors influencing this decision will be discussed in the next several sections.

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[10] Actually the classification for the central states for Golden Delicious is "fresh, dual purpose."

Qualitative Aspects

Many factors influence the "quality" of an apple crop, which in turn may influence its disposition. Only a few of the more important will be discussed here.

Size of Apples

For most processing uses, aside from juice, it is important to have a large apple (for reasons which will be discussed later). Apples 2-1/2" to 2-3/4" in diameter and up are preferred, while apples under this size are discriminated against, and apples under 2-1/4" are purchased only at a juice price. Therefore, a grower with a crop of small apples might find it more profitable to try to place them on the fresh market than to try to move them through a processor. On the other hand, if he had large apples and faced a weak demand on the fresh market, the processing market might loom more favorably.

Color, Finish

A large proportion of red color[11] and a smooth finish are very important requisites for the fresh market; for the processing market neither is important. Consumers base their

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[11]Excepting the yellow-skinned varieties.

decision to purchase fresh apples, to a large extent, on appearance. The fresh market standards, therefore, require 50 to 66% color on most varieties to make the U.S. Extra Fancy Grade, 25-33% to meet the U.S. Fancy Grade, and 15-25% to meet U.S. No. 1. As to finish, the standards for U.S. Extra Fancy state that apples ". . . shall be free from injury caused by russeting, sunburn or spray burn, limb rubs, hail, drought spots, scars, stem or calyx cracks. . . ." The requirements are the same for the Fancy and No. 1 grades except for russeting.[12] In processing, none of these are important--[13] because the apples for sauce or slices are peeled, while juice apples are just crushed.

Consequently, if a grower has a crop which is not likely to make fresh market grade, or is likely to do so only with excess cullage, the processing market may become the clear choice.

Maturity

Maturity plays a less distinct role in affecting

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[12] Anonymous, United States Standards for Apples (effective September 19, 1958, as amended June 10, 1959), U.S. Department of Agriculture, Agricultural Marketing Service, p. 2.

[13] Anonymous, United States Standards for Grades of Apples for Processing (effective June 1, 1961), U.S. Department of Agriculture, Agricultural Marketing Service.

choice of outlet. Its importance depends in part on the apple's ultimate use. If the fresh market use is to be immediate storage, the grower with fairly mature fruit may prefer to ship to the processing market. But this is not always so easily done, because there is a much narrower range of time during which the non-processing varieties of apples are of the right maturity for processing for slices or sauce. Consequently, the processor may be particular about the maturity of the apples he accepts. If this is the case, the apples may have to be placed on the fresh market for what they will bring.

Grade-Out

This factor is a composite of the three preceding factors. That is, apples sold to the fresh market generally are graded. Apples that are sorted out on the basis of inadequate color or poor finish, as has been indicated above, are quite satisfactory for processing into slices and sauce, providing they are of adequate maturity. Thus, even though apples are directed at the fresh market initially, a proportion of them (beyond the ciders) will come back to the processing market.[14]

[14]This proportion averaged about one-third of the apples graded for fresh market in a Pennsylvania study in 1953. (W. A. Lee and W. M. Carroll, Effects of Methods of Packaging

Quantitative Aspects

In some years in particular areas, the above qualitative aspects may be overwhelmed by the quantitative factors. That is in a year of a large crop the grower may face a perfectly inelastic demand in one marketing channel and he will have to turn to another. For example, the processor may have all the apples he can handle, so that he refuses to buy more apples. At other times, the fresh market may be so demoralized that the processing market will appear more attractive. However, in most cases the situation will be less obvious and the decision will be decided more largely on the basis of costs, prices and returns.

Costs, Prices and Returns

Many of the foregoing factors show themselves most clearly in the costs and prices involved with both markets.

Costs

There are sharply different costs in selling to the fresh and process markets.

Growing. If apples are raised specifically for the processing market, it is possible that they may be grown at

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Apples on Returns to Growers, Pennsylvania, 1953, Pennsylvania State University, Department of Agricultural Economics, Journal Paper 1938, January, 1955, pp. 5, 6.)

less cost than those raised for the fresh market. The lower cost could come about through the elimination of some of the fungicide sprays (surface finish not being so important) and possibly through a slightly different fertilization program (i.e., more nitrogen could be applied as color is not as important). Otherwise, though, the cultural practices would be the same.

Where apples are of a dual purpose nature, these savings will not be possible unless the decision as to which market is to be utilized is made considerably in advance. In most cases, however, this decision is not made until harvest-time, by which time it is too late to effect these economies.

Harvesting. Several recent technical improvements have sharply influenced harvesting costs.[15]

The first is the adoption of bulk bins. Apples for both fresh and processing market may be placed by pickers directly into large 20 to 30 bushel bins rather than bushel boxes. At first, it appeared that the bulk bins would be of maximum advantage to processing apples because of dumping problems with fresh apples. The introduction of water dumpers, however, has made possible their use for fresh apples. Even

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[15]For details see the several papers in the New York State Horticultural Society Proceedings, 1962, pp. 63-67, 209-213, 215-232.

so, at present the greater use is probably for the processing market because of the earlier start.

A second development, however, may move immediately and sharply favor processing apples. This is mechanical harvesting. At present, mechanical harvesting is limited to experimental methods which involve shaking the tree and letting the fruit drop to a catching frame. This results in too much bruising for fresh market but appears to be a promising method for processing apples. If it proves to be a reality, a considerable saving per bushel may be realized. With this method at present, however, the decision as to whether to go the fresh or processing market would have to be made <u>before</u> harvesting--not after, as is now possible with hand picking. Ultimately, mechanical harvesting methods may be developed which will work for fresh apples, but for now the advantage seems to lie exclusively with processing.

<u>Sorting</u>. As has been indicated earlier, apples sold on the fresh market are usually sorted, while those sold to processors are tree-run. This means that the grower considering the fresh market must also consider the costs of grading. These costs involve not only labor and inconvenience but overhead on machinery and the fact that the grower will face a shrinkage on his fresh pack volume (apples will be sorted out because of quality and sold at a lower price

elsewhere).[16]

<u>Packages and Selling</u>. Growers selling on the fresh market must supply the container; growers selling to processors get their container back.

Furthermore, growers selling on the fresh market generally have to pay some sort of sales fee--whether it be brokerage or commission--while no such fee has to be paid by the grower selling directly to the processor.

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In sum then, the person selling on the fresh market has a number of additional marketing costs which he has to pay after the apples are harvested. On the other hand, the grower selling to the processing market has virtually no further charges to pay after harvest. Evans and Hutson have estimated that in the Appalachian region, ". . . it cost from $.97 to $1.28 more to market a bushel of apples to the fresh market than to the processor."[17]

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[16] In the strict sense, the person selling to processing also faces this problem; but his fruit is graded by the processor into No. 1, No. 2, and cull, and the grower is paid accordingly. Moreover, the grading standards are much less strict for the processing market.

[17] Homer C. Evans and W. S. Hutson, <u>Marketing Appalachian Apples</u>, West Virginia University, Agricultural Experiment Station, Bulletin 372, March, 1955, p. 2.

Prices and Returns

Against the higher costs of marketing apples on the fresh market, must be balanced the potentially higher prices on this market. This is difficult to do because one is often comparing different varieties (which in turn may have slightly different costs of production). But it is a vital question for dual purpose varieties grown on farms where they may be channeled into fresh or processing use.

A further problem of comparing prices is that the USDA quotations for fresh apples include grading and container in the eastern and central states, while the fresh price in the west does not; in no case does the processing price in any area include either grading or container. Since, however, the eastern and central prices include some apples sold tree-run, it would be difficult to know how much to deflate them in order to approach the western price.

Even so, it may be of some value to recognize that over the 1946-60 period the average farm price for all fresh apples was \$2.15/bu. as opposed to an average price of \$1.26/bu. for canning and freezing apples--leaving a differential of \$0.89.[18] Considering the quantities of fresh apples sold on

[18] These figures will be discussed in detail in Chapter IV.

a tree-run or packing-house-door basis, one might estimate the differential to be wider than this--perhaps in the $.97 to $1.28 range noted above by Evans and Hutson.

If this were the case, it would suggest that there may not have been much of a difference in net returns from growing fresh and canning and freezing apples over the 1946-60 period. Supporting this is the statement of Evans in his 1956 study that in the Appalachian region, f.o.b. orchard returns were about the same for fresh and processing apples.[19]

This, however, may not always be the case. Stanton and Dominick report that in New York in 1956 and 1957, net fresh prices were definitely higher.[20] And several Appalachian studies have shown that rather than to sell exclusively tree-run fruit to the processor, as some growers do,[21] it would have been more profitable to sort out the apples of fresh

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[19]Homer C. Evans, The Nature of Competition Among Apple Processors in the Appalachian Area, West Virginia University, Agricultural Experiment Station, Bulletin 405, June, 1957, pp. 47, 90.

[20]B. F. Stanton, B. A. Dominick, Jr., and S. C. Fan, Variability in Apple Production Costs and Returns, Cornell University, Department of Agricultural Economics, A.E. Res. 17, May, 1959, p. 28.

[21]In this respect, Burrows of the International Apple Association remarks ". . . too many growers have taken the path of least resistance and sold everything to the processor." (Fred W. Burrows, "Around the Apple World in Forty-five Minutes," The Grower (Toronto), February, 1960, p. 19).

market quality from dual purpose varieties such as Stayman and sell the remainder to processors (within the limits of farm organization noted earlier).[22, 23]

The rational farmer would be expected to place his apples in each market to the point where marginal net revenue between the various outlets was the same. But as has been indicated, data is not available which would indicate when this point is reached.

If all of this leaves one with little of a very tenable nature, it at least clearly suggests that the area of costs, prices and returns among alternative outlets is an area where much further study could be profitably done.

Statistical Studies

The only published study on the factors affecting utilization was issued by Brandow in 1956. Both single and simultaneous equations were utilized. The period covered was 1934-53, excluding 1942-46.[24]

[22] Henry Dickson Bruns, "An Economic Appraisal of Alternative Market Outlets for Appalachian Apples," University of Virginia, Department of Economics, M.A. thesis, 1954, p. 44.

[23] W. A. Lee and A.N. Saylor, Which Apple Marketing Outlet is Best - Processing or Combination Fresh Market and Processing? Pennsylvania State University, Department of Agricultural Economics, Journal Paper, 1952, August, 1954, p. 1.

[24] G. E. Brandow, A Statistical Analysis of Apple Supply and Demand, Pennsylvania State University, Department of Agricultural Economics and Rural Sociology, AE and RS #2, January, 1956.

Single Equations

Multiple correlation analysis, involving first differences of least squares, was used by Brandow to estimate utilization for both fresh market and for canning. In addition, this writer has utilized simple correlations of actual data for a more recent period.

Fresh Market. About 93%[25] of the variation in the utilization for the fresh market was found to be associated with (a) size of crop in the east, (b) size of the crop in other states, and (c) carryover stocks of processed apples. Significance tests were not noted, but the coefficient of item (c) was more than three times higher than the value of the term itself--suggesting that most of the variance was explained by the production factors.[26]

When this writer studied utilization for the fresh market for the 1946-60 period, he found that 85% of the variation was explained by fluctuations in the size of the U.S. crop.[27] When production in the separate regions was

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[25]This figure represents the multiple coefficient of determination (R^2). The verbs "associated" and "explained" will be used in this and the following sections for convenience.

[26]Brandow, op. cit., pp. 3, 22-23.

[27]The figure was 74% when the September crop estimate was used.

correlated with U.S. fresh utilization, eastern production explained 49% of utilization, central production 38%, and western production 48%. August 1 carryover of canned stocks explained only 1% of the variation. On the other hand, variations in average season U.S. fresh price explained 44% of the variation in fresh utilization,[28] while variations in processing price explained only 29%.

The inference from both studies is clear: production plays a very important part--apparently more important than price or canned carryover--in determining the proportion of apples going to the fresh market.

Canning Market. Brandow explained 88% of the variation in the utilization for canning with the following three factors: (a) size of crop in the east, (b) military purchases and exports, and (c) canned carryover.[29]

This writer correlated production with utilization for canning for the 1946-60 period and found production in the east to explain 62% of the variation in canning utilization. U.S. production explained only 29% of the variations in utilization, while central production explained only 9%, and western production 1%.[30] Surprisingly, there was no

[28]The figure was 46% when the October fresh price was used and 49% when the November price was used.

[29]Brandow, loc. cit.

[30]The respective figures for all processing utilization were:east 83%, U.S. 67%, central 22%, and west 6%.

correlation between canning utilization and: fresh price (October), canning price, or canned carryover.

From the work of Brandow and this writer, it appears that U.S. production plays a lesser role in determining canning utilization than does production in the eastern states. This appears reasonable because of the concentration of processing production in the east. The influence of fresh or processing prices appeared to be negligible. Military purchases and carryover may play significant roles, but evidence on carryover is contradictory.

Simultaneous Equations

Brandow made use of two sets of simultaneous equations[31] to explain the supply and demand for both the fresh and canning market. The supply equation will be examined here and the demand equation in Chapter VI.

Fresh Market. Utilization was related to four factors (the first two of which were used in the previously noted single equation solution): (a) size of crop in the east, (b) size of crop in other states, (c) price of fresh market and (d) price of canning. Only the first two, relating to production, were significantly different from zero--the first

[31]The specific form was limited information, single equation.

at the 10% level, and the second at the 5% level.[32]

These findings appear to be consistent with the single equation studies by Brandow and this writer noted in the previous section. That is, fresh utilization was found to be largely explained by apple production. Moreover, this writer found prices to explain a lower proportion of the variation in utilization than did production.

Canning Market. Utilization for the canning market was related to the same four factors as were used to explain utilization for the fresh market. In this case, the crop production figure for other states was not significant at the 5% level, while the production in the east and prices for the fresh and canning market were significant at that level.[33] This was just the reverse of the fresh market situation.

These findings are partially consistent and partly inconsistent with the single equation results noted earlier. They were consistent in that eastern production continued to play a significant role in influencing canning utilization. The fact that price became a significant factor was not, however, entirely expected. Brandow did not include a price variable in his single equation analysis; but it will be

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[32] Brandow, op. cit., pp. 9, 11, 12.

[33] Ibid., pp. 10-12.

remembered when this writer correlated canning utilization and price, none of the variation in canned utilization was explained by fresh or processed price. Just what the reason is for this sharp conflict in results is not clear at this point.

Summary

In total, it may be seen that U.S. apple production explained a large share of variation in the quantity of apples utilized for the fresh market and that eastern apple production explained a fairly large share of the variation in the utilization for canning.[34] The relation of price to variations in utilization is not so clear-cut. Brandow, using simultaneous equations, found that price was not significantly related to fresh utilization but that it was significantly related to processing utilization. On the other hand, this writer--using single equations for a more recent period--found some correlation between price and fresh utilization but none with processed utilization. Thus, the role of price on utilization is open to some debate. The use of single equations in this situation might be questioned from the point of interdependence of price and utilization; but since the correlations

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[34] The smaller figure probably representing to some extent the relatively smaller portion of the crop used for canning than for fresh.

between price and processed utilization appeared to be non-existent, this point is not of such great significance.

This provocative area will be brought up again in slightly different form in the chapter on price analysis. For now, we turn to a closer examination of the paths taken by apples directed to the fresh market.

Fresh Outlets

General Characteristics

The fresh outlet is more important for apples than for any other major fruit raised in the U.S. About two-thirds of the apple crop is sold to fresh outlets, as opposed to about two-fifths for other fruit crops.[35] This is due, in part, to the relatively long harvest season for apples but is primarily due to the relatively long storage period.[36]

Fresh apples, as suggested earlier, may take two routes following harvest. They may move directly from the farm to

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[35] Specifically, in 1957, 69% of apples were sold to fresh outlets, while 43% of all fruits, by weight, were so disposed. The apple exceeded any of the fourteen most important fruits. (Fruits, Non-Citrus, Citrus, U.S. Department of Agriculture, 1958). However, it must be acknowledged that a portion of fresh apple sales is ultimately used for processing in the home.

[36] Cary D. Palmer and E. O. Schlotzhauer, "Trends in Apple Production and Utilization," The Agricultural Situation (U.S. Department of Agriculture), January, 1946, p. 20.

market, or they may be placed in storage.[37] Storage, in turn, may be of two forms: refrigerated and unrefrigerated. Refrigerated storage, the most important, is broken down into regular and Controlled Atmosphere (CA) storage. Regular storage is by far the more important, while Controlled Atmosphere storage is becoming increasingly important for the late season market.

Direct to Market or Storage?

The fundamental decision that must be made once the fresh market is chosen, is whether the apples should be shipped directly to market or placed in storage for sale on the fresh market at a later date. The decision hinges on several points. These include:

Variety

Many varieties of apples are unsuited for storage. This is particularly true of the summer and fall varieties--which generally may be satisfactorily stored for a maximum of

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[37] For an excellent summary of the history of cooperative fresh apple marketing, see J H. Heckman and G. H. Goldsborough, Cooperative Marketing of Apples in the United States, U.S. Department of Agriculture, Farm Credit Administration, Bulletin 55, November, 1948. A similar but more detailed analysis is presented by N. H. Morse in "An Economic History of the Apple Industry of the Annapolis Valley of Nova Scotia," University of Toronto, Department of Economics, Ph.D. thesis, April, 1952.

a few weeks.[38] The winter varieties, on the other hand, are generally well suited for storage periods of several months or more. Thus, the summer and fall varieties tend to move directly to market while a large portion of the fall apples may be placed in storage. We shall return to this point later.

Grade and Condition

The market for off-grade and off-condition apples is never very good; and, with rare exceptions, it does not improve during the season. But over-riding this is the fact that poor apples do not store well: small and immature apples tend to shrivel, large and overripe apples tend to grow mushy; apples with severe scab lose turgidity; those with severe stem punctures rot. If the farmer is to make anything out of these poor apples, they must move directly to market. Here is the way one state of Washington observer puts it.

> The important thing seems to be how much fruit men in the industry must get into the market within two or three weeks because the fruit "doesn't have legs" for long storage.[39]

[38] Exceptions include the Gravenstein, a summer apple, and the Jonathan, a fall apple.

[39] Earl W. Carlsen, Director, Fruit Industries Research Foundation, Yakima, letter, March 12, 1958.

The condition may, of course, vary on less than a regional basis--it may vary even with individual farms.

Packing Facilities

Whereas at harvest time the alternative of sending apples to market ungraded is open, this is not so much the case with storage apples. During the storage process, apples may be subject to rodent damage, decay, etc. It is generally felt necessary to remove such fruit before sending it to market. Consequently, facilities for packing out the fruit are generally associated with storages. In a recent New York study of 229 packing houses, 203 also operated cold storages.[40]

Availability of Storage

Clearly, to store apples one must have access to storage. In practice, the storage may be owned by the grower (which tends to be the case in the central and north-eastern states) or space may be rented in a central commercial or cooperative storage (which tends to be the case in the northwestern states). In years of large crop, the grower may

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[40] Ivan L. Kinne, "An Analysis of Costs and Economic Efficiency in New York State Packing Houses," Cornell University, Department of Agricultural Economics, Ph.D. thesis, 1960, p. 31.

find that his storage space is inadequate; or if he rents, he may find that he cannot get all the space that he would like. The only alternative in such cases is to move the apples directly to market. In years of light to average crops, the situation revolves more around economic factors.

Prices and Costs

There is, of course, a definite added cost with storage. Consequently, to be profitable a commensurately higher price must be received for storage apples. There are several variants to the form of the extra cost. The grower who owns no storage capacity generally pays a fixed handling charge per bushel for placing his apples in rented storage and from then on pays a monthly storage rate. On the other hand, the grower who owns his storage faces a slightly different problem; as owner of the plant he must carry the heavy fixed costs of the storage whether he places any apples in it or not.[41] Moreover, since the storage is of fixed capacity, once the room is placed into operation it costs almost as much to operate whether it

[41] In a New York study covering the 1957-58 period, fixed costs accounted for 65% of the annual cost of regular apple storage and 63% of the cost of Controlled Atmosphere (CA) storage. (John C. Thompson, Jr., "An Analysis of Apple Storage Costs in New York State," Cornell University, Department of Agricultural Economics, Ph.D. thesis, February, 1962, p. 126. A summary of this paper is presented by the same author, under the same title, in a Cornell Department of Agricultural Economics report--A.E. Res. 87, March, 1962).

contains a full load of apples or not. This means that the grower who has to rent space faces a different cost structure and may be more cautious about placing his apples in storage than is the person who owns his own storage--particularly one who has new and higher-cost Controlled Atmosphere storage.

But in either case, the hope is that the price of apples will go up faster through the season than the cost of storage. Whether it does or not in general is difficult to document because there are no detailed nationwide estimates of the cost of storage.[42] There is, however, a USDA series of average monthly prices for all fresh apple sales. And while it cannot be stated in general terms how much prices must rise to make storage pay, one can be relatively certain that when prices hold steady or drop through the season, as they have in several years, storage is not the most profitable alternative.[43]

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[42]The above New York study suggests that once apples are placed in grower-owned storage, the variable costs per bushel increase at the rate of only about $.01/bu. per month in both regular and CA storage. The average season cost for the former was $.23/bu., while the cost for CA--reflecting in part longer holdings--was $.37/bu. (including fixed and variable costs, and materials handling equipment) (Ibid., p. 94).

[43]The risk, however, seems to have been considerably less for CA--for these apples averaged an $.86/bu. premium over regular storage apples in New York State from 1953 to 1960. And there did not seem to be any tendency for the premium to decrease (Ibid., pp. 112-113).

This is the risk that the grower must face. Whether he will do so or not depends not only on his expectation of price changes but also on his financial condition. Storage apples will, by definition, not be sold for many months. If the grower is short of cash at harvest-time, he may not feel like gambling and, indeed, may have to send his apples directly to market to meet his bills.

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In total then, it is seen that the decision of whether to move apples directly to market or to place them in storage is not a simple question but involves both biological and economic factors. We now turn to a more detailed examination of the direct to market and storage outlets.

Direct to Market

The direct to market movement of fresh apples accounts for a sizeable proportion of the total crop. If this movement is defined as consisting of those apples sold to fresh outlets and not in storage on November 1,[44] the direct to market movement included nearly 25% of total production from 1946-60.

The proportion varies with the crop season and with

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[44]This means that short term storage prior to November 1 is not counted in storage stocks.

variety. As previously indicated, nearly all of the summer apples, except for some California Gravensteins, move directly to market. Fall varieties, such as Grimes Golden, Jonathan and Wealthy, also largely move directly to market. The winter varieties, on the other hand, are more likely to move to storage. Among the more important fresh varieties, the following proportions of production moved directly to market (1951-60 avg.): Jonathan, 84.1%, McIntosh, 52.8%, Red Delicious, 49.2% and Winesap, 27.7%.[45]

Apples which move directly to fresh market are less likely to be graded than those which move to market from storage. This is so for two reasons: (1) the apples are tree fresh and still relatively in good condition, and (2) the grower is busy with harvest and does not have time for grading. In a recent New York study of 229 packing houses, only 75 were open by September 1, while 163 were open by October 1, and 191 by November 1.[46]

An important outlet for these apples is the farmer's market. There are no national figures available, but a survey in Lansing, Michigan, during the last week of September, 1955, indicated that 58% of the apples purchased by members of the

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[45] Unknown, but probably small, proportions of each of these movements went into processing uses.

[46] Kinne, op. cit., p. 33.

Michigan State Consumer Panel came from farmer's roadside stands or farmer's markets. By comparison, 37% were purchased from grocery stores and 5% from other stores.[47] One should be cautious in generalizing from these figures, but they do suggest that farmer's outlets are not an unimportant market in the fall.

The apples which are graded out, or which are just too poor to place on the fresh market, are generally shipped to the juice market.

Storage

Refrigerated storage plays an important role in the marketing of apples; during the 1946-60 period about 44% of production was placed in storage. But because its technical perfection has been a fairly recent phenomenon, it is easy to dismiss the early years of storage as inappropriate to present conditions. Yet, a brief look at the history of apple storage reveals some lasting economic insights.

Development

Apples have, of course, been kept in natural or

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[47] J. D. Shaffer and G. G. Quackenbush, Where M.S.U. Consumer Panel Families Purchased Fresh Apples, September 25 - October 1, 1955, Michigan State University, Department of Agricultural Economics, Panel Report No. 23, October, 1955, p. 2.

unrefrigerated storage for many years. Where these storages are insulated and are cooled by admitting night air, they have often been referred to as common storages.

Common storage was improved upon by the use of ice and it is known that apples were profitably stored in the years immediately following the Civil War. A Cleveland storage operator, Professor Nyce, is reported to have developed one of the first successful ice storage systems in 1858.[48]

No statistics on apple holdings appear to have been prepared until 1898. In that year the executive committee of the National Apple Shippers Association estimated storage holdings as of the first of December.[49]

The successful storage of apples under mechanical refrigeration began about 1890 but was limited to public warehouses in large cities.[50] F. A. Waugh wrote in 1901, "Not a single fruit grower, company, or association today in

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[48] William A. Taylor, "The Influence of Refrigeration on the Fruit Industry," Yearbook of Agriculture, 1900, p. 565. (Professor Nyce's cold storage is described by John A. Warder in Apples [American Pomology], New York: Orange Judd Co., 1867, pp. 291-293.)

[49] Ibid., p. 570. This group was the forerunner of the present International Apple Association, whose statistics are used later in this dissertation.

[50] G. Harold Powell and S. H. Fulton, The Apple in Cold Storage, U.S. Department of Agriculture, Bureau of Plant Industry, Bulletin No. 48, 1903, p. 5.

the U S. is maintaining a private storage plant cooled by machinery."[51] However, by 1903 Powell was able to report:

> Recently . . . warehouses have been constructed in small towns, especially in western New York for the storage of fruit alone, and a few mechanically cooled plants have been built by apple growers on the farm.[52]

While the financial success of operations like Nyce's undoubtedly led to immediate interest in storage, the more general benefits were not overlooked. Writing in 1901, Taylor said of storage:

> Its greatest direct benefits to the apple producer have probably come through the prompt withdrawal from market at harvest time of a large part of the best fruit, which it will alone pay to store. In this way prices of good fruit are less likely to be depressed, and the average price of good apples throughout the year is undoubtedly higher than would have been possible without refrigeration.[53]

Moreover, the effect of storage on variety makeup was noted as early as 1903. In that year, Powell stated, "Cold storage is increasing the commercial value of many tender but otherwise desirable varieties which formerly had to be sold after picking."[54] Taylor felt that, "This promises to be the

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[51] Waugh (F.A.) op. cit., p. 98.

[52] G. Harold Powell, "Relation of Cold Storage to Commercial Apple Culture," Yearbook of Agriculture, 1903, p. 229.

[53] Taylor, op. cit., p. 571. This point was also made by Waugh (F.A.) (op. cit., p. 95).

[54] Powell, op. cit., p. 235.

most important factor in raising the quality of our commercial orchard products."[55]

But even then, there was concern of overcapacity. Powell suggested that, "There is some danger that the cold-storage warehouse business may be developed too rapidly for the present needs of the apple trade." The obvious possibility was then, ". . . that the quantity of fruit stored in a given year will be so large that the price will not reach a paying level during the winter and spring months."[56]

The most significant change in storage following the adoption of refrigeration was the introduction of Controlled Atmosphere storage just before World War II. This method of storage involved the maintenance of a special atmosphere in a sealed storage room. This, in conjunction with regular refrigeration, made it possible to store apples in good condition for many additional months--year-a-round, if desired.

The background of this idea contains a chapter which even those who have developed it have not realized. While it is often considered a distinctly twentieth century idea which originated in England, the fact is that Professor Nyce, whom

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[55]Taylor, op. cit., p. 572.

[56]Powell, op. cit., p. 236. Also see Powell and Fulton, op. cit., p. 10.

we have already noted, seems to have grasped the essential concepts in 1865. To quote a 1900 U.S. Department of Agriculture Yearbook article:

> Professor Nyce states that in his Cleveland storage house the temperature . . . did not rise above 34°F from April to August, 1865. His theory was that an atmosphere of carbonic acid gas retarded decay by preventing oxidation of the fruit tissue. He therefore abandoned ventilation, and endeavored to accumulate an atmosphere of carbonic acid gas from the exhalations of the fruit. In this particular his plan was at radical variance from the advanced practice of the present, which favors thorough ventilation even at low temperatures.[57]

Professor Nyce's ideas, however, do not seem to have caught on, and nothing further was done until the 1930's. Then some work by Kidd and West in England caught the attention of Professor Frank Allen at the University of California. The idea was then picked up by an assistant, Dr. Robert Smock. Smock moved to Cornell in the late 30's and pushed on with developmental work. In 1939, a full-sized experimental room was set up on a farm in the Hudson Valley[58] and shortly thereafter another in western New York.[59] By the end of the

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[57] Taylor, op. cit., p. 565. Also see Ice and Refrigeration, Vol. IX, 1895, p. 23.

[58] This CA operation was described by this writer in "Tree-Fresh Apples in May," Farm Journal, May, 1957.

[59] For further detail on early CA installations, see R. M. Smock and A. Van Doren, Controlled Atmosphere Storage of Apples, Cornell University, Agricultural Experiment Station, Bulletin 762, June, 1941, p. 22.

war, Controlled Atsmophere apples were reaching the commercial market. But of the subsequent growth, we shall have more to say later.[60]

Suffice it now to say that as refrigerated storage had a powerful effect on extending the season and improving the market for delicate varieties as well as for all apples, so has Controlled Atmosphere had a strong positive effect on marketing patterns.

Storage Holdings[61]

A considerable quantity of apples are placed in storage. Average annual storage holdings from 1948 to 1960 were nearly 50 million bushels. These holdings amounted to at least 44% of the crop.[62] Nearly all of the apples were in refrigerated storage, but a small proportion were held in common storage during the fall months. Most were held for the fresh market,

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[60] Further details are provided by this writer in Marketing Controlled Atmosphere Apples, Cornell University, Department of Agricultural Economics, A.E. 1028, June, 1956.

[61] The storage statistics presented in this section were computed from monthly reports of the International Apple Association; production figures, again, were based on estimates of the Crop Reporting Board of the Department of Agriculture.

[62] We say "at least" because while the figure cited represents the date of greatest storage holdings (November 1), it does not include apples which have moved in and out of storage before that date.

but some were held for processors.

In this section, attention will be focused on (1) volume in storage, (2) varieties in storage and (3) Controlled Atmosphere storage.

Volume. Here we will first be concerned with total storage holdings. Following this, regular, Controlled Atmosphere and common holdings will be examined separately.

All Storage. Storage holdings are considered in terms of total magnitude and then related to production and month to month figures.

Total Holdings. Average annual total storage holdings of apples on November 1 (over the 1948-60 period)[63] were 49.6 million bushels and on December 1 (during the 1946-60 period) were about 42.7 million bushels. Average holdings by month are listed in Table 12.[64]

There does not seem to have been more than a very mild increase (0.76% per year) in December 1 storage holdings over the period, and this appeared to be more closely related to the three large crop years in 1957, 1958 and 1959 than any other single factor.

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[63] Data not available for November 1946 and 1947.

[64] Further detail on storage holdings by month is provided in Appendix C, Table 6.

Table 12. Average U.S. monthly storage holdings of apples, 1946-60.

Month	Holdings
November 1*	49,632,100 bu.
December 1	42,728,500
January 1	33,277,500
February 1	25,231,700
March 1	16,794,800
April 1	9,866,800
May 1	4,959,200
June 1	1,860,000

*1948-60 only. Data not available for 1946 and 1947.

Source: Computed from International Apple Association statistics.

Relation to Production. The quantity of apples placed in storage bears a close relationship to production. In fact, over the 15-year period of this study, fluctuations in production "explained" 66% of the fluctuations in storage holdings on December 1.[65]

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[65] "Production" as used here refers to the final crop estimate prepared by the USDA. Addition of average October price increased the variance explained to only 67%. Approximately the same results were found for an earlier period by B. C. French, J. H. Levin, and H. P. Gaston ("Storage Holdings and Movement of Apples in Michigan and the United States," Quarterly Bulletin, Michigan State University, Agricultural Experiment Station, May, 1954, p. 418). However, Pubols obtained a figure of 87% for the 1942-51 period (Ben H. Pubols, "Factors Affecting Prices of Apples," Agricultural Economics Research, U.S. Department of Agriculture, July, 1954, p. 81). When this writer used the September 1 crop estimate instead of the final estimate, fluctuations in production explained only 37% of December holdings. When October crop estimate was teamed with October price, the figure went up to 46%.

When the production and holdings were each computed as a proportion of their 1946-60 average, storage holdings showed approximately the same or slightly more fluctuation than did production. Variations in storage holdings according to crop size are indicated in Table 13.

Table 13. Average U.S. December 1 storage holdings by crop size, 1946-60.

Crop Size	Total Holdings (millions of bu.)	Proportion of Crop
Small	37.0	38.1%
Medium	41.7	37.5
Large	49.4	39.3
Average	42.7	38.3%

Source: Computed from International Apple Association and Crop Reporting Board statistics.

The increase in physical holdings with increasing crop size is to be expected. But the fact that holdings as a proportion of crop were slightly lower in the medium size crop years is a little surprising. The answer may be in the fact that the medium crop years tended to be concentrated early in the period when Controlled Atmosphere storage had not begun its expansion. On the other hand, the large crops were concentrated later--in the expansion period.

The size of storage holdings, as a proportion of crop size, decreased steadily through the season. The holdings as of the first of the month as a proportion of production were as follows: November 44%,[66] December 38%, January 29%, February 22%, March 15%, April 9%, May 4%, June 2%--or an average decrease of about 6% per month. Fluctuations between seasons in the proportion of the crop held in storage tend to even out as the season progresses, as might be expected from the smaller holdings.

Of all the storage estimates, the December 1 estimate seems to be considered the most significant. Harrington put it this way:

> The cloudy situation of the early season becomes much clearer when the November 30 [December 1] cold storage stocks are known. Many of the other factors are pretty well sized up by this time such as the sizes, grades, and the condition of the apples, the processor demand, and buyers' general reactions.[67]

In support of this statement, a study of Michigan storage holdings over the 1935-53 period led French, Levin and Gaston to the conclusion that there is a consistent relationship between holdings on December 1 and in the following months.[68]

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[66]1948-60 only.

[67]A. H. Harrington, "Factors Influencing Apple Prices," Proceedings of the Washington State Horticultural Association, December, 1954, unnumbered reprint.

[68]French, Levin and Gaston, op. cit., pp. 419, 420.

Relation between Months. French, Levin and Gaston also noted, "Statistical analysis of historical storage records indicates that storage holdings of any particular date [in Michigan] are highly correlated with the holdings one month previous."[69] To make use of this observation they developed an equation which proved to be capable of explaining 98.5% of the fluctuations in storage holdings in subsequent months.[70] Tables were then set up so that one could read off the anticipated storage holdings on the first of the next month, knowing storage holdings on the first of a particular month.

It should be noted that this work was done in the pre-Controlled Atmosphere storage period in Michigan. To set up similar tables for a more recent period would be more difficult, particularly from March on.

Types of Storage. We now turn to a more detailed examination of the proportion of holdings in the various types of storages.

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[69] Ibid., p. 20.

[70] $X_1 = 1.09 + 0.882 X_1 - 0.53 X_2 X_3$

X_1 = storage holding time i

X_2 = storage holdings at time i minus one month

X_3 = the month or fraction of a month (Dec. = 0, Jan. = 1, etc.).

Regular Refrigerated. The bulk of apples in storage are in regular refrigerated storage. The proportion, however, has been declining as Controlled Atmosphere storage holdings increase. On the other hand, this may have been compensated for by a decrease in unrefrigerated common storage. Unfortunately, it is not known what proportion of total holdings are in common storage nationally, so that it will be necessary to consider them part of regular storage.

The proportion of regular storage apples on December 1 declined from about 99.8% in 1946 to 99.4% in 1951, to 98.7% in 1954, 96.6% in 1957, and 88.6% in 1960. Clearly, the decrease has been sharpest since 1957.

And when one leaves the fall months and starts moving through the spring, the proportion of regular storage apples becomes even less. This is clear when the 1960-61 season is examined. The proportion of monthly holdings in regular storage was as follows: November 91.7%, December 88.6%, January 85.1%, February 81.5%, March 75.9%, April 73.8%, May 73.7%, and June 81.3%.

Controlled Atmosphere. A small, but growing portion of apples are being held in Controlled Atmosphere (CA) storage. The statistics indicating this growth are the reverse of those listed for regular storage. That is, the portion of apples in CA on December 1 climbed from 0.2% in 1946 to 0.6% in 1951, 1.2% in 1954, 3.4% in 1957 and 11.4% in 1960. Total capacity in 1960 was 4.6 million bushels[71] or 4.2% of production. Moving through the season, the proportion in CA changed as follows: November 9.3%, December 11.4%, January 14.9%, February 19.5%, March 24.1%, April 26.2%, May 26.3% and June 18.7%. This type of storage will be discussed in greater detail in a following section.

<u>Common</u>. As indicated, there are no known national breakdowns on common storage holdings. And there are not likely to be because (a) common storage can take so many diverse forms, (b) it is of short duration, and (c) it is probably becoming of less importance.

The latter two points may be illustrated with some data from Michigan for the 1953-60 period. Common storage represented 8.0% of November 1 holdings, 6.7% of December holdings, 4.8% of January, 2.2% of February and reached

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[71] It is possible to state Controlled Atmosphere capacity because all CA rooms (with one exception in Oregon) are at present used for apples. The situation is different for regular storage, where normally additional quantities of space could be rented. Construction of CA rooms has not necessarily meant an expansion in total amount of storage for two reasons: (1) In some cases regular storage has been converted to Controlled Atmosphere storage; and (2) additional CA capacity may mean less rental of storage capacity in commercial warehouses.

negligible proportions in March. Over the eight years, as of November 1, a high of 11.0% was reached in 1956, and a low of 4.6% in 1960.[72]

It seems likely that a substantial portion of common storage apples are held for processing. This suggestion is based on personal observation and the close parallel between common storage holdings in Michigan and processor holdings nationally (Table 14).

Table 14. November 1 common and processor storage holdings.

	Proportion of Monthly Holdings	
Year	In Common Storage (Michigan)	For Processors (U.S.)
1953	5.9%	6.4%
1954	9.7	10.2
1955	7.3	8.8
1956	11.0	11.6
1957	8.4	7.9
1958	8.8	8.6
1959	8.0	8.3
1960	4.6	12.2
Average	8.0%	9.3%

Source: Computed from Michigan State Apple Commission and International Apple Association statistics.

The reason for the wide differential between common and

[72]Calculated from monthly reports of the Michigan State Apple Commission

processor holdings in 1960 is not known.

Varieties. There is a considerable difference between the production of certain varieties and their ultimate placement in storage.

Relation to Holdings. Storage holdings of varieties differ somewhat from their share of production. This is illustrated in Table 15.

Table 15. Proportion of U.S. production and storage by varieties December 1, 1951-60.

Variety	Classification*	Proportion of Total	
		Production	Holdings** (Nov. 1)
Delicious	F	21.0%	23.8%
McIntosh	F	12.3	13.1
Winesap	F	9.0	14.7
Jonathan	F	6.7	2.4
Rome	DP-F	6.8	5.3
York	P-DP	5.1	2.1
Stayman	DP-F	5.0	2.3
Golden Delicious	DP-F	4.3	3.0
Other		29.8	14.2
Not Reported		--	19.1
Total		100.0%	100.0%

*Key: F = fresh, DP = dual purpose, P = processing.

**The figures listed in this column for each variety are minimum figures. This is because operators did not provide a varietal breakdown on all their holdings--as indicated by the "Not Reported" category.

Source: Computed from Apple Marketing Clinic varietal classification, Crop Reporting Board statistics and International Apple Association statistics.

The fresh varieties, with the exception of Jonathan, tend to represent a larger portion of storage holdings than of production. The dual purpose and processing varieties, on the other hand (and these represent about all of the "other" category; no important fresh variety is excluded), represent a relatively smaller proportion of holdings than of production.

As the season progressed through February, the proportion represented by each variety did not vary a great deal except for Winesap which increased by 9.5% to represent the largest share of the holdings.[73] The total effect was that the "fresh" varieties increased in importance. Any changes as between dual purpose and processing were more difficult to discern.

Relation to Production. With some idea of the relative importance of the varieties in mind, the proportion of each variety in storage will now be examined. This is illustrated in Table 16. This table emphasizes the importance of storage to each variety (instead of the importance of each variety in storage). It reveals that, for instance, over 72% of the Winesaps produced were in storage on November 1, while only about 16% of the Jonathans were so placed. Moreover,

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[73] The March 1 rankings were: Delicious 21.6%, McIntosh 12.4%, Winesap 24.2%, Jonathan 1.0%, Rome 6.9%, York 1.3%, Stayman 1.4%, Golden Delicious 2.4%.

the proportion of Winesap production still in storage on February 1 was nearly 60% while the Jonathan proportion declined to a little over 3%.

Table 16. Proportion of U.S. varietal production in storage, 1951-60.

Variety	Proportion of Varietal Production in Storage		
	November 1	February 1	Change
Delicious	50.8%	22.6%	-28.2%
McIntosh	47.2	22.1	-25.1
Winesap	72.3	58.6	-13.7
Jonathan	15.9	3.4	-12.5
Rome	34.4	22.0	-12.5
York	18.6	5.6	-13.0
Stayman	20.1	5.9	-14.2
Golden Delicious	30.8	12.3	-18.5
All Varieties	44.2%	21.7%	-22.5%

Source: Computed from International Apple Association and Crop Reporting Board statistics.

The rate of decline in the holdings of each variety from December to March varied from 12.5 to 28.2%. Winesap and Jonathan declined by about the same amounts (13.7 and 12.5% respectively) despite the fact that they represented extremes in terms of proportion of production in storage.

<u>Relation to Utilization</u>. As may be apparent from the foregoing sections, storage is primarily practiced for fresh apples. However, as indicated in Table 14, certain quantities may be held for processing. Generally the apples

held for processing have been sold to the processor who is in turn paying the storage costs. It is quite unlikely that the grower would hold apples in storage for speculative late season sale to processors.

