SOME ASPECTS OF CONSUMER DEMAND FOR FROZEN FRUITS AND VEGETABLES

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SOME ASPECTS OF CONSUMER DEMAND FOR FROZEN FRUITS AND VEGETABLES

By

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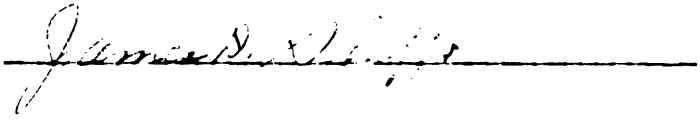
Approved by 

Robert George Marshall

ABSTRACT

This study was concerned with the characteristics of consumer demand for frozen fruits and vegetables. The primary source of data used was the tabulated food purchase records of the families of the Michigan State University Consumer Panel. As an indication of the growth of the frozen fruit and vegetable industry and of per capita consumption at the national level, a brief survey of secondary data was included in this study.

In 1955, families of the Michigan State University Consumer Panel spent 6.5 percent of their vegetable dollar on frozen vegetables, 4.9 percent of all fruit expenditures for frozen fruits (excluding fruit juices), and 66.4 percent of all fruit juice expenditures for frozen fruit juices.

Frozen orange juice, strawberries, and peas were the most popular items of all frozen fruits and vegetables considered both from the standpoint of actual expenditures and of percentage of families buying. Averaged over the three years 1952-1955, of all frozen fruit and vegetable expenditures approximately 18 percent were made for frozen orange juice, 12 percent was made for frozen strawberries, and approximately 6 percent were made for frozen peas. A wide variety of other frozen fruits and vegetables combined to make up the remaining percentage of total expenditures. In each of the years 1953 and 1954, approximately 75 percent of all the panel

families purchased frozen orange juice, 67 percent purchased frozen strawberries, and 60 percent purchased frozen peas.

Although frozen orange juice, strawberries and peas were the most popular of the frozen items, more families purchased and larger expenditures were made for fresh oranges and strawberries and canned peas than for the corresponding frozen products.

A wide variation existed among families with regard to annual per capita expenditures for frozen fruits and vegetables and frozen fruit juices. In each of the years 1953 and 1954, almost 65 percent of all expenditures for frozen fruits and vegetables were made by less than 25 percent of the families. Approximately 80 percent of all expenditures for frozen fruit juices were made by 32 percent of the families. At the other extreme only 6 to 7 percent of all expenditures for frozen fruits and vegetables and 3 percent of all expenditures for frozen fruit juices were accounted for by 40 percent of the families.

A comparison of family expenditures in 1953 with expenditures by the same families in 1954 revealed that, for both frozen fruits and vegetables and frozen fruit juices, those families making high per capita expenditures in 1953 made correspondingly high expenditures in 1954 and non-consumers in 1953 remained, for the most part, non-consumers in 1954.

The family characteristics, family income, size of family, age of homemaker, and education of homemaker, were considered as factors

related to variations in family per capita expenditures. Families in the upper income category tended to spend more for both frozen fruits and vegetables and frozen fruit juices than did families in lower income classifications. It was indicated that smaller families made higher per capita expenditures for frozen fruits and vegetables than did larger families. Other family characteristics could not be conclusively related to per capita expenditures for either commodity group.

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Of course, any errors in this manuscript are the sole responsibility of the author.

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CHAPTER I

INTRODUCTION

In a simple subsistence economy, there is little need for data on food consumption. It is quite different, however, with our complex twentieth century economic structure. The high degree of specialization in both production and marketing functions has created a need for information to assist in intelligent planning by those concerned. Fundamental to the needs of wholesalers, retailers and others engaged in the marketing process is a knowledge of consumer actions and responses at the retail level.

This is a report of a study of consumer expenditures for frozen fruits and vegetables in the city of Lansing, Michigan. The primary objective of the study was to provide basic data and information with regard to consumer purchases of frozen fruits and vegetables at the retail level. More specifically the objectives were:

1. To evaluate the relative position of selected frozen fruits and vegetables at the consumer level and to relate expenditures for the frozen products with the corresponding fresh and canned products.
2. To evaluate the purchasing patterns for frozen fruits and vegetables by families of the Michigan State University Consumer Panel.

3. To relate family expenditures for frozen fruits and vegetables to specific socio-economic characteristics of the household in an effort to identify some of the factors influencing family expenditures and preferences.