Of all the apples held in storage during the 1951-60 period, fresh and processor holdings made up the proportion of monthly holdings indicated in Table 17.

Table 17. U.S. storage holdings for fresh market and processing as proportion of monthly holdings, 1951-60.

Month	Fresh	Processed	Total
November 1	91.3%	8.7%	100.0%
December 1	51.1	8.9	100.0
January 1	85.5	14.5	100.0
February 1	90.0	10.0	100.0
March 1	94.9	5.1	100.0
April 1	93.1	6.9	100.0
May 1	91.1	8.9	100.0
June 1	83.7	16.3	100.0

Source: Computed from International Apple Association statistics.

Table 17 indicates that of all the apples in storage on November 1, about 91.3% were held for fresh market and 8.7% were held for processing.

It is a little surprising to find the proportion being held for processing fluctuating so sharply and holding so high late in the season. It may be that these apples are held for specialty use in restaurants or bakeries. Also, some may have proven to be out of condition and are shipped to processors.

But even so, it can be seen that over-all, only some 10% were being held for processing, leaving 90% held for the fresh market.[74] An increasing proportion of the fresh market holdings have been in Controlled Atmosphere storage.

Controlled Atmosphere Storage. There has been a sharp growth in Controlled Atmosphere storage in recent years. Because these holdings exert considerable influence on apple marketing, they will be discussed in some detail here.

Total Holdings

Annual. The expansion in Controlled Atmosphere storage capacity is indicated in Table 18. It will be seen that the greatest growth has taken place since 1956.

Aside from the absolute growth, it will be seen that Controlled Atmosphere storage holdings first exceeded 10% of December 1 storage holdings in 1960.

Monthly. As regular storage apples move through the season, the proportion of apples in Controlled Atmosphere storage becomes progressively greater, reaching a peak in

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[74] It will be recalled that some of the fresh apples are subsequently graded out and find their way into processing uses.

Table 18. U.S. Controlled Atmosphere storage holdings, December 1.

Year	Holdings (bu.)	Proportion of all holdings	Year	Holdings (bu.)	Proportion of all holdings
1946	76,500	0.2%	1954	530,000	1.2%
1947	87,500	0.2	1955	814,200	1.8
1948	87,500	0.3	1956	958,000	2.4
1949	99,500	0.2	1957	1,728,000	3.4
1950	113,500	0.2	1958	3,199,800	6.3
1951	206,000	0.6	1959	3,950,700	8.5
1952	301,500	0.9	1960	4,598,000	11.4
1953	392,100	1.1			

Source: Computed from International Apple Association statistics and data presented by this author in Marketing Controlled Atmosphere Apples (Cornell, 1956).

April and May every season since 1954 (except in 1956, when the peak was in May and June). Data for three recent seasons are presented in Table 19; detail is provided in Appendix C, Table 7.

State Holdings. In its early years, Controlled Atmosphere storage was limited to eastern New York State. In 1951 CA storage was constructed in New England, but it was not until 1956 that it began to spread west and south; storages were constructed in New Jersey, Michigan and California. By 1958, storages were in operation in Washington and Oregon.

As of the 1960-61 season, Controlled Atmosphere storages were in regular operation in 11 states[75] and in all major fruit areas except the Appalachian. The breakdown by states or areas is reported in Table 20.

Table 19. Proportion of U.S. holdings in Controlled Atmosphere.

	Crop Year Beginning In		
Month	1958	1959	1960
November 1	5.5%	7.3%	9.3%
December 1	6.3	8.5	11.4
January 1	8.1	11.3	14.9
February 1	10.5	15.1	19.5
March 1	14.4	19.0	24.1
April 1	18.7	22.8	26.2
May 1	21.1	21.6	26.3
June 1	17.0	20.5	18.7

Source: Computed from International Apple Association statistics.

Table 20. Controlled Atmosphere holdings by states, 1960 crop year.

Region or State	Holdings	Proportion of Total
New York	1.768,369 bu.	38.5%
New England*	1,052,967	22.9
New Jersey	92,985	2.0
Michigan	949,807	20.7
Washington	473,760	10.3
California	260,146	5.7
United States	4,598,034 bu.	100.0%

*Maine 203,211, New Hampshire 189,527, Vermont 121,500, Massachusetts 485,914, Connecticut 52,815.

Source: Computed from International Apple Association statistics.

75 In addition, there is Controlled Atmosphere space in Oregon which was used for apples in 1958 and 1959, but apparently was used for pears in 1960.

At this point one might ask, "what proportion of total storage in the particular state or region is represented by Controlled Atmosphere?" The answer, of course, varies with the month; but if March 1, the start of the heavy marketing of Controlled Atmosphere apples is chosen, some rather striking regional differences may be seen. Consider March 1, 1961. On this date in the six New England states, Controlled Atmosphere holdings represented nearly 80% (79.6%) of the total storage holdings. In New York and Michigan the proportion was about 65% (63.7 and 62.9% respectively). On the other hand, holdings were closer to 25% in New Jersey and California (24.7 and 26.4% respectively). The proportion was lowest in Washington (5.7%). The reasons for these regional variations depend to a large extent on variety.

Varietal Holdings. Controlled Atmosphere storage is particularly important for certain varieties such as McIntosh and Jonathan which normally do not store well for long periods.[76] It is of somewhat less value for harder and better storing varieties such as Northern Spy and Delicious. But again, in the case of these and other varieties, Controlled

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[76]Cortland responds well to Controlled Atmosphere storage but has been beset with scald problems. Recently an effective scald treatment has been approved and so storage quantities of this variety may be expected to increase.

Atmosphere becomes more important as the season progresses. Both of these points are illustrated in Table 21.

Table 21. Proportion of variety holdings in Controlled Atmosphere storage, U.S., 1960-61.

Variety	Proportion in Controlled Atmosphere	
	November 1	March 1
McIntosh	37.8%	86.0%
Jonathan	25.5	89.4
Newtown	11.7	30.2
Northern Spy	6.8	27.1
Rome	6.3	20.3
Red Delicious	6.1	18.4
Golden Delicious	1.9	9.6
Stayman	1.1	14.0
All Varieties	9.3%	24.1%

Source: Computed from International Apple Association statistics.

About 38% of all the McIntosh apples in storage on November 1, 1960, were in Controlled Atmosphere storage; this proportion increased to 86% by March 1. The increase was even greater for Jonathan, from 26% on November 1 to 89% by March 1. The initial and final proportions for other varieties are somewhat more modest.

On the state level, there is a decided concentration by variety. For instance, on March 1, 1962, McIntosh accounted for 98.6% of all the Controlled Atmosphere storage holdings in New England and 72.9% of the New York holdings. In

Michigan, holdings were split between McIntosh (35.1%) and Jonathan (41.1%). But in California, Newtown accounted for 100% of the Controlled Atmosphere holdings; and in Washington, Delicious accounted for 92.2% of the holdings.

Movement

So far the discussion has centered around storage holdings of apples; the out-of-storage movement by months will now be studied. The outline of this section will parallel that of the preceding section on holdings. That is, consideration will be given to (1) the movement of apples from all types of storage, (2) movement by variety and (3) the role played by Controlled Atmosphere apples.

Volume. Data are presented first on a ten-year basis and then a fifteen-year basis. A ten-year period is included to provide a base for a later discussion of movement by varieties--for which data are only available for the past ten years.

Ten-Year Period (1951-60).

Relation to Production. Over the 1951-60 period an average of 44.2% of the apple crop was placed in storage. The out-of-storage movement, for which there are records, continued from November to June. Monthly movement as a proportion of production reached its peak in December and declined more or less gradually through June. This is indicated in the following movement figures: November 5.9%,[77] December 8.8%, January 7.8%, February 6.8%, March 6.2%, April 4.4%, May 2.7% and June (and later) 1.6%.

Relation to Storage Holdings. Considering monthly movement as a proportion of total storage holdings rather than production for 1951-60, indicates the same sort of pattern as above. The exact percentages are, of course, higher: November 13.4%, December 19.9%, January 17.7%, February 15.3%, March 14.0%, April 9.9%,[78] May 6.1%, June 3.7%.

Fifteen-Year Period (1946-60).

Within Season. If monthly movement is calculated as a proportion of total seasonal holdings, as above, it may again be seen that movement declined at a fairly steady rate from December to June (November 12.6%, December 19.3%,

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[77] This figure does not indicate total November movement because of the sizeable quantities moving directly from the orchard into consumption.

[78] Drew suggests that the rate of movement of apples out-of-storage is about 20% per month until April--a figure which seems out of line in view of these estimates. (William H. Drew, "Demand and Spatial Equilibrium Models for Fresh Apples in the United States," Vanderbilt University, Department of Economics, Ph.D. thesis, January, 1961, p. 39.)

January 17.8%, February 15.9%, March 14.2%, April 10.0%, May 6.3%, June 3.8%).

The surprising thing is that when the 15 years were broken down into large, medium and small crop years, the percentage movements by months were very close (a maximum variation of ± 0.6%). This means that irrespective of the size of the crop, about the same proportion moved out each month.

<u>Between Seasons</u>. If monthly movement is calculated as a percent of average movement for that month over the 15-year period, the differences between crop years can be clarified.

This procedure indicated that as the season progressed, movement became larger in the large crop years and smaller in the small crop years. That is, in the large crop years (when production was 15% above average), movement in November was only 10% above average; but as the season progressed it increased to 19% above average in June. Conversely, in the small crop years (when production was 15% below average), movement in November was 9% below average; but as the season progressed it dropped to 15% below average. This is to be expected, for in the small crop years apple holdings are lower, and are exhausted somewhat more quickly than they are in large crop years.

<u>Varieties</u>. For a discussion of movement by varieties, we return to the 1951-60 period. Varieties held in storage in the greatest quantity had, of course, the greatest rates of movement through the season.

<u>Relation to Total Movement</u>. Varietal movement, as a proportion of total monthly movement, varied as the season progressed. For instance, McIntosh movement remained relatively constant; while that for Rome, Newtown, and particularly Winesap increased; and that for Delicious, York, Stayman, Jonathan and, to a lesser extent, Golden Delicious declined. Winesap movement, which underwent the sharpest change, increased from 6.4% of the December movement to

Table 22. Proportion of U.S. monthly movement represented by variety, 1951-60.

Variety	December	March*
Delicious	41.5%	22.7%
McIntosh	12.0	12.0
Winesap	6.4	29.7
Jonathan	3.6	0.7
Rome	4.5	6.4
York	3.4	1.1
Stayman	4.2	0.9
Golden Delicious	3.6	2.1
Other	20.8	24.4
All Varieties	100.0%	100.0%

*Variety breakdown by month not available after March. The figures reported here represent the varietal breakdown of apples available for movement in March and thereafter.

Source: Computed from International Apple Association statistics.

29.7% of the March and later movement. On the other hand, Red Delicious declined from 41.5% of the November movement to 21.7% of the March and later movement.

Relation to Production. If, alternatively, monthly movement as a proportion of total production of each variety is examined, it can be seen that over 50% of the Winesap apples were moved out-of-storage after March 1. Conversely, less than 4% of the Jonathan, York and Stayman production remained in storage on that date.

All of this, then, suggests that there is quite a different variety "mix" moving to the market at the end of the season than there is at the beginning. This is probably largely due to the storage qualities of the various varieties. The composition of the movement is also influenced by Controlled Atmosphere storage.

Controlled Atmosphere. As Controlled Atmosphere storage has represented an increasingly larger proportion of storage holdings, it has also represented an increasing portion of the out-of-storage movement.

Because apples must be in Controlled Atmosphere storage at least 90 days to be so labeled in most states, their movement is necessarily limited to a point some three months following placement in storage. The apples may, of course, be withdrawn from storage prior to that time; but they cannot be sold as Controlled Atmosphere apples.

The proportion of monthly movement represented by Controlled Atmosphere apples reaches its peak in April, May and June when it represents a sizeable proportion of the total out-of-storage movement. This is illustrated in Table 23. With the exception of some of the Newtowns in California which have been held for processing, all of the Controlled Atmosphere apples are used for the fresh market.

Table 23. Proportion of U.S. monthly movement represented by Controlled Atmosphere Apples

	Crop Year Beginning In		
Month	1958	1959	1960
November	0	0	0
December	0	0	0
January	0.4%	1.0%	0.4%
February	0.3	6.8	8.8
March	5.5	14.2	21.0
April	15.7	23.8	26.1
May	25.1	22.0	30.8
June*	17.0	20.5	18.7

*This represents the movement in June and following summer months.

Source: Computed from International Apple Association statistics.

Controlled Atmosphere apples represent a higher quality product than apples out of regular storage and in the last several years have had an effect on the marketing of regular apples. That is, because of the superior quality and longer shelf-life of Controlled Atmosphere apples, buyers--reflecting consumer demand--have tended to neglect regular storage apples later in the season. This, in turn, has led to an attempt to move more regular storage apples before the Controlled Atmosphere apples come on the market.

* * *

In addition to the 9% or so of the total holdings which are moved to processors, there is a movement, suggested earlier, of apples sorted out of fresh market packing operations to processing uses, particularly juice. The proportion of the total monthly movement ultimately ending up in such usage is variable, depending on the condition of the apples and the late season availability of processing outlets. More will be said of this in the next section, which is devoted to a discussion of the processing of apples.

Processing Outlets

Processing is a relatively small but growing outlet for apples. Although a smaller proportion of apples are processed than is true for any other major U.S. fruit crop--estimates range from 30 to 32% for the 1946-60 period--apple processing has expanded sharply since the war. At present there are well over a dozen apple products on the market--equaling if not exceeding the number of processed forms of other fruits.

Brief History of Apple Processing

Apple juice (or cider as it is better known) was long, with grape juice, the most important processed fruit product. But attempts to process apples and other fruit into other products were not, to the turn of the century, particularly successful from the grower's point of view. F. A. Waugh of Massachusetts Agricultural College put it this way in 1901:

> Unfortunately, it must be said that the utilization of fruit wastes has never proved conspicuously successful; and furthermore, that in the majority of instances where something has been done, the profit has not accrued chiefly to the man who grew the fruit.[79]

The situation appeared little improved by 1928. Wells A. Sherman, of the U.S. Department of Agriculture, wrote that the price paid by manufacturers of necessity must be so low that no farmer could continue in business if they furnished his only outlet. The factory could not contract for entire apple crops because (at that time) it was felt that just as good canned and evaporated apples and cider could be made

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[79] Waugh (F.A.), op. cit., p. 31.

from culls as from the best grades. Sherman went on to point out that in the case of apples, a cull could result from purely surface blemishes, whereas "The culls of nearly all other fruits and vegetables have inherent defects or sustained injuries which reduce their value for manufacture." So, in the case of apple culls, "The factory need only pay as much as is necessary to induce the owner . . . to bring the fruit to the door after it is loaded." On the other hand, he made the cogent observation that " . . . the market for manufactured apple products can be glutted as disastrously as can the market for [fresh] apples."[80]

For these, and perhaps other reasons, the total market for processed apples grew slowly--and per capita consumption changed little up to the late 30's.[81] Before World War II, processing techniques were improved and consumption started a growth that has continued to the present time (see Chapter IV for detail).

General Characteristics

The processing apple market today is composed of two

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[80] Wells A. Sherman, Merchandising Fruits and Vegetables, New York: A. W. Shaw Co., 1928, pp. 136-138.

[81] Anonymous, Supplement for 1960 to Consumption of Food in the United States 1909-52, U.S. Department of Agriculture, Economic Research Service, August, 1961, p. 17.

sharply different segments--and this may have contributed to its postwar growth. While one sector continues to make use of the cull apples noted by Sherman, another sector makes use of a much higher quality tree-run apple.

From total value point of view, the most important processing outlet is for apples which will be cored and peeled. These are the apples which in turn are sliced or made into sauce, and canned; or to a lesser extent, dried, frozen or sold fresh. For the most part, these are tree-run apples produced--and this would surprise Sherman--specifically for processing. Minor quantities are grade-outs from fresh market grading tables. Nearly half of all the apples sold for processing are directed to this use, and the farm price per bushel has averaged over twice that for other processed uses.

The other major outlet is for apples which are ground and pressed into juice. The juice, in turn, may be sold in fermented or unfermented form. Apples for this purpose are generally drops, sorts or culls, but may consist of small quantities of tree-run apples. In addition, some juice is prepared from the cores and peelings left over from the coring and peeling process noted above.

Relatively minor quantities of whole or sliced apples are used for spicing, while jam, butter, and jelly may be manufactured from the preceding products (further information on the forms of processed products at retail are provided in Chapter IV).

A more complete presentation of the processing apple picture is provided in Figure 1. The solid lines indicate the main flows of apples; the dotted lines represent lighter movements. It will be noted that a by-product of the juice process is pomace, which currently is of relatively little value.[82] Unfermented apple juices primarily include fresh and processed juice and cider, with smaller quantities of concentrate and sirup. Among the fermented apple products, vinegar accounts for the largest volume, followed by cider, wine and brandy.

One major general characteristic which the preceding chart does not show is the very definite regional patterns of processed apple utilization. While raw apple juice production is a common denominator of all regions, the situation is quite different for cored and peeled apples. Processing of the latter is largely found in the Appalachian region and New York State. In fact, 85% of the canned slices and 78% of the canned sauce was produced in these two regions from 1951 to 1960. Small quantities of canned slices are produced in the northwest, while apple sauce is produced to some extent

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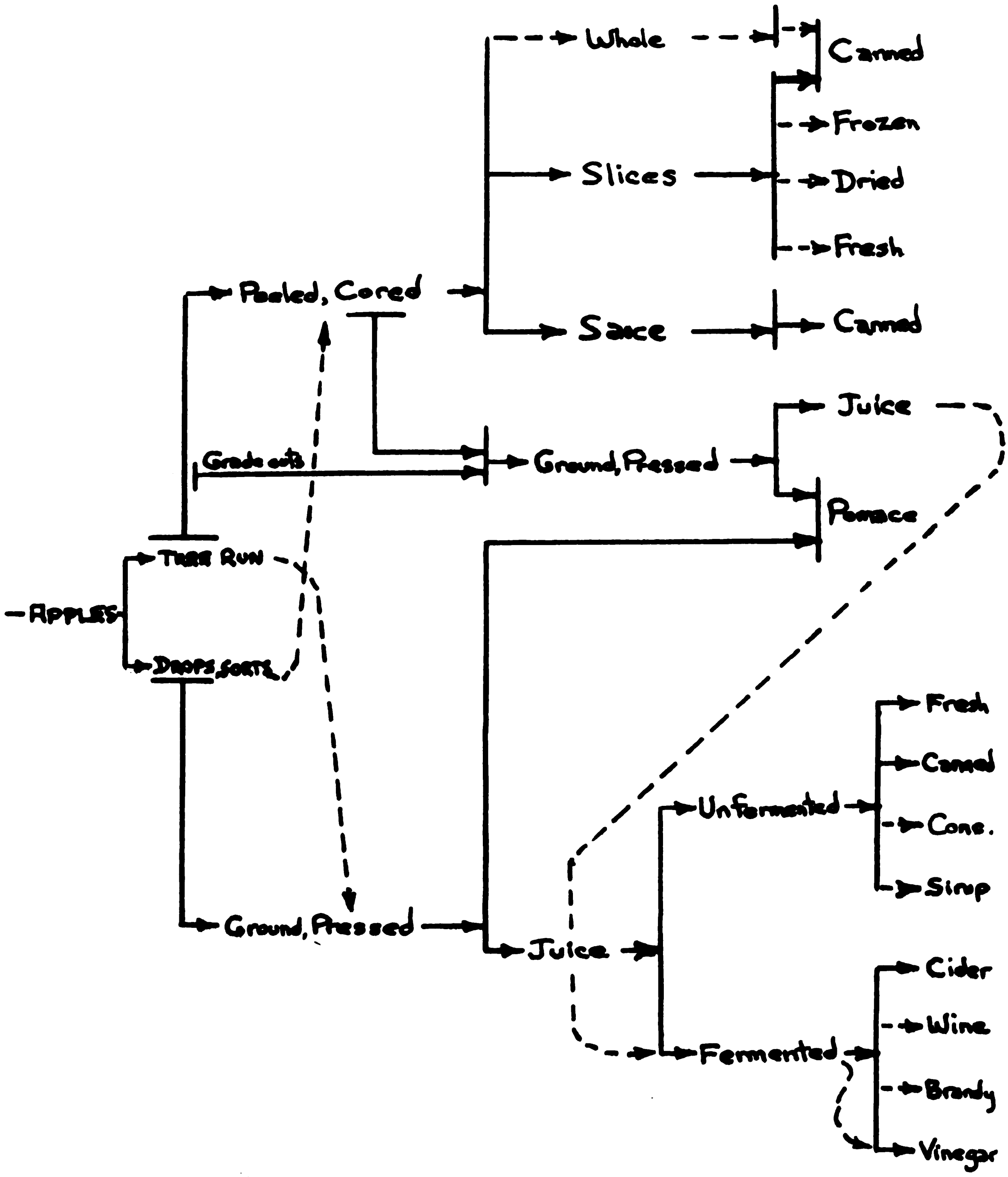
[82] Before problems of DDT residue, dried pomace was fairly widely used as cattle feed.

Figure 1. Apple product flow.



Source: Adapted from Smock and Neubert, op. cit., p. 246.

in Michigan and California.[83]

Thus, for many areas of the country the processing alternatives may be considerably more limited than indicated on the preceding chart.

Core and Peel, or Press?

Because of the difference in price, the decision of whether to sell to the coring and peeling market or to pressing is not a difficult one. With prices of the former outlet averaging \$1.26/bu. over the 1946-60 period, as compared to \$.54/bu. for the latter, the coring and peeling outlet, if available, is the clear choice. There are, however, several factors which bear on this decision which should be noted.

Volume

The volume of apples produced seems to be more closely to utilization for juice than for canning or freezing.[84] This is probably because with a large quantity of apples, the demand by coring and peeling outlet is more apt to become inelastic than would be the case for the juice outlet. The

[83] Computed from National Canners Association statistics.

[84] It will be recalled that U.S. production explained only 29% of the utilization for canning during the 1946-60 period; conversely, production explained 82% of the utilization for "other," which is principally juice.

inelasticity of the coring and peeling outlet results, in part, from the more involved physical processes involved and from the short season. However, it is probably largely due to the fact that the relatively few processors have some idea of the demand for their product and control their purchases of apples accordingly. The juice outlet, on the other hand, involves a relatively simple physical process--which can be more easily carried out over a longer season by the thousands of small mills scattered around the country who pay less attention to demand. In other words, competition in the canning industry is probably less perfect than it is in the juice industry. Consequently, the form of processing depends to some degree on crop size, with a comparatively larger portion going to juice outlets in heavy production years.

Variety

Variety, which has played an important role in earlier decisions, is not such a decisive factor per se in deciding between core and peel, and juice outlets, once the apples have been committed to processing. Certain varieties are preferred for coring and peeling, but even the price paid for the least desirable apple for this outlet is above that paid for juice apples. The decision then is based more heavily on other factors, which may be associated with variety.

Condition, Size and Maturity

For canning and peeling, condition, size and maturity are of particular importance. This is largely because of the nature of the coring and peeling process.

Condition would include such defects as severe bruising or scab, partial rots, etc. These are undesirable because they must be cut out by hand. Consequently, the processor pays a much lower price for No. 2 apples than for No. 1--so much lower, in fact, that in recent years the No. 2 price has run but little above the juice price.

Size. For coring and peeling it is very important to have large apples. This is because of the relatively fixed amount of time required to peel an apple regardless of its size;and because of the waste involved. That is, it takes but little longer to peel a larger apple than a smaller one, and in peeling and coring the percentage waste is less with a large apple than with a small one. Consequently, it required, in one study, 142 lbs. of 2-3/4" apples to produce 100 lbs. of apple slices, as against 169 lbs. of 2-1/4" apples.[85] The smaller waste, plus the time element, means that the processor could afford to pay about 50% more

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[85] Evans, op. cit., p. 48.

for 2-3/4" apples, than for 2-1/4"-2-1/2" apples.[86] In fact, during the last several seasons, processors have generally paid only little above juice or cull prices for apples in the 2-1/4"-2-1/2" size range. Varieties which tend to have large-sized fruit, therefore, are much more highly favored for coring and peeling. This places otherwise acceptable varieties, such as Jonathan, at a disadvantage in coring and peeling processing channels.

Maturity must also be considered. For the coring and peeling process, a hard apple which will stand up during processing is desired. This is not a problem with the "processing" varieties but may be a factor in determining purchases of softer "fresh" and "dual purpose" varieties. Among the latter, a slightly less than mature apple is desired; overmature fruit may have to go into juice--where it is really not very desirable because it yields juice with a high level of suspended matter and low acidity.

Prices and Costs

The premium paid for coring and peeling apples has

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[86] Cited by C. F. Bedford, Michigan State University, Department of Food Science, March 23, 1962. The proportion of apples noted grading No. 1 2-1/4" and up was reported to be 96% in New York during the 1961-62 season (W. D. Tyler, Secretary, New York State Canners and Freezers Association, Rochester, letter, March 19, 1962).

been indicated. There is a little more to the process, however, that should be mentioned. The first is that the processor generally buys most of his fruit on a tree-run basis. On arrival at the plant, the fruit is graded, and the grower is paid on this basis. For example, the following "typical" grade breakdown and relevant prices were quoted in a recent Appalachian Service newsletter.[87]

Grade	Proportion of Load	Price Per Cwt
U. S. No. 1 Canner		
2-1/2" up	75%	$2.25
2-1/4"-2-1/2"	10	1.00
U. S. No. 2 Canner	10	.75
Ciders	5	.50

While the processor may use both the No. 1 and No. 2 apples for coring and peeling, the cider apples are pressed. A survey of processing prices in New York and the Appalachian region, as reported by grower organization newsletters, reveals that for apples below No. 1, 2-1/2" up, the difference in price to the grower usually is not large. Consequently, where his processing apples run heavily to small size, the grower might be nearly as well off to take them off to a

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[87] Carroll R. Miller, Appalachian Apple Service (Martinsburg), Bulletin 507, September 15, 1961.

nearby cider mill.[88]

Institutional Factors

If coring and peeling outlets are to be considered, plants producing slices and sauce must be present and within economical hauling distance. As noted earlier, these outlets are highly concentrated in the Appalachian-New York areas, and are found to a lesser extent in Michigan and on the West Coast. Otherwise, the grower must be content with the pressing outlets.

An important further factor is timing. Since coring and peeling outlets largely use tree-run apples, they must use these apples when they are available, and available at least cost. This means harvest time. And, as it turns out, 74% of the canned apple pack and over 82% of the canned sauce pack was put up before December 1 during the 1951-1960 period. Therefore, the coring-peeling outlet is largely a fall market.

The juice market has a somewhat different character. Its raw product consists to a much larger degree of apples graded out of fresh operations--and these are available

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[88] Some canners and freezers have no particular desire to handle juice, but put it up to make use of the culls from regular packing operations. Their cider price, therefore, may be set so as to discourage delivery of juice apples. Prices paid by specialized cider mills, on the other hand, are apt to be higher, particularly for tree-run apples.

throughout the season. Consequently, the pressing outlet is spread out through the season a little more--though the bulk is still probably concentrated in the fall.

* * *

Horticultural and economic factors, then, determine whether apples will be sold for coring and peeling, or for juice. We turn now to a closer examination of coring and peeling utilization.

Cored and Peeled

The cored and peeled outlet for apples (including canned, dried and frozen) accounted for about two-thirds of the apples sold for processing, or 18 to 19% of the total apple crop over the 1946-60 period.[89]

The proportion used for these purposes has increased steadily since the war; the average percentage for the 1946-50 period was 16.2%, while the average proportion during the 1956-60 period was 22.1%. For specific products, the following changes are found when (because of limitations of data) the 1947-51 period is compared with 1954-58: canned apple sauce

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[89] Specifically, USDA data suggest that 19.0% of the crop was utilized for these uses, while the estimate based on National Apple Institute data was 18.2%.

from 6.5 to 8.8%; canned slices, from 4.4 to 5.1%; canned babyfood, from 1.2 to 1.7%; dried slices, from 3.1 to 3.0%; and frozen slices, from 0.9 to 2.3%.[90]

Apples used for these purposes are largely tree-run. In fact, in the Appalachian region during the 1961 and 1962 seasons about 94% of the apples that were purchased for peeling and coring were tree-run. The proportion was a little less than one percent higher for Yorks, and about one percent less for other varieties. The other 6% of the purchases was about equally divided between culls and drops--with the proportion of drops running higher for Yorks and the proportion of culls running higher for the other varieties.[91] The proportion of purchases represented by tree-run apples is probably somewhat lower in New York and may be around 85 to 90% in Michigan.[92]

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[90]Computed from National Apple Institute statistics (see section E, Reference section). A different breakdown, based on USDA data for 1946-50 and 1956-60, indicates the following changes: canned, from 10.7 to 16.0%; dried from 4.2 to 3.2%; and frozen, from 1.3 to 2.9%.

[91]Survey conducted by Charles Mahoney of the National Canners Association (Washington, D.C.) and personally reported to this writer in East Lansing on March 14, 1962.

[92]Ray Floate, Horticulturist, Michigan Canners Inc., Benton Harbor, letter March 12, 1962. Nationally then, probably about half of all the apples sold for processing (including juice) were sold on a tree-run basis. (Calculated from above data; corresponds to an estimate made by Fred Burrows of the International Apple Association in a letter to this writer, March 15, 1962).

The preceding data on Yorks suggested that the primary processing varieties are more apt to be sold on a tree-run or drop basis, while the other varieties are more apt to be culls from fresh market packing operations. This would probably be particularly true for some of the softer fresh varieties such as McIntosh and Cortland as the season progresses.

Along with this, within the same grade there is a definite price distinction between (a) tree-run and (b) drops and sorts. During the 1961 season in the Appalachian region, for instance, processors were paying $.50/cwt. more for tree-run No. 1, 2-1/2" and up apples than they were for drops and sorts. It is not certain why this differential exists--a study by Johnson shows no difference in trimming waste[93]--but possibly the processors feel that the tree-run apple is apt to be harder, or better in some other way. No differential existed for the smaller sizes.

A more general practice is to offer a premium for some of the more desired processing varieties. Certain varieties are preferred because they hold up well in processing and produce a higher yield of product. The particular variety desired varies somewhat, depending on the region and whether

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[93] Joseph M. Johnson, What's in a Grade?, Virginia Polytechnic Institute, Department of Agricultural Economics, undated, p. 6.

the apples are to be used for slices or sauce. But in general, the following varieties seem to be preferred, in decreasing order.[94]

1. York Imperial (and Gravenstein for sauce)
2. Golden Delicious
3. Northern Spy
4. R.I. Greening
5. Baldwin
6. Grimes Golden and Stayman

In the Appalachian area in 1961, No. 1, 2-1/2" and up Yorks were bringing $.50 to $.75 per cwt. more than other varieties. In New York during the same season, No. 1, 2-1/2" and up class A varieties--such as R.I. Greening, Baldwin, Rome, Stark, Northern Spy and Ben Davis--were bringing from $.25 to $.75/cwt. more than class B varieties, which included all others (the exact classification varying with the processor).[95]

The choice of the product to be produced will, to some

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[94] Charles H. Mahoney and Edwin A. Crosby, Raw Product Quality Specifications of Apples for Canning, National Canners Association (Washington, D.C.), October 1, 1956, pp. 3, 4.

[95] Summarized from newsletters of the Appalachian Apple Service and the Western New York Apple Growers Association. During the 1959-60 season in New York, class A apples accounted for 66.8% of purchases, class B 29.7%, and culls and ciders 3.5%.

extent, determine the particular variety desired by the processor. If slices are to be produced, it is not possible to blend varieties because of possible differences in texture. But if apple sauce is to be produced, the texture is not so important and it is possible to blend varieties. So, when the softer varieties of apples are purchased by corers and peelers, they are more likely to be blended.

Sauce production is more apt to be concentrated at the beginning of the season, while sliced apple production, utilizing harder apples, can be carried on later. This is borne out by the fact that canned slice processing tends to lag behind sauce processing (i.e., 26.6% of the canned apple pack was put up after December 1, whereas 17.6% of the canned apple sauce was put up after this date during the 1951-60 period).

With numerous varieties of apples, and several products involved, the processors' mix of raw product and finished product may not always dovetail. In years of light processing apple and heavy fresh apple production, he may be faced, of necessity, with heavier than desired quantities of fresh varieties of apples. And even in more normal years, he may receive fewer of the processing varieties and more of the fresh varieties than he desires. In New York in 1959, for instance, processors indicated a desire for 20 times more

Twenty Ounce, and 18 times as many Spies; conversely, they got 53 times more McIntosh and 71 times more miscellaneous varieties than they desired.[96] The study goes on to observe that:

> The varieties processed in 1959 were distributed in such a way that only 27% of the processors' variety requirements were met. The same apples could have satisfied 43% of these requirements had there been optimum distribution of varieties.[97]

Clearly, much remains to be done to bring about a better varietal balance for slice and sauce apples. And when one considers the growth in consumption of processed apples, with no increase projected for processing apple production, it can be seen that problems of long-run balance may be even more severe.

Then, too, there is the possibility of technological change. Suppose someone were able to devise a way to stabilize the color of apple sauce so that it were not necessary to peel the apples before pressing? If this could be done, it would open up the applesauce production to a much wider range of apples.[98]

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[96]Often growers base their sales of harder varieties on the condition that the processor takes a certain quantity of their softer varieties.

[97]M. L. Beckford, <u>A Survey of Buyers of Apples (for Processing) in Western New York</u>, Cornell University, Department of Agricultural Economics, August, 1960, pp. 3, 4.

[98]Such a sauce, made from McIntosh apples, is reportedly in the developmental stage by the New England Apple Products

Pressed

The pressed outlet for apples accounted for about one-third of the apples sold for processing, or nearly 11 to over 12% of the apple crop over the 1946-60 period.[99]

The proportion of apple production pressed has declined during the postwar period; the average percentage for the 1946-50 period was 11.7%, while the average during the 1956-60 period was 10.6%. The change appears to have been largely due to the decreasing utilization of vinegar; during the 1947-51 period an estimated 9.1% of the crop was used for this purpose, while during the 1954-58 period, only about 2.2% of the crop was so utilized. Meanwhile, the portion used for canned juice increased from 2.3 to 3.9%, and that for cider increased from 3.7 to 4.7% (small portions of the latter in turn being used for fermented products).[100]

Apples used for these purposes, as noted several times, generally are drops, sorts, and culls. In addition, small quantities of juice may be pressed from tree-run lots of

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Co. of Littleton, Mass. Another innovation, by a Canadian processor, is the use of infra-red heat to peel apples--avoiding the time consuming process of placing each apple on a peeling machine.

[99] Specifically, USDA data suggests that 10.9% of the apple crop was pressed for juice, while National Apple Institute data places the figure at 12.6%.

[100] Computed from National Apple Institute estimates.

apples and from cores and peelings left over from the slice and sauce preparation.

While some varieties make particularly good juice, normally the consumer does not show enough preference for one juice over another to make it possible to pay a premium for any one variety. In most years, prices range from $.50/cwt. to $1.00/cwt., or possibly a little more. This is a salvage market and these are salvage prices.

The price may vary to some extent with the particular outlet and the geographic location. The juice business has a dichotomy in its structure. On one side, there are the slice and sauce producers for whom juice is a by-product--the utilization of apples graded out from those brought in for coring and peeling, and the utilization of cores and peels. These outlets, as noted, are concentrated in the northeast. On the other side, there are many small and privately owned cider mills scattered throughout all of the fruit-growing areas. With juice and cider of lesser importance to many of the big firms, it is seldom that they pay a particularly striking price. The more specialized local mills, however, may be apt to pay a higher price.

The type of product varies with the type of operation. The large commercial firms generally put up a bottled or canned and pasteurized apple juice and cider, while the small mills put up a bottled but unpasteurized "fresh" apple juice and cider. The former is sold through commercial channels, while the latter is more apt to go through a roadside or local outlet. Vinegar operations are more apt to be associated with the commercial operations as are those involving the preparation of fermented products.

The decline of the vinegar market, noted earlier, does not appear to have resulted in any particular dislocations. It was, at best, a low-grade salvage outlet; and the movement away from it probably represented an improvement in alternative outlets. These have been juice and cider. The country has been drinking more of its fruit, and apples are more than holding their own in this growth. This outlet requires a better quality raw product than was true for vinegar, and a slightly higher price is paid. As processing and marketing techniques improve, this market may be expected to continue its past growth--both in terms of per capita and total consumption. And since the product can be produced from many varieties, there should be no serious problems in supply.

The Processed Product[101]

So far, discussion of the processed apple business

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[101] The statistics presented in this section were obtained from reports of the National Canners Association (see part E of the Reference section for individual reports).

has been approached largely from the point of view of the farmer supplying the raw material. In this section the point of view has been shifted to direct attention to the canned and frozen processed apple product.

Canned

Primary attention will be given to the canned product because (a) it accounts for over half of the apples processed, and (b) it is the one on which there is the most complete set of data. Canned items covered include canned slices (including, probably, a small quantity of canned whole apples) canned applesauce, and canned apple juice and cider.

Pack

Total Pack. The total quantity of canned apple products has increased unevenly from 1951. During 1951, 11.7 million cases (24/2-1/2 basis) were packed; while by the 1960 season, the quantity had increased to 21.1 million cases.[102] Over the ten-year period, canned slices averaged nearly 21% of the total pack, canned sauce slightly over 53%, and juice about 26%. The proportion of slices has dropped off in recent years; sauce has held its own or strengthened its

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[102] Pack figures by crop year are presented in Appendix C, Table 8.

position; and juice has increased its percentage. Two-thirds to three-quarters of the slice pack is put up in institutional size cans (no. 10), whereas only about one-eighth of the sauce pack is so canned--suggesting a predominantly institutional market for the former and a household market for the latter.

Pack by Region. The regional nature of the production of these items is particularly clear when the statistics on production by state are assembled for the ten-year period from 1951-60. This is done in Table 24.

Table 24. U.S. canned apple pack by region, 1951-60.

	Type of Product		
Region or State	Slices	Sauce	Juice
New York	27%	31%	?
Appalachia*	58	47	23
Michigan	?	?++	15
California	?+	15	15
Northwest**	10	1	?
Other	5	6	47
United States	100%	100%	100%

*Maryland, Pennsylvania, Virginia.
**Washington, Oregon, Idaho
? Indicates inclusion in "Other" category
+Avg. 4% for 1956-60.
++Avg. 6% for 1959-60.

Source: Computed from National Canners Association statistics.

The eastern regions of New York and Appalachia accounted for 85% of the pack of canned apples and 78% of the pack of canned sauce. The western regions accounted for a little over 10% of the sliced pack (Northwestern states) and 16% of the sauce pack (California). The central states, therefore, could have only produced a few percent of the slices and sauce--and most of this would have been in Michigan.

And though three states or regions pretty well cornered the slice and sauce production--leaving only 5 and 6% respectively for the other areas--this was not so for canned juice. Here, three states or regions accounted for only a little over half of the pack--leaving some 47% for the other areas.[103]

Timing of Pack. The highly seasonal nature of the slice and sauce pack has already been noted. The proportion of the seasonal pack put up by months is presented in Table 25.

With such a seasonal concentration of production, one might wonder about economies that might be induced by spreading the processing out over a longer season. Balanced against this, however, would have to be the added costs--including quality loss--that would be involved in storing tree-run fruit for such an operation. Greater use might be

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[103]It is unfortunate that detail is not provided on juice production in the key state of New York. But even if this were as large as Appalachia, it would still leave 24% for other states.

made of fresh packing house culls; but here there would be problems, mentioned earlier, of variety, size, and maturity, plus an added problem of stability of supply of raw product.

Table 25. U.S. canned apple pack by months, 1951-60.

Month	Type of Product	
	Slices	Sauce
August-September	10.7%	26.0%
October	33.5	33.6
November	29.2	22.9
December	14.7	8.7
January	7.8	4.5
February	2.6	2.4
March	1.1	1.1
April	0.3	0.6
May	0.1	0.2
Total	100.0%	100.0%

Source: Computed from National Canners Association statistics.

Movement. Even though the canned apple pack is very seasonal, the movement out of processor's hands to wholesalers or retailers is somewhat more even, though a peak was still reached in October. Monthly movement is indicated in Table 26.

Canned slice movement led sauce movement from October to January, after which sauce movement took over the lead. This might be due to the type of pack and outlet predominant for each. Institutions may be more apt to concentrate their buying of slices during the fall, while retail purchases of sauce tend to be more even throughout the season.

Table 26. U.S. movement of canned apples by months, 1951-60.

	Type of Product	
Month	Slices	Sauce
July	6.6%	6.7%
August	6.2	5.7
September	7.8	9.6
October	12.6	11.0
November	10.9	9.2
December	9.0	6.9
January	10.0	9.5
February	7.5	8.9
March	7.4	8.9
April	7.4	8.3
May	8.1	7.9
June	6.5	7.4
Total	100.0%	100.0%

Source: Computed from National Canners Association statistics.

<u>Carryover</u>. That portion of a canners pack which remains in processors' hands at the end of a season is termed carryover. It remains to be consumed at the beginning of or during the following season.

Over the ten-year period from 1951-60, an average of 32% of the season's slice pack remained in processor's hands on the first of the following July; the proportion for applesauce was nearly 22%. The proportions for both products ran about 12 and 10% higher, respectively, during the second half of the period than they did during the first half. The lower carryover of sauce, compared to slices, would be expected because the sauce pack, as has been indicated, peaks earlier in the season.

If the August 1 carryover stocks for the 1951-60 period are converted back to bushel equivalents, the carryover is found to be equivalent to about 3.05 million bushels[104] or about 2.8% of the total apple production.

These holdings are generally considered very important in influencing processors' planned output for the season and, in turn, their demand for processing apples. Consequently, this factor is heavily weighted by all groups in anticipating the outlook for a particular season.

However, when the August 1 carryover of canned goods was converted back to bushels and correlated with data from the following season over the 1947-60 period, it was found that there was practically no correlation with canned utilization. On the other hand, the variation in carryover explained 30% of the variation in the prices paid for canning apples. Thus, it would seem that the effect of carryover is on price of

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[104] Skinner, op. cit., p. 71. If frozen is included, this is increased to about 3.9 million bushels. For details see Appendix C, Table 9.

canning apples rather than on quantity utilized for canning.

Frozen[105]

While frozen apples are considerably less important than the canned product, they should not be overlooked.

The total pack increased from 48 million pounds in 1950 to 72 million pounds in 1959. Production was distributed as follows over the period: northeast 36%, south 6%, midwest 33%, west 25%. August 1 carryover was equal to about 850,000 bushels of apples.

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This brings to a close discussion of the utilization of the apple crop. While it has been seen that utilization patterns are heavily influenced by production or supply in any one season, this has not been the only factor. Utilization is also influenced by consumer demand. Production has already been discussed, so we now turn our attention to the factors influencing the consumption of fresh apples and apple products.

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[105] These data were computed from material in Agricultural Statistics, U.S. Department of Agriculture, annual.

CHAPTER IV

CONSUMPTION

So far, little has been said about the consumer or the consumption of apples. Chapter II of this paper was concerned with production or the supply of apples; and Chapter III reflected the influence of supply and demand on utilization of apples, principally at the farm level. Here, we will move on to a consideration of the consumption of apples. This will provide some insights into the nature of the demand for apples--for as Alfred Marshall stated, "The ultimate regulator of all demand is . . . consumer demand."[1]

Domestic Civilian Supply

General

In studying the civilian consumption of apples in the United States, that portion of the crop which is exported or used by the military must first be excluded. At the same time, it is necessary to account for imports of apples.

Both exports and imports, and military purchases

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[1]Alfred Marshall, Principles of Economics (8th edition), London: Macmillan, 1890, p. 78.

are taken into consideration by the Department of Agriculture in calculating per capita consumption. On the other hand, because the figures are a bit difficult to track down, few people recognize the role they play in influencing the quantity of apples available for domestic use in any one season.

Exports and Imports[2]

The apple has long played a role in the U.S. export trade. Apples were one of the first, if not, the first fruit to be exported--the first shipment supposedly being that of Newtown Pippins to Ben Franklin in London in 1758-59. No other fruit was listed in the export statistics of the U.S. until 1865.[3]

Exports

While apples got off to a strong start a century ago, their present position in the export trade is considerably

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[2] The statistics in this section were computed from reports of the Foreign Agricultural Service, U.S. Department of Agriculture and correspondence with the director of the Fruit and Vegetable Division (see part E, of the Reference section for detail).

[3] Smith, op. cit., p. 240. The apple export trade, during the 150-year period from 1770 to 1940, is described in detail by Stewart Bell, Jr., "Some Economic Aspects of the Apple Export Trade of the United States," University of Virginia, Department of Economics, M.A. thesis, 1940.

more modest. During the 1946-60 period, apples were exported in three forms: fresh, dried, and canned. The fresh exports averaged about 2.7 million bushels per year, while canned and dried exports in terms of fresh added up to an average of about 0.83 and 0.06 million bushels respectively.[4] The average yearly total then was the equivalent of about 3.6 million bushels (75% of which was fresh, about 22% dried and 2% canned). Taking the size of the apple crop into consideration, exports represented some 3.2% of total production.

The importance of exports varied, as might be gathered from above, by utilization of the crop. That is, whereas exports of canned apples accounted for only about 0.4% of the apples utilized for canning (for the 1946-58 period), exports of dried apples accounted for 19.4% of the apples utilized in dried apple production. The proportion for fresh apples was about 3.6%. In other words, while exports in total did not represent a large proportion of total production, they were quite important in terms of the dried apple industry.

Imports

The United States imports as well as exports apples. Fresh apple imports over the 1946-60 period averaged about

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[4]Data for dried and fresh had not been released for 1959 and 1960 when this paper was prepared. Therefore, these figures refer to 1946-58.

1.3 million bushels. Data on imports of dried and canned apples is more sketchy but that which is available for the eight-year period from 1951-58, shows an average (in fresh weight equivalent) of about 0.03 million bushels of dried and 0.18 million of fresh.

Export-Import Balance

When exports of fresh apples are weighed against imports, it can be seen that net exports of fresh apples averaged about 1.4 million bushels for the 1946-60 period. It is not possible to study the balance for processed apples for the same period because of shortages of data; but for the 1946-58 period[5] the net exports of dried apples appeared to be the equivalent of nearly 0.9 million bushels of apples, while net imports of canned apples were the equivalent of a little over 0.1 million bushels. If it is assumed that the 1946-58 average for processed apples is also representative of 1959 and 1960, a summation of the three groups would suggest an average total net export figure for the period of 2.1 to 2.2 million bushels. This would represent about 1.9% of the crop.

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[5]Except for canned apple imports from 1946 to 1950. To compensate for this, the 1951-58 average was assumed to be representative of this period.

Variability

One difficulty in dealing with period averages is that we overlook the variability of exports and imports from season-to-season. This is particularly important with respect to exports. From 1946 to 1960, total exports varied from a low of 1.6 million bushels in 1948 to a high of 8.2 million bushels in 1957. On the other hand, imports, during the 1951 to 1958 period, varied only from lows of 1.0 million bushels in 1951 and 1956 to a high of 2.5 million bushels in 1953. In neither case did there appear to be a trend over the period.

Exports are probably highly related to apple production in other countries--particularly Canada and Europe. When, due to weather, crops happen to be short in these areas in any one year, our exports increase. But this is not the sort of thing one could predict. However, with sharp over-all increases expected in European fruit production, even this outlet might recede.

Government Purchases[6]

The U.S. government, through the Department of

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[6] The statistics in this section were computed from data provided in letters from the Agricultural Marketing Service of the U.S. Department of Agriculture, and the Military Subsistence Supply Agency of the U.S. Department of Defense. (See part E of the Reference section for detail.)

Agriculture and the Military Subsistence Supply Agency, purchases both fresh and processed apples. The Department of Agriculture purchases are ultimately consumed by civilians (generally school children) while the latter are, of course, consumed by military personnel.

Fresh

Data on government purchases of apples are available for only 10 of the 15 years from 1946 to 1960; the Military Subsistence Agency reported that it does not have records of its fresh purchases from 1953 to 1957. For the 10 years we do have information, total purchases varied rather widely. The military purchased a fairly stable quantity of apples in each year, while the Department of Agriculture--through the Agricultural Marketing Service (AMS)--purchased apples in only five of the years; and these were concentrated in the first part of the period (1947, '49, '50, '51 and '52).[7]

Combined government fresh purchases for the 10 years averaged 1.8 million bushels and ranged from a high of 3.96 million bushels in 1949 to a low of 0.64 million bushels in 1960 (a period when there were no USDA purchases). Purchases appeared to peak from 1949 to 1951 when they averaged 3.46

[7]1952 purchases were almost negligible.

million bushels, and dropped off to a much lower level from 1958 to 1960 when they averaged 0.67 million bushels. Over this most recent period, government purchases represented about 0.86% of fresh sales and about 0.56% of total apple production.

<u>Processed</u>

Data problems continue into the sphere of government purchases of processed apples; we have records for only the seven-year period from 1954 to 1960. Again, the military purchased a relatively constant quantity of processed apples in each season (though the division between canned, sauce and juice did vary), while the Department of Agriculture purchased processed apples only during the last three years of the period (and then did not purchase juice).

Combined government purchases for the period averaged about 0.81 million cases,[8] ranging from a high of 1.60 million cases in 1958 to a low of 0.41 million cases in 1955 (a period when there were no AMS purchases). Purchases were highest in the most recent three-year period when the AMS entered the market.

Among the three processed products, government purchases

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[8] A case is defined here as the equivalent of 24 No. 2 1/2 cans.

represented a particularly high portion of the production of canned slices (about 10.3% for the 1954-60 period) and smaller portions of the canned sauce and juice pack (from 3.3 to 3.5% respectively).

Over the three-year period 1958-60, total government processed purchases amounted to about 6.1% of total processed production or approximately the equivalent of about 2% of total apple production.

Fresh and Processed

In total, over the three-year period from 1958 to 1960, government purchases of fresh and processed apples amounted to an equivalent of about 2.6% of apple production. Purchases of processed apples were considerably more important than purchases of fresh apples.

If one were to try to build government purchases as a variable in a study, there are, as may have been apparent, troublesome data problems. The lack of data for differing periods for both fresh and processed apple products have left only a three-year period when both were available.

A further consideration might be the fact that these purchases are for the most part made at competitive prices. The military organization, which has been well described,[9]

[9]See Harold Rogers, "Uncle Sam as a Produce Buyer," Produce Marketing, February, 1962, pp. 7, 9, 10.

operates on a decentralized basis, while the Department of Agriculture purchases of processed apples, at least, seem to consist of competitive bids taken at the national level with allowances made for transportation.[10]

Thus, there would be some definite difficulties in building government purchases into a statistical analysis.

Per Capita Consumption

In calculating per capita consumption, allowance is made for exports and imports of apples as well as military purchases.

Data on per capita consumption of apples are available from the U.S. Department of Agriculture on a calendar year basis and from the Michigan State University Consumer Panel on a crop year basis for a limited period. In both cases, "consumption" refers to the form in which the fruit was produced or purchased; it does not mean that the item was actually consumed in the home in that form.

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[10] Anonymous, "USDA Buys Applesauce and Sliced Apples for School Lunches," The National Apple News (Washington, D.C.), October, 1961, pp. 2, 3.

U.S. Department of Agriculture[11]

The Department of Agriculture reports per capita consumption figures for apples (and other leading fruits) in total, in fresh and processed forms, and by various processed groupings. All the figures refer to civilian consumption only.

Total Consumption

Average annual per capita consumption of all fruits on a farm-weight basis from 1946 to 1960 was 203.3 lbs. Of this, apple consumption represented 28.5 lbs., citrus 86.0 lbs., and "other" 88.8 lbs. In other words, apples accounted for about 14% of the total, citrus 42.3%, and "other" 43.7%.

Several trends were apparent over the period. The first was the gradual decrease in total fruit consumption--about 1.4 lbs. or 0.69% per year.[12] The decrease was greatest for "other" fruits--about 0.88% per year. The difference between apples and citrus was much smaller than many would

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[11] The statistics presented in this section were computed from data issued by the Economic Research Service of the U.S. Department of Agriculture. (See part E of the Reference section for detail). Further data are presented in Appendix C, Tables 10, 11.

[12] These and the trend figures which follow were obtained through regression analysis. The percentages were obtained by dividing the regression coefficient by the average consumption, in pounds, for that item.

anticipate--a decrease in apple consumption of about 0.56% per year compared with a decrease for citrus of about 0.53% per year. Thus, the rate of decrease for apples was greater by about only 0.03% per year.

On a year-to-year basis, consumption of apples appeared to move more closely with that of "other" fruits than it did with citrus.[13] This could be because the "other" category includes a number of fruits, such as peaches and pears which are grown in the same areas as apples and which would be subject to some of the same factors influencing production.

Consumption by Form

Apples, as we have suggested earlier, may be consumed in many forms. The U.S. Department of Agriculture, however, has divided its breakdown into a somewhat more limited number of categories: fresh and processed, with processed being composed of canned, juice, frozen, and dried.

Of the average annual per capita consumption of 28.5 lbs. of apples in the postwar period, 22.4 lbs. or 78.6%, were consumed in fresh form and 6.1 lbs. or 21.4% were consumed in processed form. Within the processed grouping, 3.7 lbs. (or 13.0% of total consumption) were consumed in canned

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[13] In turn, consumption of "other" and citrus appeared to move in opposite directions from year-to-year.

form, 0.9 lbs. (or 3.2%) in the form of juice, 0.6 lbs. (or 2.1%) in frozen form, and 1.0 lbs. (or 3.5%) in dried form.

In terms of consumption in pounds, total apple consumption, as we noted, has been decreasing at the rate of about 0.56% per year. Fresh consumption has been decreasing at the rate of about 1.6% per year, while processed consumption has been increasing at the rate of about 3.3% per year.

When the proportion of total apple consumption represented by each of these categories is considered over the 1946 to 1960 period, several rather striking trends emerge. The first is the decrease in the proportion represented by fresh apples (from 83.4% in 1946-47 to 73.7% in 1959-60) and the commensurate increase in proportion represented by processed apples (from 16.6% to 26.4%). The relative increase in processed consumption was largely brought about by the increase in canned consumption (which increased from 7.4% in 1946-47 to 16.4% in 1959-60) and, to a lesser extent, by the increase in juice consumption (from 1.6% to 5.1%). Offsetting these increases to a slight degree were decreases in frozen (from 2.8% to 2.3%) and dried apples (from 4.9% to 2.7%).

* * *

All told then, it can be seen that apple consumption has been decreasing gradually since the war, but that the rate of decrease was only slightly greater than for citrus, considerably less than for "other" fruits and somewhat less than for "all" fruits.[14] Within the apple classification, it was found that the decline in consumption was most severe in the fresh forms, while processed consumption showed an increase in consumption. The increase in processed consumption was in the canned and juice lines.

While these figures give some idea of trends, they do not provide a very detailed breakdown on consumption--particularly of the processed forms--within the crop year. To obtain this information, we turn to the Michigan State Consumer Panel.

M.S.U. Consumer Panel

A unique record of per capita purchases of apples is provided for the five-year period from 1953 to 1958 by the Michigan State University Consumer Panel. The panel was composed of 250 households in Lansing, Michigan, a city of

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[14]One wonders if the apparent decline in total fruit consumption may be tied, to some extent, with the shift in the form of consumption. That is, with increased processed consumption, there is less opportunity for the loss of fruit by deterioration or spoilage--fruit which would be counted in the consumption figures but which would not actually be consumed by the purchaser.

about 100,000. Panel families reported weekly purchases and receipts of food items. Included were data on fresh and processed apples--the processed category including 14 different items. Over the five-year period records were obtained on 28,800 purchases of apples (fresh 16,134, processed 11,666).[15]

The data were analyzed from two main points of view. Because five years is too short a period to present particularly reliable trends, the yearly figures were combined to present (1) a five-year annual average and (2) a five-year weekly average.

Yearly Data

The yearly data indicate, in the first instance, the relative importance of apples and apple products at the retail level. Later in the section, data will be provided on home-grown supplies and gift receipts.

Purchases. Over the five-year period, yearly purchases of apples (retail weight) averaged 30.8 pounds per person.[16]

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[15]A separate report of Panel purchases is provided by this author in Consumer Purchases of Fresh and Processed Apples, Michigan State University, Department of Agricultural Economics, Ag. Econ. 806, January, 1961.

[16]This figure errs on the high side because of a computing problem. Several of the items were not on the market for the full period: the pies were reported for only four seasons, while the pie mix and apple-apricot and juice baby food were reported for three seasons. In order to

Of this, 79.9% or over 24.6 pounds were in the fresh form, while 20.1% or nearly 6.2 pounds were in processed form. The most important products on a quantity basis were sauce (and butter) and cider, while the least important forms were dried or frozen. The complete breakdown is shown in Table 27.

Table 27. Average yearly per capita purchases of apples, Michigan State University Consumer Panel, 1953-57 crop years.*

Product	Retail Weight	Proportion of Total
Fresh apples	24.612 lbs.	79.88%
Processed apples	6.198	20.12
1. Sauce and butter**	2.132	6.92
2. Cider	1.655	5.37
3. Juice	0.746	2.42
4. Pie	0.595	1.93
5. Canned slices	0.333	1.08
6. Sauce baby food	0.310	1.01
7. Pie mix	0.137	0.45
8. Jelly	0.118	0.38
9. Apple-apricot bfd.	0.096	0.31
10. Juice baby food	0.048	0.16
11. Apple-blueberry pie	0.011	0.04
12. Apple-cherry pie	0.011	0.03
13. Frozen	0.004	0.01
14. Dried	0.002	0.01
Total	30.810 lbs.	100.00%

*With exceptions cited in footnote 16.

**Unfortunately, applesauce and apple butter were not separated in the original report forms.

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represent their more recent market position, they were averaged as if they had been on the market for the full five seasons. This increased the total figure slightly, but was felt to be the best alternative. Pie and baby food blends with other fruits were included on a weighted basis: the figures reported in this paper represent 2/3 of the weight reported by the M.S.U. Panel.

Grouping the individual processed items in product categories (denoted by the letter in parentheses) reveals that (a) sauces (and butter) and (b) juice and cider were purchased in about the same quantities, 2.44 vs. 2.40 pounds. Purchases of (c) pies and mixes totaled about 0.75 pounds, while purchases of (d) canned, frozen, dried and jelly totaled about 0.50 pounds. In other words, group (a) represented about 7.9% of all purchases, (b) 7.8%, (c) 2.4%, and (d) 1.6%.

Home-grown and Gift. In addition to purchases, a sizeable quantity of apples and apple products are obtained as gifts or, in the case of fresh apples, raised at home. Over the period of the study, a yearly average of nearly 5.5 pounds per person were home-grown or gifts. Approximately 93.63% (5.19 pounds) was fresh and 6.37% (0.35 pounds) was processed. The most important processed products were sauce (and butter) which represented 3.84% (0.213 pounds) and cider which represented 1.9% (0.106 pounds). The remaining 0.63% (0.035 pounds) was composed of ten of the other products.

Total Quantity. If gifts and home-grown are added to purchases, the total quantity available for consumption[17] reached nearly 36.36 pounds per person per year. About 82% of this or 29.81 pounds were fresh apples and 18% or 6.55

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[17] With the reservation noted in the previous footnote.

pounds were processed apples. The detailed breakdown is presented in Table 28.

Table 28. Average yearly per capita acquisition of apples purchases, gifts and home grown, Michigan State University Consumer Panel, 1953-57 crop years.

Product	Retail Weight	Proportion of Total
Fresh apples	29.8054 lbs.	81.98%
Processed apples	6.5514	18.02
1. Sauce and butter	2.345	6.45
2. Cider	1.761	4.84
3. Juice	0.753	2.07
4. Pie	0.595	1.64
5. Canned slices	0.339	0.93
6. Sauce baby food	0.314	0.86
7. Pie mix	0.138	0.38
8. Jelly	0.129	0.35
9. Apple-apricot bfd.	0.096	0.26
10. Juice baby food	0.051	0.14
11. Apple-blueberry pie	0.011	0.03
12. Apple-cherry pie	0.011	0.03
13. Frozen	0.006	0.02
14. Dried	0.003	0.01
Total	36.357 lbs.	100.00%

Inclusion of gifts and home-grown did not change the order noted in Table 27, but the percentage for each of the processed items was less. The relationships within the table for processed items were about the same except that the differentials between sauce (and butter) and sauce baby food, and cider and juice were widened slightly.

If we now wish to look back and check the source for each item acquired, it may be observed that in total nearly 85% of all apple acquisitions were purchased and that slightly over 15% were home-grown or gift. About 82.6% of the fresh apples were purchased, while 94.6% of the processed apples were purchased. Of the processed items, aside from frozen and dried, the proportion of gifts was highest for sauce (and butter) with 9.1%, jelly with 8.0% and cider with 6.0%. The proportion was below 5.0% for the other items.

Comparison with USDA Data. The data presented so far have been on a crop-year basis. In order to make comparisons with U.S. Department of Agriculture data, the panel figures were combined on a calendar-year basis for the six-year period 1953-1958. Then comparisons were made between total acquisitions for the M.S.U. panel (which were assumed to be consumed) and U.S. per capita consumption on a retail-weight basis as reported by the USDA.[18] This revealed that total apple consumption of the panel was about 40% higher than the national averages presented by the USDA.[19] The figure for

[18]Compiled from Supplement for 1959 to Consumption of Foods in the United States, 1909-52, U.S. Department of Agriculture, Agriculture Handbook No. 62, September, 1960, pp. 4-6. Also Supplement for 1957, August, 1958, pp. 3-5. Retail weight figures include both commercial and non-commercial production.

[19]Generally the panel has tended to underestimate rather than overestimate purchases. See G. G. Quackenbush and J. D. Shaffer, Collecting Food Purchase Data by Consumer Panel--A Methodological Report on the M.S.U. Consumer Panel, Michigan State University, Agricultural Experiment Station, Technical Bulletin 279, August, 1960, pp. 42-44.

fresh apples averaged 36% higher, while the processed figure was 62% higher. As noted earlier, consumption of all apples in Lansing might be higher than in other areas because of proximity to production and consequent lower prices. It is not clear why the processed figure should have been so much higher.[20]

Seasonal

With some concept of the over-all pattern or purchases of apple and apple products in mind, we now turn to an analysis of the seasonal patterns of purchases.

As previously noted, data on quantities were available on a weekly basis for fresh apples and the processed products. To facilitate analysis, three-week moving averages were computed and the quantities were graphically plotted.

The results of this analysis indicated a distinct pattern for fresh apples; but among the processed items, only apple cider showed any clear-cut pattern. Graphs for the other processed items revealed remarkably little in the way of seasonal trends.

Fresh. Fresh apple purchases showed a seasonal

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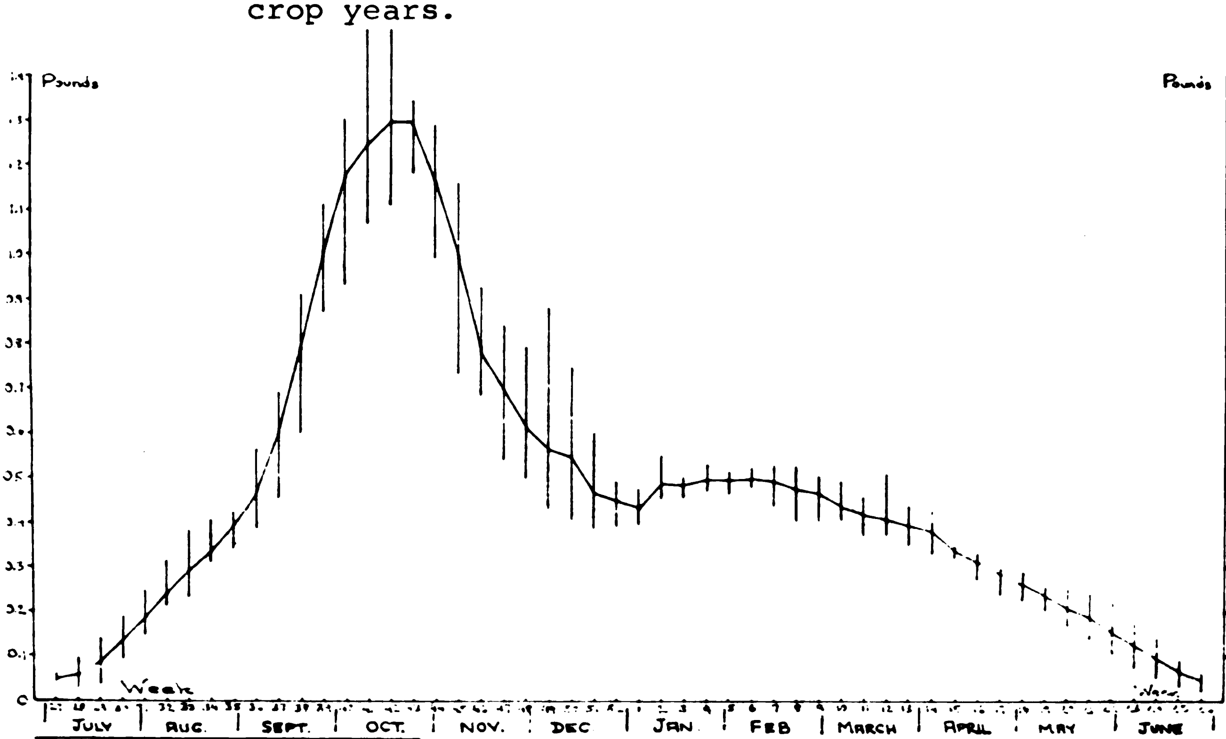
[20]The other ingredients used in the manufacture of pies may have added to the weight, but not enough to account for the difference reported here.

pattern that was quite uniform from year-to-year, despite Michigan crops which varied from 6.6 to 12 million bushels and national crops which ranged from 96 to 119 million bushels. The graph representing this pattern is reproduced in Figure 2. For ease of presentation the five crop years have been averaged.[21] This average is represented in the variable line that runs from left to right. The vertical lines represent the range in price quotations for the week in question.

Figure 2. Average yearly per capita purchases of fresh apples, Michigan State University Consumer Panel, 1953-57 crop years.



[21]The charts then represent averages of three-week moving averages. The breakdown into months is approximate because of the calendar shift of one day from season-to-season.

The chart is, for the most part, self-explanatory but several items may be noted. The purchases were concentrated around October; and, in fact, nearly 33% of the season's purchases were concentrated in the seven-week period 39 to 45 (which starts in late September and runs through the first of November). Peak purchases were found in mid to late October; a slight dip was noted during the December-January holiday period.

Processed. The seasonal trends, if any, for individual processed apple products were, for the most part, unclear. To some extent this is to be expected because of (a) the large number of processed items sharing only one-third of the apple market, and (b) the less perishable nature of the product. Comments for individual processed items follow.

Canned sauce and butter: Purchases showed less variability than other items and increased gradually through the season from a low in September. This probably reflected a gradual substitution for fresh apples made into sauce.

Canned sauce baby food: Purchases were fairly steady through the season, with perhaps a slightly greater quantity in the early and late months of the crop year, and a slightly smaller quantity in January and February. There was less variability in purchases later in the season.

Cider: As indicated previously, this item showed the most consistent seasonal pattern of any of the processed items. Significantly, it is one of the most perishable. Nearly all the purchases were made in the September-December period, with a seasonal peak in mid to late October (when 44% of the purchases were made in a three-week period).

Canned juice: Purchases showed very wide variation from year-to-year; but it appeared that they dropped from July to a seasonal low in September, then increased, then dropped through late November and early December, and then increased more or less gradually through the rest of the season. The early season trends would seem to reflect the influence of heavy marketings of cider.

Canned juice baby food: No apparent pattern.

Bottled jelly: Purchases were slightly higher in March and early April and again in late May and early June.

Canned slices: Purchases showed a slight tendency to increase from a low in October to a higher point in March and April--probably representing a substitution for fresh apples.

Pie: No visible pattern, but for several years, purchases were higher in the January-March period.

Pie Mix: Purchases seemed to be greater during the second half of the season when fresh purchases were less.

Apple-apricot baby food: Purchases were quite steady.

The data on pie blends, and dried and frozen apples were too fragmentary to comment on.

Characteristics of Consumption

Now that some of the quantitative aspects of apple consumption have been discussed, some of the qualitative aspects are given closer attention.

Consumer Use and Preferences

The first item to be examined is the uses that are made of apples and apple products and the varieties that appear to be most desired for these purposes.

Fresh Apples

At the beginning of this paper, it will be remembered that apple varieties were grouped into three categories: fresh, dual purpose and processing. That division will be paralleled here. Apples purchased in a fresh form may, in the context of their use within the home, be classified as eating, dual purpose and cooking.

Eating apples are considered to be those which are consumed in fresh (raw) form. This may include eating out-of-hand or, to a lesser extent, use in salads. In two studies, these uses were found to account for 50 to 67% of the total purchases of fresh apples.[22, 23] The preferred varieties according to the USDA investigation (and these should be no surprise) were Delicious, followed by McIntosh and Jonathan.[24] Eating apples are most often used as a between-meal snack or are consumed in the evening. Small quantities are consumed at dinner and lunch.[25, 26]

Dual purpose apples may be consumed fresh or cooked. Preferred varieties, according to the USDA report mentioned above, were Jonathan, McIntosh, Stayman and Winesap.[27]

Cooking apples may be made into applesauce or pie, or may be baked or used in other forms. Favorite cooking varieties,

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[22] W. E. Black, Consumer Demand for Apples and Oranges, Cornell University, Agricultural Experiment Station, Bulletin 800, August, 1943, p. 22.

[23] Anonymous, Consumer Preferences Regarding Apples and Winter Pears, U.S. Department of Agriculture, Agriculture Information Bulletin 19, 1950, p. 43.

[24] Ibid., pp. 4, 10, 11.

[25] Robert W. Johnson, "A Special Report on the A. J. Wood Study," Proceedings of the Washington State Horticultural Association, December, 1959, p. 170.

[26] Anonymous, "New Thoughts on Food Marketing, First . . . Apples," British Farmer (London), October 10, 1959, pp. 29, 38.

[27] Anonymous (Consumer Preferences . . .), op. cit., pp. 10-11.

according to the above survey, were Greenings in urban areas and Jonathan and Winesap in the rural areas.[28]

In the early 1940's, consumers indicated that of total fresh purchases about 45% were used in these forms--20% for sauce, 17% for pie, 6% were baked, and 2% were used in other forms.[29] In another survey reported in 1950, the proportion used for cooking had dropped to 24% and that for baking was halved to 3%.[30]

If use is looked at from a slightly different point of view, it is found that among consumers who used apples from the 1948 crop, 66% made pies, 57% made sauce, and 48% baked the apples.[31] The percentages among another group in 1959 were pies 56%, sauce 45%, and baked 38%.[32]

Though the evidence is scattered it appears that while the proportion of apples processed in the home may have dropped in recent years, it still accounts for a considerable portion of home consumption.

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[28] _Ibid_.

[29] Black, _op. cit_., p. 23.

[30] Anonymous (Consumer Preferences . . .), _op. cit_., p. 43.

[31] _Ibid_., p. 13.

[32] Johnson, _op. cit_., p. 170.

Processed Apples

From the homemaker's point of view, the most important processed apple products are applesauce, apple juice and to a lesser extent, slices.

Applesauce. In 1959 and 1960, applesauce was found to be most often used as a meat accompaniment (i.e., with pork) followed by use as a dessert, as an ingredient in cakes, and lastly, as a breakfast fruit.[33, 34, 35]

When New York State customers were asked about the relative volume of the commercial and homemade sauces in the early 1940's, it appeared that consumers made about twice as much sauce as they bought.[36] A comparable figure is not available for later years; but on a national level in 1950, 58% of the homemakers who bought canned applesauce reported

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[33] Douglas J. Dalrymple, "A Study of Consumer Preference for Applesauce Using the Two-Visit Interview Technique," Journal of Farm Economics, August, 1961, p. 696. (For detail see his Fruit Merchandising Experiments, Cornell University, Department of Agricultural Economics, A.E. Res. 38, July, 1960).

[34] Anonymous, A Consumer Survey on Apple Products, Consumer and Market Research Division, Owens, Illinois (Toledo), February, 1959, p. 9.

[35] It will be noted that for two of these uses--use as a side dish with meat (pork) and as an ingredient in cake--there are probably no closely competing fruit products.

[36] Black, op. cit., p. 25.

using homemade applesauce as well.[37] The figure in New York in 1960 was 35%.[38] This, and the per capita consumption data, suggest that purchased canned applesauce is to some extent replacing the homemade product.

While processors appear to think that certain varieties and certain processed grades make a more desired sauce, consumer preference studies do not bear this out. Extensive research conducted in New York State in 1959 and 1960 among nearly 1400 households suggested that (a) the U.S. grades do not appear to be representative of consumer preference for sauce, and (b) that there was no particular varietal preference--except for a sauce which contained 25% McIntosh (a variety usually not highly recommended for sauce).[39] Similarly, consumer panel tests in Michigan in 1960 and 1961 indicated that sauce made from Greenings was not significantly preferred over sauce made from fresh varieties including Red Delicious, Jonathan or McIntosh.[40]

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[37] Anonymous (Consumer Preferences . . .), op. cit., pp. 14, 45.

[38] Dalrymple (D. J.), op. cit., p. 697.

[39] Ibid., pp. 690-697.

[40] W. Smith Greig, C. L. Bedford, and Henry Larzelere, "Consumer Preferences Among Apple Varieties in Fresh and Processed Farms," Quarterly Bulletin, Michigan State University, Agricultural Experiment Station, February, 1962, pp. 517-518.

Apple slices, as we have noted, are a much less important item in the home--but they are important in public eating establishments and bakeries. There, they are used to manufacture apple pies, which led all types of pies in purchases in the Michigan State Consumer Panel.[41] And while processors feel that certain processing varieties make pies which are preferred by consumers, consumer preference tests do not bear this out. Studies conducted in Michigan in 1960 and 1961 with pies made from conventionally frozen and dehydrofrozen apple slices indicate that there was no significant varietal preference.[42]

This finding, and the similar one noted above for applesauce, may well turn out to be of considerable importance if consumption of processed apples continues to increase and production of processing varieties remains about the same.[43]

Apple juice appears to be most often used as a

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[41] Ben C. French, "Some Economic Aspects of Pie Consumption," Quarterly Bulletin, Michigan State University, Agricultural Experiment Station, February, 1959, p. 493.

[42] Greig (et. al.), op. cit., pp. 512-514.

[43] But this alone is not enough to persuade processors to take a more permissive look at "fresh" varieties. Processing costs must be, and are, considered. These costs, under present technologies, favor the "processing" varieties--so much so that a premium is paid for them, a premium that would not be paid for "fresh" varieties.

between-meal snack followed by use as a breakfast beverage.[44] Varieties do not appear to be considered by the processors as important in influencing consumer preference as they are in sauce and slices. This is in part because most juices are blended and excessive quantities of less desirable varieties as Delicious are avoided.[45]

Interrelationships

Certain segments of the fresh and processed apple market appear to be quite independent. That is, there is no processed apple product that could be considered a close substitute for fresh apples which are eaten out-of-hand or consumed in salads. And it is quite unlikely that many apples are purchased fresh and pressed for juice in the home.

On the other hand, it has been suggested that canned applesauce may be replacing homemade applesauce. The slice question is less clear; but there does seem to be an increase

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[44] Anonymous (A Consumer Survey . . .), op. cit., p. 9.

[45] Much more detail on apple juice and cider is provided in the following reports by this writer:

Marketing Fresh Apple Juice and Cider, University of Connecticut, Department of Agricultural Economics, Progress Report 27, November, 1958. Also, supplement issued in August, 1959.

Market Potentials for Apple Juice and Cider, Michigan State University, Department of Agricultural Economics, Ag. Econ. 804, December, 1960.

in the sale of apple pie mixes and, perhaps, in the purchase of commercially prepared pies. If this is the case, then there may have been some substitution of processed apples for fresh.

This brings up the question of whether the decline in the per capita "consumption" of fresh apples is actually due to a sharply decreased consumption of fresh apples, or whether or not it is largely due to a decrease in home canning and a substitution of commercially processed apples. Perhaps the homemaker is not actually eating sharply increased quantities of processed apples--as the per capita figures might at first suggest--but is merely acquiring her product in a more nearly finished form.

Variations Among Families

Michigan State University Consumer Panel data indicate a wide difference in the quantity of apples purchased per person. For instance, 20% of the families (those that purchased the most fresh apples) bought 68 pounds per person annually, while another 20% of the families bought only six pounds per person. A similar but even more pronounced concentration was found for sauce.[46] Why the difference? We do not know the

[46]J. D. Shaffer and G. G. Quackenbush, Consumer Purchases of Apples, Michigan State University, Agricultural Experiment Station, Special Bulletin 405, December, 1955, pp. 4, 24. It is not reported whether the same households were in the top 20% for both product groupings.

whole answer, but can consider factors influencing fresh and processed purchases.

Fresh Purchases

It seems to be generally believed that income is an important factor in influencing purchases of fresh apples over time. Just how important it is, in any one year, is more difficult to say.

In 1943, Black reported:

> As the family's income increased, its increased expenditure for apples was only to a small extent for more apples; instead it was for whatever higher prices represent--better apples or marketing services.[47]

He felt, therefore, that income influenced primarily the price of apples, not the quantity consumed.[48]

Ten years later, Shaffer and Quackenbush observed that while "There was some indication that families with higher income per capita bought more apples per person than those with lower incomes, . . ." the correlation with per capita income ". . . is very low." But in contrast to Black, they then added that "The same is true in respect to total expenditures for all apples." The conclusion was that "Neither

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[47] Black, *op. cit.*, p. 16.

[48] *Ibid.*, p. 44. He observed that income had the opposite effect on oranges--it had primary influence on the quantity consumed and little relation to their prices.

income nor the other factors (age and education of the homemaker, size of family) appear to be as important as individual taste in explaining the large variations in consumption."[49]

The USDA Household Food Consumption Survey of 1955 seemed to bear out the above observations pertaining to income. The study was conducted from April to June, which is hardly a period of peak apple consumption, but indicated that apple purchases increased moderately as income per household (after taxes) increased to $4,000, then leveled out until incomes reached $8,000 when they jumped sharply--only to decrease as incomes passed $10,000. The "value" per household followed about the same path.[50]

Processed Purchases

The few studies that we have on the influence of income on processed purchases also appear to indicate only a moderate influence of income. The higher income families use somewhat more processed apple products and spend more, but it is not clear that these are significantly higher

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[49] Shaffer and Quackenbush, op. cit. (1955), p. 5.

[50] Anonymous, Food Consumption of Households in the United States, U.S. Department of Agriculture, Household Food Consumption Survey, Report No. 1, December, 1956, p. 124.

amounts.[51, 52, 53, 54]

The amount of canned products purchased in the USDA study peaked out at the $6,000 range, rather than at $8,000 as with the fresh.

Quality of Apples

Variations in apple consumption are often related to variations in quality. Apple quality is composed of many things: color, firmness, sugar and acid levels, freedom from blemishes and bruising, shape, etc. Because quality represents so many characteristics, there is no one generally accepted measure of quality above minimum grade specifications. There are, however, two aspects of quality which are generally thought of particular importance on the retail level and which can be measured and, to a degree, controlled. These are color and bruising.

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[51] H. L. Stier, Director, Division of Statistics, National Canners Association, letter, February 27, 1958.

[52] J. A. Brayton, P. B. Dwoskin, and S. A. Robert Jr., New Concentrated Apple Juice, Its Appeal to Consumers, U.S. Department of Agriculture, Bureau of Agricultural Economics, November, 1951, pp. 25, 38, 40-43.

[53] L. A. Powell, Sr. and Marshall Godwin, Economic Relationships Involved in Retailing Citrus Products, University of Florida, Agricultural Experiment Station, Technical Bulletin 567, August, 1955, pp. 18, 19.

[17] Anonymous (Food Consumption . . .), op. cit., p. 137.

Red Color

It has long been thought that the more red color, the greater the retail sales appeal of the apples--even though the red color may not reflect any inner physiological superiorities in the apple, and which may in fact, reflect an overmature product. Several merchandising studies have shown clear preferences for apples with greater red color (up to 75%) at the same price--but not necessarily at a higher price.[55, 56, 57, 58]

It is not clear just how much color it would pay the grower to try to obtain. If he can obtain enough color by planting red strains of varieties as part of his regular replanting, the cost is not high. But if he has to prune his trees particularly heavily, use special sprays, and risk overmature fruit, the cost may be too high in terms of what the

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[55] M. E. Cravens, Retail and Wholesale Distribution of Apples in Upstate New York, Cornell University, Agricultural Experiment Station, Bulletin 794, May, 1943, p. 16.

[56] Bennett A. Dominick, Merchandising McIntosh Apples, Cornell University, Agricultural Experiment Station, Bulletin 895, May, 1953, p. 18.

[57] Homer C. Evans and Ray S. Marsh, Apple Color--Its Development and Sales Appeal, West Virginia University, Agricultural Experiment Station, Bulletin 396, March, 1957, p. 2.

[58] G. E. Blanch, Apple Quality and Its Effect on Price and Rate of Sale, Cornell University, Agricultural Experiment Station, Bulletin 826, May, 1946, p. 13.

consumer is willing to pay.

Bruising

Bruising presents a similar economic problem. Consumers, naturally, prefer bruise-free fruit, but just how much value they put on bruise-free fruit is also not clear. It is possible to provide fruit nearly free of bruises, but whether the consumer will pay the extra cost is another, and largely unanswered, question.[59, 60, 61]

The answer, as with color, seems to be to continually try to get a bruise-free fruit to the consumer through methods which do not sharply increase cost.

There are many other factors of quality, however, which cannot be controlled, and which vary widely with the crop, the area, and the variety. For this reason, quality in any broad sense is most difficult to measure, let alone control.

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[59] *Ibid*., p. 15.

[60] Dominick, *op. cit*., p. 18.

[61] For further detail see Donald A. Van Waes, "Economic Significance of Bruising on Retail Sales of McIntosh Apples," Cornell University, Department of Agricultural Economics, Ph.D. thesis, February, 1951.

Competitive Relationships

In assessing the consumption of apples, it is necessary to examine their relationships with competitive products. If a change in the price of the other fruit results in a change in quantity of apples purchased in the same direction, a substitute relationship exists; if the quantity purchased changes in the opposite direction, a complementary relationship exists.

Here, particular attention will be given to the competitive relationship of apples with other fruits.

Apples and Oranges

Oranges are generally treated as apples' closest competitor, probably because they are the most important fruit produced in the United States. But before going into statistical studies which incorporate oranges, it might be well to pause and examine the comparative forms and times of consumption.

Consumption

Form. To start with, it should be recognized that two-thirds or more of the orange crop is processed, while only about one-third of the apple crop is so treated. Moreover, most of the oranges are processed into orange juice. At the same time, a portion of the fresh orange crop is pressed for juice in the home. In neither case are apples directly competitive in a major sense because: (a) a relatively small portion of apples are made into juice, and an insignificant quantity is concentrated and frozen--most is sold in cans or as fresh cider; and (b) very few apples are pressed for juice in the home. For the most important processed apple products--apple slices and applesauce--there is no comparable orange product. Thus, only to the degree that (a) apples and oranges are eaten fresh out-of-hand or used in salads and (b) canned apple juice and canned orange juice appeal to the same market, would they appear to be competitive.

Can we quantify this degree of overlapping consumption? Unfortunately, not easily. However, a study conducted by Black and published in 1943 casts some interesting light on this problem. Following an intensive study of orange and apple purchases and consumption in Syracuse, New York, he worked out a comparative consumption rating which is presented in Table 29.

It will be seen that the areas of maximum overlap at that time were out-of-hand and juice. In the 20 years that have elapsed since, there has probably been a decrease in the out-of-hand consumption of both, while at the same time there has probably been an increase in juice consumption.[62]

Table 29. Forms of apple and orange consumption, Syracuse, New York, 1940 season.