The analyses formulated in this study were based upon the hypothesis that an appraisal of the potential market for frozen fruits and vegetables could only be accomplished through an indication of the vagaries of consumer acceptance in the immediate past. It was also believed that the analyses presented would provide useful information on consumer response at the retail level. Some of the uses to which information presented might be of value are briefly listed:

1. Information on the movement of frozen fruits and vegetables into consumption should be an aid in the understanding of the market for frozen food packers, distributors, brokers, and retailers. It is the consumer who justifies the existence of the various marketing services. An insight into consumer purchasing patterns may be of assistance in solving the problems of communication between the consumer and those engaged in providing the necessary marketing services.
2. Trade groups, organized within segments of the industry may find information in this study that would be of value in planning promotional programs or in evaluating promotional efforts of the past.
3. It is believed that the results of this study will be of special interest to those charged with the responsibility of

consumer education. The comparatively recent introduction of frozen products has meant changes in consumption patterns. Education specialists, given relevant information are in a position to speed up these changes should they be deemed consistent with general welfare.

It is implicit in this study that the information contained therein may provide an indication of the potential market for frozen fruits and vegetables. The impact that development of this market might have upon the corresponding fresh and canned products, and its effect on returns to growers and market organizations has not been considered. Southworth states that:[1] "The frozen food industry furnishes a current example of how new methods of processing and distribution can draw upon new producing areas, expand year-round market outlets, and offer consumers both a better product and greater convenience." It is the author's belief that information directly or indirectly concerned with the conversion of perishable agricultural commodities into permanently stable, palatable, convenient to use forms, made available throughout the year merits economic consideration.

Source and Limitations of Data

The primary source of data used in this study was the tabulated food purchase records of families constituting the Michigan State

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[1] Herman Southworth, "What Can It Do For Us?" Yearbook of Agriculture, United States Department of Agriculture, Washington, D. C., 1954, p. 10.

University Consumer Panel.[2] Approximately 250 families of Lansing, Michigan record in weekly diaries information regarding price, quantity and expenditure for each food item purchased. In addition, each family reports its income, expenditures and number of meals away from home during the week, and the number of guest meals served in the home. Relevant family characteristics such as size of family, age, education, number in the family working, and occupations are recorded for each panel family.

The Michigan State University Consumer Panel has been operating since 1951. Approximately 100 families have reported continuously since its inception with approximately 200 families reporting continuously in any one year. A detailed discussion of the representativeness and characteristics of the sample can be found in J. D. Shaffer's doctoral thesis[3] and in a Journal of Farm Economics article by Dr. Shaffer.[4]

The types of analyses that were originally intended as the objectives of the project were stated by Dr. G. G. Quackenbush as follows:[5]

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[2] The Organization and Operation of the M.S.U. Panel is under the direction of Dr. G. G. Quackenbush and Dr. J. D. Shaffer.

[3] J. D. Shaffer, Methodological Bases for the Operation of a Consumer Purchase Panel, unpublished Ph. D. thesis, Michigan State University, 1952.

[4] J. D. Shaffer, "A Plan for Sampling a Changing Population Over Time," Journal of Farm Economics, vol. 36, No. 1, Feb. 1954, pp. 153-163.

[5] G. G. Quackenbush, "Demand Analysis From the M.S.C. Consumer Panel," Journal of Farm Economics, vol. 36, No. 3, Aug. 1954, pp. 415-427.

> The first is to determine the effect of price changes (both real and money) upon the quantities of foods purchased, and the associated time-lag in adjustment. The second objective is to determine the effect of a change in income (both real and money) upon the quantity purchased and expenditures for various food products, and the associated time lag. The third objective is to measure the effect of price changes and income changes upon substitution among different products. In a sense, therefore, the objectives are to determine price elasticity, income elasticity and cross-elasticity of demand.

Dr. Quackenbush goes on to say:

> Panel data provides a mass of information which is not directly related to studies of elasticities, but which might be termed supplemental to them. This information includes consumer purchase patterns, buying habits, allocation of the food dollar and others which have many practical applications.

It is this latter type of information which has formed the analytical bases for this study.

The data from the Michigan State University Consumer Panel are unique in that they are based on a source of continuous information at the consumer level. With these continuous records, information on consumer purchasing patterns is obtained which cannot be derived from the more traditional aggregative time series or from cross-sectional studies where food purchases for a limited period of time are obtained.

There are several inherent limitations in panel data. One of the more obvious limitations is the limited geographic area of study. The city of Lansing is the statistical universe for the Michigan State University Consumer Panel. The Lansing area may be similar to other urban areas for certain characteristics but dissimilar in other respects. To the extent that the major fruit and vegetable producing areas in the United States are fairly widely dispersed, the purchase

pattern of consumers in any one location may be considerably influenced by geographic situations.

A second limitation of panel data arises from the fact that it's impossible to make distinctions on the bases of quality and variety. There are practical limitations on the amount of detail that can be obtained on food items purchased for home consumption. The lack of reliable grade standards for most fruits and vegetables prohibits the identification and reporting of grades by panel members.

Finally, there are undoubtedly errors in the reporting of purchases. Errors of omission are probably unimportant. It is probable that, as a result of the vast array of different products and combinations of products available at the retail level, confusion in reporting may exist for some items. However, it is doubtful if these errors of confusion are of sufficient magnitude to have any bearing on the results of this study.

CHAPTER II

THE DEVELOPMENT AND GROWTH OF THE FROZEN FRUIT AND VEGETABLE INDUSTRY IN THE UNITED STATES

Introduction

Freezing is one of the most recent technological developments in commercial food processing and has resulted in substantial changes in the marketing of fruits, vegetables, meats and other foods. The production of frozen fruits, vegetables, poultry, meats, seafoods, fruit juices and specialties increased twelvefold between 1938 and 1953.[1]

Preservation of food products by freezing first became commercially practicable with advances in the application of mechanical refrigeration. Freezing or cold-packing fruits for processors was developed into a standardized established industry shortly after World War I.[2] The fruit was packed in large containers and frozen slowly for several days at comparatively high temperatures. Products preserved in this way were used mostly for preserves, ice-cream manufacturing, commercial baking and other industrial uses.

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[1] A. B. Paul and L. B. Mann, "What Our Grandparents Did Not Have," Yearbook of Agriculture, United States Department of Agriculture, Washington, D. C., 1954, p. 121.

[2] F. L. Thomsen, Agricultural Marketing, New York: McGraw-Hill Book Co., Inc., 1951, p. 141.

The history of the introduction of quick frozen foods to the retail trade, for the most part, is the story of Birds Eye's operations in the early 1930's.[3] Early attempts to distribute frozen fruits in small packages to the retail customer met with failure of a greater or less degree. The principal difficulty encountered was the lack of facilities for keeping the fruits frozen until they could be delivered to the consumer.

The institutional trade proved receptive to the advent of frozen foods. In 1935, hotel and restaurant operators were using and expressing satisfaction with frozen fruits and vegetables.[4] Retail distribution difficulties were not as easily overcome. The retail grocer had no low temperature storage facilities and hesitated to make a substantial investment to satisfy an unknown demand. Reluctance by the retail trade to make the necessary investments for accommodating frozen goods no doubt retarded the marketing of this new product.

The status of the frozen food industry just over twenty years ago is indicated by the following quotation:

> Retail distribution was practically in a state of collapse in the summer of 1935, except in New York, Boston, and the western New York cities of Rochester and Syracuse where Birds Eye had tried out a new experimental sales policy. In the large cities in the Midwest and North East, interviews with leading grocers, a few of whom had been induced to buy cabinets and attempt to sell the new food, found nothing but pessimism.

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[3] For a detailed historical description of the development of the frozen food industry see Carlton, The Frozen Food Industry, University of Tennessee Press, 1941.

[4] Ibid., p. 6.

> Nowhere throughout this section was there any evidence that the housewives knew anything about frozen foods--either as to cost, proper handling and cooking, or nutritive value and identity with fresh foods rather than with canned or the old-fashioned cold storage product.[5]

In comparison, in 1954 it was estimated that over 70 percent of the retail outlets in the United States handled frozen foods with frozen foods accounting for 3.7 percent of total grocery store sales.[6]

It is difficult to isolate any particular factor as influencing the rapid rise in commercial production of frozen foods since World War II. Changing consumption patterns, widespread consumer acceptance, technical developments in storage facilities and home refrigerators, all undoubtedly played a part. In addition, improvements in freezing methods and the developments of new varieties have enabled packers to introduce a wide variety of products for the retail trade.

Trends in the National Consumption of Frozen Fruits and Vegetables

Frozen fruits and vegetables constitute the largest part of the volume of frozen foods to date. From 1939 to 1953 the freezing of fruits increased from 141 million pounds to 1,254 million pounds and that of vegetables from 73 million pounds to 1,077 million pounds. The corresponding figures for the other main frozen food groups are: poultry, 15 to 470 million pounds; meat, 10 to 140 million pounds;

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[5] Ibid., p. 7.