Form of Consumption	Apples	Oranges
Out-of-hand	45%	27%
Sauce	23	--
Pie	14	--
Cider & juice	8	69
Baked	5	--
Apple butter	2	--
Salad	1	3
Other	2	1
Total	100%	100%

Source: Black, Consumer Demand for Apples and Oranges (Cornell, 1943), p. 40.

However, the forms of juice purchases are quite different. That is, orange juice is largely concentrated and frozen, while apple juice consumption is divided between canned and fresh juice and cider. This is illustrated in Table 30.

While the canned juices were fairly similar products--both being pasteurized and largely put up in 46 oz. tins--

[62]W. E. Black, Director, Economic and Marketing Research, Florida Citrus Commission, Lakeland, letter, February 22, 1962. Of oranges purchased in the fresh form, a 1958 study suggests that the out-of-hand use was most important, followed, in decreasing order, by drink usage, salads, segments, and cooking. (Esther Hochstim, Homemakers Appraise Citrus Products, Avacados, Dates and Raisins, U.S. Department of Agriculture, Marketing Research Report 243, June, 1958, pp. 20, 21, 90.)

Table 30. Estimated U.S. per capita apple and orange juice consumption, 1959.

Form	Apple	Orange
Canned	.99 lbs.	3.25 lbs.
Frozen	--	13.79
Chilled	1.08*	1.87
Total	2.07 lbs.	18.91 lbs.

*Fresh juice and cider.

Source: Dalrymple (D. G.), Market Potentials for Fresh Apple Juice and Cider (Michigan State, 1960), p. 7.

the "chilled" juices were not. The "chilled" category (adopted for convenience here) for apples included all non-canned and non-pasteurized juices, which means the fresh apple juice and cider largely produced and sold by farm and local cider mills in glass jugs. The chilled orange juice is quite a different product. It is put up by commercial firms in Florida, often treated with heat or chemicals, chemically refrigerated and sold in one or two-quart paper cartons or glass bottles in retail stores. Not only are the products different in these senses, but their uses differ to some extent; apple juice is most often used as a thirst quencher between meals, while orange juice finds its greatest use at breakfast.[63]

[63]For detail see the paper by this writer on "Fresh Chilled Fruit Juice," New York State Horticultural Society Proceedings, 1958, pp. 214-219.

In summarizing the role of form of consumption of apples vis-a-vis oranges, we might quote Drew's recent study, "Although there is probably some substitution between processed apples and citrus products, it does not appear to be an important factor."[64] It would seem, rather, that the major area of direct competition is in the out-of-hand form. Unfortunately, we do not have any recent data comparing these two forms of consumption. An important factor, however, may be timing.

Timing. Timing of fresh apple and orange marketing differs to some extent. Michigan State University Consumer Panel data reveal that fresh apple purchases increase sharply in August and September and reach a peak in October. They begin to decline in November and even out at a lower level in December, which is held until February. Thereafter, they decline gradually for the rest of the season.[65] Fresh orange purchases peak later, becoming most important in the February to May period.[66] Past differences in timing, however, may be mitigated somewhat as Controlled Atmosphere storage makes

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[64] Drew, op. cit., p. 85.

[65] Dalrymple (D. G.), op. cit. (1960), p. 9.

[66] J. D. Shaffer and T. A Creager, Consumer Purchase Patterns for Fresh Oranges, Michigan State University, Department of Agricultural Economics, Consumer Panel, Panel Report No. 38, March, 1957, p. 2.

it possible to market a higher quality apple in this period.

Processing, of course, tends to even out the timing of marketing. But, it would only do so for the canned juices. Fresh apple juice and cider production is very highly concentrated--even more so than fresh apples--in the fall season. Chilled citrus juice, on the other hand, is sold more or less evenly throughout the season.

* * *

In total, it would seem that the maximum competition between apples and oranges would be between the quantities purchased for out-of-hand use in the winter and, to a lesser extent, spring and fall months. Therefore, when oranges are to be considered a competitive product for apples it appears that this form of consumption would be of greatest immediate significance.

Statistical and Empirical Studies

A number of statistical and empirical studies have been conducted which further consider the competitive relationship between oranges and apples.

Quantity of Oranges and Apple Prices. The quantity of oranges available seems to have a less influential effect on apple prices--and in some cases the opposite effect--than many people would realize.

Ockey, in 1938, was among the first to study the influence of orange production on season average U.S. apple price at the farm. It was one of three variables utilized, and not the most important. Moreover, Ockey cautioned that ". . . part of the causal effect attributed to orange production may actually be due to the decline in foreign demand for apples or increased production of other fruits."[67]

The following year, DeGraff investigated factors affecting the farm prices of all apples in the Newfane-Olcott area of New York and concluded that ". . . the size of the orange crop was of no significance."[68]

Also in 1939, Van der Merwe examined wholesale prices for fresh apples on the New York City market. He found that the simple correlation between orange supply and apple price was only -0.08.[69] Even so, a concurrent study in New York

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[67] G. E. Ockey, "Factors Affecting Apple Prices," <u>The Fruit Situation</u> (U.S. Department of Agriculture), August, 1938, p. 8.

[68] Herrell F. DeGraff, <u>Factors Affecting the Year to Year Change in the Farm Price of Western New York Apples</u>, Cornell University, Department of Agricultural Economics, A.E. 276, June, 1939, p. 4.

[69] Claudius Van der Merwe, "Interrelationships of Supply and Prices of Apples, Oranges, Bananas and Grapefruit in the United States, 1910 to 1937," Cornell University, Department of Agricultural Economics, prepared as an M.S. thesis but not used for that purpose, August, 1939, p. 31.

City by Weinland indicated that store managers thought that oranges were an important competitor of apples in the high income groups.[70]

A more extensive study of New York State apple prices by Woodin, published in 1941, indicated that ". . . the net effect of orange production on apple prices is negligible. . . . The orange crop has no appreciable effect on apple prices, either on a year-to-year basis, or over a long period of time."[71]

Moving from orange production to consumption, Black concluded in 1943 that ". . . the quantity of apples consumed in Syracuse households had no influence on the quantity of oranges consumed, or vice versa."[72]

When Henderson examined the influence of selected marketing services on apple sales in 1952, he observed that "Increasing apple sales in this experiment did not decrease

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[70] Donald A. Weinland, "Consumption of Apples and Competing Fruits in New York City as Represented by Independent Retail Outlets for 1937-38," Cornell University, Department of Agricultural Economics, M.S. thesis, June, 1939, pp. 1, 2, 80. The opposite situation was suggested in a Florida study reported 16 years later by Powell and Godwin (op. cit., p. 63).

[71] M. D. Woodin, Changes in Prices of Apples and Other Fruits, Cornell University, Agricultural Experiment Station, Bulletin 773, December, 1941, pp. 9, 11.

[72] Black (1943), op. cit., p. 39.

the sale of oranges by a significant amount." And, ". . . neither orange or apple sales were affected when oranges and apples were displayed side by side."[73] On the other hand, Henderson et. al. went on to note in 1961 that a study of promotion programs revealed that ". . . orange sales followed the same trend as apple sales when apples were advertised." Henderson then stated, "These findings correspond to results found in previous research which indicated that merchandising practices which increase sales of apples also benefit sales of oranges."[74]

As a result of these studies, one is left with the impression that the quantity of oranges has had little measurable effect on apple prices--and if there is an effect, it is not that of a direct competitor.

Orange Prices and Apple Prices. As might be expected from the previous section, there seems to be a tendency for orange and apple prices to move in the same direction.

In 1938, Van de Merwe found a simple correlation

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[73] Peter L. Henderson, "Influence of Selected Marketing Services on Apple Sales," Cornell University, Department of Agricultural Economics, Ph.D. thesis, September, 1952, p. 112.

[74] Peter L. Henderson, Sidney E. Brown, and James F. Hind, Special Promotional Programs for Apples, Their Effects on Sales of Apples and Other Fruits, U.S. Department of Agriculture, Marketing Research Report 446, January, 1961, p. 8.

coefficient of +0.52 between apple and orange prices on the New York market for the period 1909 to 1936. He cautioned though, that this and other correlations ". . . may be due, to a greater or smaller extent, to a failure to adjust completely for the influence of the general price level."[75]

Black went on to observe in 1943 that "Most of the association in expenditures for apples and oranges is not due to the influence of the expenditure of one on the expenditure for the other, but rather to the influence of a third factor, income, on both."[76]

Citrus Prices and Quantity of Apples. Using both single and simultaneous equations, Drew found that fresh citrus appeared to be a complementary product rather than a substitute--an observation that does not seem at all unlikely in view of the two previous sections.[77]

Apples and Bananas

While the nature of the competitive relationship between apples and oranges is cloudy, the relationship with bananas is clearer--though it is an area which has received considerably

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[75] Van der Merwe, op. cit., pp. 35, 38.

[76] Black, op. cit., p. 40.

[77] Drew, op. cit., pp. 128-132.

less attention.

Van der Merwe's 1939 study indicated a simple correlation coefficient of -0.39 between the price of apples and imports of bananas (it will be remembered that the similar figure for oranges was only -0.08).[78]

In 1952, Henderson noted that "The sales of both apples and oranges were decreased when displayed beside bananas."[79] Nearly ten years later he observed that when apples were advertised, banana sales dropped. "These sales results, while not statistically significant, are similar to findings of previous studies which have indicated that apples and bananas are competitive products."[80]

That this could be so should come as no surprise. There are no statistics indicating actual consumption of apples in fresh and processed form, but a market analyst for United Fruit estimates that only about one percent of the total quantity purchased is processed.[81] Since a larger quantity of apples are purchased fresh than any other domestic fruit, one would expect an area of substantial

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[78] Van der Merwe, op. cit., p. 31.

[79] Henderson (1952), op. cit., p. 112.

[80] Henderson, et. al. (1961), op. cit., p. 8.

[81] K. E. Kinsinger, Market Analyst, United Fruit Company, Boston, letter, February 26, 1962.

competitive overlap.

It might, therefore, be well to pay a little more attention to bananas, and perhaps a little less to citrus when considering competitive relationships in the future.

Apples and Other Fruit Products

It has been suggested that the competitive relationship between processed apple and orange products is not particularly close. This is not to say that processed apple products have no specific competitors, but rather to acknowledge that they have not been specifically identified.

Sauce. It has been shown that sauce has several uses that would appear to have few or no direct fruit competitors. These are as an accompaniment with pork and as an ingredient in cakes. However, when sauce is used as a dessert or breakfast fruit, it would compete with a host of other processed fruits.

Slices. Slices are probably most often used for making pies. This is an area in which there are many other ingredients available. In a study of per capita consumption of commercially prepared pies from 1953 to 1957, French found apple pie to be the most important, followed in decreasing order by cherry, blueberry, pumpkin, pineapple and berry pies.[82]

[82] French, *op. cit*. (1959), p. 493.

Juice. Commercially prepared canned apple juice faces a wide range of competitive juices. Farm-prepared fresh apple juice and cider is, on the other hand, a more unique product; and it would be difficult to judge how closely it competed with other fruit beverages. Because of its very concentrated marketing season, competitive items are probably not too important.

Apples and Non-fruit Products

Apples, of course, do not compete only with other fruits and fruit products; they also compete with other foods.

The specification of these other foods, though, is even more difficult than in the case of other fruits. But inasmuch as fresh apples are consumed as a snack item, they probably compete with other items such as candy, cookies, etc.[83] And apple juice and cider consumed as a thirst quencher would face competition from other beverages as soft drinks, coffee, tea, etc.

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In total, despite the aforementioned fragments of information, one is forced to admit that our knowledge of the

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[83]Anonymous ("New Thoughts on. . ."), op. cit., p. 31.

competitive relationship of apples leaves something to be desired. Indeed, today, as in 1927, "We have no complete knowledge of the extent to which bananas, oranges, and other fruits compete with apples."[84]

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[84]Davis, Waugh and McCarthy, *op. cit.*, p. 81.

CHAPTER V

PRICES

Having discussed the factors which influence the supply and demand for apples and the effect of supply and demand on utilization, we now turn to another result of this interaction--the prices for apples.

Retail

Systematic data on retail prices of apples are few and far between. While an occasional study may report some retail prices for a short period of time, there are only two known records of retail prices which cover a period of years. These have been provided by the Bureau of Labor Statistics and the Michigan State University Consumer Panel.

Fresh

The only record of retail prices of apples for the United States for the period from 1947 to 1960 has been collected as part of a series by the Bureau of Labor Statistics of the U.S. Department of Labor.[1] This record covers the

[1] The material presented in this section was obtained by letter from the Bureau of Labor Statistics of the U.S. Department of Labor (see part E of the Reference section for detail).

average mid-month price of U.S. No. 1, medium-sized, all-purpose apples in the leading cities of the United States. Because the number of cities included, the type of stores selected, etc., have changed over the period, the prices have been converted to an index, with 1947-49 = 100.

This series includes price only; no information on quantities purchased is obtained. As a result, it is not possible to compute weighted average season prices. However, one still can trace out the price movement over the season. The average monthly price index for the 1947-60 period is indicated in Table 31.

Table 31. Average monthly retail price index: fresh apples 1947-1960: 1947-1949 = 100.

Month	Index	Month	Index
July	146	January	110
August	115	February	113
September	111	March	117
October	100	April	126
November	101	May	138
December	106	June	156

Source: Computed from Bureau of Labor Statistics data.

Prices dropped from an early season high in July to a considerably lower level in August. They then dropped gradually to a seasonal low in October, then increased at an accelerating rate during the remainder of the season.

There does not appear to have been any particular trend in retail prices from 1952 to 1960. Prior to that period, prices were somewhat lower from 1947 to 1948 and considerably lower from 1949 to 1951. Correlations between production and the October and November price index over the period indicated that production "explained" only 11% and 21% of the variations, respectively, in price.[2]

Fresh and Processed

Data is available in greater detail from the Michigan State Consumer Panel on prices paid for fresh and processed apples over the 1953-57 period. This is presented first on a yearly, then a seasonal basis.

Yearly

For the five-year period studied, the average price paid for all fresh and processed apples (if we divide total expenditures by total quantities) was about 10.17¢ per pound. The average price for fresh market apples was somewhat less, 8.71¢ per pound, while the average price for all processed items was considerably higher, 17.16¢ per pound.

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[2]Whereas variations in production "explained" 47% and 52% of the variation in average farm price for these months during the 1946-60 period. ("Explained" is used here as the equivalent of r^2.)

Prices for individual processed items were recorded for only the last four of the five seasons and were obtained from an average of yearly averages of weekly prices. The most expensive item proved to be dried apples, which averaged about 57¢ per pound (retail weight); while the most inexpensive was cider at 7.33¢ per pound (the only processed item to be less expensive than fresh apples). The detailed breakdown is presented in Table 32.

Table 32. Average retail prices paid for processed apple products, Michigan State University Consumer Panel, 1954-57 crop years.

Processed Form	Price Per Pound
1. Dried	56.99¢
2. Apple-blueberry pie	40.49
3. Apple-cherry pie	38.89
4. Juice baby food	37.20
5. Pie	33.64
6. Sauce baby food	32.24
7. Jelly	29.55
8. Apple-apricot baby food	28.22
9. Frozen	22.40
10. Pie mix	21.17
11. Canned slices	19.76
12. Sauce and butter	15.80
13. Juice	10.32
14. Cider	7.33

It is difficult to make comparisons between the items because of the differing amounts of processing involved. If, however, the processed items are grouped by major category, it is found that the pies and mix averaged nearly 32¢ per pound, followed by: canned, frozen, dried and jelly at slightly over 23¢, sauces (and butter) at nearly 19¢, and juices and cider at nearly 9¢ per pound.

Seasonal

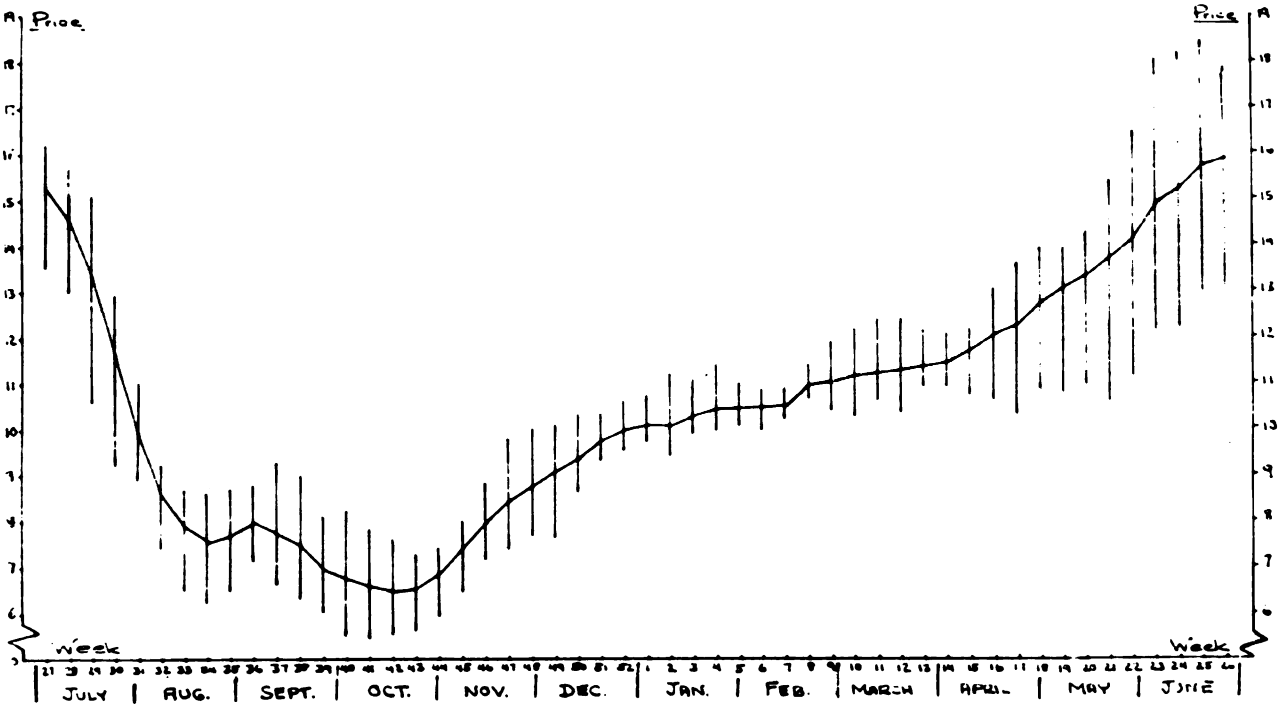
Apple prices were available on a weekly basis for fresh apples and the processed products. Prices were computed on the basis of a three-week moving average and were then plotted for each crop year.

A distinct pattern emerged for fresh apples, but except for cider, the processed products showed no clear-cut pattern.

Fresh. The yearly path for fresh prices can best be analyzed by reference to Figure 3. The curved line represents average price, while the vertical lines represent the weekly range in price paid by each household.

The chart indicates the sort of pattern that might be expected from the BLS figures noted earlier--except possibly for the slight dip in prices in mid to late August. It is to be noted that there was a relatively small amount of variability of price in the January-February period and a much wider amount in July, May and June.

Figure 3. Average retail price paid for fresh apples: cents per pound, Michigan State University Consumer Panel, 1953-57 crop years.



<u>Processed</u>. As suggested, few price patterns were apparent for processed apples, except for cider. The few comments that might be made for each item follow.

Canned sauce and butter: No particular pattern aside from a dip in late January.

Canned sauce baby food: Prices evidenced somewhat less variability through the late fall months than during the rest of the season.

Cider: This item showed the most consistent seasonal pattern of any of the processed items. Prices increased through the first three weeks of September and were then rather constant until December when they began to decline.

Canned juice: Prices were fairly uniform, though they tended to be lower and more variable from August to October, when fresh cider was available in quantity, than later in the season.

Bottled jelly: Price did not seem to follow a pattern, but there was less variability later in the season.

Apple-apricot baby food: Prices were most uniformly steady of any of the products.

Expenditures

Annual Consumer Panel expenditures per person for apples over the five-year period averaged about \$3.36. Of this, over 69% or about \$2.32 was spent on fresh apples, and nearly 31% or slightly less than \$1.04 was spent on processed apples. The most important processed items in this sense were sauce (and butter) and pie, while dried and frozen apples were least important. The exact breakdown is provided in Table 33.

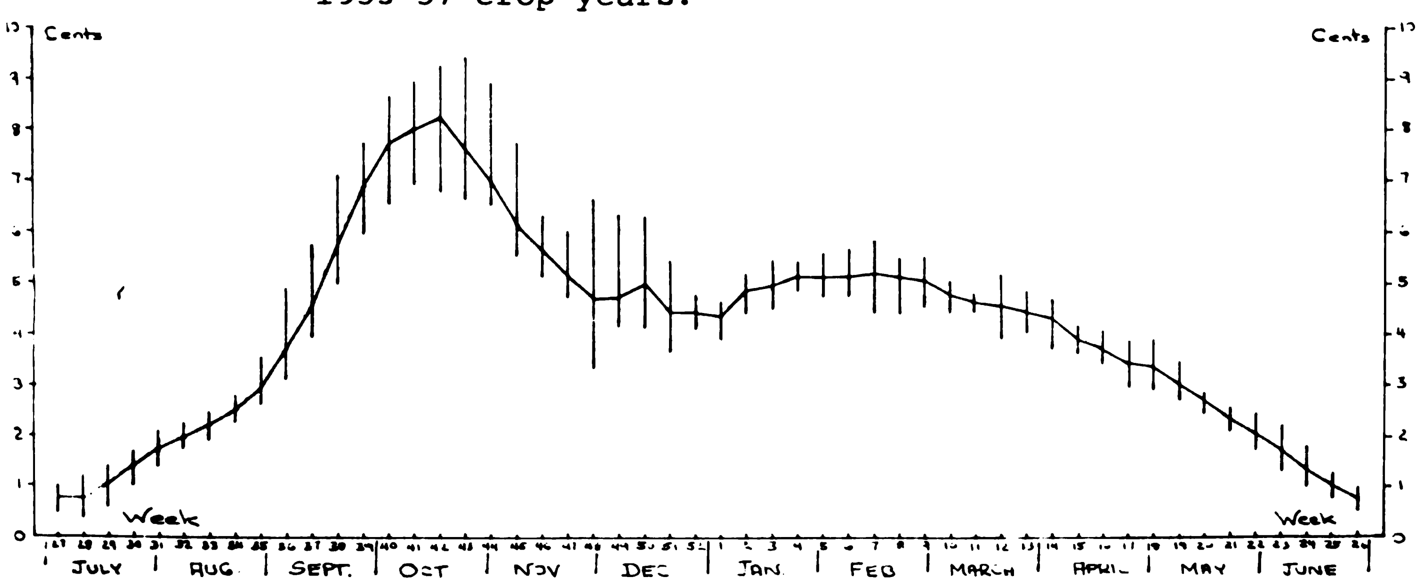
Fresh apple expenditures, when placed on a seasonal basis showed the pattern indicated in Figure 4.

It will be noted that there was, in effect, a slump in expenditures from about the middle of November to the middle of January.

Table 33. Average annual per capita expenditures on apples. Michigan State University Consumer Panel 1953-57 crop years.

Product	Expenditure	Proportion of Total
Fresh apples	232.16¢	69.13%
Processed apples	103.65	30.87
1. Sauce and butter	34.67	10.32
2. Pie	20.17	6.01
3. Cider	12.11	3.61
4. Sauce baby food	10.00	2.98
5. Juice	7.98	2.35
6. Canned slices	6.31	1.88
7. Jelly	3.61	1.08
8. Apple-apricot bfd.	3.03	0.90
9. Pie mix	2.87	0.85
10. Juice baby food	1.78	0.53
11. Apple-blueberry pie	0.60	0.18
12. Apple-cherry pie	0.43	0.13
13. Dried	0.10	0.03
14. Frozen	0.08	0.02
Total	335.81¢	100.00%

Figure 4. Average per capita expenditure on fresh apples, Michigan State University Consumer Panel, 1953-57 crop years.



Processed apple expenditures, like price, showed few patterns. Therefore, we turn back to annual data, which become clearer if we consider product categories. When this is done, expenditures ranged as follows: (a) sauces (and butter), 47.70¢; (b) juice and cider, 21.79¢; (c) pies and pie mix, 24.08¢ and; (d) canned, frozen, dried and jelly, 10.10¢. As a proportion of all expenditures on apples, the figures were (a) 14.2%, (b) 6.5%, (c) 7.2%, and (d) 3.1%. This classification emphasizes the importance of sauces and the less important role of canned, frozen, dried and jelly. Of the total, 14.8¢ or 4.4% was made up of baby food products.

* * *

Between the retail prices noted here and the farm price are marketing margins. These will be discussed in the next section.

Marketing Margins

Before entering the study of marketing margins for apples, we pause briefly to examine the structure of marketing margins.

Structure of Margins[3]

Margins may be considered as being "systematic" or "non-systematic." Attention here will be placed on systematic margins.

"Systematic" margins are of two major types: the absolute (or cents per pound) margin, and the percentage margin (which may be a percent of wholesale or retail prices). Both systematic types of margins may be constant or variable; the constant margins remain the same, in terms of cents or percent respectively, despite changes in price or quantity, while variable margins may increase or decrease. Constant absolute and percentage margins have been fairly well developed in the literature; variable forms of each margin have been less well explored and will not be discussed in detail here.

The absolute margin involves the addition of a dollars and cents margin to purchase price. As indicated, this margin may be fixed or it may increase or decrease with price and quantity. In most cases it is sufficiently rigid that the price elasticity of demand at retail is greater than at the farm level. In general, with a given retail demand

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[3]Greater detail on this subject is provided by this writer in On the Nature of Marketing Margins, Michigan State University, Department of Agricultural Economics, Ag. Econ. 824, April, 1961.

function and price constant, changes in absolute margins result in opposite changes in elasticity of demand at the farm level (that is, as margins increase, elasticity of derived demand decreases, and vice-versa).

The percentage margin involves the calculation of margin as a percent of purchase or sale price. The percentage may be constant, or it may increase or decrease with price or quantity. In the case of the constant percentage margin, price elasticity of demand at retail is equal to that at the farm.

Empirical Studies

Actual studies of margins on apples have been conducted for fresh apples only. No published information is known to be available for processed apples.

Prewar

Several studies conducted prior to World War II touched on some of the theoretical phases of margins noted in the previous section. All related to fresh apples.

In 1927, Warren and Pearson examined the prices for five leading varieties of apples and noted that "When there is a very large crop, the price in a surplus area is so reduced that the spread between farm and retail prices is increased." The increasing spread they referred to was of an absolute, rather than percentage basis. This is a little surprising, for as they acknowledged, "One would assume that a large crop could be passed through the channels of trade at less cost per bushel than a small crop."[4]

In 1935, Oliver observed that ". . . it costs a greater percentage per bushel to distribute a large crop than to distribute a small crop."[5] More specifically, he reported that in years when the crop was 23% above average, the margin was 55% of the wholesale price; whereas in years when the crop was 23% below average, the margin was only 24% of wholesale price.[6] Oliver recognized that this was due to the fact that "Distribution costs are made up principally of wages and other fixed changes and have little fluctuation from year-to-year."[7]

The inflexibility of the intermediate marketing costs was also noted by Woodin in 1941. For this reason, he stated that "The elasticity of demand at the point of purchase by

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[4]G. R. Warren and F. A. Pearson, "Apple Prices," Farm Economics (Cornell University), October, 1927, p. 779.

[5]Russell V. Oliver, "Factors Influencing Apple Prices in Virginia," Virginia Polytechnic Institute, Department of Agricultural Economics, M.S. thesis, 1935, p. 85.

[6]*Ibid.*, p. 174.

[7]*Ibid.*, p. 85.

consumers probably is higher than at point of sale by producers. . . ."[8]

Postwar

Starting in 1946, several investigations were conducted which came much closer to isolating the specific nature of margins.

In that year, Blanch reported that retailers tended to add about the <u>same</u> mark-up in cents to the purchase price, regardless of purchase price. In other words, the margin as a proportion of selling price was higher on lower-cost fruit and less with higher-cost fruit. He felt that this was a defensible practice because ". . . it costs a retailer as much, or more, to handle a pound of low-priced fruit as a pound of high-priced fruit." The possibly higher margin required on low-priced fruit, according to Blanch, might be necessitated because of higher spoilage or wastage.[9] This latter point is an interesting one; and if poorer quality could be associated with larger crops,[10] it might bear out, to some

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[8] Woodin, <u>op. cit</u>., p. 21.

[9] Blanch, <u>op. cit</u>., pp. 47, 48.

[10] In this respect it may be noted that of what pomologists considered the three poor quality crop years since 1946 (Skinner, <u>op. cit</u>., p. 71), two came in years of large crop.

extent, the phenomenon noted earlier by Warren and Pearson.

The nature of the wholesale as well as retail margins were defined by Zahn in 1951. In an extensive study in Denver, he found that wholesalers applied a constant percentage mark-up, while retailers were more variable, but (as Blanch reported) most often applied a constant dollar margin. Consequently, the wholesale-retail margin fell between a constant percentage and a constant dollar margin.[11]

Lee, the following year, reported on a detailed investigation of retail margins in Pittsburgh. He compared margins for eastern and western apples and found that for western apples the absolute margin was higher while the percentage margin was lower--both reflecting the higher wholesale and retail prices on western apples.[12] In contrast to Zahn and Blanch, he did not find that one method provided a satisfactory explanation of variation in margins.[13] But,

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[11] G. D. Zahn, Marketing Washington Apples in Denver (1948-49 Season), State College of Washington, Agricultural Experiment Station, Circular 148, May, 1951, p. 13.

[12] Wayne A. Lee, Marketing Margins for Selected Fresh Fruits and Vegetables Sold in Pittsburgh, July 1950-January 1951, Pennsylvania State College, Agricultural Experiment Station, Progress Report 87, September, 1952, pp. 10-13.

[13] Ibid., p. 29. A USDA study conducted in the same city a year later reported "Most of the stores had no consistent pricing policy for apples." (H. W. Bitting and H. T. Badger, Marketing Charges for Apples Sold in Pittsburgh, December 1949-May 1950, U.S. Department of Agriculture, Agriculture Information Bulletin 47, June 1951, p. 2).

a few years later, in 1955, he allowed that ". . . retailers in the aggregate apparently use pricing policies that result in margins somewhere between a constant dollar mark-up and a constant percentage mark-up."[14]

The exact nature of the retail margin then probably varies somewhat with the area and the size of store--but, in any case, it looks as though total marketing margins for apples are structured largely of constant dollar and, to a lesser extent, percentage units.

Size of Margins

Most margin studies are not so much concerned with the structure of margins as with measuring their total magnitude. This is, of course, indicated by the difference between farm and retail price and is reported in dollar terms (not to be confused with a dollar or absolute margin) or as a percent of retail price (not to be confused with a percentage margin).

These measurement studies are of a continuing and a momentary nature.

Continuing Studies

The U.S. Department of Agriculture reports data that

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[14] W. A. Lee and L. E. Fouraker, "Profit Maximization and Margins in the Retailing of Perishables," Journal of Marketing, October, 1955, p. 171.

reveals marketing spreads for apples on a quarterly and an annual basis.[15]

On a quarterly basis, the margin does not vary sharply; but it appears that the spread, as a proportion of retail price, is lowest during the October-December period and highest in the April-June period. The average figures for the postwar period are reported in Table 34.

Table 34. Marketing spreads for fresh apples, U.S., 1946-60.

Period	Proportion of Retail Price
1. July-September	67%
2. October-December	62
3. January-March	65
4. April-June	69
Season Average	66%

Source: Computed from Economic Research Service statistics.

These variations in margins are probably related to some degree to seasonal fluctuations in retail spoilage. The lowest margin was found when apple spoilage was at a minimum, while the highest margin was found during a period when spoilage was probably at a peak.

[15] Data on marketing spreads is issued periodically by the Economic Research Service of the U.S. Department of Agriculture (see part E of the Reference section for detail).

Over the 1946-60 period, marketing spreads averaged about 66%. In general, the margin went up moderately through the period. Calculation of a trend line indicates that this increase was at the rate of about 0.56% per year--probably reflecting increased services. And, as suggested by Oliver, the margin appeared to be higher (70%) during the large crop years than it was during the small crop years (64%).

Special Studies

The U.S. Department of Agriculture, in cooperation with several states, sponsored several margin studies in the early 1950's which were of a more analytical nature.

Several covered the margins on western apples sold in Chicago and Pittsburgh. Margins for western Delicious apples sold in Chicago during the 1947-48 season were found to average nearly 74% of retail price, with 34% ($1.74) going for the wholesale-retail margin.[16] During the 1949-50 season in Pittsburgh, western apples showed a slightly higher margin, 76%, with 30% ($1.60) going to the wholesale-retail margin.[17]

During the same season in Pittsburgh, eastern apples

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[16] H. H. Reizenstein and H. W. Bitting, Farm-to-Retail Margins for Washington Delicious Apples Marketed in Chicago, 1947-48 Season, U.S. Department of Agriculture, Agriculture Information Bulletin 6, December, 1949, p. 5.

[17] Bitting and Badger, *op. cit*., p. 10.

had a slightly higher margin than western apples in percentage terms, 78%, and the wholesale-retail section was particularly high, 43%.[18] However, the wholesale-retail margin in dollar terms was almost identical with that of the higher-priced and lighter-weight western box. The amount going to the wholesaler for eastern apples was \$0.07/bu. less (\$0.33/bu. vs. \$0.40/bu.), but the amount going to the retailer was higher by \$0.08/bu. (\$1.28/bu. vs. \$1.20/bu.).[19]

In the case of both eastern and western apples, then, the proportion going to the wholesaler was about the same (8.8% vs. 8.6%), while the proportion taken by the retailer varied much more widely (34.3% vs. 23.4%). This adds some support to Zahn's earlier hypothesis that retailers tend to add an absolute margin, irrespective of the cost of the apples to them.

It is unclear why the retailer would have charged both a higher absolute and percentage margin on eastern apples,

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[18] Ibid. Approximately the same eastern figures were reported for Chicago by Reizenstein and Bitting (H. H. Reizenstein and H. W. Bitting, Farm to Retail Margins for Appalachian Apples Marketed in Pittsburgh, 1949-50 Season, U.S. Department of Agriculture, Agriculture Information Bulletin No. 44, April, 1951, p. 5). Also see H. W. Bitting, "Problems in Measuring and Analyzing Marketing Margins for Selected Fruits and Vegetables," University of Minnesota, Department of Agricultural Economics, Ph.D. thesis, April, 1952.

[19] Bitting and Badger, op. cit., p. 10.

but one suggestion may be put forth: the study was conducted from December, 1949, to May, 1950, a period which was less favorable in terms of store quality for eastern apples (Controlled Atmosphere storage was still very limited) than it was for the harder western varieties. Therefore, the spoilage rate might have been higher on eastern apples, necessitating a higher margin. This hypothesis seems to have been borne out in another study conducted from July to January in Pittsburgh the following season. Wholesaler-retailer margins on eastern apples in this case were \$0.23/bu. less than on the western apples.[20]

* * *

No further special margin studies seem to have been done on fresh apples since the early 50's. And nothing at all has been done on processed apples. But the over-all message seems clear: marketing margins are largely composed of inflexible absolute charges; the only fairly consistent flexible unit is the relatively small percentage wholesaling margin.[21] Consequently, the price elasticity of demand at

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[20] Lee, op. cit., pp. 10-12.

[21] And, depending on the method of sale, perhaps a brokerage type of percentage margin for selling.

retail will be higher than the derived demand at the farm level.

Farm Prices

The U.S. Department of Agriculture reports national apple price data at the farm level for the following categories:[22]

- All apples
  - Fresh apples
  - Processing apples
    - Canning and Freezing
    - Drying
    - Other processing

While the processing prices are reported on a ton basis for fruit only, the fresh price quotation, even though it refers to a 48-lb. bushel, has several different meanings. In Washington and Oregon, the fresh price is on the basis of equivalent packing house door returns. According to the USDA, this represents:

> . . . actual prices adjusted to apply to returns at the packing house door. That is, the F.O.B. price is adjusted to the incoming packing house door by subtracting all costs that accumulate between the incoming packing house door and the F.O.B. local shipping point such as grading, packing, packing material, inspection fees, selling and other costs.[23]

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[22]These prices are issued by the Crop Reporting Board of the Statistical Reporting Service. See listing in part E of the Reference section.

[23]Anonymous, <u>NonCitrus Fruit Prices by States and</u>

In California, the price represents "equivalent first delivery point"; this is not defined. In all other states the price is "as sold." Thus, the fresh price quotations represent quite a different item in the Pacific states than they do elsewhere. Even so, the "all" fresh category just represents a lumping together of these three specifications.

In no case is this series of data available on a variety basis.

In the following sections, attention is first directed to prices on a national level and then on a regional and a state basis.

National

There is a difference in the price data available on a yearly and on a monthly basis. Yearly data is available for all the categories noted above, while monthly averages are available only for fresh apples.

Yearly

Yearly prices may be looked at in terms of actual dollars or may be converted to percentage relationships.

United States, Agricultural Prices (U.S. Department of Agriculture), Supplement No. 2, July, 1961, p. 2. Container is not included in these prices. (B. R. Stauber, Chief, Agricultural Price Statistics Branch, Statistical Reporting Service, U.S. Department of Agriculture, letter, April 27, 1962).

Actual Prices. Over the 15-year period from 1946 to 1960, the average price for all apples was $1.78 per bushel. The average for all fresh apples was $2.15 per bushel, while conversion of processing prices to a 48-lb. bushel basis indicated an average of $0.94. However, the processing price varied considerably between form of utilization; that for apples sold for canning and freezing averaged about $1.26/bu., and that for "other" (principally juice and cider) averaged $0.54/bu.[24]

In evaluating these figures, several differences must be kept in mind. First, the fresh price in the eastern and central states generally includes container and grading. And since it is an average price over a season, it also may include storage. On the other hand, the processing price is for apples only; none of the above three services are involved. Secondly, it is obvious that the processing market is not a homogeneous entity. The canning and freezing price is considerably different from that for "other" outlets--reflecting the fact that the former is a "first-line" outlet, while the latter is a salvage operation.

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[24]Data for individual years are presented in Appendix C, Table 12. In order to simplify the presentation, drying apples are not listed separately here but are included in the "all"processing price.

Despite these problems, it still may be of interest to make a comparison between fresh apple price, and that for canning and freezing. When this is done for the 15-year period, it appears that the fresh price ran $0.89/bu. higher. Whether, after deducting costs of packing, storing, etc., for fresh apples, there is a significant difference is another matter.

When fresh and processing prices were plotted over the 15-year period studied in this paper, they appeared to follow each other quite closely, with the exception of a dip in processing prices in 1951.[25] If there was an upward trend in either fresh or processing price, it seemed to be offset by deflating the price by the cost of goods and services index.[26]

When the prices were averaged by crop size classification, the usual inverse relationship between price and quantity was evident. This is illustrated in Table 35.

This relationship was further illustrated by correlating yearly prices with production. When this was done, it appears that fluctuations in production explained 53%

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[25]When fresh prices were compared with canning and freezing prices, they appeared to follow each other closely, except in 1948 and 1951.

[26]This index was obtained from The Farm Cost Situation (U.S. Department of Agriculture), November, 1960, p. 2.

of the variations in the price of all apples, 43% of the price of fresh apples, and 22% of the price of processing apples. Curiously, in each case, price was most highly correlated with production in the west (the respective figures being 45%, 55%, and 20%) and least correlated with production in the east (the respective figures being 18%, 8%, and 5%).

Table 35. U.S. apple prices by use and crop size, 1946-60. Price per bushel.

Category	Crop Size		
	Small	Medium*	Large
All apples	$2.03	$1.87	$1.43
Fresh apples	2.40	2.26	1.78
Processing apples	1.09	0.98	0.74
Canning & freezing	1.42	1.37	1.00
Other processing	0.63	0.55	0.45

*If 1946 is excluded (it was the first year of production after the severe freeze of 1945), the prices for this column are, respectively; $1.82, 2.22, 0.93, 1.27, and 0.52. "Other" processing here and in the following tables is principally juice and excludes drying apples.

Source: Computed from Crop Reporting Board statistics.

<u>Prices in Percentage Terms</u>. It may be more convenient, in examining the relation between fresh and processing prices, to turn from actual figures to percentages.

The percentages may be calculated in two ways:

(a) fresh and processing apples as a proportion of "all" apples within each season.

(b) fresh and processing prices as a proportion of the 15-year average for each utilization.

The first method will be noted below as the within season category, while the second will be listed as the between season category.

Within Season. Fresh apple prices from 1946 to 1960 were about 21% higher than the average for "all" apples, while processing apples were 47% below. The processing prices, in turn, were broken down into canning and freezing prices which were only 29% below the "all" average, and "other" prices which were 70% below.

For individual years during the period, fresh prices ranged from 114% to 128%, while processing prices ranged from 38% to 66% of the average for "all" prices.[27]

While this kind of measure does away with the problem of accounting for changes in the price level, it introduces problems of its own. The principal problem is that fresh apple utilization is about twice as large as processing so that the "all" apple price is apt to be much closer to fresh than it is to processing price.

Another approach is to express processing prices as a percentage of fresh prices. When this was done, processing

[27] Canning and freezing prices ranged from 50% to 89%.

prices were found to average about 43% of fresh prices, varying from 30 to 57%.[28] Processing prices represented a slightly smaller proportion of fresh prices in the large crop years (42%) and a slightly larger proportion in the small crop years (45%).[29] The reasons for this variation are probably related to elasticities of demand and will be discussed early in the next chapter.

Between Seasons. In this section, a different approach is taken to the examination of price. This is done by comparing apple prices with the 15-year average for that utilization. This overlooks the problem of deflating for changes in the level of prices but provides a clearer picture of the difference in fluctuations in fresh and processing prices.