[6] T. Millott, "Where the Frozen Food Industry is Headed in the Next Few Years," reprint from the 1956 Frozen Food Factbook and Directory, National Frozen Foods Distributor Assoc., New York 17, N. Y.

seafoods, 50 to 100 million pounds, and prepared foods, .5 to 300 million pounds.

Vegetables. As shown in Table 1, the total civilian per capita consumption of commercially produced vegetables increased from 1937 to the immediate post World War II years. From 1946 to 1954, consumption has been declining slowly although remaining considerably higher than in the late 1930's.

The per capita consumption of both the fresh and canned products reached a peak in 1946. From that date to the present time, consumption of fresh vegetables had declined to the pre-war level, while that of the canned product has remained relatively stable. The per capita consumption of frozen vegetables followed a radically different pattern increasing twelvefold between 1937 and 1954 and from 4.6 pounds per capita in 1946 to 12.2 in 1954.

From a small .6 percent of the total commercial vegetable market in 1937, the consumption of frozen vegetables has increased to include 6.0 percent of all commercially produced vegetables in 1954. As indicated in Figure I, the frozen product's increased share of the total market appears to have come about at the expense of fresh product. Canned vegetables appear to have maintained a relatively constant share of the total market.

At the retail level, the growth of frozen vegetable consumption is even more spectacular than indicated in Table 1. Prior to World war II the largest part of the frozen vegetable market was dependent on the institutional trade. In 1944, only 44 percent of the total

TABLE 1

CIVILIAN PER CAPITA CONSUMPTION OF COMMERCIALLY PRODUCED VEGETABLES. UNITED STATES 1937-1954*
Index 1937-39 = 100

Year	All Vegetables	Fresh	Canned**	Frozen**
1937	97	97	95	100
1938	100	100	101	90
1939	103	103	103	120
1940	106	103	112	140
1941	107	100	119	170
1942	114	105	129	250
1943	108	102	122	160
1944	116	11	121	380
1945	132	121	148	430
1946	134	120	159	460
1947	122	111	138	590
1948	119	112	123	670
1949	116	106	125	670
1950	121	108	136	730
1951	121	104	140	920
1952	121	105	136	1120
1953	122	104	139	1160
1954	120	103	135	1220

*Civilian Consumption only after 1941.
**Based on Fresh Weight equivalent.

Source: The Vegetable Situation, Agricultural Marketing Service, U. S. Dept. of Agric., Nov. 29, 1955.

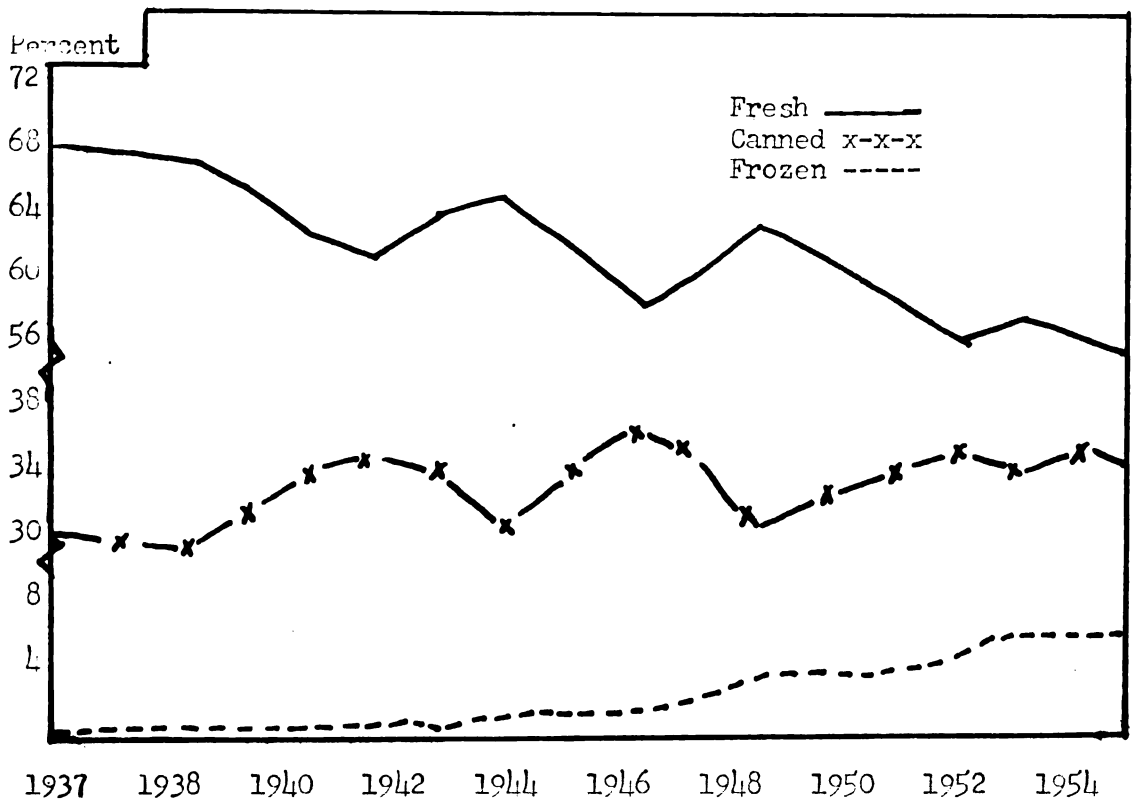

Figure I. Consumption of Fresh, Canned and Frozen Vegetables as a Percentage of Total Vegetable Consumption, United States 1937-1954 Based on Fresh Weight Equivalent.

production of frozen vegetables was packed in retail size containers. In 1953, 64.8 percent was packed for the retail market. As shown in Figure II, since 1944 the production of frozen vegetables packed in retail size containers has increased almost 700 percent whereas total production has increased approximately 350 percent.

Although many different vegetables are sold in the frozen form,[7] vegetables vary in popularity with the consuming public. Frozen peas accounted for over 27 percent of the frozen vegetable pack in 1954

[7] Over 40 different kinds of vegetables have been frozen, but only about 15 are of any commercial importance.