And the picture is again one of wider fluctuation in processing prices than in fresh prices. The range was from 64 to 127% for fresh apples and from 58 to 161% for processing apples.[30]

When prices are grouped by crop size (Table 36), the

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[28] Canning and freezing prices averaged nearly 59% of fresh, ranging from 40 to 74%.

[29] Comparable figures for canning and freezing were 57% and 59%.

[30] Prices for canning and freezing apples paralleled those for all processing apples, but showed slightly less variation. Their range was from 68 to 154%.

somewhat wider fluctuation in processing prices is seen.

Table 36. U.S. apple price by use and crop size (as proportion of period average for that utilization).

Category	Crop Size			
	Small	Medium	Large	All
All apples	114%	105*	80	100%
Fresh apples	112	105	83	100
Processing apples	116	104	79	100
Canning & freezing	113	109	79	100
Other processing	117	102	83	100

*When 1946 is omitted, the figures in this column become respectively, 103%, 103, 101, 103, and 98.

Source: Computed from Crop Reporting Board statistics.

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According to both methods of computing annual prices in percentage terms then, fresh prices showed less fluctuation than processing prices.

Monthly

Monthly prices are reported only for fresh apples. This is because fresh apple sales are conducted throughout the year, while processed apple sales are largely concentrated in one or two months during the fall. For our purposes, a crop year will be defined as beginning in July and ending in June. Prices noted for each month are based on mid-month quotations. Controlled Atmosphere and regular storage apple prices are not reported separately in this series.

Actual Prices. During the period from 1946 to 1960, the average monthly prices for fresh apples varied from a seasonal low of $2.03/bu. in October to a seasonal high of $2.50/bu. in June. The figures for each month are listed in Table 37. (Data for individual years are presented in Appendix C, Table 13.)

Table 37. U.S. average monthly price of fresh apples, 1946-60.

Month	Price	Month	Price
July	$2.29/bu.	January	2.16
August	2.21	February	2.14
September	2.20	March	2.14
October	2.03	April	2.20
November	2.10	May	2.32
December	2.17	June	2.50

Source: Computed from Crop Reporting Board statistics.

It will be noted that September prices were just a little below August price, and that after rising in December, prices dropped off gradually through January, February and March, only to start rising again in April.

The correlation between production and season price was noted earlier. If production and monthly price are now correlated, it is found that variations in U.S. production explained 26% of the variation in September price, 47% of October price, 52% of November, 52% of December, 48% of January and 12% of June price. Significantly, when the September crop estimate was substituted for the final estimate used above, the percentages increased to 48%, 69%, 63%, 63%, 53%, and 24%, respectively. It appears then that prices are based more heavily on the estimated, rather than actual size of crop. This point will be developed further in the next chapter.

Prices in Percentage Terms. Prices may be further related to (a) the yearly average, (b) crop size, and (c) the proportion of the crop in storage.

Period Prices. Prices were first averaged for each month over the 1946-60 period and expressed as a proportion of the average seasonal fresh price for the period ($2.14). This process revealed that prices ranged from 5% below average in October to 16% above average in June (Table 38).

These monthly figures can also be calculated in another way. Rather than taking average prices for the period and computing percentages, as was done above, each year might be studied individually with monthly price plotted as a proportion of the season average. One can then add the percentage for each month and compute another average. Averaging of percentages is generally not recommended, but avoids the problem of deflating prices, and provides a method of checking the above calculations. As it turns out, the percentages obtained in this way differ from the previous method only by 1% from October on; prior to that they averaged 2 to 3% higher.

Table 38. U.S. average monthly price of fresh apples, 1946-60 (proportion of season average).

Month	Proportion	Month	Proportion
July	107%	January	101
August	103	February	100
September	102	March	100
October	95	April	102
November	98	May	108
December	101	June	116

Source: Computed from Crop Reporting Board statistics.

<u>Prices by Crop Size</u>. If the yearly price estimates just noted are combined into five-year periods representing large, medium, and small production, the influence of size of crop on seasonal price movement can be noted. This influence can also be studied by calculating monthly prices as a percentage of the 15-year average for that month and by combining into the three periods noted above.[31]

[31]These classifications are equal, respectively, to the "within" and "between" seasons classifications used earlier in this section.

Either method indicates that in large crop years, prices were high from July to September, low from October to March, closer to average in April and May, and high in June. Small crop years showed almost the opposite pattern; that is, prices were low from July to September, high from October to March, closer to average in April and May, and variable in June.

These movements support the correlations presented in the previous section. The July, August, and to a lesser extent September prices represented months when few apples are marketed and season production is probably not very important in determining fresh price. But from October on, as previous correlations have suggested, total production is more important in determining monthly price (with heavier production resulting in lower seasonal price, and vice versa). This influence becomes less important as the season progresses and by April or May has about died out. Also, in these spring months, in recent years, Controlled Atmosphere storage has been particularly important.[32]

<u>Proportion of Crop in Storage.</u> The above section suggests that production slipped in importance in influencing

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[32] Three of the large crop years were during the last four years of the period when Controlled Atmosphere storage was expanding sharply.

price later in the season. Consequently, it seems appropriate to try to relate price to some other measure for grouping crop years such as storage stocks. If one looks just at magnitude of December 1 stocks, there is little difference in the listings from those obtained only on the basis of crop size. If, however, the proportion of the crop in storage on December 1 is examined, there is a difference in ranking which is not closely associated with size of crop. Two five-year periods were selected, one including years when less than 37% of the crop was in storage (1948, '49, '51, '52, '59) and the other including years when more than 39% of the crop was in storage (1947, '50, '55, '57, '58).

These classifications were then averaged by the two methods indicated at the beginning of the previous section. The results were rather startling. In both cases, in the years when less than 37% of the crop was in storage, the prices climbed sharply from October to June. The climb leveled off a bit in February and April, but the over-all trend was distinctly up. On the other hand, in the years in which more than 39% of the crop was in storage, the price dropped steadily and without hesitation from November to March. Thereafter, it varied in April and May, and rose somewhat in June.

To check on this relationship, a correlation was run between proportion of apples in storage, and average price in March and June. It was found, however, that the December 1 storage figure explained only 27% of the variation in March prices and 31% of the variation in June prices. These relatively low correlations suggest that there may be a great deal of yearly variability in the above relationship. This was shown to be the case when data for individual years were plotted.

Despite this variability, this relationship seems worthy of further study.

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With this we conclude study of average U.S. prices and turn to an examination of prices by regions and states.

Region and State

Regional comparisons of price are made difficult by the differences in reporting specifications for fresh apples noted earlier in this section. That is, western fresh prices are for apples as they arrive at the packing house, while eastern apple prices are "as sold." The former excludes container and grading; the latter may include both.[33]

Region Prices

Bearing the variations in reporting in mind, it may at least be of interest to lock at the regional differences in prices. For the 1946-60 period, the average price for all apples in the east was $1.79/bu., while in the central states it was $1.92/bu., and in the west $1.72/bu. In other words, eastern prices were 1% above the U.S. average, central prices 8% above, and western, 3% below. With the higher proportion of the crop in the west sold fresh, one would expect the prices to be higher there than in the east. The answer probably is in the method of price reporting noted above.

Independent of this problem, however, is the variability in prices within the three regions. On a yearly basis, compared to the U.S. average price, region prices varied as follows: east, -10% to +18%; central, -5% to +28%; west, -25% to +15%. When yearly data were plotted graphically, the western states appeared to show the most variability in prices, while the central and eastern states were fairly evenly matched. Since the central and western states each sold about

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[33]But because the central and eastern apples include an unknown portion sold without grading or container, it would be hazardous to try to convert their prices to an equivalent of a western price.

the same proportion of their production to fresh and processing, it is difficult to understand the reason for the greater price variability in the west.

State Prices

In the previous section our purview was limited to the average prices for all uses; here we shall look at each utilization independently for each of nine states.[34] The variations between the various states can be most conveniently expressed in tabular form (Table 39).

In the previous section, it was noted that the average price quoted in the west was lower than in the east. Here, ignoring for the moment the difference in fresh price reporting, the situation on the state level is a little different. In New York, the No. 2 state in production, for instance, prices were clearly lower than in Washington, the No. 1 state in production--the relationship being closely related to utilization (in New York 52% of the crop was sold fresh, while in Washington 87% of the crop was sold fresh). The "eastern" price, however, was pulled up by the Appalachian states (and those not listed, particularly New England where 87% of

[34]The selection was limited to nine because the processing price is broken down by state only for those listed here.

Table 39. State apple price by use, 1946-60 (as proportion of U.S. average for that utilization).

State	Utilization: All Apples	Fresh	Processing
New York	91%	100%	109%
Pennsylvania	101	112	120
Maryland	112	114	123
Virginia	93	104	116
West Virginia	98	105	121
Michigan	97	98	91
Washington	102	92*	64
Oregon	81	76*	78
California	73	93*	101
United States	100%	100%	100%

*The western price is on a packing house door basis. The others are on an "as sold" basis.

Source: Computed from Crop Reporting Board statistics.

of the crop was sold fresh), while the "western" price was pulled down by California (where only 33% of the crop was sold fresh).

While the state breakdown clears up this point, it suggests several complications of its own. Why does the "all" apple price in the eastern states and California run relatively lower than <u>both</u> the fresh and processing price for those states, while the reverse is true in Washington and Oregon? Since the former states are primarily processing states and the latter two primarily fresh states, the reason may be related to utilization. A further cause may be the fact that the nine states listed include the bulk of the processing market and a smaller portion of the fresh market. But even if the situation is somehow explained by these factors, there are several other points which they do not cover.

Why, for instance, is there such a difference in price within a utilization category between the eastern states? In general, the states with the heaviest production might be expected to have somewhat lower prices because the local market is more nearly saturated. But when production is so concentrated in one geographic area, as it is in the Appalachian region, it is difficult to understand how two states (Pennsylvania and Maryland) can have substantially higher prices for fresh apples than two adjacent states (Virginia and West Virginia).[35] On the other hand, the Appalachian region, over the 1946-60 period, had notably higher processing prices than New York. Yet, when the processing price was broken down, the canning and freezing price in New York (102%) was little different from that in the Appalachian region (about 103%). More variation between regions was shown in

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[35]If only the 1956-60 period is considered, Pennsylvania drops down to join Virginia and West Virginia. In either case, the four states sell about the same proportion of their crops to the fresh and processed market.

the "other" processing price,[36] New York (95%) running below Pennsylvania, Maryland (108%) and West Virginia (100%), but well above Virginia (85%). Combining the two prices, one wonders why the New York "all" processing price is relatively as low as it is.

And among the western states, there are also some peculiarities. First, it is difficult to see why Oregon should have such a low fresh price compared to Washington and California. Secondly, while Washington has a very low "all" processing price (64%), neither its canning and freezing price (77%) nor its "other" processing price are so low. The reverse situation holds for Oregon.

* * *

An examination of state prices in the terms used here seems to raise more questions than it answers. It may be that the method of computing prices as a proportion of national average prices distorts the relationship between the "all" category and "fresh" and "processing," and between "all" processing and "canning and freezing" and "other." But it does not explain why some peculiar differences exist within each group. It may well be that there is something in the

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[36]Principally juice; excludes drying.

price reporting system that leads to these abberations.

Price Reporting

In the previous section some of the problems of comparing USDA statistics on apple prices were noted. Yet these are not the only problems.

The prices reported are averages, which means that they can and do include a tremendous range in prices. This is less of a problem in processing prices which are pretty much a standard tree-run unit (cwt.); but when one deals with fresh apples, the range in sizes, varieties and grades of apples--as well as containers--is very wide. Not only is there a large number of possibilities within any one season, but the "mix" varies from season to season. Red strains of varieties and consumer packages of many different-sized units, for instance, have become much more important in recent years.

This makes for a bewildering array of different "specifications" if one is trying to maintain a series of prices over a period of years--as this writer found when he started studying prices to farmers for apples during the 50's on the Benton Harbor market. And even here, there was some question as to the validity of the market prices when a large portion of the sales are felt to bypass the farmer's market.

Because of the rapidly changing nature of packages and sales methods, it would seem desirable for growers or the government to try to develop a farm price series for fresh apples, exclusive of container and selling costs--a price for fruit only.[37] This would be similar to the current Washington price. But more than this, price quotations should be extended to cover the major varieties. Because most apples are sold on a graded basis, perhaps prices on a grade and size breakdown should also be included.[38]

This is, in fact, roughly the sort of information that has been gathered by state fruit traffic organizations--first in Washington,[39] and more recently on a considerably more modest basis in Connecticut. These associations, sponsored by growers, issue complete periodic reports to members on sales. The reports do not include just a fruit price, as recommended above, but rather report on prices

[37] Even though the price quoted to the grower includes container, the costs of such units are fairly well known to growers.

[38] Since growers sell most of their fresh fruit on a graded basis, they know what they are being paid for the final unit. But since most don't know what their grade-out is, it would be difficult for them to correct the graded price into a tree-run price.

[39] Dick Larson, "Washington Growers Clearing House," Western Fruit Grower, December, 1961, pp. 9-11.

with container. In both cases, however, a much more uniform pack is involved than would be true on a nation-wide basis.

This writer, then agrees with Drew when he says:

> By far the most important problem encountered concerns the basic data. It would be difficult to overemphasize the problems encountered in obtaining accurate empirical data concerning prices and sales of fresh and processed apples by grades, varieties, and origin of production.[40]

Farm Value

The farm value figures of the Department of Agriculture are of two types: (1) farm value of production and (2) farm value of sales.[41] For the former, production having value is multiplied by price. Production having value includes apples used in the farm household but excludes quantities not utilized because of economic conditions--that is, fruit not harvested and excess cullage. The farm value of sales category excludes both quantities not utilized because of economic conditions and quantities used by the farm household. In this section we shall refer to both types of farm value, but will be most concerned with the value of sales.

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[40] Drew, op. cit., p. 140.

[41] These statistics were computed from data provided by the Crop Reporting Board, Statistical Reporting Service. Data for individual years are listed in Appendix C, Table 14.

Value of Production

Over the 15-year period from 1946 to 1960, the average farm value of production of apples was $191.8 million. The yearly figure ranged from a low of $135.6 million in 1949 to a high of $238.7 in 1946,[42] and $238.2 in 1960. As indicated, this figure includes farm consumption. Because the quantity of apples consumed on the farm is fairly low (averaging 3.1%), is declining gradually (about 0.2% per year), and probably does not play a vital role in price determination, we shall move directly on to value of sales.

Value of Sales

The actual farm value of apple sales averaged $185.4 million from 1946 to 1960 ($182.3 million if 1946 is excluded)--ranging from a low of $129.6 million in 1949, a large crop year, to a high of $233.5 in 1960, a medium-sized crop year. The trend over the period followed that for value of production quite closely.

If, however, the value of sales figures are deflated by the index of cost rates and prices paid by farmers in the

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[42] The 1946 season was unusual in two respects: (1) it followed the very short crop of 1945 when most of the country's fruit areas were severely frozen out, and (2) it was the first year when price controls were released (Harrington, op. cit.). For these reasons, the value of production may have been abnormally high.

United States[43] to account for changes in the price level, the picture is somewhat different. The average value of sales is pushed down to $171.7 million, and the range varies from a low of $128.3 million in 1949, a large crop year, to highs of $275.4 million in 1946, a medium-sized crop year, and $195.7 in 1954, also a medium-sized crop year.

In the case of both the deflated and undeflated values, the highest sales values were in the medium-sized crop years, and the lowest sales values were in the large crop years. How true was this more generally?

By grouping the 15 years from 1946-60 into three periods, representing small, medium and large crops, the relationship of size of crop to sales value may be studied. We have noted both actual and deflated values, and the inclusion and exclusion of 1946, so all of these are included. The results are presented in Table 40.

In every case, the farm value of sales was higher in the small crop years than it was in the large crop years--the percentage ranging from 9.8 to 9.9% higher using actual figures, and 10.3 to 10.7% higher using deflated figures.

The situation with respect to medium-sized crops, which initially suggested this investigation, was less clear.

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[43]This figure was obtained from The Farm Cost Situation, op. cit.

When 1946 was excluded, the farm value of medium-sized crops was 0.5 to 0.7% higher than that for small crops and 10.4 to 11.4% higher than for large crops. When 1946, with its unusually high prices was included, the value of the medium-sized years was considerably higher.

Table 40. U.S. farm value of apple sales by size of crop.

	Crop Size			
Period	Small	Medium	Large	Average
1946-60				
Undeflated	101.7%	106.4%	91.9%	100%
Deflated*	99.2	111.9	88.9	100
1947-60				
Undeflated	103.4	103.9	93.5	100
Deflated*	103.6	104.3	92.9	100

*Deflated by the index of cost rates and prices paid by farmers.

Source: Computed from Crop Reporting statistics and The Farm Cost Situation (USDA, 1960).

All of this suggests that the elasticity of demand for apples at the farm level from 1947 to 1960 was not greatly different in the small and medium-sized crop years (though the elasticity may have been slightly higher in the medium-sized years), but that it was definitely lower in the large crop years.

Along with this apparent greater degree of inelasticity of demand at the farm level and lower value of sales in the large crop year, there is an additional set of problems facing the farmer. These center around the costs of harvesting and marketing. That is, it costs the same amount per bushel to pick, transport, store (if rented), and pack apples, whether the crop is large or small. The situation is the same as where there is an absolute marketing margin. So with a fixed cost per bushel for these factors, the net returns in a large crop year may be even less, in many areas, than is indicated by the gross returns at the farm level.[44]

This over-all relationship was apparently observed in some more general sense by the horticulturist Magness, who in 1959 stated that during the decade from 1949 to 1959:

> . . . crops of about 110 million bushels or less have been profitable for most growers. Crops of more than 115 million bushels have been generally unprofitable.[45]

This is not to suddenly recommend a program of crop limitation, however, for as will be shown, the demand for apples at the retail level appears to be elastic. This subject will be taken up in much greater detail in the next chapter.

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[44] Here again one must remember the vexatious problem of the regional differences in price quotations; equivalent packing house door returns for Washington and Oregon, equivalent first delivery point for California, and as sold for other states.

[45] John R. Magness, "The Future of the Apple Industry," Virginia Fruit, September, 1959, p. 6.

CHAPTER VI

PRICE ANALYSES

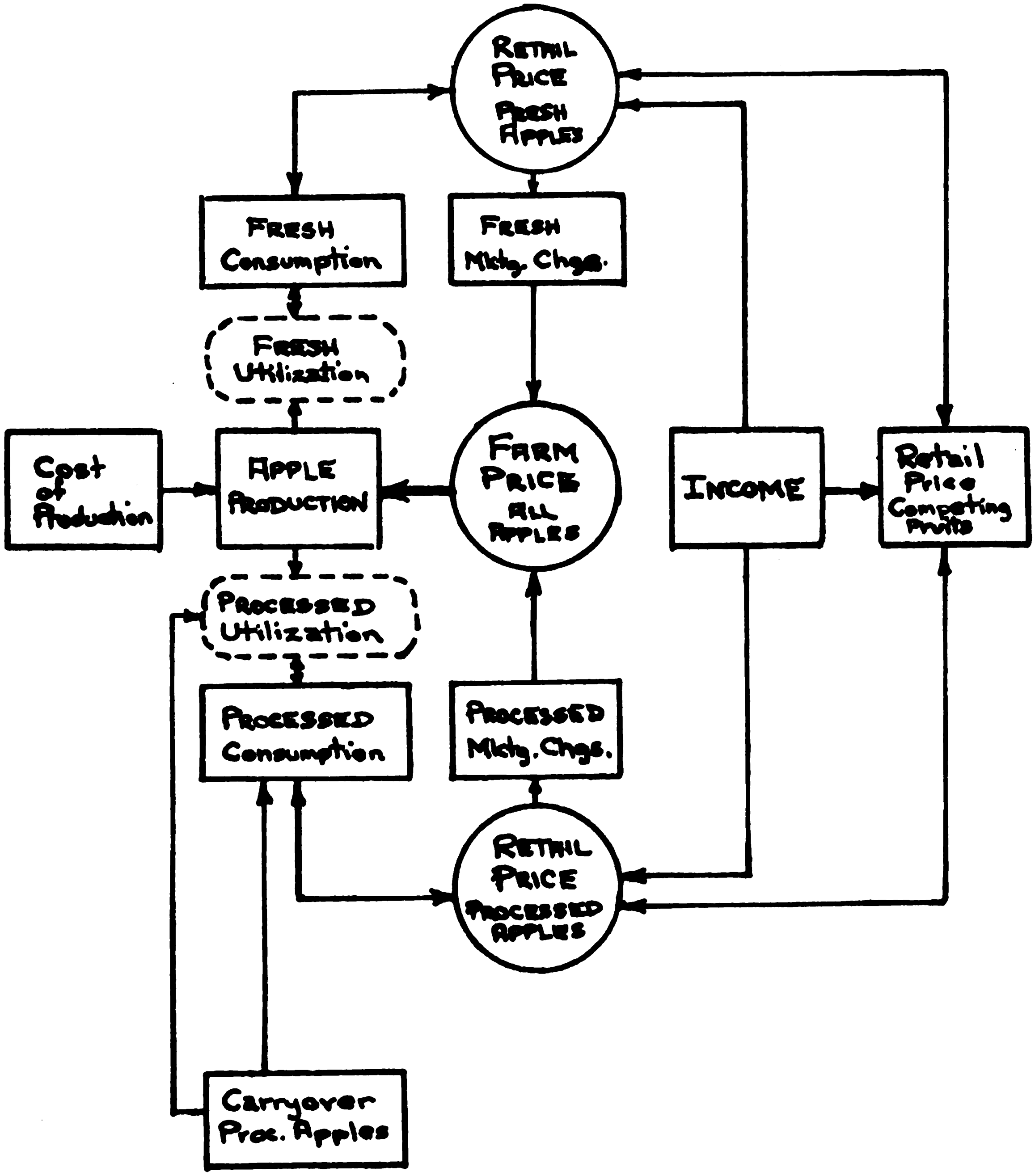
General

So far the discussion has been centered about the supply and demand factors pertaining to apples, and the resulting utilization and prices. But all three have been referred to as rather separate entities; little attempt has been made to weld them together in a manner such that the influence of one or another can be quantitatively assessed. This quantitative specification is, in part, accomplished through price analysis.

Figure 5 presents, in rather simplified form, some of the main elements of the previous section and shows their interrelationship. It may be of help in following some of the material to be presented in this section.

Specifically, at first we will examine studies which provide information on the elasticity of demand for apples. Then studies that relate more closely to the actual determination of apple prices will be considered. Thus, in the first case, the principal interest is the coefficients of the independent variables themselves, while in the second case

Figure 5. United States domestic apple market.



Source: Adapted from Drew, op. cit., p. 82.

greater emphasis is placed on the dependent variable, price. Both items are of considerable importance in the operation of centralized marketing programs.

Elasticities of Demand

There are three principal elasticities of demand which will be dealt with in this section: (1) price, (2) income, and (3) cross. Emphasis will be placed on price.

Price Elasticity of Demand

This elasticity will be considered at the retail and farm levels. The price elasticity of demand is generally lower at the farm than at the retail level because of the relatively inflexible marketing margins.

Retail

Retail demand will be studied from the point of view of elasticities obtained for (1) entire seasons and (2) those obtained at different points during the season.

Seasonal.

Previous Studies. Several merchandising studies have provided information on the effect of changes of prices on fresh sales. For instance, Cravens reported in 1952 that when apple prices were ". . . increased from 40% below to

30% above normal there was no significant change in apple sales in dollars."[1] This, of course, suggests a unitary elasticity of demand. A year later Dominick reported that dropping the price of regular apples 35% increased sales 44%. "This means that the demand for apples within these price ranges was elastic in these stores at that time."[2]

Drew, in 1961, was the first to try to estimate price elasticities of demand at retail for both fresh and processed apples. He studied the 1934-52 period. Lacking good retail price information on processed apples, he constructed his retail prices by adding marketing margins, cost of processing, etc. to farm prices. Both least squares and simultaneous estimating techniques were used. For fresh apples, he obtained an elasticity of -0.61 using single equations and -1.10 using simultaneous equations. For canned apples, the elasticities were lower and closer together; -0.55 using single equations and -0.67 using simultaneous equations. Drew placed greater faith on the elasticities derived from the

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[1] M. E. Cravens, Jr., D. L. Anderson, G. B. Wood and F. C. Gaylord, Studies in Midwest Apple Marketing, Michigan State University, Agricultural Experiment Station, Special Bulletin 378 (North Central Regional Publication No. 29), June, 1952, p. 29.

[2] Dominick, op. cit., p. 12 [underlining added]. Yet when this writer computed an arc elasticity from these percentages it appeared to be less than one, indictating an inelastic demand.

simultaneous equations.[3]

These figures call for comment from several points of view. First, with the exception of the -1.10 figure, they are less than this writer would expect. And, in fact, the figure provided by the single equation method for fresh apples (-0.61) was less than that obtained at the farm level in studies by Brandow using the same method (to be reported in the next section). Secondly, it was surprising to see the retail elasticity lower in both cases for canned apples than it was for fresh. This writer would have expected the opposite because of the greater number of services involved with the processed product.[4] Drew's use of artificially constructed retail prices for processed apples may have led to a distortion of the actual relationship.

Michigan Consumer Panel Studies. In an attempt to shed some light on these matters, this writer computed price elasticities for fresh apples and for applesauce from data provided by the Michigan State Consumer Panel.

Five-Year Period. Elasticities were first obtained from weekly data on actual quantities purchased and

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[3] Drew, *op. cit.*, pp. 122-132. The "canned" reference was to slices and sauce.

[4] For further discussion of this point see fn. 28, this chapter.

prices paid over the five-year period from 1953 to 1957. The computations took the form of a single regression with quantity as the dependent variable. This method produced a price elasticity of -<u>2.26</u> for fresh apples and -<u>5.44</u> for applesauce.[5] Thus, the demand was clearly elastic for both--with processed applesauce having the greater elasticity. This is the relationship which this writer would expect.

The actual magnitude of the figures, particularly for applesauce, was somewhat higher than might have been expected from the previous studies. This was probably due to the fact that the elasticities were computed on the basis of weekly rather than annual data. Shepherd has reported that elasticities based on short-term data, such as weeks, are apt to be greater than elasticities based on annual data because of the influence of storage. He states:

> The lowest elasticity of demand for a good, therefore, is that which is based on data each of which represents a period just a little longer than the storage life of that good. . . . Most analyses of the demand for farm products are based on annual data, and the elasticities found for the semiperishables are likely to be the minimum elasticities. . .[6]

This then would suggest that the elasticities obtained by this writer, particularly for fresh apples, were higher

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[5]This figure includes small quantities of apple butter.

[6]Geoffrey S. Shepherd, <u>Agricultural Price Analysis</u> (4th edition), Ames: Iowa State College Press, 1957, p. 67.

than they might have been had they been calculated from annual data.[7]

On the other hand, it will be remembered that per capita apple consumption in Lansing, compared to the U.S. average, was 36% higher for fresh apples and 62% higher for processed apples. If Lansing prices were the same as or lower than for the U.S. as a whole, this would suggest that the price elasticity of demand in Lansing was lower than for the U.S. as a whole.[8] Because Lansing is fairly closely located to a leading apple producing area, a different price elasticity of demand might be expected than for the country.[9]

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[7]However, when weekly data were combined to provide annual data for the relatively short five-year period and a correlation run between price and quantity (with the latter dependent) with the view of developing an elasticity, the r^2 was only 0.10 while the $\overline{r}^2$ was 0. Elasticity was therefore not computed.

[8]This may be seen by viewing a straight line demand curve. On this curve the elasticity ranges from very elastic at the upper end to very inelastic at the lower end. If price is lowered and quantity increased, one initially moves down the demand curve--and thereby reaches a more inelastic position. The result is the same if the price remains the same and the demand curve shifts to the right.

[9]It may also be of interest to note that according to a study in Buffalo, New York, which is close to a leading apple area, apples were not bought as luxury products. Rather, it was observed that an important part of the market was made up by medium and low income areas. In more distant cities, consumption tended to be concentrated among higher income groups. (M. E. Cravens, Retail and Wholesale Distribution of Apples in Upstate New York, Cornell University, Agricultural Experiment Station, Bulletin 794, May, 1943, pp. 14, 15, 28).

<u>Individual Years</u>. The five-year period noted above included three small, one medium and one large crop year. Since the discussion in the previous section on farm value indicated that the elasticity of demand for all apples may be higher in small than in large crop years and higher in medium than in small crop years, the elasticities were recomputed on an individual year basis. Again, weekly data were used.

The calculations indicated that the elasticity of demand for fresh apples in the three small crop years ranged from -<u>2.27</u> to -<u>2.04</u>, while the elasticity in the one large crop year was -<u>1.90</u>. In turn, the elasticity in the one medium-sized crop year was -<u>2.54</u>.[10] Thus, it appears that price elasticity of demand for fresh apples increased as the crop moved from the small to medium, but that it dropped off in large crop years to a level below that for the small or medium-sized crop. This means that the over-all elasticity figure cited (-<u>2.26</u>) was perhaps lower than it might have been had more medium-sized crops been represented, but higher than would have been the case had there been more large crop years.

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[10] The actual elasticities by crop year were: 1953(s) -2.04, 1954(m) -2.54, 1955(s) -2.27, 1956(s) -2.11, 1957(l) -1.90.

The calculations showed rather puzzling results for applesauce. The elasticities in two small crop years[11] were -2.31 and -2.63, while the elasticity in the one large crop year was not less, but was considerably greater, -6.71. The elasticity in the one medium-sized crop year was less than either, -2.05. In other words, the relative ordering of the elasticities in the medium and large crop years was reversed from the fresh market situation. Just why the elasticity of demand for sauce would have been lowest in the small crop year and highest in the large crop year is not clear.[12] But it at least suggests that the elasticity figure of -5.44 for applesauce cited earlier for the period might have been even greater if more large crop years had been included and slightly smaller had more medium-sized crop years been included.

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In total then, the yearly price elasticity of demands for fresh apples (-2.26) and applesauce (-5.44) at the retail level, based on weekly data from the MSU Consumer Panel for 1953-57, were clearly elastic. If the elasticities had

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[11] The results for 1953 were not significant, and it was excluded.

[12] There was no particular change in either the price or quantity of applesauce consumed from year to year over the period.

been calculated from annual data, they might have been lower--but this might have been compensated for, to some degree, by the fact that elasticity of demand in Lansing may have been lower than for the U.S. as a whole. Further, the elasticity figures cited for fresh apples and applesauce for a period of predominantly small crops may have been closer together in a year of a medium crop and considerably farther apart in a year of a large crop.

Intraseasonal. Price elasticities of demand vary not only on a yearly (interseasonal), but on an intraseasonal basis. However, consideration of shifts in elasticity lead to some questions about the demand curve which it might be well to clear up at this point.

The Demand Curve. Changes in elasticity within (and between) seasons can be brought about by (a) an actual shift in the demand curve, generally parallel, or (b) a change in position on the demand curve.[13] A modification of (a) is introduced by a change in slope as well as a shift. When economists note differing elasticities of demand, they

[13]Samuelson warns the reader to ". . . take care not to confuse an increase in demand by which is meant a shift of the whole curve to the right and upward, as more is bought at each and every price-with an increase in the quantity demanded as a result of moving to a lower price on the same demand curve." (Paul A. Samuelson, Economics: An Introductory Analysis, New York: McGraw-Hill, 1951, p. 441).

are referring to phenomenon which can be brought about by any one of the above types of changes or movements. Mention of different elasticities does not by itself specify the functional form of the change in demand involved.

Empirical reference to the first two forms is made by Mehren and Erdman when they state:

> The question at issue in this note is whether changes in prices of a perishable product during its marketing season represent intraseasonal movement along a single demand function or a systematic pattern of intraseasonal shifts of the demand function itself.[14]

They then go on to make the important comment that if demand varies within a season ". . . knowledge of these shifts is essential to maximizing returns from intraseasonal distribution of a given volume of product." But to demonstrate that these shifts actually occur ". . . it must be shown that intraseasonal price variations cannot be explained by simultaneous variations in the quantity put on the market."[15]

And though they assumed that the demand curves shift in a parallel manner (the slope did not change), an examination of the Hammond, Louisiana, market revealed that the striking fact was ". . . the systematic decrease in slope from week to

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[14] G. L. Mehren and H. E. Erdman, "An Approach to the Determination of Intraseasonal Shifting of Demand," Journal of Farm Economics, May, 1946, p. 587.

[15] Ibid., pp. 587, 588.

week as the season progresses," ". . . elasticity of demand increases as the season advances."[16] This would suggest the modified form of curve (a) noted above.

But for our purposes, the actual elasticities at various periods during the year are probably of more immediate importance than the specification of the functional form involved.

Seasonal Differences in Demand. Price elasticities of demand for fresh apples and applesauce[17] were computed by this writer from Michigan State University Consumer Panel data. The period covered the five crop years from 1953 to 1957. Data were available from the panel on a weekly basis. These were broken down into four thirteen week quarters: quarter 1 representing July to September; quarter 2, October to December; quarter 3, January to March, and quarter 4, April to June. In all cases, a three-week moving average was used.

For fresh apples, the price elasticity of demand was -2.04 in the first quarter. This increased to -2.34 in the second period when the bulk of the apples go to market. But in the third period the elasticity decreased to -1.31.

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[16] *Ibid*., p. 595.

[17] Including small quantities of apple butter.

In the fourth period, on the other hand, the elasticity increased to -4.57. The fact that demand appeared to be less elastic in January, February, and March--approximately the midpoint of volume marketings--has not gone unobserved by other writers. Folley, an English economist, writes, "There is an unmistakable indication that the 'demand lines' are tending to become more upright during January and February than in March or December."[18] And in a study of the demand for plums, Foytik noted that demand was less elastic during the mid-season than for earlier or later sales.[19]

The pattern for applesauce was not particularly clear. In period 1 its elasticity was -4.10, and in period 3 it was -3.61. But in period 2 the figure was +1.15 and in period 4 it was +0.25; in both cases, however, the r^2 of the original quantity-price relationship was negligible, and the t value for the price coefficients were not significantly different from zero at the 5% level. Thus we can be fairly certain of rather elastic demands only for quarters 1 and 3; our data is insufficient to comment on quarters 2 and 4.

With these retail elasticities in mind, attention is

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[18] R. R W. Folley, "The Market for English Dessert Apples," Agriculture (London), March, 1961, p. 638.

[19] Jerry Foytik, Characteristics of Demand for California Plums, Hilgardia, University of California, Agricultural Experiment Station, April, 1951, p. 481.

now diverted to elasticities at the farm level.

Farm

Studies of price elasticity of demand at the farm level may be grouped into those for (1) all apples, (2) fresh apples, and (3) canning apples.

All Apples. In 1952 Sharp reported that for the U.S over the 20-year period from 1929-49, ". . . for all practical purposes, the demand could be called unitary elasticitity."[20] However, when Foote transformed some of Fox's figures for the 1922-41 period, he obtained an elasticity of -1.27.[21, 22]

In either case, for marketing purposes it is probably more important to know specific elasticities for fresh and processed apples.

Fresh Apples. An elastic demand for apples for fresh market was reported by Bressler and Seaver in

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[20] John W. Sharp, "Elasticities of Demand for Selected Agricultural Products," Ohio State University, Department of Agricultural Economics, Ph.D. thesis, 1952, p. 106. [Underlining added.]

[21] Richard J. Foote, Price Elasticities of Demand for Nondurable Goods With Emphasis on Food, U.S. Department of Agriculture, AMS-96, March, 1956, pp. 29-30. Comparative figures were: all deciduous fruits, -1.47; oranges, -0.62; all citrus, -0.76.

[22] Transformation of price flexibilities into elasticities, however, seem to give higher values than when quantity is dependent. See p. 242.

1940.[23] This was not followed up until 1956 when Brandow studied the 15-year period from 1934 to 1953, excluding 1942 to 1946. He obtained an elasticity of -0.73 using simultaneous equations, -0.68 using single equations with quantity dependent and -0.85 using single equations with price dependent.[24] Bartter, working on New York prices, obtained price flexibilities for the postwar period. When these were converted to elasticities, they indicated a figure of -0.77 in a normal year and -0.53 in a large crop year.[25]

Canning and Freezing Apples. Brandow's 1956 study seems to have been the first to provide an estimate for

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[23] R. G. Bressler, Jr., and S. K. Seaver, The Marketing of Connecticut Apples, University of Connecticut, Department of Agricultural Economics, September, 1940, p. 33.

[24] Brandow, op. cit., pp. 2, 20. Elasticities were computed with postwar averages. Where the equation was fitted with price dependent, essentially a price flexibility was obtained. The reciprocal of this gave the price elasticity. This method is satisfactory where there is one source of demand and where the cross elasticities are zero (William A. Cromarty, lecture notes, advanced price analysis, Michigan State University, April 11, 1960). While this might be the case for all apples, it is less likely to hold for fresh or processing apples because of the possibility of substituting one for another. Despite this limitation, the figure may be of interest for comparison purposes.

[25] Lynn M. Bartter, Effects of Apple Supply Management Programs in New York State, Cornell University, Department of Agricultural Economics, A.E. Res. 62, April, 1961, p. 3. The lower elasticity in years of large crops was consistent with previous findings by this author at the retail level. (Also see previous fn. about transforming price flexibilities).

canning apples. He obtained the following figures: -0.21 using simultaneous equations, -0.13 using single equations with quantity dependent, and a discordant figure of -0.68 when price was dependent.[26]

The latter figure is not so out of line, however, when compared to the elasticities obtained from Bartter's price flexibility figures. These data suggested an elasticity of -0.59 for canning and freezing apples and -0.48 for other processing apples, in years of normal crops. In years of larger crops, the figures were reduced to -0.39 and -0.28 respectively.[27]

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Thus, the most recent sets of estimates at the farm level--by Brandow and Bartter--indicated an inelastic demand for fresh and for canning and freezing apples. Concurrently, the demand for fresh apples was more elastic than for canning and freezing apples.

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[26] Brandow, *op. cit.*, pp. 2, 20. While Brandow referred to canning and freezing price, he used only canning utilization. Since the portion of the crop frozen was probably negligible over the period of his study, this was probably not important. But in future studies, it would seem advisable to combine canning and freezing utilization if the canning and freezing price is used.

[27] Bartter, *op. cit.*, p. 3. (Also see fn. 24).

Discussion

The more recent retail and farm level elasticity figures determined in the preceding studies are presented in Table 41.

Table 41. Price elasticities of demand.

	Simultaneous Equations	Single Equations: Quan. dependent	Single Equations: Price dependent*
Fresh apples			
Retail level			
Drew	-1.10	-0.61	
Dalrymple		-2.26	
Farm level			
Brandow	-0.73	-0.68	-0.85
Bartter			-0.77
Canned apples			
Retail level			
Drew	-0.67	-0.55	
Dalrymple**		-5.44	
Farm level			
Brandow	-0.21	-0.13	-0.68
Bartter***			-0.59

*Transformed from price flexibilities (see fn. 24).
**For applesauce (and some apple butter).
***For canning and freezing apples.

Assuming, for the moment, that fresh and canned apples had similar price elasticities of demand at retail, the derived demand for canning apples at the farm level might be expected to be less elastic because of the larger quantity of services involved in processing.[28] If this is the case, Brandow's and Bartter's figures appear to be consistent.

Drew, on the other hand, presents figures which indicate that the elasticity of demand at retail is greater for fresh than for canned apples. One, therefore, might expect the derived demand at the farm level for canning apples to be even more inelastic than in the case cited above, and certainly lower than for fresh because of the added services involved. Yet, Drew goes on to state--though as far as this writer can see never proves--that the elasticity of demand at the farm level is greater for canning apples than for fresh apples.[29] The reasons he gives for this are as follows:

> The fact that processed apples can be stored from one crop year to another tends to increase the price elasticity of demand for processing [canning] apples at the farm. Most processors of apples are engaged in processing many other products as well. They are thus quite flexible and will tend to buy large quantities of apples during years of bumper crops and low prices in anticipation of succeeding years when small crops and high prices might prevail.[30]

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[28] The margin for fresh apples, as noted in Table 34, was about 66%. Unfortunately, similar data are not available for processed apples; but one report would place the figure at 79% (Hunt, op. cit., p. 66), though unpublished data observed by this writer would suggest that the figure is higher. It would seem unlikely that the margin for processed apples would be more flexible than is the margin for fresh apples; this, however, is a point which should be investigated further.

[29] Drew, op. cit., pp. 136, 212.

[30] Ibid., p. 138.

In light of the figures reported by Brandow and Bartter concerning elasticities at the farm level for fresh and canning apples, it appears that Drew has the elasticities reversed. Moreover, his rationalization appears doubtful. He states that processors "will tend to buy large quantities of apples during years of bumper crops and low prices." Yet it will be remembered that this writer found that variations in apple production explained only 29% of the variations in utilization for canning, as compared to 85% of the utilization for fresh market. Further, there was no correlation between canning and freezing price and canning utilization, while variations in fresh price explained 44% of the variations in fresh utilization. Finally, if the demand for canning apples were more elastic than for fresh, less variation would be expected in canning price: however, it was also found earlier that canning and freezing prices varied more than fresh market prices. For these reasons it would seem unlikely that the demand for canning and freezing apples at the farm level is more elastic than for fresh market apples.

Implications

A knowledge of price elasticities of demand is very important for marketing decisions on an industry level. Questions of volume control, for instance, find quite different answers depending on whether the demand is elastic or inelastic. If grower returns are to be increased, volume limitation of all apples would work in the first instnace only if the price elasticity of demand at the farm is less than one.[31] If, however, there is a difference in elasticity of demand between fresh and canning apples, it may also be profitable to limit marketing of the item with the less elastic demand or, more likely, to push additional volume into the more elastic outlet until marginal net revenues are equalized. In this light, it may prove enlightening to see what some of the previous studies have had to say on this subject.

Bressler and Seaver. The question of the value of a diversion program seems to have been taken up first by Bressler and Seaver in 1940. While they felt that the elasticity of demand for fresh apples was greater than one, they were faced with the fact that ". . . similar information is not available for the demand for processing apples." But with the low processing prices then prevailing, they thought it ". . . highly improbable that a diversion program (to

[31] Over the long run, this writer would suggest that the price elasticity of demand might have to also be less than one if such a program is not to place the marketing groups at a disadvantage. This point will be discussed in greater detail later in this section and in Chapter VII.

processing) will result in an increase in incomes"[32]

Drew. The point was taken up again 21 years later by Drew. If the goal is to stabilize incomes, he recommended:

> . . . Some system of orderly marketing whereby the annual quantity of apples being sold on the level of the fresh market would be maintained at a fairly constant level. Surpluses would be allowed to flow into processing channels for storage.[33]

In evaluating this statement, it makes quite a bit of difference as to whether one is basing his recommendation on elasticities at the retail or farm level.

If it is assumed that Drew based his recommendations on his own retail elasticities--which indicated the price elasticity of demand to be more elastic for fresh apples--this would appear to be the wrong advice.[34] That is, it would seem more profitable to direct more apples into the market where their price elasticity of demand is higher rather than expand shipments to the market where the elasticity is less; this in the light of Drew's elasticities would mean more to the fresh market and less to the canning market.

On the other hand, Drew intimated, though never proved, that the ordering of the elasticities was reversed at the

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[32] Bressler and Seaver, op. cit., pp. 33, 34.

[33] Drew, op. cit., p. 139.

[34] Though in light of this writer's retail price elasticities, it would be the right recommendation.

farm level; this according to his retail elasticities would have meant a more elastic demand for canning than for fresh apples. In this sense, his recommendations would have been consistent--but wrong in the light of Brandow's and Bartter's elasticity figures.

Bartter. Bartter considered the possibility of volume control programs for New York State.[35] He discussed two possibilities: (a) volume control of processing use, and (b) volume control of fresh and processing use. The elasticity figures he worked with, which were noted earlier, were as follows at the farm level (transformed from price flexibilities):

	Crop Size	
Utilization	Normal	Large
Fresh	-0.77	-0.53
Canning or freezing	-0.59	-0.37
Other processing	-0.48	-0.27

With these elasticities it might seem profitable for U.S. apple producers to try to limit volume--more for the less elastic item than for the more elastic item. Bartter, therefore, examines several ideas which some growers have had on this subject.

The *first* idea is to hold back from sales to processors apples of less than 2-1/4". This is, as Bartter partly

[35] Bartter, *op. cit.*, pp. 1-8.

recognizes, a peculiar suggestion economically for "Processing use quantity is sharply curtailed and carries the entire burden of volume control." But it would carry the burdens in ways which he doesn't seem to be aware of.

First, it would mean that the grower would have to grade all the 2-1/4" apples out of the tree-run stock he ships to the processor. This would cost the grower money, but would please the canner and freezer for it would save him the trouble and expense of grading out these apples, which he doesn't use in his coring and peeling operations anyway. This step would also discriminate against the grower who raised large quantities of smaller apples such as Jonathan.

Secondly, the limitation of 2-1/4" sales would mean a very sharp curtailment of shipments of apples to cider mills (mills, that is, which buy all their apples) because the grower could not afford to pick the apples of less than 2-1/4" out of the drops and tree-run apples he sends to the mill. And while the mills would have to pay higher prices for grading table culls--which is about all they could get--it is doubtful that they could pay the grower enough more to make up the loss sustained by the loss of the 2-1/4" market. The result would probably be that many of the larger, more efficient cider mills which buy apples would be placed at a disadvantage--while at the same time there could be an increase in more inefficient individual farm operations (for there is no limitation on farmers use of 2-1/4" apples). For these reasons the limitation of sales to processors of apples under 2-1/4" would seem of doubtful value.

A <u>second</u> proposal would be to limit sales on the fresh market and to canners and freezers to apples of 2-1/2" and up. Apples between 2-1/4" and 2-1/2" could be sent to cider uses; but presumably, again, no apples under 2-1/4" could be marketed. This idea makes more sense, but is partly subject to the criticisms of the foregoing idea. That is, growers would have to grade the apples under 2-1/2" out of those they ship to processors; this would cut down the economies of tree-run sales and transfer the expense of grading from the processor (he would be quite happy with 2-1/2"-up apples) to the grower. Also, cider outlets would be reduced, though the mills themselves would at least have the benefit of the 2-1/4" to 2-1/2" packing table culls. Any losses on the cider end might well be more than offset from gains on the fresh end; but even here, certain small varieties would be discriminated against.

<u>In General</u>. On the basis of the elasticities cited, this writer would have reservations about limiting the quantity of apples marketed. While limitation would seem logical on

the basis of the inelastic demand at the farm level, it might lead to complications because of the elastic demand at retail. That is, the marketing agency appears to be in the position of buying apples at the farm level on an inelastic demand schedule and selling them on a retail market where the demand is elastic. Therefore, a supply limitation program might sharply increase the price the marketing group has to pay for apples while at the retail level the price will be raised but little. This means that the profits of the marketing agency could be curtailed. While the farmers might shed few tears over this in the short run, they might grow concerned in the longer run if the marketing agency shifted its demand schedule for apples at the farm level--in this case, for instance, made it more elastic. The marketing agency might also shift to importing apples, or move out of apples altogether. This is not to say that these things will happen in response to a program of supply limitation, but they might. Because of the importance and complexity of these issues, they are discussed in greater detail in Chapter VII, Marketing Policy.

An alternate proposal might be to try to equalize marginal net revenue in fresh and processing outlets. In years of heavy production, this would mean diverting apples into the outlet with the greatest elasticity of demand.

At the retail level this seems to be the canning outlet.[36] The problem with following this policy centers about the fact that while the demand for canned apple products at retail may be more elastic than for fresh apples, the demand at the farm level for canning apples appears to be more inelastic. If these elasticities hold in large crop years, it means that the processor is able to buy apples much more cheaply than normal and yet sell an increased volume of apples at a price that is not much reduced.[37] Consequently, the direction of a greater than usual portion of apples to a processor in a large crop year may not benefit the growers as planned, but might benefit the processor. If the grower is to share in the profits of such a venture, it would seem necessary to make the farm demand curve for canning and freezing apples more elastic in large crop years. Perhaps this is a field where a bargaining association could perform a real service to farmers.[38] It is, however, an area which clearly involves

[36]It will be remembered that in the Consumer Panel the elasticity of demand for applesauce and butter was at its highest in the one large crop year for which there were records, while concurrently, the elasticity for fresh apples was at its lowest.

[37]But if these farm level elasticities also applied in small crop years, the processor would be considerably disadvantaged because the farm price would shoot up in response to the inelastic demand.

[38]Specifically in large crop years the bargaining association could hold out for a higher price than might normally exist. However, in a short crop year the group would

some thorny theoretical problems--discussion of which will also be taken up in Chapter VII, Marketing Policy.

Aside from the question of fresh vs. processing, there is the question of how to schedule the sale of apples destined for the fresh market. The quarterly elasticities obtained from the Michigan State University Consumer Panel for Lansing for 1953-57 suggest that the biggest opportunity was, for those years at least, to increase marketings in period 4, April, May and June, when the elasticity of demand was greatest (-4.57). The opportunities were next highest in period 2, October, November, and December (when the elasticity was -2.34). The opportunities were least in period 3, January, February and March (when the elasticity was -1.31). Just what the relationships would be today with the expansion of sales of Controlled Atmosphere apples is difficult to say. That is, the continuing price premium for Controlled Atmosphere over regular storage apples would suggest an increase in demand for this item in periods 3 and 4.[39] However, it is less clear what influence

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have to settle for lower prices (see previous fn.). This process would presumably not be necessary in dealing with a cooperative.

[39]The premium averaged $0.86/bu. in New York from 1953 to 1960. (Thompson, op. cit., pp. 112-113). This has been substantially above the added costs involved and may well be related to the higher quality and longer shelf-life of Controlled Atmosphere fruit.

this would have on the elasticities of demand.

With this we close the discussion of price elasticities of demand and turn to cross elasticities.

Cross Elasticities of Demand

As the previous discussion of consumption relationships indicated, we are less than fully informed on the competitive relationships between various forms of apples, and between apples and other fruits.

In fact, the only studies the author knows of were conducted by Drew. He found that at the retail level:

(a) A substitute relationship existed between fresh and canned apples.

-an increase of 1% in the price of canned apples increased fresh apple purchases 0.32%.

-an increase of 1% in the price of fresh apples increased purchases of canned apples 0.67%.

(b) A complementary relationship existed between apples and oranges.

-an increase of 1% in fresh orange prices reduced fresh apple purchases by 1.22%.

-an increase of 1% in fresh orange prices reduced processed apple purchases by 2.67%.[40]

These relationships have in part been suggested earlier

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[40] Drew, op. cit., pp. 213-214.

and appear reasonable.[41]

Income Elasticities of Demand

This elasticity measure is more of theoretical than practical interest to the farmer--as there is not much apple growers can do to influence the consumer's income. But income elasticity of demand can be an important consideration in price analysis.

As with cross elasticities, little has been done in this area in the way of formal study. Foote's transformation of Fox's data indicate an income elasticity of demand for apples of +1.32 at the farm level.[42] Drew obtained the following figures at the retail level: fresh apples +0.35, processed apples +0.53.[43]

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While elasticities may play an important part in the

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[41]Efforts by this writer to obtain cross elasticity figures between fresh apples and applesauce (and butter) from Michigan State University Consumer Panel did not produce significant results (that is, the r^2's between quantity and price were negligible).

[42]Foote, op. cit., pp. 29, 30. Comparative figures were: all deciduous fruits +1.59, oranges +0.83 and all citrus, +0.74.

[43]Drew, op. cit., pp. 213-214.

operation of centralized marketing programs, many groups--particularly those engaged in price bargaining--are interested in isolating the factors affecting price and using them to estimate or predict price. This is the subject of the next section.

Price Studies

The study of apple prices, as may have been gathered from previous sections, is not an easy task. Even so, a number of analyses have been conducted, most of which provide some valuable insights for understanding the price-making forces for apples and for the conduct of future studies. In this section, therefore, a comprehensive review is made of all known published apple price analyses. Wherever possible these studies are evaluated, in terms of previous material, for the contributions they may make in terms of selections of variables influencing price, method of analysis, and results. In addition, this writer has extended some of this work to cover the 1946-60 period. And in the closing sections, a model for predicting canning and freezing prices is presented.

Early Studies

It is difficult to say when the first price study was done on apples because some of the early work may have gone unpublished. But in the published category there are four items of interest which were prepared before 1930. The first of these, published in 1901, was not strictly an apple price analysis in a statistical sense, but the author showed a surprising savoir faire of the factors involved in price analysis for fruits. The other three studies, prepared in the 1920's, followed a more statistical approach.

Waugh

In 1901, F. A. Waugh an eminent horticulturist, published a remarkable little book on Fruit Harvesting, Storing, Marketing. Much of the data is, of course, now dated but his comments on price have a rather timeless ring about them.

He started by indicating that "A study of the causes affecting prices . . . becomes a study of the conditions affecting both supply and demand." Among the factors affecting supply he listed (1) production, which in turn depends on weather and prices; (2) transportation; (3) information; (4) perishability; and (5) storage. The conditions affecting demand were (1) price; (2) quality; (3) acquaintance; (4) season; and (5) supply of other fruits.[44]

On the supply end, he noted a dilemma in factor

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[44] Waugh (F.A.), op. cit., pp. 27-30.

(1) production--which he indicated depended on (a) weather and (b) prices. The problem was with prices:

> Higher prices stimulate production. Low prices diminish production. Thus, our equation reacts upon itself. The mathematics of it are spoiled; but that ought not to draw a complaint from the mathematician, for the same circumstances have often spoiled the calculations of the fruit grower.[45]

And at the same time on the demand end, (1) price ". . . influences demand still more, thus reacting doubly upon itself." He goes on to point out that nothing else will move a quantity of fruit so quickly as an attractive reduction in price. Along with this is (2) the quality of the fruit: "Good fruit sells much more quickly than poor fruit. Poor fruit is apt to lag in the market at any price." On point (4), season, he indicated, "There is an urgent demand for limited quantities of certain fruits out of their normal season. For most fruits, however, the greatest volume of demand coincides with the market season of each fruit." And finally, concerning (5) competitive relationships, "When peaches are low in price they are canned in preference to high-priced plums. The price of plums is in fact determined by the supply of peaches."[46]

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[45] Ibid., pp. 27-28. Here Waugh recognized what is now referred to as the identification problem.

[46] Ibid., pp. 29-30.

Most of these statements would seem reasonable today--over 60 years after they were originally made.

Scoville

The first statistical price analysis appears to have been done by Scoville in 1923, with somewhat similar analyses appearing in 1924 and 1925 in Farm Economics. In all three cases he was concerned with predicting the average New York City season barrel price for 16 varieties of apples.

In the 1923 report, Scoville considered (1) the September crop forecast (with an adjustment made in the light of the accuracy of previous crop forecasts) and (2) the forecasted January 1 population. He did not predict a single price as such, but rather indicated the probability that the actual weighted price would fall in a certain range.[47]

The 1924 report, unlike the 1923 paper, forecasted a specific average price. This was reduced by 9%, ". . . to reflect the fact that forecasted prices for the past eight years averaged 9% too high."[48]

More light was shed on the previous estimates in the 1925 report. Predicted and actual prices were listed for

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[47] G. P. Scoville, "Apple Prices," Farm Economics (Cornell University), September, 1923, pp. 59-62.

[48] G. P. Scoville, "Apple Production and Prices," Farm Economics, October, 1924, p. 189.

the five crop years from 1920 to 1924. A specific price was also predicted for 1925. In addition, Scoville made predictions of average monthly prices from August to June--which seemed to be based on a presumed normal increase in price.[49]

Rauchenstein

> Early in 1927 the Gravenstein apple growers in the Sebastopol district of California, organized partly for the purpose of strengthening their position with buyers in determining the price which they should receive for their apples. This brings up the problem of estimating at the beginning of the season, the price which will equate supply and demand under the conditions prevailing that season.[50]

So wrote Rauchenstein in a 1928 issue of Hilgardia. The situation he described is very similar to one existing in Michigan and other states in 1962.

Rauchenstein's analysis covered the fourteen-year period from 1914 to 1927. To predict Gravenstein prices, two variables were used: (1) the July 1 estimate of U.S. production, (2) estimated Gravenstein production in the Sebastopol district (the bulk of the Gravenstein crop being marketed in July). These variables were found to explain 69% of the

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[49] G. P. Scoville, "Apple Production and Prices," Farm Economics, November, 1925, p. 357.

[50] Emil Rauchenstein, Factors Affecting the Price of Gravenstein Apples at Sebastopol, Hilgardia, University of California, Agricultural Experiment Station, June, 1928, p. 325. This section is based on pp. 335-338.

variation in Gravenstein prices, 61% being due to the influence of U.S. production and only 8% due to the influence of Sebastopol production of Gravensteins. Estimated prices fell within $0.25/bu. of actual prices in 10 out of the 14 years. A similar analysis centered around the eight-year period from 1919 to 1927.

Use of the July 1 estimate is of current interest. Rauchenstein found that the final crop estimate gave a better fit (the r^2 with price was .64 using final estimates and .58 using July 1 estimates);[51] but he recognized that for prediction purposes at the beginning of the season, the July 1 estimate would have to be used. He went on to observe that if accurate data could be obtained as to the total quantities of apples coming onto the markets during the period when Gravensteins are marketed, a higher coefficient with price would probably be obtained. But this information was not available, and in its absence, the July 1 estimate was deemed the best to use.

In closing, Rauchenstein set up a three-dimensional graph to demonstrate the use of the equations he developed; he also included a simplified table that could be used by growers.

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[51] This writer obtained a reverse situation using September 1 estimate and U.S. price for the 1946-60 period. This will be discussed later.

Chen

A considerably less elaborate study was completed by Chen as an M.S. thesis in 1929.[52] He appeared to be most interested in tracing out monthly movements in price by the link relative method. Chen also noted that ". . . Dr. (C. C.) Taylor has been using chain relative to forecast apple prices for three years." He went on to suggest that "The higher the price of fruit at harvest time, the greater will be the profit from storing it . . ."

Fresh (and all) Apples

At the outset, the classification of this section calls for some comment. Most of the early price studies conducted in the 30's were concerned either with the prices of all apples or of fresh apples--there being relatively little difference because nearly all apples were sold fresh. For this reason, studies covering both fresh and all apples have been grouped together in this section. Within this grouping, the studies may be classified into those concerned with yearly average prices and those concerned with monthly average prices. We shall turn first to yearly prices.

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[52] C. T. Chen, "A study of the Economic Factors Influencing Apple Prices," Virginia Polytechnic Institute, Department of Agricultural Economics, M.S. thesis, June, 1929, pp. 25, 33.

Yearly Studies

Studies of average yearly prices have been carried on at both the (1) national and (2) state level.

National. Four studies have been conducted pertaining to prices at the national level. Each refers to the average price for all apples.

Ockey. Ockey, a Department of Agriculture economist, investigated the factors affecting the price of apples for the 15-year period from 1922 to 1937.[53] He found that variations in price were largely determined by the following factors: (1) supply of apples available for market, (2) supply of oranges (representing competing fruits), and (3) income of industrial workers (in index form). Of the three, income was the most influential and, in fact, was about as important as the other two variables combined.

In considering variable (2) Ockey cautioned:

> It should be remembered, however, that part of the causal effect attributed to orange production may actually be due to the decline in foreign demand [for apples] and increased production of other fruits.[54]

This report was published in the quarterly publication,

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[53] Ockey, op. cit., pp. 5-6.

[54] Ibid., p. 87.

The Fruit Situation. Strangely, it was the only study of this kind ever to appear, to this writer's knowledge, in a Department of Agriculture periodical for popular consumption.

Fox. Fox's reference to factors affecting apple prices was included with many other commodities in a Department of Agriculture Technical bulletin.[55] Though released in 1951, it also covered the prewar period, specifically the years from 1922 to 1941. Fox did not include orange production as a variable. But the two variables used, (1) the size of the apple crop and (2) the amount of disposable income of domestic consumers, were similar to those used by Ockey. The two were placed on a per capita basis and fitted by first differences of logarithms. They "explained" 96% of the variation in price. A 1% change in production was found to be associated with a change in price of 0.79% in the opposite direction; a 1% change in disposable income was related to a 1.04% change in price in the same direction.[56]

The high degree of "explanation" would suggest that,

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[55] Karl A. Fox, The Analysis of Demand for Farm Products, U.S. Department of Agriculture, Technical Bulletin 1081, 1953, p. 65.

[56] Here and throughout the rest of the paper we shall use the word "explained" rather than the more cumbersome term "coefficient of determination." In this sense, then, "explained," will cover both the simple (r^2) and multiple coefficients (R^2).

over this period, the importance of other variables--the most likely of which would have been production of competing fruits such as oranges--was of comparatively minor importance in influencing prices.

French. The only study in this category which ventured, in part at least, into the postwar period was conducted by French.[57] He studied the 20-year period from 1930 to 1953, excluding the years 1943-46. In terms of the variables selected, French followed the preceding studies. That is, he included (1) total quantity of apples sold in the U.S. (in terms of bushels per capita)[58] and (2) per capita disposable income (on an index basis, 1947-49=100). Unlike Fox, but like Ockey, French included a competing fruit variable. This was (3) U.S. total consumption of oranges, pears and bananas (in terms of pounds per capita). These three variables explained 97% of the variations in average farm price.[59] A fairly high intercorrelation (.91) was found between income

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[57] French, op. cit., pp. 7-9.

[58] French's figure was based on estimated total, not just commercial, production. Since total production has not been reported on an annual basis (except when the census is taken) since the 30's, it is not certain why it was selected--particularly since the prices used were those from commercial states. This is, in fact, the only postwar price study to use an estimated total figure.

[59] $\bar{R}^2 = .972$.

and competing fruits because both trended up over the period. French felt that this was not too much of a problem, though, because over-all R^2 was high and the two had opposite signs.

In terms of the coefficients, a 1% increase in apple production was associated with a decrease in price of 0.84% (Fox had obtained a figure of 0.79% for an earlier period), a 1% increase in disposable income resulted in a 0.99% increase in price (almost the same as obtained by Fox), and a 1% increase in consumption of competing fruits resulted in a decrease in price of 1.10%.

Since the coefficients of multiple determination obtained by Fox and French were nearly the same, one is left wondering about the value of the competing fruit variable.

Other. In the work of French as well as that of Fox and Ockey, production was taken on a national level. With their emphasis on the prewar years this is not unreasonable. But with the growth of processing since the war, it is possible that production in certain areas is likely to be more highly correlated with, say, fresh price than was formerly the case.[60]

Consequently, this writer studied the 15-year period

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[60]This procedure was also used by Brandow and will be treated in a subsequent section.

from 1946 to 1960.[61] Fresh price was examined first. When U.S. average farm price for fresh apples was correlated with production on a national and then regional basis, the following results were obtained: U.S. production explained 43% of the variation in price; eastern production explained only 8% of the variation; central production explained 23%; and western production explained 55%. The magnitude of the results was rather startling. While this writer would expect that, among the regions, western production would be most influential (because of the large proportion sold fresh), it was surprising that it towered over eastern production--and even exceeded U.S. production.

When the same production variables were associated with average U.S. price for all utilizations, the same general ordering was obtained, though the magnitude of the figures was altered. U.S. production explained 53% of the variation in price, exceeding western production which explained 45%. Still, western production seemed more influential than central production (which explained 31% of variation) and eastern production (which moved up to explain 18% of the price variation).

All of these calculations were made on the basis of

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[61]Price was the dependent variable. A simple least squares correlation of actual data was utilized.

actual U.S. production. When September 1 crop estimates were used instead, the proportion of the variation in prices explained by U.S. production increased from 43 to 63% for the fresh price and from 53 to 63% for the "all" price.

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From these studies, it would seem that variations in U.S. average price have been largely explained by considering production of apples (possibly on a regional level and possibly in terms of, say, September 1 estimates) and some measure of income. The bringing in of a competing fruit production, particularly oranges, is of more uncertain value. In fitting these equations to explain year-to-year fluctuations, first differences of logarithms have been generally used.

Having looked at national average season price analyses, we now turn to studies on the state level.

State. Price analysis studies on average yearly apple prices were, for the large part, conducted in New York State in the prewar period. However, one study was conducted in Virginia before the war and another after, while a postwar study was also done in Michigan. Because of the concentration of these studies in the 30's, the emphasis was on the fresh or "all" price; then processing was a minor outlet.

<u>New York</u>. During the 1930's, New York researchers had a unique collection of data available to use in price analysis work. This was a complete set of prices received at the farm by variety, size and grade in the Newfane-Olcott area of Western New York. This material was collected from shortly after World War I to the early 1950's. These prices were used in the first two studies reported here.

<u>Manning</u>. Manning studied seven factors which were felt to influence farm price: (a) grade of apples, (b) size of apples, (c) variety of apples, (d) size of apple crop, (e) method of sale, (f) time of sale and (g) percentage composed of McIntosh.[62] Not all variables were used at once; rather, from one to four variables were used in a number of analyses for one crop season--apparently 1930 or 1933. The presentation of the material is a bit confusing, but it appears that the results may be summarized as indicated in Table 42.

This may seem like a rather prosaic set of variables, but most of them have not been included in any other studies.

The relationships between the variables, rather than

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[62] Frank L. Manning, "A Statistical Study Involving Multiple Curvilinear Correlation, of Factors Affecting the Farm Price of Apples," Cornell University, Department of Agricultural Economics, Ph.D. thesis, September, 1935, pp. 55-114.

their absolute values, may be of greatest interest to us today. In this sense it may be seen that size of apples had greater influence on price than grade of apples, and in turn, grade of apples had slightly more influence than time.[63] While time has been included in other studies in the form of monthly prices, neither size nor grade of apples has been included, with one exception.

Table 42. Factors influencing apple price, Western New York.

Single variable	Approximate Proportion of Price Variation Explained
Grade of apples	1/6
Size of apples	1/4
Time of sale	< 1/6
Two variables	
Grade & size of apples	1/3
Grade & time of sale	1/6
Size of apples & time	< 1/3
Size of apples & crop	1/4
Size of crop & % Mac.	1/3
Three variables	
Grade & size of apples, time	
Linear	1/4-1/3
Curvilinear	3/4
Size of apples & crop, % Mac.	2/5

When the above three variables were combined, it was found that a combination of grade and size of apples resulted

[63]The present U.S. grades say nothing about size.

in a higher degree of explanation, as did a combination of size of apples and time of sale. A combination of grade and time of sale resulted in no improvement. This writer interprets this to mean that in combination, size of apples was the most important variable.

Further, when size of apples was added to grade and time of sale, or to the size of crop and percent McIntosh, the proportion of the price variation was increased perceptibly.

Finally, the sharp increase in the amount of price variation explained when curvilinear relationships were used instead of linear is to be noted.

<u>DeGraff</u>. Working with the same Western New York price data, DeGraff used a somewhat more traditional set of variables in 1939.[64] He considered price to be influenced by (a) production of apples, (b) production of oranges, and (c) purchasing power. Total production of apples in the New York, Appalachian and Central Western areas was found to be more important than U.S. production and so the regional total estimate was used.[65] Production of oranges

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[64]DeGraff, <u>op. cit.</u>, pp. 1-8, 13.

[65]While this will appear to be in conflict with findings by this author for a later period, it must be remembered that DeGraff was concerned with essentially county prices.

was found to be of no significance. Purchasing power was measured by the New York factory payrolls index.

When prices were predicted for the 16-year period from 1921 to 1936, the predicted price was within 10% of the actual price in 12 of the seasons and within 20% in all seasons.

This was the only attempt that this writer knows of, aside from that of Rauchenstein, to predict prices on a intra-state level. But it differed from Rauchenstein's study in that it covered all apples rather than just the almost exclusive production of one variety.

Woodin. A somewhat similar price study was conducted by Woodin a few years later, but at the terminal market level.[66] He explained 63% of the variation in the average wholesale price of six important varieties of apples in New York City over the 1920 to 1939 period with three factors: (a) the size of the New York apple crop, (b) the price level of farm products, and (c) orange production. Most of the variation (58%) was explained by the size of the crop, while a small proportion (4%) was explained by the price level of farm products.[67] The effect of orange production

[66] Woodin, op. cit., p. 9.

[67] And though the price level had a relatively small amount of influence in year-to-year changes in price compared to production, when Woodin examined long-run changes in prices--

was negligible (1%).

Raeburn. Manning's study, in its reference to grade, hinted at the influence of quality. A much more explicit investigation of the influence of quality on the price of apples was made by Raeburn in 1934 (though not reported until 1939).[68] Raeburn's study was made on the New York market during October and November. He considered "quality" to be composed of five factors: (a) diameter and index of defects, (b) skin punctures and slight bruises, (c) decay, (d) color and (e) other.[69] The five quality factors were found to explain nearly 52% of the variation in the price of lots sold to jobbers and nearly 63% in the price of lots sold by jobbers.

The variation in quality, then, had a very substantial influence on price of McIntosh apples (a relatively soft variety) sold on a terminal market. For harder varieties of

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over a 50-year period--the situation was reversed. Then changes in the price level accounted for about 60% of the variation in prices, while the size of the crop explained about only 5% (Ibid., pp. 10-11).

[68] John R. Raeburn, Joint Correlation Applied to the Quality and Price of McIntosh Apples, Cornell University, Agricultural Experiment Station, Memoir 220, March, 1939, p. 33.

[69] This classification did not include such intangibles as flavor--but did reflect firmness, through bruising. Many of the items noted above are not included in U.S. grades because they may have occurred after packing.

apples sold closer to the farm, the role of quality might be less.

Yet the evidence would seem to be sufficient to bear out a statement made by Waugh several years earlier (and which was cited in Chapter II of this paper):

> In the case of many farm products, the variation in quality is so great as to be more important than variation in supply and demand conditions from time to time.[70]

The role of quality was emphasized many years later by the director of Fruit Industries Research Foundation (Yakima, Washington), who stated:

> In all these studies on the prices of apples, there is one main element that is left out; that is the condition of the fruit or the quality of the crop. I am impressed by the fact that the prices are affected by . . . the condition of the fruit. This is a real debacle in this year's price [1957-58 crop season]. Had we had better conditioned fruit out here, the season would have been entirely different.[71]

Important as this factor may be, we shall not see it again in the reports noted in this study--the basic reason, as noted earlier, being the problem of measurement.

Virginia. Studies of season average price have been conducted in Virginia, subsequent to Chen's original work. They add little to what has already been covered, so they are

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[70] Waugh (F. V.), op. cit., p. 776.

[71] Carlson, op. cit.

noted only brielfy.

Oliver's study covered the longest range of any price study so far encountered--the 44-year period from 1889 to 1932.[72] The dependent variable was the Virginia farm price. The independent variables were three in number: (a) total U.S. production, (b) index of U.S. wholesale price of all commodities, and (c) time trend. Despite the long period the variables explained 62% of the fluctuations in price.

Grisso's study, on the other hand, concentrated on prices during one season (1957-58) in three areas of Virginia.[73] Survey data was obtained providing detailed information on sales for that period. Regression analyses were then run on a number of variables including: time of sale, grading standard, actual grade, pack, buyer, storage, variety, sizing basis, actual size and quantity per sale. The three most important factors appeared to be grade, variety and type of pack (type of container). These results provide an interesting contrast with Manning's study in that size of

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[72] Oliver, op. cit., pp. 74-75.

[73] Robert D. Grisso and Joseph M. Johnson, An Economic Analysis of the Elements That Affect the Success of Marketing Apples in the Appalachian Apple Belt, Virginia Polytechnic Institute, Department of Agricultural Economics, 1958, p. 35.

fruit in this instance was less important than grade.

Michigan. In attempting to determine the farm price for all apples in Michigan, French in 1956 considered four variables: (a) Michigan apple production having value (bu/per capita); (b) total U.S. production sold in the U.S. (bu/per capita); (c) per capita disposable income (index); and (d) U.S. total consumption of competing fruit (lbs. per capita).[74] Using logs, these variables explained over 97% of the variation in annual farm prices in Michigan.

The period studied was the 20-year period from 1930 to 1953, excluding 1943-46. Since, for this particular investigation, the prupose was to make long-run, rather than year-to-year predictions, first differences were not used.

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Thus, when prices were analyzed on a state level, the range of variables considered was widened somewhat. Instead of just considering apple and competing fruit production and disposable income, as was done on the national level, the state or intra-state studies brought out the importance, at a level closer to the individual farmer, of such other factors as size, grade and particularly the quality of apples.

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[74]French, op. cit., p. 12.

Again, the inclusion of orange production was of questionable value. The income variable was represented by a rather wide variety of items--a factory payroll index, the price level of farm products, the index of wholesale prices and, again, per capita disposable income.

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All of the studies covered in this section have related to annual price. The main value of these investigations has been to isolate factors incluencing over-all apple price. These factors become particularly important in a policy sense when considering a period longer than a year. In any one season, supply is essentially given, and the grower faces the problem of how to space his marketings through the season. For this, a national or state season price is not of the greatest value.[75] Instead, what is needed is some way of estimating monthly prices.

Monthly Studies

Rather comprehensive studies of monthly prices have been conducted at both the national and the state levels. All relate to fresh prices, which are the only ones reported

[75]With an exception noted in the following section.

on a monthly basis.

United States. The most extensive study of monthly prices was conducted by Pubols of the U.S. Department of Agriculture in 1954.[76] His work covered the 30-year period from 1921 to 1951. Data were transformed to a per capita basis, and first differences of logarithims were used. Along with Pubols' work, this writer studied some similar variables, but for a shorter and more recent period (1946 to 1960), and using simple correlations of actual data. In both cases, the major variables studies were crop estimates and storage holdings estimates. In addition, Pubols considered income.

August to October Crop Estimates. The August crop estimate, combined with 4th quarter disposable income, was found by Pubols to "explain" 66% of the variation in the September price, 81% of the October price, and 83% of the November price.

The September crop estimate alone was found by this writer (as noted in Chapter V), to explain 48% of the variation in the September price, 69% of October, 63% of November, 63% of December, 53% of January, 33% of March, and 24% of June.

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[76] Pubols, op. cit., pp. 77-83.

The October crop estimate, combined with 4th quarter disposable income, was found by Pubols to explain 85% of the November price, 84% of the December price, and 82% of the January price.

Thus, it appears that the effect of estimated production on price would appear to have its greatest influence from October to December, and lesser influence in September and January. Since the October to November period is one of peak marketings, this is not unreasonable.

It may be of value to repeat here an observation made earlier: when this writer used final production estimates, instead of September crop estimates, the proportion of the variation in monthly prices explained varied from 11 to 22% less.[77] This would suggest the price is based more on what the size of crop is thought to be than what it actually turns out to be.

December Storage and Crop Estimates. Pubols used both December crop and storage estimates in combination with per capita income to explain the average price for the period from January to May. It was found that the crop estimate (with income) explained 79% of the price variation, while the

[77] The actual figures, based on the final estimate, were: September 26%, October 47%, November 52%, December 52%, and January 48%.

storage estimate (with income) explained only 74%.

It was surprising to find the storage estimate ranking lower in effectiveness than the crop estimate for this period. The answer may lie in the fact that Pubols used USDA crop estimates, which are not considered by the trade to be particularly complete for the period studied (1921 to 1951).

This writer, instead, utilized International Apple Association storage estimates, which are considered more complete for the postwar period. The December 1 estimate was found to explain 42% of the variations in December price, 52% of the January price, 51% of the March price and 36% of the June price.[78] Similarly, the September crop estimate explained 63% of December price, 53% of January, 33% of March and 24% of the June price. Therefore, the September crop estimate appeared to be comparable to December storage holdings in explaining price through January, but after that storage holdings became more important.

<u>January-May Storage Holdings</u>. As an extension of the above section, monthly prices might be correlated with storage holdings during the preceding month. This was done by Pubols for the 1941 to 1950 period. Disposable income for

[78] November 1 storage holdings explained 38% of December price and 49% of January price.

the period was also considered. Such calculations explained 73% of the variation in January price, 73% of February price, 79% of March, 61% of April and 63% of May. With the advent of Controlled Atmosphere storage subsequent to the time of this study, the late season relationship might be somewhat altered.

We now turn to studies of monthly price at the state level.

Individual States. Factors influencing monthly price movements have been studied in two states, Connecticut and Michigan.

Connecticut. In 1940, Bressler and Seaver examined the movement in monthly price in Connecticut between March and October.[79] Their first step was to estimate an average price for each marketing season from the size of the New England and Connecticut commercial crops, the trend in demand, and the level of purchasing power in the northeast. Next, this estimated price was compared to the actual October price and the price changes that occurred from then until March. It was then observed that when the estimated price was considerably above the actual October price, ". . . a

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[79] Bressler and Seaver, op. cit., p. 22.

pronounced seasonal increase is to be expected and usually occurred."[80] Bressler and Seaver explained this by suggesting that the market at the beginning of the season over-estimated supplies or underestimated demand. In the process of correcting for this mistake, prices were raised an unusual amount.

In this way, then, a season average price could be of assistance to a grower in planning his marketing program.

Michigan. In 1952, Boger reported on a study of monthly price movements in Michigan over the 1923-50 period, excluding 1943-46.[81] He examined the influence of size of U.S. crop and total U.S. personal income on prices from September to April, using first differences of logarithms. His results showed surprisingly high correlations, particularly late in the season. The proportions of price variation explained were: September 71%; October, 85%; November, 74%; December, 87%; January, 79%; February, 80%; March, 83%; and April, 80%.

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[80] On the other hand, it will be recalled that Chen observed in 1929 that "The higher the price of fruit at harvest time, the greater will be the profit from storing it . . ."

[81] L. L. Boger, When Should Apples Be Sold? Michigan State University, Agricultural Experiment Station, Special Bulletin No. 381, September, 1952, p. 9, 11, 13, 18-19.

In contrast to this writer's findings at the national level, Boger noted that Michigan prices were most responsive to size of U.S. crop as the season progressed; a change in the size of the crop appeared to have more effect on prices during the months from January through April, than for September through December. He felt that the unexplained variation in prices could have been due to (1) rate of sales from storage, (2) location of the crop, and (3) the proportion of the crop processed.

An added step was to calculate estimated monthly prices. Boger reported that when actual September price was below estimated price, the market price was too low and that it would probably pay to place apples in storage. This observation was, of course, very similar to that made by Bressler and Seaver. Similar reasoning over the 23 years included in the study indicated that it would have paid growers to sell at harvest in 10 of the years (and in all these years, the season price rise proved to be less than normal), and to store in 13 of the years (and the seasonal price rise failed to occur in only two of these years, 1935 and 1947).

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Thus, it is seen that a fairly extensive amount of work has been done with the analysis of fresh apple prices on a monthly basis. The bulk of this has been at the national level, but some has been done for at least one state. In the future, much more attention will probably be given to state or regional monthly prices.

One problem that will require increasing attention will be the influence of Controlled Atmosphere storage on prices. In recent years, CA storage apples have brought about $0.90/bu. more than regular storage apples. With the quantity of CA apples increasing most sharply in recent years, a complex structural problem is presented.

And when and if more complete statistics become available, it would be well to consider the influence of variety on prices.

Fresh and Processing

In this section, discussion will be centered on studies which were concerned with both the fresh and the processing market. Least squares and simultaneous equations were used, but there was somewhat less emphasis on price per se than there was in the previous section. This work has been done on a yearly basis and proposed for a quarterly analysis.

Yearly Studies

Studies in this category have been conducted by Brandow and Drew. Brandow's investigation was conducted at the farm level; Drew's at the retail level.

Brandow. Brandow's study, as was noted earlier, was released in 1956 and covered the crop years from 1934 to 1953, except for 1942-46. First differences were used and prices were placed in logs.

Brandow used simultaneous equations (limited information, single equations) to set up demand and supply equations relating to utilization for the fresh and canning markets. The supply equations were discussed in Chapter III of this paper. Here we shall look at the demand equations.[82] Fresh demand was associated with (a) price for the fresh market, (b) wholesale food prices, (c) export factor for fresh apples, and (d) orange production. Only the first variable was significant at the 5% level. Canning demand was associated with (a) price for canning, (b) wholesale food prices, (c) military purchases and exports, and (d) carryover. In this case, all variables were significantly different from zero at the 5% level (and carryover at 1%) except for wholesale food prices.

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[82] Brandow, op. cit., pp. 9-11.

The results of the simultaneous equation analysis were used to select factors for estimating prices at the farm level through least squares analysis.[83] He found that 86% of the variation of fresh market prices at the farm level[84] was explained by (a) the wholesale food price, (b) apple production in the eastern states, and (c) apple production in the other states.[85] Concurrently, about 90% of the variation in canning and freezing apple prices was explained by (a) the wholesale food price, (b) apple production in the eastern states,[86] (c) military purchases and exports, and (d) August 1 carryover.[87] The significance level for each variable was not indicated, but the standard error for the military purchase--export factor was twice the

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[83] Ibid., pp. 22, 23.

[84] This was not the standard USDA price but was specially constructed.

[85] As noted earlier, when this writer correlated production and price for the 1946-60 period, 43% of the variation in price was "explained." When U.S. production was divided into regions, western production was most important (simple correlation, actual data).

[86] Curiously, when this writer correlated eastern apple production with processing for 1946-60, only 5% of the variation in processing price was explained. (This point will be discussed later).

[87] A simple correlation of August 1 canned and frozen carryover (converted to bushel terms) and processing prices for 1946-60 explained 30% of the variation in price.

coefficient, suggesting that it was not significantly different from zero.

Changes in the wholesale food price were found to be considerably more influential on processed price than they were on fresh price. On the average, a 1.00% increase in the wholesale food price was associated with an increase of 0.86% in the fresh price and an increase in 3.20% in the processing price.[88]

Brandow felt that the lack of more significant results in general may have been due to his small sample, but this writer would suspect that it was also due to the different nature of the pre- and postwar years--a problem that no longer has to be faced because of the sufficient number of postwar years.

Drew. Drew's study was not so much aimed at price per se as it was at exploring factors influencing per capita purchases of fresh and processing (farm weight equivalent) apples at retail.[89] He used the same four factors in both cases: (a) deflated retail price for fresh and (b) canned apples (sauce and slices), (c) the retail price of fresh oranges, and (d) per capita disposable income. When

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[88] Brandow, op. cit., p. 2.

[89] Drew, op. cit., pp. 122-132.

these were fitted by least squares (logs), he explained 73% and 79% of the variations in purchases of fresh and canned apples. In the case of fresh apples, the retail price of processed apples and per capita disposable income did not prove to be significant. In the case of canned apples, the retail price of fresh apples was not significant. In both cases, a negative sign was obtained for orange price, indicating the complementary relationship noted earlier. This means that the only factor common to purchases of both fresh and canned apples was their respective price.[90] Drew did not go on to attempt to use least squares for estimating, as did Brandow.

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Both Brandow and Drew used simultaneous equations to isolate the factors having the most important influence on apple price or purchases on an annual basis, but did not use them to predict price. This was accomplished through least squares analysis.

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[90]When this writer correlated purchases of fresh and processed apples in the Michigan State Consumer Panel, an r^2 of .67 was found between fresh prices and purchases while an r^2 of .70 was obtained for prices and purchases of applesauce.

Quarterly Studies

Instead of dealing with yearly data, Cromarty attempted to ". . . construct an econometric model which will be useful in analyzing seasonal or short-term demand fluctuations . . ."[91] This was approached by setting up four functions, each on a quarterly basis. The functions were: (1) retail, (2) storage, (3) processing, and (4) export. In each case, the equations were set up in "implicit" form; that is, two endogenous variables--price and quantity at the farm level--were included, either or both of which could be considered dependent. The periods were as follows: I, July, August; II, September-November; III, December-March; and IV, April-June.

Retail. For this function, four predetermined variables were hypothesized: (a) consumer disposable income, (b) average consumption during the same period during the four preceding years, (c) average consumption during the immediately preceding period, and (d) the price of competing fruits[92] (it was acknowledged that price was not really predetermined).[93] This was a rather unique set of variables--

[91]William A. Cromarty, "An Experiment in Designing an Econometric Model to Explain Short Term Demand Fluctuations for Apples," Michigan State University, Department of Agricultural Economics, M.S. thesis, July, 1953, p. 5.

[92]Pears, peaches, grapes, lemons, oranges, grapefruit.

[93]Cromarty, op. cit., pp. 27-34.

particularly items (b) and (c)--but, curiously, it overlooked production of apples. Significantly, when Cromarty himself attempted to fit this function several years later (1958), he used only one of the above variables, (a), and went on to include time and production--the latter turning out to be significantly different from zero at the 1% level.

Storage. For this function, five predetermined variables were put forth: (a) quantity on hand at beginning of the period, (b) quantity on hand at the end of similar quarters, (c) prices of competing fruits, (d) index of costs of storing apples, (period II, handling and storage for one month; periods III and IV, storage only), (e) index of seasonal price increase for previous year (period II only).[94] This writer would have some reservation about the value of items (b) and (e), feeling that indices of apple prices or production might have more significance. Item (d) would be difficult to measure and, in fact, is an area where very little information is available. It is not clear which factors were used when Cromarty later fitted this function, but it appeared to be some combination of (a) and (b), and (d). Recognizing the seasonal nature of storage, he indicated that there was no demand for storage in period I, a positive

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[94] Ibid., pp. 35-42.

demand in period II, and negative demands in periods III and IV.

Processing.[95] For this function, four predetermined variables were suggested: (a) index of processing costs, (b) index of carryover stocks of processed apples, (c) index of prices of pears, peaches and apricots, and (d) price of red cherries.[96] Again, it was recognized that (c) and (d) were really not predetermined, but were included because suitable quantity data were not available. Both were considered to represent competitive items, (c) as a competitor of sauce, and (d) as a competitor of slices used in pies. The variables selected appeared reasonable, but this writer would enter two caveats: first, the index of processing costs, (a), is very difficult to determine; and there is some question as to how accurate Cromarty's rather involved system would be; secondly, production was again overlooked. When the function was run by Cromarty in 1958, only variable (b) was included from the above list, but income and production variables were added.

Export. This function envisaged three variables: (a) the quantity of apples harvested in the main importing

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[95] Canning, freezing and drying apples only.

[96] Cromarty, op. cit., pp. 43-49.

countries, (b) the volume of apples exported to Canada, and (c) the index of wholesale prices in the important importing countries.[97] While this data might be cumbersome to get, the variables appear reasonable. The over-riding factor now, however, is that from 1946-60 exports represented a very small proportion of production (about 1.9%) and were important only in years of short European crops.

With European production definitely on the increase, the proportion may be expected to become even smaller. For these reasons, this writer would not bother with this function, but instead would suggest that more attention be given to the other three functions--particularly storage and processing. The former might be revised to take account of Controlled Atmosphere storage, while the latter might be extended to cover some of the factors included in the next section.

Processing

While the several studies noted in the previous section included the processing price, only one study has heretofore dealt specifically with this subject--and this has not been published. Yet this is an area which will probably be the subject of much attention in the near

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[97] *Ibid.*, pp. 50-59.

future. Consequently, we turn to a preliminary inquiry conducted by Tomek in 1961.[98]

Tomek examined the factors influencing the price of processing apples in New York State over the 1947-60 period, omitting 1950 and 1954. The study was unique in its selection of variables in that it recognized processor preference for certain kinds of apples: (a) type A varieties included the preferred varieties, Baldwin, Ben Davis, Northern Spy, R.I. Greening, and Rome; (b) type B varieties included all others. The three other variables included: (c) production in the Appalachian states, (d) carryover of apple products on July 31 (fresh equivalent), and (e) U.S. disposable income. All variables were expressed in per capita terms.

When the equation was fitted in log form, the four variables were found to explain 96.4% of the variation in processing prices. No relation was found between the residuals and the production of other fruits. It is of particular interest that variables (a) and (c), relating to New York production of type A varieties and Appalachian production, were not significant--whereas production of type B varieties in New York was significant. This suggests that fresh

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[98] William G. Tomek, "A Progress Report: An Analysis of the Price of Apples for Processing in New York," Cornell University, Department of Agricultural Economics, unpublished manuscript, 1962.

production was more closely related to processing price than was processing production.

A somewhat similar finding was obtained by this writer. It will be remembered that when the relationship of apple production to U.S. processed price was examined, eastern production had less apparent influence than did western production. Specifically, eastern production explained only 5% of the variation in U.S. "all" processed price, while central production accounted for 18%, and western production 20%. Eastern production, it will be further remembered, is much more processing oriented than is western production, which largely moves fresh. The fact, then, that western production explained a larger portion of processing price than did eastern production seems to be consistent with Tomek's findings.

But, because the crop estimates are not available during the season by variety or use classification, it would be difficult to tie prices to type of production at harvest time.[99] Thus, the concept at first does not appear operational. There is, however, a way around this. Let us assume (and this seems reasonable) that fresh prices are largely determined under conditions characterizing pure competition.

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[99] In addition, there is the problem of handling the dual purpose apples which could go to either fresh or processing market.

In turn, Evans hypothesizes[100] that apple processors, realizing that they cannot influence the fresh price, take it as given and adjust processing prices accordingly. That is, they base the processing price that they will pay on the prevailing fresh market price. They realize that they will have to pay a competitive price to attract the dual purpose varieties, which otherwise might go to the fresh market.

If this actually were the case, it would seem that there should be a rather high correlation between September or October fresh prices and average processing price. When correlations using actual data were run by this writer between these variables over the 1946-60 period, it was found that fluctuations in the September price explained 74% of the fluctuations in the "all" processing price while variations in the October price explained 62% of the processing price. When monthly prices were correlated with the canning and freezing price, the situation was reversed, with September prices explaining 59% of the variation, and October prices explaining 70%. These results would seem to bear out Evan's suggestion that processing price is based on fresh price.

Fresh prices, though perhaps the most important single factor influencing processing prices, are not the only factor.

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[100] Evans, op. cit., p. 57.

As we have seen, the September 1 crop estimate and August 1 carryover stocks are also important. Since these three are individually important in determining processed price, it would seem that together they could do a better job.

To test this, the author attempted to estimate the average U.S. price paid for canning and freezing apples. This was done with information that would be available as of September or October for the period from 1947 to 1960.[101]

Thus, for September, the variables tested were (a) August 1 processed carryover (canned and frozen), (b) September crop estimate, and (c) September fresh price. Similarly, for October the variables tested were (a) August 1 processed carryover, (b) October crop estimate, and (c) October fresh price.

When the equations were fitted by first differences of logarithims, it was found that the September data explained 94.5% of the variation in price($\bar{R}^2$ = .93), while the October data explained 92.9% of the variation ($\bar{R}^2$ = .91). In both cases, carryover (a) and fresh prices (c) (c') were significant at the 1% level, while the crop estimates (b) (b') were significant only at the 10% and 20% levels respectively

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[101] 1946 was omitted because of lack of information on carryover stocks, and because it was an unusual price year.

(and when the equations were run without the crop estimates the variation explained dropped only to 92.2% and 91.4% respectively--probably due to the intercorrelation with fresh price).[102]

These results, it will be noted, were obtained without the use of an income variable. If an appropriate income figure could be obtained, the estimated prices could conceivably be even closer to actual prices.

In total, then, it appears that a reasonably good job can be done of estimating the national season price for canning and freezing apples, using carryover and September fresh price, and to a much smaller extent the September crop estimate, in log form. First differences provided a slightly better fit than untransformed data.

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But even though prices may be statistically estimated, there are substantial institutional problems that need to be faced.

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[102] In both cases, the fit using logs of untransformed data was nearly as good--94.2% for September and 91.0% for October. In the first case, all variables were significant at the 1% level, while in the second, production was not significant at even the 50% level.

In the case of both the untransformed and first difference equations, the advantage of logs was of particular advantage in September (from 86.7% to 94.2%, and 83.2% to 94.5%), and of less advantage in October (from 88.8% to 91.0%, and 92.1% to 92.9%).

Institutional Problems[103]

At present, the apple industry in several regions, at least, has expressed a rather strong interest in price analysis. And, in the case of bragaining associations for apples, there is interest in having public agencies predict a "fair" price. This was not always the case. In fact, there was a period only seven years ago when apple groups favored a bill which would have prevented the publication and presumably the discussion of future price prospects for apples by any employee of the U.S. Department of Agriculture, including cooperative employees of the Federal-State Extension service.[104]

The actual incident which brought about this proposal seemed innocuous at the time, but perhaps provides a lesson. In the August, 1953 Fruit Situation, it was stated:

> Later in the summer as marketings become heavier, grower prices for apples generally probably will decline to levels somewhat under those of 1952. Moreover, prices next fall may not rise as sharply as . . . in the fall of 1952.

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[103] This section is largely based upon Apple Prices, Hearing before the Subcommittee on Departmental Administration and Crop Insurance of the Committee on Agriculture, House of Representative, 84th Congress, First Session, on H.R. 5183, and H.R. 5188, April 27, 1955, 26 pp.

[104] Specifically, "That section of the Agricultural Marketing Act (Act of June 15, 1929; 12 U.S.C. 1141 j (d), as amended) is hereby amended by inserting after the word 'cotton,' the words 'or apples.'"

This was based on a large crop forecast. As it turned out, the crop reports went down for the next few months; and, in the final analysis, prices were higher.

The Fruit Situation projections have always appeared so mild and so obvious that it is difficult to see how they could be considered more than general indicators. However, this apparently is not always the case.

The Roanoke (Va.) papers published an extract of the above report. According to Jones of the Virginia State Horticultural Society, some of the customers went out to roadside stands and priced apples. Finding prices higher, they supposedly said that they would not buy apples. Similar experience was had by another group which sold to truckers. Shortly thereafter, the above bill was introduced by three congressmen from Virginia.

At the hearing held on April 27, 1955, representatives of the Virginia State Apple Commission, the Virginia State Horticultural Society, the Appalachian Apple Service, the Western New York Apple Growers Association, the New York-New England Apple Institute, the National Apple Institute, and the American Farm Bureau Federation all spoke for the bill. They were most explicit in their opposition to "price predicting" by the government, even though O. V. Wells had stated:

> We do not try to predict specific prices. We are largely interested in the direction in which the situation is going, and we frankly are far more interested in the economic education with respect to supplies and demand factors, and the relation between them, than we are in the specific price forecast as such.

The reasons stated for opposing government forecasts ranged from the ridiculous to the reasonable. The ridiculous included such statements as: ". . . it is wrong to have the market, the conditions of the market affected by wild guesses as to what the price is going to be." In general, however, most of those who testified seemed to be expressing a conviction that when a lower price is predicted, the buyers use this information to beat down the price.[105] Nothing was said about the reaction when a higher price is predicted. And no one seemed to have looked at the more basic purpose of education in respect to supply and demand factors as stated by Wells.

A more serious criticism springs from the inherent difficulties of making price forecasts. The representative

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[105]Appalachian growers appear to still be on guard. A recent news item datelined Martinsburg, West Virginia reported ". . . A prohibition against 'prohibitions' is being scrupulously demanded by fruit growers in this belt." ("Complaints on Federal-State News Service," The Packer, November 14, 1959, p. 16A). Citrus growers have expressed similar sentiments ("Lay off Calling Our Fruit Prices," Food Field Reporter, November 9, 1959, p. 13).

of the National Apple Institute stated, the greatest ". . . lack is the absence of any usable record of prices received by growers for preceding crops." He then suggested that ". . . the Department's efforts in the whole matter would be better directed to improvement of the price reporting." This is an important, if somewhat overstated, point and one that bears further study.

Notably absent from the group of growers which testified against price work was any delegation from Michigan. It is not known whether this was by accident or design, but it is interesting to note that on December 3, 1958, the Michigan State Horticultural Society passed the following resolution:

> . . . Be it resolved that Michigan State University establish a special chair or study for the price analysis of fruits grown in Michigan; and that such chair or study be established on a permanent and unbiased basis and be equally available to growers, processors and handlers of Michigan fruits.[106]

The reason for the difference in attitude between Michigan and other growers on this subject probably stems from two points: (1) the Michigan growers had been better educated as to the value of price analysis in studying variables affecting supply and demand through the reports

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[106] Eighty-Eighth Annual Report of the Secretary of the State Horticultural Society of Michigan, 1958, p. 12.

of Michigan State University; (2) growers may be more distrustful of work done "way off" in Washington than they are of work done in their own state by people they do know.

All of this suggests that apple price analysis faces a certain public relations program if it is to be done and published on a national level. If the work is to be done on a state level, by request, this problem is not so severe.[107]

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[107]Though it remains to be seen what the response would be to what the growers considered an unfavorable forecast.

CHAPTER VII

MARKETING POLICY

This study has suggested two areas which are of particular relevance to the formulation of marketing policy for apples. These concern: the regional impact of divergent trends between fresh and processing apples in production, utilization and consumption; and questions of a more theoretical nature, but of considerable applied importance, concerning the role of bargaining and controlled distribution programs. These points have been alluded to earlier but are more fully developed here.

Production and Consumption Trends: Regional Impact

Apple production increased gradually over the 15-year period of the study, from 1946 to 1960, and further increases are expected in the near future. In fact, it appears that production will increase most sharply within the next four to five years.

The changes in production, moreover, have not and likely will not be evenly distributed by variety. During the postwar period, production of "processing" varieties held relatively constant, while production of the "fresh" varieties increased. This trend is expected to continue--with perhaps actual decreases in the processing varieties and accelerated increases in fresh varieties such as Red Delicious.

These trends by themselves are not particularly alarming; but when changes in consumption are considered, they give some pause for concern--for there appears to be a shift in consumption from fresh apples to processed apples. Thus, the industry will be facing not only increased production, but increased production of the "wrong" varieties.

The impact of these opposing changes in production and consumption may vary by region of the country.[1] Under present conditions it would seem that the northwest may become increasingly disadvantaged, while certain eastern states may be relatively advantaged.

This could be so for two reasons, varieties and processing facilities. Although production in the west trended down over the period of this study, this trend is not expected to continue for long. Rather, much of the increased production of fresh varieties will be found in the

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[1] This study has not been concerned with the costs of production which probably vary considerably by region and which may offset some of the changes indicated here.

northwestern states. Production in eastern areas is apt to run more heavily to dual purpose and processing varieties. With increased consumption of processed apples, it is the dual purpose and processing varieties which will face increasing demand--the derived demand at the farm level coming from the established processing plants.

With the concentration of processing facilities and production of dual purpose and processing varieties of apples in the east, it would, therefore, seem that this region is in a somewhat more favorable position, at least for a while. The northwest, on the other hand, has fewer processing or dual purpose varieties and few processing facilities, and may not immediately be so well situated.

There are, however, two factors which may temper these positions. One is psychological-technological, and the other is more purely economic.

We have spoken of dual purpose and processing varieties. These classifications have largely been set up by the trade with respect to apples which stand up well in processing and to apples which they think the consumer desires in processed form. It appears though, that the consumer may have different ideas. Preliminary consumer preference studies suggest that the consumer may not have a significant preference for "processing" apples over "fresh" apples in processed form--a point that bears further investigation.

If this lack of preference proves to be real, it throws the choice of using fresh varieties for processing back onto questions of economies in processing. At present, the processing varieties unquestionably do stand up better in the coring and peeling process and give a higher yield at less cost. This is reflected in higher prices for certain processing varieties.

But is it absolutely necessary to core and peel apples which are going to be crushed into sauce anyway? Sauce can be made without this process--but there is a technological impasse at present concerning color stabilization. If this could be solved, a sauce which would meet consumer acceptance might be economically manufactured from fresh varieties. Similar innovations might eventually be made for other apple products.

An unanswered question is whether such products made from fresh varieties would meet the same level of consumer demand over a period of years as products made from processing apples have. There may not, however, be time to worry about all the implications of this. With the prospect of immediately increasing fresh production and decreasing fresh consumption, something will have to give, and in a hurry. This may be the present industry attitude about what varieties go into, and how to manufacture, sauce and then other apple products.

If these problems could be worked out, the northwestern states might not be at such a disadvantage from a varietal point of view. But the significant remaining fact is that they do not have the processing facilities. These would have to be built.[2] This takes money and time.

Whether all these things--further testing of consumer preference for processed products made from fresh apples, development of new ways of preparing sauce that are better adapted to fresh varieties, and the establishment of processing facilities in fresh areas--can be done in time to meet the expected increase of production is problematical.

On the fresh apple side, the position of the northwest has probably not been advantaged as much as the east by Controlled Atmosphere storage. CA storage has had its greatest growth in the northeast. It has made it possible to hold the more tender eastern varieties into the spring months--months when western varieties used to have the market to themselves. This has meant that western apples have to face increasing competition in eastern markets.

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[2] Once built, however, they might be considerably more efficient in operation than older eastern plants.

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While the issues raised here are, in the first instance, of most concern to the northwest, they are also of concern to the rest of the country. This is because apples, as suggested in the Introduction and evidenced throughout the paper, are very much a national commodity. The supply and demand factors at work in one area are not without influence in other areas. In this way, the price paid for canning and freezing apples in the east seems to be based on the United States fresh price-- and the United States fresh price seems to be more highly correlated with total western production than with total United States production. Consequently, what happens to production and prices in the west is very likely to be of concern to those who are concerned with processing price in the east. The problems of one production area soon become the problems of other areas. The apple industry would be well advised, therefore, to consider such issues in the light of their national perspective.

Bargaining and Controlled Distribution

In an effort to stabilize and increase grower returns, consideration has been given to apple bargaining associations and associated controlled distribution programs. Though the two are often thought of synonymously, it might be well, to start with, to look at them independently.

Bargaining for Price

Bargaining groups have expressed considerable interest in leveling out within-year and year-to-year price movements of apples, basing their negotiations on statistical price analysis. In this respect, two misunderstandings may arise.

First, while bargaining for an annual price may reduce the variations of price within a season, it will not automatically reduce the fluctuations in year-to-year price. If the annual price sought by the bargaining group is based on a conscientious effort to increase price above what it has been in low price years in the past and to settle for a somewhat lower price than has been received in high-price years, then the year-to-year variability may be reduced. If, however, the annual price is to be based <u>solely</u> on a statistical analysis of past prices, there is less reason to expect the year-to-year variations to be evened out. This is because statistical models, as generally formulated, can only estimate what a future price might be based on supply and demand relationships which existed in previous years. Since the previous period showed year-to-year variability in price--which presumably led to concern over this matter--

the statistical analysis will normally just incorporate these relationships in projecting a price. Consequently, bargaining based only on historical data will not automatically lead to a smoothing out of average year-to-year price. To do this, other factors must be brought into the bargaining negotiations.

Secondly, it is questionable whether grower groups really should want to even out average prices from year-to-year. This is because a program of stabilizing prices could in some cases lead to unstabilizing and reducing farm income--and growers are basically probably more interested in stabilizing and maximizing farm income.[3]

Thus, it may be seen that price bargaining based on historical data alone does not, and possibly should not, attempt to even out year-to-year price variations. It may, however, have other important benefits--such as reducing price variation within a season. It also may prove useful in conducting diversion programs, a point which will be discussed later in this chapter.

Controlled Distribution

Controlled distribution as proposed for apples takes two main forms: a limitation of quantity of apples sold;

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[3]This point is discussed in some detail by Frederick L. Thomsen and Richard J. Foote, Agricultural Prices, New York: McGraw-Hill, 1952, p. 210, and Shepherd, op. cit., pp. 184-185.

and a diversion of apples from one outlet to another. Both programs should be based on specific price elasticities and costs, with the objectives of maximizing net farm values. Because so much rests on the value of the elasticity figures, it is important that one of their lesser-known but vital characteristics be understood.

Changes in Elasticity

For policy purposes, it is perhaps most important to recognize that elasticities of demand may change; an elasticity, once calculated, does not hold for all time. Rather, a specific elasticity exists for only the period under study. For a different period and different conditions, the elasticity may be different. This is particularly true if one bases a crop limitation or diversion program on a known elasticity for a past period--for the enactment of the policy may alter the elasticity which suggested the program in the first place.

Although the possible difference between elasticities of this nature is one that has not been well covered in economics or marketing texts, this subject has been treated at the consumer level in several journal articles.

Mighell and Allen in 1939 made one of the earliest and perhaps more detailed presentations on this point.[4] They stated that demand theory has been cast in terms of instantaneous or short-term schedules--even if the demand schedule was developed from extended time series data. They go on to point out that:

> We have developed neither the theory or methodology for estimating what quantity of any product will presently be taken by consumers if the price has fallen to a level 10 percent lower relative to other prices and consumers have reason to believe it is there to stay. And similarly if the price has risen. . . . Nothing that has been done on the subject has given us an adequate approach to the problem of consumers' response to price over more than the short run.[5]

Mighell and Allen felt that the utility function or indifference system of the individual is partly dependent upon previously existing price relationships and may be altered in the course of time as a result of changing price relationships.[6]

These points lead to critical problems in relation to the limitation and diversion programs noted earlier. Mighell and Allen acknowledged that the "normal" demand curves are extremely useful for problems arising within a

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[4] R. I. Mighell and R. H. Allen, "Demand Schedules - 'Normal and Instantaneous,'" Journal of Farm Economics, August, 1939, pp. 555-569.

[5] Ibid., p. 555.

[6] Ibid., p. 562. Clearly, Mighell and Allen have a shift in the demand curve--not just a movement along it--in mind.

single year or so, but they went on to state that if continuing programs affecting the production and sale of farm products are to be planned and carried out successfully, it is necessary to reason in terms of an elasticity of demand based on a "modified" demand curve.[7] They indicated that the use of the normal demand curve in estimating consumers' response to price changes underestimates the extent of the response when the new prices are to be in effect for a period of several years. Specifically, it was suggested that the normal demand curves are less elastic than the modified demand curves.[8]

Despite the fact that Mighell and Allen's article was prominently reported, few applied studies have made explicit recognition of the differences between normal and modified elasticities. Exceptions include Kuznets and Klein, Working, and Smith. In their study of the demand for lemons in 1943, Kuznets and Klein stated:

> The conclusion that revenue to growers could be increased in the long run if drastic limitation of shipments were instituted is not implied by the foregoing since the long-run effects are not

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[7] Ibid., p. 565. Actually Mighell and Allen write in terms of short and long-run demand curves, but because this terminology may confuse those who associate the short-run with elasticities computed from data obtained within one season as opposed to data collected over a period of years, this writer has chosen to use the more general terms, "normal" and "modified."

[8] Ibid., p. 569.

treated in the formulations underlying these calculations.[9]

Working, in his study of the demand for meat, was more explicit. He stated that from the standpoint of national policy the most significant result of his analysis was the evidence developed to show that there is a difference between the normal and the modified elasticity of demand for meat. He found that normal demand for meat at retail to be somewhat inelastic. However, when the supply of meat was decreased and the supply maintained at that lower level over a period of years the modified demand for meat at retail became elastic.[10] And in his recent study on lemons, Smith takes the point of view that the usual economic concept of demand is a short-time one--that is, it does not account for the possibility of a modified demand curve.[11]

While these studies recognize the differing nature of demand as controls are applied, they are less than

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[9]G. M Kuznets and L. R. Klein, A Statistical Analysis of the Domestic Demand for Lemons, 1921-41, University of California, Department of Agricultural Economics, Report No. 84, 1943, p. 56. (Cited by Roy J. Smith in "The Lemon Prorate in the Long Run," The Journal of Political Economy, December, 1961, p. 575.)

[10]Elmer J. Working, Demand for Meat, Chicago: The University of Chicago Press (for the Institute of Meat Packing), 1954, p. xi (also see pp. 13, 38, 47). Like Mighell and Allen, Working used the expressions "short-run" and "long-run." For the reasons stated in fn. 7, these have been changed to "normal" and "modified."

[11]Smith, loc. cit.

explicit in describing methods of estimating the modified elasticity--for by its nature it remains to be influenced by proposed programs.

However, the main point is clear: statistically derived price elasticities of demand are not likely to remain the same following the instigation of supply control programs. From the data presented, it appears that elasticity under controls may gradually increase. This important point has meaning for both crop limitation and diversion programs. It also applies to the question of whether to base these programs on elasticities at the farm or retail level.

Quantity Limitation Programs

Many individuals connected with the apple industry have considered the possibility of a program of limiting the quantity of apples marketed--similar perhaps to the green drop program of the California cling peach industry--as a way of raising farm income from apples. Such a program is based, of course, on a presumed inelastic normal demand for apples at the farm level.

The previous discussion has suggested a number of serious theoretical problems in following such a program. First, as noted in the above section, there is the fact that we are dealing with a normal elasticity. It is an elasticity based on past relationships which have not included periods of quantity limitation. When marketing controls are incorporated over a number of years, the demand relationships may be changed and the elasticities are likely to increase. If apples were to follow the example set by meat, it is possible that inelastic demand could, over time, become an elastic demand. This could come about as consumers, faced by smaller quantities of higher-priced apples, lose their preference for apples and transfer their demand (at this price) to other fruits.[12] A move in this direction seems to have taken place for lemons. Smith describes the situation in this way:

> The lemon industry in its prorate program has attempted to increase growers average returns by exploiting an assumed inelasticity of demand for its fresh fruit. The effect that such a program might have on long-run production has been disregarded. In consequence the long-run results . . . would appear to have been different from those sought. Growers' returns per carton, in the long-run have _not_ been increased. The effect on long-run market demand has also been disregarded . . . the prorate is in effect subsidizing a product which is competitive and which is driving the fresh fruit out of the market.[13]

A further problem is that while the short-run demand

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[12] That is, there is a shift in the demand schedule for apples--not just a movement along it--which results in a more elastic demand. See fn. 7.

[13] Smith, _op. cit._, p. 586. [Underlining added.]

for apples at the farm level appears to be inelastic, the short-run demand at retail appears to be elastic. This is apt to place the marketing firm in an awkward position. That is, the firm that handles both wholesaling and retailing functions (as would be the case in a supermarket chain) is faced, on one hand, with an inelastic demand schedule at the farm level and, on the other hand, with an elastic demand at the retail level. Therefore, if farmers elected to limit the supply of apples, the marketing firm would have fewer apples to sell at retail. Because the normal demand at the farm is inelastic, the price that the marketing firm would pay would presumably rise. Conversely, because of the elastic demand at retail, the retail price would rise but little. This means that the marketing firm would be buying fewer apples at higher prices (total expenditures for apples would increase) and selling them at approximately the same price (decreasing total revenue). The result could only be lowered profits from apples to the marketing firm. If this happens very often, it seems reasonable to assume that the marketing firm will react by modifying its demand for apples at the farm level. The firm, in essence, will make the demand at the farm level--in years when supply is artifically limited--more elastic by paying a lower price[14] than might exist in the absence of supply control. The degree to which this can or will be done will depend on the amount of oligopsony power exercised by the buyer. But since a less than perfectly competitive market appears to exist, it seems likely, especially in the canning and freezing area, that a tendency towards a lower price might be expected.[15] This would be comparable to a more elastic demand--which does not seem unlikely in light of the preceding paragraph. That is, if consumer reaction to a control program would lead to a higher elasticity of demand at retail, it would seem that a more rapid response in the same direction at the farm level might be expected from marketing firms who buy on an inelastic market and sell on an elastic market.[16] The result at the farm level might eventually be lower prices for fewer apples.

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[14] This is not to say that the whole demand curve is modified; we can only say that this section of the demand curve becomes more elastic--sufficiently so that if extended it would intercept the former or normal curve.

[15] It will be noted later in this section that the oligopsony power of buyers may be offset by oligopoly powers gained through bargaining.

[16] It may be that if apples represent a minor portion of the volume of a marketing firm, it will not be particularly concerned with the effects of a supply limitation program. But even though the relationships might not hold for every firm, this writer would suggest that the general movement would be as noted above.

In total then, it would appear that a program of supply limitation for apples may not be advisable, unless it is practiced infrequently. If practiced steadily, such a program may lead to higher elasticities of demand at the farm level--particularly since the demand at retail is elastic--which might over the long run defeat the purposes of the program.[17] And in the longer run, production will have probably increased due to higher prices, further aggravating the situation. In addition to these theoretical problems, there are a host of practical problems of enforcing such regulations--i.e., what total quantity is to be withheld? how is the quantity to be limited? what is to happen to the apples withheld?, etc. Because of these difficulties, a more acceptable solution might center about a program to distribute apples between fresh and processing outlets.

Diversion of Supply

When the price elasticity of demand in two separate markets for a product differs, it is possible to practice price discrimination. That is, higher prices may be charged in the market with the less elastic demand than in the case

[17] An exception might be provided if the purpose were to stabilize farm income. This would be accomplished if the elasticity were raised to and held at one.

in the market with the elastic demand. To carry this further, the industry can maximize profits by controlling the flow of the product into each market until marginal revenues are equaled.[18] In this sense, the program might alternatively be labeled discriminatory diversion of supply.

In either case, the next question that arises is one of costs. How much should be produced to maximize profits, given costs? This point, as stated in economics textbooks, is reached when the marginal revenues in each market are equal to each other and to marginal cost; aggregate marginal revenue then equals marginal cost.[19]

While this formulation brings in cost, it does so in only an incomplete manner. It implicitly assumes that the costs of selling in each market are the same. In actual cases, this may not be so. The costs of selling apples to the fresh market, as indicated earlier in this dissertation, are quite likely to be different from those involved in selling to the processor. Unfortunately, this somewhat more realistic case has not been widely treated in the literature.

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[18] This point is covered in many textbooks, but one of the clearest presentations is made by Richard H. Leftwich in The Price System and Resource Allocation, New York: Rinehart & Co., 1958, pp. 212-213.

[19] This point is again clearly presented by Leftwich, Ibid., pp. 214-215.

In earlier sections of this paper where this question arose, however, this writer suggested equalizing marginal net revenues in the two markets. This concept calls for further explanation. Marginal net revenue is considered the equivalent of marginal revenue minus marginal cost. Therefore, the equalization of marginal net revenue involves the following relationship.

$$MR_a - MC_a = MR_b - MC_b$$

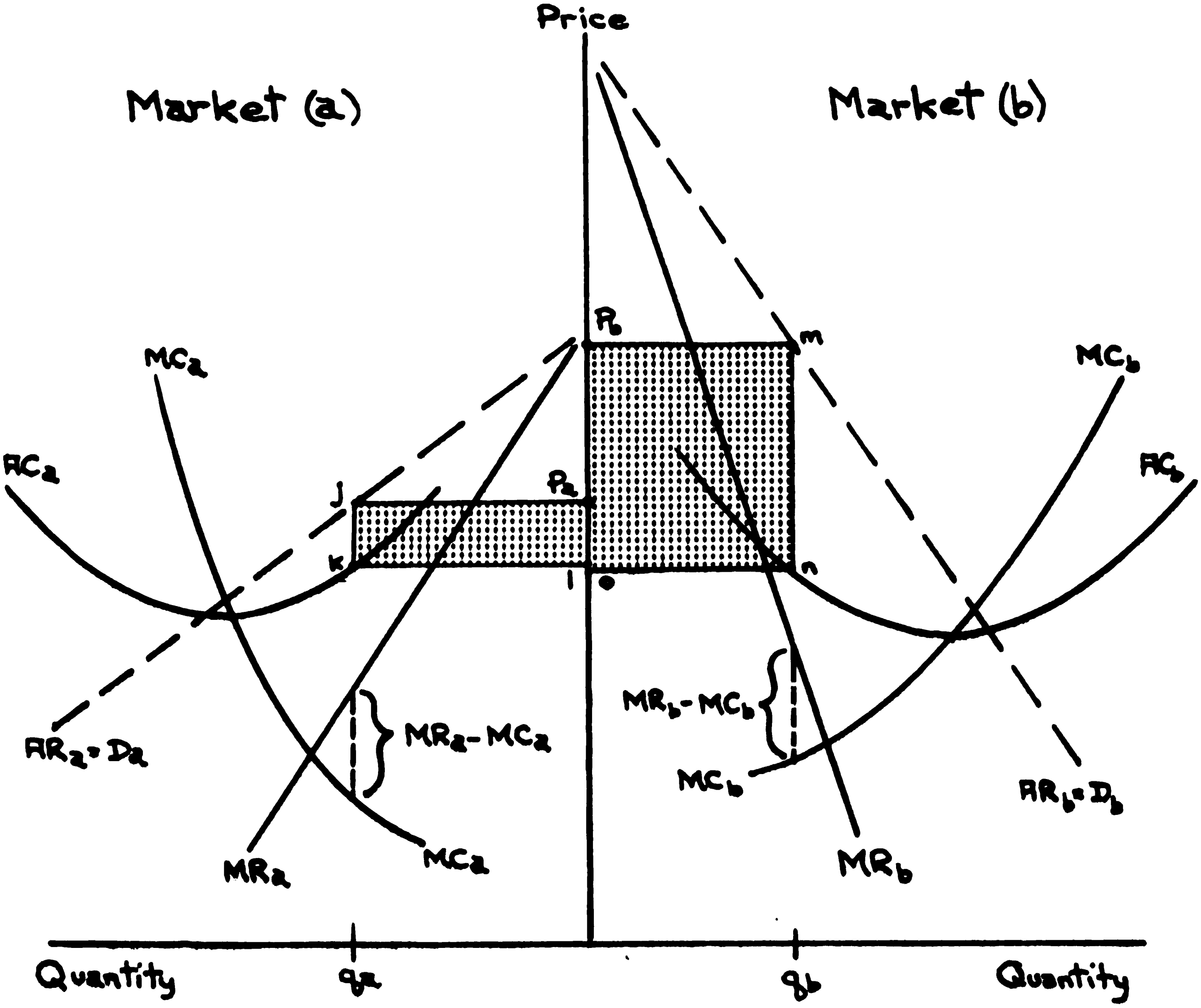
MR_a and MC_a refer to market (a) and MR_b and MC_b refer to market (b).

The relationship between the two markets may become clearer if presented diagrammatically. This is done in Figure 6.[20] It is assumed that there is a given quantity (Q) to be marketed which is less than the quantity which would equate marginal revenue and marginal cost in each market.[21]

[20] An alternative and more general formulation, suggested by Carleton Dennis, would be as follows: (1) Starting with two or more conventional sets of MR & MC curves, plot a Net Marginal Revenue (NMR) cure for each set by subtracting MC_i from MR_i over a series of quantities; (2) take the individual NMR curves and add them horizontally (just as Letwich [op. cit., p. 214] adds MR curves); (3) place a vertical supply curve at the point which indicates the total quantity available; (4) from the point where the supply curve intersects Σ NMR, draw a horizontal line to the Y axis. The point where this line intersects each NMR curve indicates the quantity to be placed in each market.

[21] If the quantity were greater than this amount, the relationship would be reversed and the quantity to be placed in each market to minimize the reduction in profit would be: $MC_a - MR_a = MC_b - MR_b$.

Figure 6. Price discrimination with unequal costs.



It is further assumed that market (a) has the more elastic demand schedule as well as higher average and marginal costs; market (b) is assumed to have a more inelastic demand and lower average and marginal costs.

Net profits will be maximized when q_a units of the product are placed in market (a) and q_b units are placed in market (b). These points were determined graphically by selecting quantities of each which would equate marginal net revenue. At these points, the price in market (a) is P_a, and the price in market (b) is P_b. The total profit is represented by a combination of rectangles $P_a$jkl and $P_b$mna.

At the farm level, market (a) might have been considered the fresh market for apples, while (b) might have been considered the processing market. Or the situation might have been viewed at the retail level, in which case (a) might have been the processed market and (b) the fresh market.

The point of maximum profit could alternatively have been determined algebraically.[22] The same assumptions are made as in the previous case. In this instance, however, the marginal revenues and costs are given algebraically in terms of slopes. The derivation of the point of maximum net profit takes the following path.

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[22]Adapted from G. G. Quackenbush, "A Brief Review of Firm Theory in Marketing," Michigan State University, Department of Agricultural Economics, unpublished and undated paper, p. 12.

(1) $MR_a - MC_a = MR_b - MC_b$

(2) Assume

$$MR_a = 20 - 2q_a$$

$$MC_a = .10q_a + 4$$

$$MR_b = 25 - 3q_b$$

$$MC_b = .08q_b + 5$$

Substituting,

(3) $(20 - 2q_a) - (.10q_a + 4) = (25 - 3q_b) - (.08q_b + 5).$

This reduces to

(4) $2.1q_a = 4 + 3.08q_b.$

Since $q_b = Q - q_a$,

(5) $2.1q_a = 4 + 3.08\ (Q - q_a).$

This reduces to

(6) $q_a = .59Q - .77.$

This means that 59% of the total quantity, less .77 units, should go into market (a) and the rest to market (b). The specific quantities going into each market (q_a and q_b) could then be determined by inserting the actual value of Q.

Thus, given data on marginal costs and revenues, it is possible to determine the most profitable allocation of product between the two markets. Yet several serious problems remain.

The first is that data on marginal costs and revenues for both the fresh and processing markets are scarce. While they might not be too difficult to get if one were interested only in the farm level, the situation would be difficult at the retail level. There are practically no published figures available on the costs of processing and selling canned apples. Consequently, before a diversion program is adopted, it would be necessary to select the level which will be studied--farm or retail--and then gather a rather extensive amount of statistical material on costs and revenues.

A second problem centers about the question of whether farm or retail elasticities should be chosen. This is a vital issue because the relationship between fresh and processing apples at the farm level appears to be reversed at the retail level; at the farm level the elasticity of demand appears to be greater for fresh than for processing apples, while at the retail level the elasticity of demand appears to be greater for processing than for fresh.[23] Clearly, the policy recommendation would take quite different forms, depending upon which level elasticity is chosen. The diversion of a greater number of apples into canning would seem logical from the retail elasticities; but considering the farm elasticities,

[23] This inverse relationship, as suggested earlier, appears reasonable because the marketing margin for applesauce seems to be much larger and probably no more flexible than that for fresh apples.

it would appear that additional apples might better go into fresh outlets.

The choice of farm or retail level elasticity may depend on frequency of diversion. If a diversion program is to be carried out only occasionally, it might be possible to base it on farm elasticities. However, if a diversion program is to be carried out frequently, a slower change in the long-run elasticities might result--for the reasons suggested in the previous section--if the program were based on the retail elasticities.[24] If the retail elasticity is chosen, it would mean, in years of large crops, the diversion of additional apples into canning outlets until marginal net revenues are equated at the retail level. But in doing this, a further difficulty arises. This centers about the fact that at the farm level the elasticity of demand seems to be greater for fresh market apples than for processing apples. Under such conditions, growers understandably might be reluctant to ship additional apples to the processing market. To make this outlet more attractive to growers, a bargaining program might prove of assistance (this will be discussed later).

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[24]That is, if the consumer responds to supply limitation and higher prices by increasing the elasticity of demand, it would seem fair to suggest that the marketing firm--with an inelastic demand on the farm end and an elastic demand at retail--would react in the same direction, but even more quickly.

A third problem centers about the fact that the elasticities used above, despite the reliance on the retail level, are "normal" elasticities. As a diversion program operated over a period of time, the relationships would be expected to change--possibly to the point where the diversion program was no longer worthwhile. To know what changes were taking place as the program continues, it would be necessary to compute elasticities of demand each season at the level being studied.

Despite these problems, it would seem that a program of diversion might offer greater longer-run possibilities of increasing net farm income than would a program of over-all supply limitation. However, as indicated, to carry out a diversion program a certain amount of bargaining may be advisable.

Bargaining and Diversion

The potential interrelationship between bargaining for price and diversion programs may be illustrated by considering the case of fresh apples and canned applesauce.

Initially, one faces differing orderings of elasticities at the retail and the farm level. The retail elasticity of demand for applesauce is greater than one and higher than for fresh apples, while the elasticity of demand at the farm level for apples for sauce is less than one and apparently lower than for fresh market apples. If in years of large crops, growers adopt a diversion program, they might decide on the basis of the retail elasticities to place more of their apples in the canning market.[25] Once this is determined, there are several other issues to be faced.

The next problem is that at the farm level the elasticity of demand may be less for canning than for fresh apples. This means that with a large crop the canning price might drop more than the fresh price--particularly when larger than usual quantities are diverted to canning. The processor, therefore, obtains increased quantities at much lower prices than in normal years. But at the same time, the retail demand for applesauce is elastic. Therefore, the processor may be able to buy larger quantities of raw product at lower prices and sell increased quantities at prices that are not much lowered. Thus, diversion to canning in a large crop year could conceivably be profitable to the processor, but not necessarily so to the producer.

This potential profit, however, may be tempered by increased costs. While the processor is able to buy apples more cheaply, the raw product is only one of his inputs.

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[25]Within the constraints of farm organization, varietal makeup, etc. listed in Chapter III.

With increased volume, lower fruit costs may be offset by increases in other costs.

The bargaining group, therefore, faces a complex task. On one hand, it might seem that for the farmer to share in the added revenue to be obtained from a diversion program in a large crop year, it would be necessary to bargain for a higher farm price for canning apples than might normally be paid. At the same time, the bargaining group should consider the possibility of higher processing costs with additional volume. But within these constraints, it might be possible for the bargaining group to obtain a higher net farm income than might be normally expected in large crop years.

At the same time, the bargaining group should recognize that in a short crop year when high farm prices might be expected, it may be necessary to settle for a somewhat lower price in order to get the processor to ascribe to the program. Bargaining and diversion cannot be considered from only the farmer or processor level. Both must be taken into account over a long-run period.

In total, if these things are done, it is possible that bargaining and diversion could result in more stable and perhaps higher returns to growers within and between seasons. But because the whole area of marketing policy for apples is complicated and ill-explored, much further study of elasticities and costs is to be recommended before any program is implemented.

CHAPTER VIII

SUMMARY

In this summary the original chapter headings will be followed.

I. Introduction

1. In recent years, interest in industry-wide marketing programs for apples has increased. This requires economic knowledge of apple marketing on a broad level. Such information has been lacking. It was, therefore, the purpose of this study to construct a comprehensive and scientific body of knowledge about the economics of apple marketing on the national level. The study incorporates, wherever relevant, information from the field of horticulture and gives particular attention to the relationships between fresh and processed apples. It is hoped that this report will be of value to the leaders of regional and national apple organizations and agricultural economists specializing in fruit marketing. While the study was intended to provide background information for these individuals to adapt to specific problems, it does shed light on two important and current national policy issues: the regional impact of divergent trends

in production and consumption of fresh and processed apples, and the economic rationale behind centralized marketing programs such as bargaining and diversion. These two items are referred to through the text but treated explicitly in Chapter VII, Marketing Policy.

II. Production

2. Annual apple production during the postwar period (1946-60) averaged about 111.5 million bushels and increased at a rate of about 0.44% per year. Approximately 45% of production was located in the east, 19% in the central states, and 36% in the west. Over the period, production increased in the east and central states and declined in the west. Concurrently, fluctuations in production were greater in the eastern and central states than they were in the west. Eight states produced over 3/4 of the crop. The leading state was Washington (23%), followed by New York (15%), Michigan (9%), and Virginia (9%).

3. Many varieties of apples are produced, but four varieties represented nearly half the total production. They were Delicious (21%), McIntosh (11%), Winesap (9%), and Jonathan (7%). There was a wide regional difference in the importance of each variety. Generally, two to three varieties were predominant in each region.

4. Of total production, about 58% was of "fresh" varieties, 32% of "dual purpose," and 10% of "processing." Over the period there was an increase in the production of "fresh" varieties and a decrease in "dual purpose." "Processing" varieties held about steady.

5. Production estimates are made monthly from July to December by the Department of Agriculture. Estimates are broken down by states but not by varieties. Over the period, the monthly estimates have varied rather widely in any one year, but the August, September and October estimates averaged out rather close to the final estimate. In general, the crop was overestimated in small crop years and underestimated in large crop years. Estimates are also prepared in June by the National Apple Institute and in July and August by the International Apple Association. The National Apple Institute estimate is the only one broken down by variety.

6. Over the long run, apple production appears to have run in cycles--observed to be about 14 years long in two studies. These cycles are largely related to the profitability of apple production at the time the trees are planted.

7. It is estimated that average apple production will increase sharply from 1962 to 1966. One university study places production by 1965 or 1967 at about 144 million bushels, while one industry estimate places 1956 production at about

135 million, and another places 1967 production at 132.5 million. In the case of both industry studies, it appears that the increase will be sharpest in fresh varieties--particularly Red Delicious.

III. Utilization

8. The apple crop is utilized in three main ways: fresh, processed, or not marketed. The fresh market consists of direct sale or placing apples in storage; it has, in the postwar period, accounted for about 65% of the crop. Processed apples may be cored and peeled for use in sauce or slices, or pressed into juice (small quantities are also stored for later processing); this outlet has taken about 30% of the crop. The non-marketed sphere is composed of apples which are abandoned or used on the farm; it has accounted for about 5% of the crop.

9. The proportion of the crop sold to the processing and fresh markets varied widely between states. New York and the Appalachian states sold over 48% of their production to processors (exceeded by California with 67%), while the New England and the northwestern states sold about 87% of their crop to the fresh market.

10. The proportion of the crop sold to the fresh market was higher in small crop years than in large crop years. A

reverse relationship was shown for processing apples: the proportion of the crop sold for processing was lower in small crop years than in large crop years. This reflects the relative stability in the quantity of apples sold fresh and the greater proportional variability in the quantity sold for processing.

11. The decision as to whether to sell apples to the fresh or to the processed market is primarily limited to the grower who has a farm organization which lets him deploy his apples from one market to another--and who grows dual purpose varieties. Within this framework, the decision is related to: size, color and finish of apples; availability of outlets; and costs, prices and returns.

12. In a statistical sense, the utilization pattern generally appears to be more nearly explained by production than by price. For fresh utilization, U.S. production was most important--explaining 85% of the variation. For processed utilization, eastern production was most important--explaining 83% of the variation. On the latter point, the evidence is contradictory, with one study showing no significant correlation with production but a significant correlation with price.

13. A sizeable portion of the apple crop--some 44%--was placed directly into storage. Most of this was for the fresh

market but a small proportion was for processing. Storage holdings were correlated with apple production. Variations in U.S. apple production explained about 2/3 of the variations in December 1 storage holdings. Storage holdings from month to month, thereafter, were strongly correlated.

14. Controlled Atmosphere apple storage increased sharply through the postwar period--to the point where it made up 11.4% of U.S. apple storage holdings on December 1, 1960. In turn, the proportion of total holdings held in Controlled Atmosphere storage increased through the 1960-61 season, reaching a peak of 26% in April and May.

15. Because of the variability of response of various varieties to storage and institutional patterns, the variety mix available for market gradually changes through the season.

16. Processing facilities vary sharply in regional location. While juice and cider mills are found throughout the country, applesauce and slicing operations are very largely concentrated in New York State and in the Appalachian region. (About 78% of the canned sauce and 85% of the canned slices were produced in these regions from 1951-60.)

17. Processing facilities also vary in timing of operation. While juice and cider are pressed throughout the season, most of the applesauce and slices are put up before December 1. (About 82% of the canned sauce and 74% of the canned slices

were packed before December during the 1951-60 period).

IV. Consumption

18. Per capita consumption figures generally exclude exports and military purchases. Net exports of fresh and processed apples have generally been of minor importance--averaging the equivalent of less than 2% of the crop. For specific items such as dried apples, exports have been considerably more important.

19. Government purchases are made up of purchases by the military and by the Department of Agriculture. Military purchases were fairly steady from year to year, but agriculture purchases varied sharply. Because of a shortage of data, it is impossible to get a full record of purchases since the war; but in recent years, combined purchases have represented the equivalent of about 2.6% of apple production. Government purchases (especially military), however, represented a much larger proportion of the canned apple pack--over 10%.

20. Per capita "consumption" of apples in all forms decreased at the rate of about 0.56% per year for the 1946-60 period. This rate of decrease was just slightly greater than for citrus, but considerably less than for "other" fruit. The rate of decrease for all fruit was 0.69% per year.

21. Of total apple "consumption" on a farm weight basis,

nearly 79% was in the fresh form and over 21% was processed. Within the processed category, canned sauce and slices accounted for about 13% of "consumption," juice 3.2%, frozen 2.1%, and dried 3.5%. Since some fresh purchases are processed in the home (which is not reflected in the fresh figure), the government figure probably overstates actual fresh consumption and understates processed. Over the period, fresh "consumption" decreased at the rate of 1.6% per year, while processed "consumption" increased at the rate of 3.3% per year. The increase in processed "consumption" was sharpest in the sauce and juice category.

22. Data from the Michigan State Consumer Panel in Lansing, Michigan, for the crop years from 1953 to 1957 indicated that of total quantity of apples obtained by the family (in terms of retail weight), 82% were in the fresh form and 18% in processed form. The most important processed forms were: sauce and butter 6.5%, cider 4.8%, juice 2.1%, pie 1.6%, slices 0.9%, and sauce baby food 0.9%. Nearly 85% of all the items were purchased, while slightly over 15% were home grown and gifts. Fresh consumption showed a fairly consistent pattern from year to year, but processed consumption showed few distinct patterns (with the exception of cider).

23. It is not clear what products compete most closely with apples. When apples and oranges are broken down into

their various forms of consumption, it appears that the two products do not compete directly with each other except for the portion of each which is eaten fresh (out-of-hand) or in the canned juice form. It is not surprising, then, that most statistical studies have not found apples and oranges to be substitute products; conversely, several have suggested a complementary relationship. On the other hand, even more bananas are consumed in fresh form than apples--and a substitute relationship is indicated. Because of the many processed forms of apples, it is difficult to pick out the one or two most strongly competing processed items.

24. Consumer preference studies for processed apple products have suggested that from the consumer's point of view, it may not be as necessary to use "processing" apples in preparing apple products as many processors believe.

V. Prices

25. Retail price information for apples is limited. The only available series for the postwar period has been prepared by the Bureau of Labor Statistics for fresh apples. Because of changes in weighting, etc., this data is best viewed in index form. It is released on a monthly basis and covers U.S. No. 1, medium-size, all-purpose apples. No variety is specified.

26. Detailed retail price information on both fresh and

processed apples within the period studied was available from the Michigan State University Consumer Panel for Lansing for the five crop years from 1953-57. This material, involving prices and quantities, was reported on a weekly basis. The average price for all apples was about 10.2¢/lb.; that for fresh somewhat lower at 8.7¢/lb., while the average processed price was about 17.2¢/lb. Fresh prices showed a fairly uniform seasonal pattern, while processed apples showed no pattern, except for cider.

27. Marketing margins represent the difference between retail and farm prices for apples. Margins tend to be of an absolute type; that is, a certain amount in terms of cents is added to each unit irrespective of price. This accounts, in part, for the inflexible nature of margins.

28. The aforesaid absolute nature of margins means that when they are expressed as a proportion of retail price, they are higher in years of low price (generally years of heavy production) than they are in years of high price. Similarly, their absolute nature means that the elasticity of demand at the farm level is less than at retail.

29. During the postwar period, the marketing spread for fresh apples appears to have averaged about 66% of retail price. It increased gradually, at the rate of about 0.56% per year.

30. Rather detailed information is available on the farm price of apples. However, caution must be exercised in its use. The price for apples for fresh market is not comparable between eastern and western states because of variations in the inclusion of grading, containers, etc. And while the prices of western fresh apples are comparable in this respect to those for processing, prices throughout the rest of the country are not.

31. Within these restrictions, a number of useful observations can be drawn. One of the clearest is the greater year-to-year variability of processing prices than of fresh prices.

32. Within the processing category there is a considerable difference between the prices of apples sold for canning and freezing and the prices of apples sold for juice. Over the postwar period, the former averaged about $1.26/bu., while the latter averaged $0.54/bu. Canning and freezing sales are generally made in one or two months in early fall.

33. Fresh prices were the only ones reported on a monthly basis. Over the postwar period, prices dropped from an early-season high of $2.29/bu. in July to a seasonal low of $2.03/bu. in October, and then climbed to a seasonal high of $2.50/bu. in June. The price from November through the rest of the season must cover the additional cost of storage and

represents a gradually changing variety mix.

34. When monthly fresh prices were related to crop size, it was found that in large crop years prices were particularly low from October to March but higher during the remainder of the season. (This may, however, be due to the fact that three of the five crop years were at the end of the period when Controlled Atmosphere storage was available in volume.) The opposite was true of small crops. This suggests that the influence of production on price fades out later in the season.

35. Monthly fresh prices tended to climb through the season when less than 37% of the crop was in storage on December 1 and decline when over 39% of the crop was in storage.

36. When correlation analysis was used to measure the influence of production on season price, it was found that variations in U.S. production explained 53% of the variation in the price of all apples, 43% of the variation in fresh apple prices, and 22% of the price of processed apples. Curiously, production in the western states seemed to be much more closely related to variations in all three prices than was eastern production. In fact, western production explained 45% of the variation of the price of all apples, 55% of the variation in fresh price (12% more than U.S. production) and 20% of the variation in processed price. (The influence of production on processing price will be discussed in item 49.)

37. It was subsequently observed that the September crop estimate was in every case more closely associated with price than was the final crop estimate, which was used above. When the September U.S. estimate was used, the proportion of the price of all apples explained was increased to 63%, that for fresh apples to 63%, and that for processing apples to 49%.

38. Turning to monthly prices, it was found that the September crop estimate explained 48% of the September price, 69% of October, 63% of November and December, 53% of January, 33% of March, and 24% of June.

39. Farm value of sales was observed to be highest in the medium-sized crop years and only slightly lower in small crop years. Gross value was definitely lower in large crop years--and net returns would be even lower because of the relatively fixed harvesting and packing costs.

VI. Price Analyses

40. The price elasticity of demand at the retail level was calculated from Michigan State University Consumer Panel data for Lansing, Michigan, from 1953 to 1957 (least squares, actual data, quantity dependent). Over the five-year period the elasticity of demand for fresh apples was -2.26, while for applesauce it was -5.44. Because the elasticities were calculated from weekly data, they may have been higher than

figures obtained from annual data. On the other hand, the elasticity of demand in Lansing appeared to be lower than for the U.S. as a whole.

41. On a yearly basis, the retail elasticity of demand for fresh apples varied from -2.04 to -2.27 in the three small crop years, to -2.54 in the medium-sized crop year, to -1.90 in the large crop year. Applesauce showed a different pattern, varying from -2.31 to -2.63 in two small crop years, to -2.05 in the medium-sized crop year, to -6.71 in the large crop year. The figures for fresh apples suggest, starting with a small crop year, a slightly more elastic demand in medium-sized crop years and a considerably less elastic demand in large crop years. (This fits the observations on farm value indicated in item 39.) On the other hand, the demand for applesauce was least in the medium crop year and largest in the large crop year.

42. When retail elasticities were computed on a quarterly basis for fresh apples, the elasticity was greatest, -4.57, in the fourth quarter (April-June) and least, -1.31, in the third quarter (January-March). The mid-season drop in elasticity fitted in with other studies.

43. At the farm level, other researchers have found the demand to be inelastic for apples for both the fresh and processing market. However, the elasticity generally was

greater for fresh than for processing apples.

44. On the basis of these elasticities, this writer would not recommend limiting the over-all supply of apples in large crop years but would suggest placing the additional volume into the more elastic market up to the point where marginal net revenues are equaled. Discussion of these points, however, is rather involved and is therefore treated separately in the next section on marketing policy.

44. Within the marketing season for fresh apples, the 1953-57 Consumer Panel elasticities would suggest selling more apples from April to June than from January to March if farm returns are to be increased. To some extent this is being made possible by Controlled Atmosphere storage.

45. Attempts to predict price appear to have first been made in New York and California in the 1920's. Most of the price analyses which followed through the 30's on a national level were aimed at the average season price for all apples. Generally, these studies included production, an income variable, and less often a competing fruit or orange variable. These two or three variables did quite a good job of explaining the variation in annual prices. In studies of state price, a somewhat wider range of variables was considered. One of the most significant appeared to be quality of the fruit.

46. While analysis of average annual price for apples is of help in isolating variables that affect year-to-year changes of price, within any one season an analysis of monthly prices may be of greater assistance to growers of fresh apples. Such a study of monthly prices on a national level revealed that estimated production apparently had its greatest influence on prices from October to December, while the influence of storage holdings became more important after February. Connecticut and Michigan studies revealed that when the estimated fresh price was above the actual market price, a price rise occurred and it would pay to place apples in storage.

47. Simultaneous investigations of both fresh and processed price have been limited in number. It appears, however, that with the exception of an income indicator, different variables are called for in the case of each utilization (as was suggested in item 36). It may, for instance, be desirable to break production down on a regional basis. And for processing, it may be desirable to bring in canned carryover and possibly military purchases and carryover. While such analyses have been carried out only on a seasonal level, a model for a quarterly approach has been prepared which includes functions for retail, storage, processing and export demands.

48. The analysis of processing prices is one in which there is much interest at present--particularly from the point of view of apple price bargaining associations. While canned carryover and income would be standard variables in such an analysis, a peculiar question arises with respect to the role of production. That is, processing price appears to be more closely related to fresh production than to processing production.

49. The answer seems to be that processing price is fairly closely correlated with fresh price--and fresh price is in turn set under competitive conditions and is heavily influenced by production. But because the crop estimates do not indicate production by variety and because it would be difficult to assess dual purpose production, this concept would be difficult to utilize to predict processing price. If, however, fresh price is taken as representing fresh production, an operational concept is available--provided fresh and processed prices are correlated. And they seem to be. For the 1946-60 period, variations in the September fresh price were found to explain 74% of the variations in the "all" processing price and 59% of the canning and freezing price. Variations in the October fresh price explained 62% of the variations in the "all" processing price and 70% of the canning and freezing price.

50. In an attempt to predict canning and freezing price, fresh price was combined with estimates of carryover and production on the basis of information available for September and October. Specific variables utilized were (a) August 1 processed carryover, (b) September and October crop estimate, and (c) September or October fresh price. When equations were fitted by first differences of logarithms, it was found that carryover and the September crop and price estimates explained about 94.5% of the variation in price, while the carryover and the October crop and price estimates explained 92.9% of the variation. In both cases, the crop estimate contributed least to the explanation of the price variance (and was significant at only the 10% and 20% levels, respectively). On this basis, it would seem possible to do a reasonably accurate job of predicting average annual canning and freezing price.

51. Substantial institutional problems remain to be faced in price analysis. While growers in some areas have recently been asking for assistance in this matter, growers in other areas at other times have spoken out strongly against it. A program of public education on the objectives and capabilities of price analysis appears to be called for. Another critical obstacle concerns serious gaps in the present statistical material--particularly with respect to price.

VII. Marketing Policy

52. The prospect of sharply increased production of apples, particularly of fresh varieties, combined with a downward trend in the consumption of fresh apples suggests that the apple industry will be faced with complex problems of market adjustment in the future. These problems may be most severe in the northwestern states where much of the increase in "fresh" production will be located and where few processing plants are found at present. Eastern states, with a larger proportion of "processing" varieties and processing plants, may not be disadvantaged so quickly.

53. The potential problems noted above may be tempered by some recent research findings. Specifically, from a consumer preference point of view the lack of processing varieties may not be as troublesome as expected. Several preliminary studies have suggested that consumers may not significantly prefer products made from "processing" apples over those made from "fresh" varieties. If this is generally true, it shifts the issue to the greater economy presently involved in canning "processing" varieties as opposed to "fresh-market" varieties. The answer to this may be to investigate radically new methods of processing which do not, for instance, involve coring and peeling.

54. While these matters should be of most immediate concern to the northwest, they also concern the rest of the country. This is because the price of apples in one region is closely associated with prices in another. For example, the price for canning and freezing apples in the east appears to be heavily influenced by national fresh price--which in turn is heavily influenced by price and production in the northwest. One apple region cannot isolate itself from another; the supply and demand relationshipsin any one region are matters of national concern. Marketing policies, therefore, need to take into consideration the highly interrelated nature of the apple industry.

55. One program that has been proposed to stabilize and increase net farm income from apples is a combination of bargaining for price and controlled distribution. Bargaining for price, using price analysis, will probably have more influence on reducing the dispersion of prices within any one season than it will in reducing the year-to-year variation in average prices or increasing income. Controlled distribution has as its purpose the obtaining of the highest possible net income from the crop in any one year. This is attempted by limiting the supply of apples marketed or controlling the distribution of apples between fresh and processing outlets.

56. Controlled distribution programs are usually based on specific price elasticities of demand. It has not been widely recognized, however, that the enactment of distribution programs may in time affect the elasticities which suggested the programs in the first place. Frequent use of distribution programs may, for example, result in a change in demand for apples which leads to a greater elasticity.

57. One form of controlled distribution that has been proposed is market supply limitation. This program is based on an inelastic demand for apples at the farm level. From a purely theoretical point of view there are several problems with supply limitation. The most obvious was covered in the preceding item; over a period of years the elasticity of demand for apples may rise to the point where the program is no longer effective in raising net farm income. This problem may be hastened by the fact that the demand for apples at retail appears to be elastic. This means that a program which limits marketed supply will probably lead to lowered profits for the marketing firm. So if, as suggested above, the consumer reacts to a limitation program by changing elasticity of demand, this is apt to happen even more quickly in the case of the marketing firm faced with conflicting elasticities. Also, the higher prices may have stimulated additional production, compounding the problem. In addition

to these theoretical problems, there are substantial practical problems in carrying out a limitation program. For these reasons, limitation of market supply would appear to be of questionable long-run desirability.

58. A more palatable, but no less difficult, program might be that of controlling diversion between fresh and processing markets. The idea here would be to secure maximum net profit by equating marginal net revenue in each of the markets. While it is theoretically possible to determine when this point is reached, in reality the very detailed statistical data required to do so are not available. Another problem centers about the reverse elasticity relationship between fresh and processing apples at the retail and farm levels. Diversion of apples to the processing market would appear advisable on the basis of retail elasticities, but not advisable on the basis of farm elasticities. If it is decided to use retail elasticities--because they may change less rapidly over time than farm level elasticities--there is the dilemma that at the farm level the policy would not appear to immediately benefit the farmer.

59. Because diversion of apples to the processing market in years of large crop would appear--under present demand schedules--to benefit the processor more than the grower, it might prove useful for the growers to employ bargaining for

price as a method of sharing in the dividends. That is, growers, in years when diversion was planned, might bargain with processors for a somewhat higher price than would be normally paid. On the other hand, it should be recognized that in small crop years the growers might have to take a lower price than would normally be the case. In this way, bargaining and diversion might work together to even out and maximize farm income.

60. The establishment of marketing policies for apples, as should be evident by now, is a complex and ill-explored field. It is, however, a vital area where much further work will be needed as apple marketing becomes more centralized and national in character.

APPENDIX A

REVISION IN CROP AND PRICE REPORTING

During the summer of 1961, the Crop Reporting Board of the Department of Agriculture revised its estimates on fresh apples for the 1949-59 period. They did not, however, release revisions for previous years. Since, in this study, we are concerned with the period starting in 1946, it is necessary to study the nature of the changes made in the post-1949 period and make corresponding revision in the material for the 1946,'47 and '48 crop seasons.

Production

In the unrevised data, fresh production in some areas, principally the Pacific Coast states, was reported on a "box" basis--which in weight was not strictly comparable to the 48-lb. bushel used in the eastern and central states.[1] And particularly in recent years ". . . the increased importance of cartons and the use of various types of pack of apples . . .

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[1]Processing apples were reported on a 48-lb. bushel weight throughout the period.

[has] resulted in a declining net weight per box."[2] Therefore, western containers were converted to a 48-lb. bushel. According to the chief of the agricultural price statistics branch of the statistical reporting service of the Department of Agriculture, weight adjustments for the 1946-48 period would be as follows:[3]

	Pounds per unit	
	From	To
Washington	46	48
Oregon	45	48
California	40	48

The data for the three-year period was then adjusted on this basis for each state--which in turn resulted in a lowered production in terms of bushels. This, in turn, was incorporated in regional and U.S. totals.

Since variety estimates ". . . as published before revision represented a specific percent of the total crop in each state," the old proportion was applied to the revised total production estimates to arrive at the revised variety production estimate by state. These, in turn, were incorporated in revised regional and U.S. totals.

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[2] Fruits--NonCitrus, by States, Production, Use, Value (Revised estimates, United States, 1949-59), U.S. Department of Agriculture, Statistical Reporting Service, Statistical Bulletin No. 292, August, 1961, p. 3.

[3] Stauber, op. cit.

Prices

With changes made in the container weight, it was necessary to make corresponding alterations in the fresh price. That is, with weight per container increased 4.3% in Washington, 6.7% in Oregon, and 20% in California, Stauber advised that prices be adjusted upward by these percentages. This was done at the state level and corresponding adjustments were made in the regional and national figures.

It was not possible, however, to adjust monthly fresh prices.

APPENDIX B

WHOLESALE PRICES

Wholesale prices are reported by quite different groups for fresh apples and for applesauce.

Fresh

Fresh apple prices on various farmers or terminal markets are reported in rather great detail by the market news service. The problem with this material is almost the plethora of detail. Prices are reported for a range for the unit sold--which includes the size and grade of fruit and the container used. This is fine for any one season, but over a period of seasons, the units change so much that it is difficult to build up a price series of any extent.[4] Also, the quantity sold in each classification may change widely. Further, to obtain this information, it is necessary to examine the daily reports for each market: the annual summaries report such a range in prices that they are of limited usefulness. And, if this were not enough, the quantity of apples sold on the

[4]As this writer found out when attempting to summarize prices on the Benton Harbor market for the '50's.

various markets, as a proportion of the total crop, has been declining in recent years.

There is, however, one set of data which avoids some of these problems. This is the conveniently reported series on auction prices for the New York and Chicago markets.[5] The New York market reports auction prices for eastern McIntosh and Red Delicious and western Gravensteins, Jonathan, Golden Delicious, Rome, Red Delicious, Yellow Newtown, and Winesap. The Chicago market covers midwestern Red Delicious and Wealthy as well as western apples. The auction fruit is probably of better than average quality and is generally packed in boxes. The only real problem with these prices is the question of how representative they are of prices in general. As noted above, a decreasing amount of fruit is moving over these markets. And eastern fruit was never represented on the auction in very large quantities compared to western fruit anyway.[6]

For these reasons, this writer would have some

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[5] Fresh Fruit and Vegetable Prices--1961 Wholesale, Auction, F.O.B., U.S. Department of Agriculture, Agricultural Marketing Service, April, 1962, pp. 6, 24, 32. This particular publication did not list auction prices for eastern apples, though earlier issues did.

[6] The greater use in the west over a period of years of a wooden box with individually wrapped fruit produced a more highly standardized pack which was more suitable for auction sale.

reservations about using these reports. They do, however, provide information on prices by varieties which is found nowhere else--and from this point of view may find application.

Processing[7]

The reporting of wholesale prices for processed apples is done on a more highly standardized, but more limited basis. Wholesale prices are reported only for canned applesauce by the Bureau of Labor Statistics. The specification reads: Fancy, No. 303 can, canners to wholesalers and retail chain stores, f.o.b. cannery, per dozen cans. As with fresh apples, the prices are reported on an index basis, and cover the period from 1947 to the present.

When the 1947-60 prices were averaged by month, they showed very little change throughout the season--appearing to be only slightly higher from December to April than during the rest of the year. A high of 112.9 (1947-49 = 100) was reached in January, while a low of 111.0 was found in September. There did not appear to be any trend in prices over the period.

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[7]This material was obtained by correspondence from the Bureau of Labor statistics of the U.S. Department of Labor (See part E of the Reference section).

APPENDIX C

TABLES

Table 1. U.S. and regional apple production, in thousands of bushels.

Crop Year	U. S.	Region: East	Region: Central	Region: West
1946	115,765*	52,845	19,057	43,863*
1947	109,044*	39,946	20,559	48,539*
1948	86,869*	36,583	14,295	35,991*
1949	134,309	55,067	32,192	47,050
1950	123,769	56,849	20,633	46,287
1951	111,799	53,464	26,221	32,114
1952	94,085	40,653	16,492	36,940
1953	95,778	41,184	19,616	34,978
1954	111,878	57,090	17,218	37,570
1955	106,263	49,766	16,792	39,705
1956	101,315	46,895	22,550	31,870
1957	119,258	51,780	22,093	45,385
1958	127,485	61,040	24,285	42,160
1959	126,847	64,220	25,423	37,204
1960	108,515	52,870	23,625	32,020

*These are not official figures but were revised in accordance with the procedure outlined in Appendix A.

Source: Statistics published by the Crop Reporting Board, Statistical Reporting Service, U.S. Department of Agriculture. See part E of the Reference section for detail.

Table 2. U.S. apple production by use classification, according to Apple Marketing Clinic varietal breakdown.

Crop Year	Use Classification		
	Fresh	Dual Purpose in thousands of bushels	Processing
1946	65,066	38,193	12,526
1947	62,634	35,978	10,430
1948	50,327	27,306	9,236
1949	78,406	43,905	11,998
1950	71,886	39,259	12,624
1951	61,573	38,540	11,686
1952	52,815	31,132	10,138
1953	59,329	28,227	8,222
1954	60,821	37,699	13,358
1955	62,905	32,039	11,319
1956	55,979	34,085	11,251
1957	74,081	34,428	10,749
1958	75,364	39,320	12,801
1959	74,429	40,040	12,378
1960	63,591	34,633	10,291

Source: These figures were constructed in the following manner: (a) the USDA crop estimate was taken by variety for each region of the country; (b) this varietal production was classified according to the Apple Marketing Clinic breakdown (next table) for each region; (c) the regional figures were then combined to provide the above figures.

Table 3. Apple Marketing Clinic varietal breakdown by region.

F = fresh, DP = dual purpose, P = processing

Variety	Region		
	East	Central	West
Delicious	F	F	F
McIntosh	F	F	F
Winesap	F	F	F
Jonathan	F	F	F
Rome	DP	F	DP
York	P	DP	-
Newtown	DP	-	DP
Stayman	DP	F	DP
Golden Delicious	DP	F-DP	F
Baldwin	DP	DP	-
Cortland	DP	F	-
R. I. Greening	P	DP	-
Northern Spy	DP	DP	-
Grimes Golden	P	DP	-
Wealthy	DP	F	-
Misc. Summer	F	F	F
Misc. Fall	DP	DP	DP
Misc. Winter	DP	DP	DP

Source: Michigan State Apple Commission.

Table 4. U.S. monthly crop estimates,* in thousands of bushels.

Crop Year	Crop Estimate July	August	September	October	November	December	Semi-Final (Dec.t+1)
1946	106,465	111,728	116,697	120,657	121,494	121,520	119,410
1947	111,174	113,589	113,079	112,910	112,503	112,503	113,041
1948	100,049	100,445	100,478	96,319	90,288	90,288	88,407
1949	121,081	127,823	129,423	132,126	133,388	133,181	133,742
1950	119,180	118,227	119,053	120,104	120,499	120,499	123,126
1951	121,916	121,338	119,892	117,524	113,268	112,935	110,660
1952	101,767	98,122	98,058	95,975	92,696	92,696	92,489
1953	102,320	100,416	99,611	97,262	94,064	92,584	93,307
1954	101,999	101,521	102,313	103,011	103,716	103,773	109,854
1955	105,560	107,389	108,201	107,323	104,813	105,293	106,357
1956	89,263	90,453	93,433	94,938	96,145	97,077	100,623
1957	112,904	115,640	111,362	113,372	116,308	117,308	118,548
1958	123,920	125,999	126,813	125,338	124,717	124,717	126,610
1959	119,122	118,707	118,274	115,843	117,727	118,227	121,787
1960	106,870	109,400	109,220	107,710	107,370	106,360	108,515

*These are unrevised figures (as defined in section A) and, therefore, they will not agree with those presented in Table 1.

Source: The monthly crop estimates appeared in Crop Production, published monthly by the Crop Reporting Board of the U.S. Department of Agriculture. The semi-final estimate appears in the December issue following the particular December estimate (i.e., t+1).

Table 5. Utilization of U.S. apple production, in thousands of bushels.

Crop Year	Fresh	Processed					Not Marketed		
	Total	Total	Canned	Dried	Frozen	Other	Total	Farm Use	Not of Value
1946*	72,560	37,330	13,747	5,714	2,175	15,694	5,875	5,368	507
1947*	73,654	26,369	9,003	4,926	762	11,678	9,021	4,806	4,215
1948*	62,475	19,455	7,796	2,564	913	8,182	4,939	4,116	823
1949	80,082	37,218	14,140	4,667	1,731	16,680	17,009	4,777	12,232
1950	75,184	40,353	17,052	6,331	1,730	15,240	8,232	4,437	3,795
1951	69,153	28,196	11,925	3,495	1,229	11,547	14,450	4,374	10,076
1952	65,587	24,918	11,364	3,529	1,496	8,529	3,580	3,580	0
1953	65,023	27,612	13,341	3,272	1,441	9,558	3,143	3,143	0
1954	69,277	39,112	19,260	3,693	2,342	13,817	3,489	3,189	300
1955	67,836	32,930	15,884	3,890	2,041	11,115	5,497	2,628	2,869
1956	63,408	35,161	18,220	3,589	3,014	10,338	2,746	2,726	20
1957	78,553	36,274	17,423	4,509	2,528	11,814	4,431	2,665	1,766
1958	82,297	40,342	19,553	4,110	3,219	13,460	4,846	2,540	2,306
1959	79,872	43,003	19,131	3,807	4,268	15,797	3,972	2,365	1,607
1960	70,164	36,091	18,477	2,859	3,873	10,882	2,260	2,160	100

*These are not official statistics, but were revised in accordance with the procedure outlined in section A of this appendix.

Source: Statistics published by the Crop Reporting Board, Statistical Reporting Service, U.S. Department of Agriculture (see part E of the Reference section for detail).

Table 6. U.S. total storage holdings of apples, on first of month, in thousands of bushels.

Crop Year	November	December	January	February	March	April	May	June
1946	NA	43,223	32,804	23,481	14,752	8,655	4,583	1,784
1947	NA	45,909	37,456	28,664	20,264	12,539	5,957	2,147
1948	34,286	30,234	23,160	16,832	11,335	6,782	3,727	1,415
1949	52,601	45,082	35,234	25,553	16,454	9,078	4,123	1,389
1950	57,172	54,101	45,261	35,046	24,644	14,669	7,811	3,043
1951	40,671	36,074	27,635	19,745	13,124	7,207	3,438	1,200
1952	38,402	33,617	26,497	19,756	13,652	8,328	4,152	1,753
1953	44,207	37,129	28,242	21,036	15,084	8,799	4,682	1,833
1954	48,120	43,226	34,145	25,460	17,434	10,253	5,427	2,088
1955	51,352	45,017	34,489	25,723	17,696	10,509	5,090	1,660
1956	45,123	39,156	30,064	21,215	13,836	7,754	3,578	1,184
1957	59,008	50,391	39,037	27,819	18,494	9,728	4,335	1,304
1958	58,313	50,734	39,547	29,986	21,855	14,599	8,197	4,077
1959	53,959	46,754	34,972	25,428	17,401	9,709	4,569	1,280
1960	49,003	40,281	30,619	22,729	15,897	9,393	4,719	1,741

Source: Obtained from monthly reports of the International Apple Association.

Table 7. U.S. Controlled Atmosphere storage holdings of apples, on first of month, in thousands of bushels.

Crop Year	November	December	January	February	March	April	May	June
1951	206	?	?	?	?	?	?	?
1952	302	?	?	?	?	?	?	?
1953	392	392	392	392	367	254	98	-
1954	530	530	530	530	530	451	258	77
1955	814	815	815	815	814	665	385	64
1956	958	958	958	958	901	686	273	-
1957	1,729	1,729	1,729	1,729	1,695	1,298	553	12
1958	3,200	3,200	3,200	3,159	3,137	2,735	1,729	695
1959	3,951	3,951	3,951	3,851	3,308	2,212	987	262
1960	4,579	4,598	4,560	4,426	3,828	2,462	1,241	325

Key: ?, monthly holdings not reported, -, negligible quantity.

Source: (a) 1951-52, Dalrymple, Marketing Controlled Atmosphere Apples (Cornell, 1956).
(b) 1953-60, International Apple Association monthly storage reports.

Table 8. U.S. pack of processed apples, in millions of cases, 24/2-1/2" basis.

Crop Year	Total	Form: Sauce	Slices	Juice
1951	11,693	5,496	3,177	3,020
1952	11,006	5,532	2,355	3,119
1953	12,710	6,983	2,706	3,021
1954	17,783	9,378	4,333	4,072
1955	14,939	8,284	3,300	3,355
1956	17,100	9,454	3,603	4,043
1957	16,656	8,855	3,375	4,426
1958	18,979	10,395	3,348	5,236
1959	21,636	11,368	3,711	6,558
1960	21,053	11,757	3,060	6,236

Source: Computed fron National Canners Association statistics.

Table 9. U.S. August 1 carryover of processed apples, in million 48-lb. bushel equivalents.

Crop Year	Total	Form		
		Canned Sauce	Canned Slices	Frozen
1946	N.A.	N.A.	N.A.	N.A.
1947	3.6	1.5	0.9	1.2
1948	3.0	1.7	0.6	0.7
1949	0.4	0.1	N.A.	0.3
1950	1.5	0.5	0.5	0.5
1951	8.7	5.3	2.5	0.9
1952	3.2	1.1	1.6	0.5
1953	0.7	0.1	0.2	0.4
1954	1.1	0.4	0.2	0.5
1955	4.0	1.9	1.3	0.8
1956	3.6	1.4	1.3	0.9
1957	5.5	2.5	1.6	1.4
1958	4.8	2.0	1.8	1.0
1959	4.7	2.2	1.4	1.1
1960	2.7	0.1	1.6	1.0

Key: N.A. -- Not available.

Conversion procedure: Skinner converted canned carryover to equivalent cases of 24/2-1/2", and then multiplied the sauce figure by 58.824 and the slice figure by 66.67 to give the raw product equivalent in pounds. The following factors were used in converting to the 24/2-1/2 case unit: 48/8, 0.58; 24/303, 0.57; 6/10, 0.92; 24/2, 0.67. There is no one standard method of converting so the results may vary with the method and factors used.

Source: Skinner, "Industry Processes in Appraising Price-Making Factors for Apples" (Cornell, 1962), p. 71.

Table 10. U.S. per capita fruit consumption, farm weight.

Calendar Year	All Fruit	Apples	Citrus	Other
1946	227.9 lbs.	27.9 lbs.	95.3 lbs.	104.7 lbs.
1947	219.9	30.1	94.1	95.7
1948	214.0	31.3	93.1	89.6
1949	203.6	30.2	82.4	91.0
1950	188.5	29.3	73.3	85.9
1951	198.7	31.5	82.8	84.4
1952	200.7	28.2	84.4	88.1
1953	202.2	26.6	85.6	90.0
1954	198.7	26.2	86.0	86.5
1955	201.7	26.5	91.4	83.8
1956	200.2	26.3	88.0	85.9
1957	201.6	25.7	89.2	86.7
1958	191.9	29.8	75.6	86.5
1959	199.1	30.6	82.8	85.7
1960	201.1	27.7	86.3	87.1

Source: Economic Research Service statistics (as reported in The Fruit Situation, August, 1958, 1961.)

Table 11. U.S. per capital apple consumption; farm weight.

Calendar Year	Total		Processed			
	Fresh	Proc.	Canned	Juice	Frozen	Dried
1946	23.0 lb.	4.9 lb.	1.9 lb.	0.5 lb.	1.0 lb.	1.5 lb.
1947	25.4	4.7	2.4	0.4	0.6	1.3
1948	26.3	5.0	2.8	0.3	0.6	1.3
1949	25.0	5.2	2.9	0.7	0.5	1.1
1950	23.2	6.1	3.5	0.9	0.5	1.2
1951	25.9	5.6	3.4	0.8	0.4	1.0
1952	21.9	6.3	4.0	0.8	0.5	1.0
1953	21.0	5.6	3.5	0.8	0.4	0.9
1954	20.1	6.1	3.6	1.1	0.5	0.9
1955	20.0	6.5	4.1	0.8	0.7	0.9
1956	19.3	7.0	4.4	1.0	0.9	0.7
1957	19.3	6.4	4.4	1.0	0.6	0.4
1958	22.5	7.3	4.7	1.2	0.6	0.8
1959	23.0	7.6	4.5	1.5	0.7	0.9
1960	20.1	7.6	4.9	1.4	0.6	0.7

Source: Economic Research Service statistics (as reported in The Fruit Situation, August, 1958, 1961).

Table 12. U.S. season average apple price, 48-lb. bushel basis.

Crop Year	All Apples	Total: Fresh	Total: Processing	Processing: Canning & Freezing	Processing: Other*
1946	$2.06/bu.	$2.42/bu.	$1.18/bu.	$1.76/bu.	$0.65/bu.
1947	1.55	1.78	0.72	1.28	0.38
1948	1.93	2.21	0.76	1.11	0.46
1949	1.10	1.37	0.54	0.84	0.30
1950	1.35	1.64	0.81	1.20	0.41
1951	1.54	1.94	0.58	0.77	0.35
1952	2.17	2.59	1.05	1.41	0.63
1953	2.29	2.62	1.50	1.94	0.84
1954	2.00	2.43	1.25	1.65	0.63
1955	1.64	2.03	0.83	1.06	0.51
1956	2.11	2.57	1.29	1.60	0.70
1957	1.51	1.83	0.83	1.07	0.51
1958	1.49	1.87	0.71	0.86	0.51
1959	1.71	2.19	0.82	1.03	0.51
1960	2.20	2.72	1.17	1.38	0.73

*Juice and cider. Does not include freezing and drying.

Source: Computed from Crop Reporting Board statistics.

Table 13. U.S. monthly average fresh apple price, dollars per 48-lb. bushel.

Crop Year	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
1946*	$3.04	$2.31	$2.32	$2.26	$2.27	$2.33	$2.35	$2.46	$2.64	$2.60	$2.55	$2.60
1947*	1.82	1.84	2.19	1.91	1.90	1.81	1.45	1.40	1.29	1.17	1.41	1.69
1948*	2.01	2.02	2.03	2.00	2.14	2.31	2.50	2.49	2.44	2.19	1.71	2.33
1949	1.89	1.65	1.50	1.14	1.17	1.27	1.37	1.41	1.49	1.58	1.97	2.41
1950	2.41	2.06	2.03	1.67	1.60	1.70	1.56	1.42	1.24	1.09	1.06	1.53
1951	1.89	1.88	1.80	1.69	1.89	2.01	2.12	2.06	2.20	2.36	2.87	2.87
1952	2.47	2.36	2.38	2.43	2.58	2.78	2.78	2.68	2.82	2.82	3.01	2.96
1953	2.73	2.72	2.56	2.60	2.66	2.68	2.62	2.68	2.53	2.58	2.55	2.75
1954	2.41	2.40	2.39	2.38	2.38	2.58	2.45	2.42	2.39	2.50	2.60	2.72
1955	2.37	2.40	2.25	1.96	2.07	2.06	2.03	1.98	1.77	1.87	2.09	2.07
1956	2.52	2.29	2.46	2.44	2.51	2.64	2.66	2.67	2.70	2.74	3.02	3.32
1957	2.57	2.41	2.17	1.89	1.75	1.63	1.63	1.42	1.49	2.06	2.05	2.37
1958	2.39	2.18	2.09	1.51	1.84	1.82	1.84	1.95	1.88	1.93	1.57	1.46
1959	1.33	1.98	2.23	2.01	2.08	2.17	2.24	2.28	2.33	2.39	2.76	2.88
1960	2.44	2.57	2.63	2.50	2.60	2.69	2.73	2.83	2.86	3.07	3.61	3.47

*Not revised. See section A of this appendix.

Source: Crop Reporting Board statistics.

Table 14. Farm value of U.S. apple production and sales, in thousands of dollars.

	Farm Value of	
Crop Year	Production	Sales
1946	$238,703	$228,594
1947	165,648	156,222
1948	167,949	160,008
1949	135,626	129,602
1950	162,875	155,805
1951	157,046	150,306
1952	204,172	196,061
1953	219,731	213,349
1954	223,638	217,224
1955	169,741	164,921
1956	214,205	208,468
1957	178,663	173,925
1958	186,865	182,611
1959	214,171	209,958
1960	238,161	233,480

Source: Crop Reporting Board statistics.

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