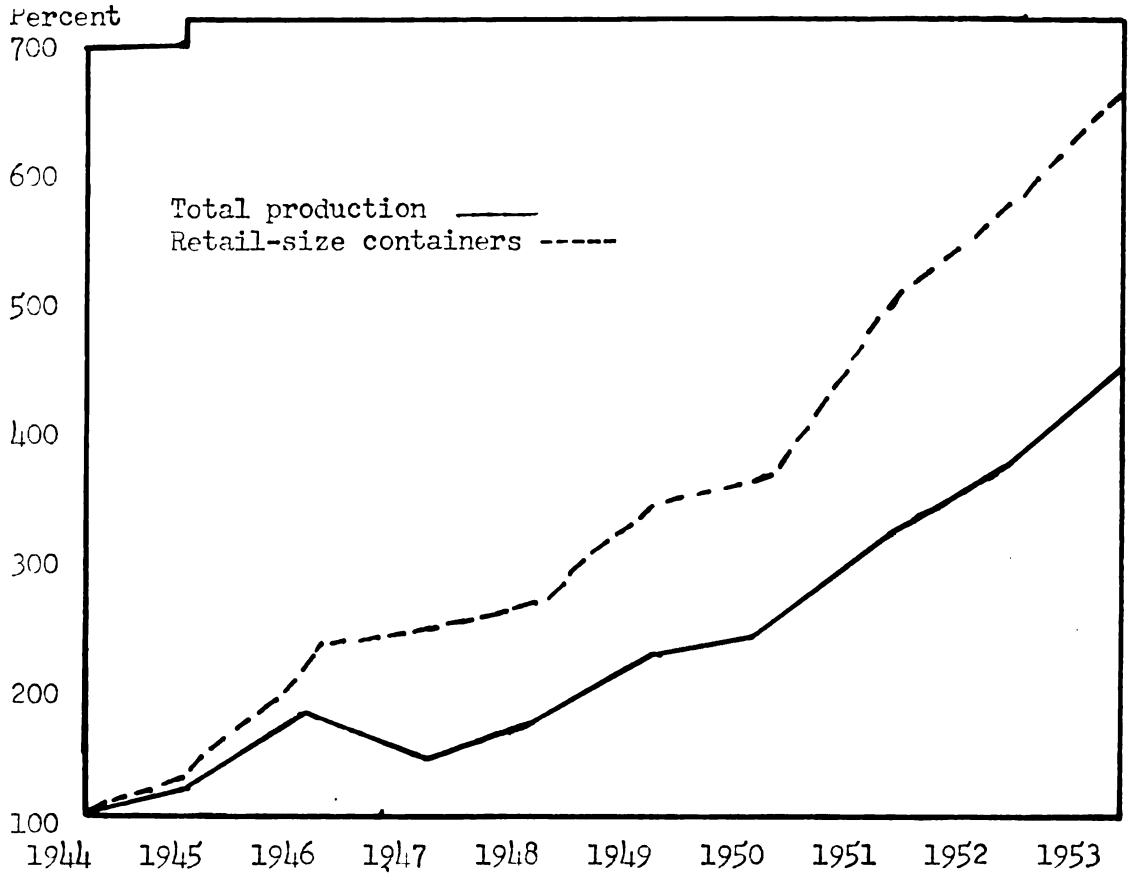

Figure II. Index of Total Production and Production in Retail Size Containers--Frozen Vegetables. United States 1944-1953. 1944=100

followed by lima beans with over 13 percent, as shown in Table 2. Other vegetables of commercial importance in order of size of pack are: snap beans, spinach, corn, broccoli, and asparagus.

On a relative basis, production for the frozen market is much greater for some commodities than for others. Almost 60 percent of the total commercial production of lima beans is dependent on the frozen market, just under one-half of the broccoli production is sold in the frozen form and frozen peas and frozen spinach account for approximately one-third of the commercial production of each commodity.

TABLE 2

CIVILIAN PER CAPITA CONSUMPTION OF SELECTED COMMERCIALLY PRODUCED FROZEN VEGETABLES, UNITED STATES 1954

Commodity	Per Capita Consumption lbs.*	Percent of all Frozen Vegetables*	Percent of Total Production Sold in Frozen Form**
Peas	1.32	27.6	31.2
Lima Beans	0.72	13.3	59.3
Snap Beans	0.56	10.4	10.8
Spinach	0.51	9.4	36.3
Corn	0.48	9.0	7.4
Broccoli	0.43	8.0	43.3
Asparagus	0.16	3.0	15.2

*Frozen weight.
**Based on fresh weight equivalent.

Source: The Vegetable Situation, Agricultural Marketing Service, U. S. Dept. of Agri., November 29, 1955.

Frozen Fruits (excluding citrus fruits). The increase in production of frozen fruits, other than citrus, has been moderate in comparison to the rapid expansion of the frozen vegetable market. As shown in Table 3, per capita consumption of frozen fruits has not increased greatly since the early post World War II years. Over the same period of time, however, the per capita consumption of fresh and dried fruits has decreased considerably while that of the canned products has remained relatively constant.

Frozen fruits, other than citrus, command a relatively small part of the total market. Approximately 3 percent of all commercially produced non-citrus fruits was consumed in the frozen form in 1954, as compared with 0.5 percent in 1937 and 3 percent in 1947. At the

TABLE 3

CIVILIAN PER CAPITA CONSUMPTION OF COMMERCIALLY PRODUCED FRESH AND PROCESSED FRUITS, UNITED STATES, 1937-1954*
Index 1937-1939 = 100

Year	All Fruits**	Fresh	Canned**	Dried**	Frozen**
1937	102.8	106.2	101.5	95.8	57.5
1938	96.3	95.8	95.0	98.4	114.9
1939	100.9	98.0	104.0	105.8	126.4
1940	101.3	91.8	120.5	109.4	137.9
1941	102.8	98.2	123.0	94.8	137.9
1942	83.1	75.0	113.5	74.3	137.9
1943	68.5	56.8	83.5	87.4	114.9
1944	82.3	79.1	61.0	109.9	195.4
1945	91.8	86.4	86.0	109.4	206.9
1946	103.5	89.4	144.0	96.9	287.4
1947	95.0	90.1	118.5	75.4	321.8
1948	88.2	82.9	112.0	70.7	287.4
1949	90.1	84.1	115.5	74.9	252.8
1950	85.8	72.0	128.5	75.4	275.9
1951	83.8	74.9	114.5	71.7	252.8
1952	89.2	77.4	131.0	72.3	298.9
1953	88.8	75.0	138.0	70.7	298.9
1954	82.8	71.0	123.0	68.6	287.4

*Civilian consumption only after 1941.
**Fresh weight equivalent.

Source: The Fruit Situation, Agricultural Marketing Service, U. S. Dept. of Agri., Oct. 28, 1955.

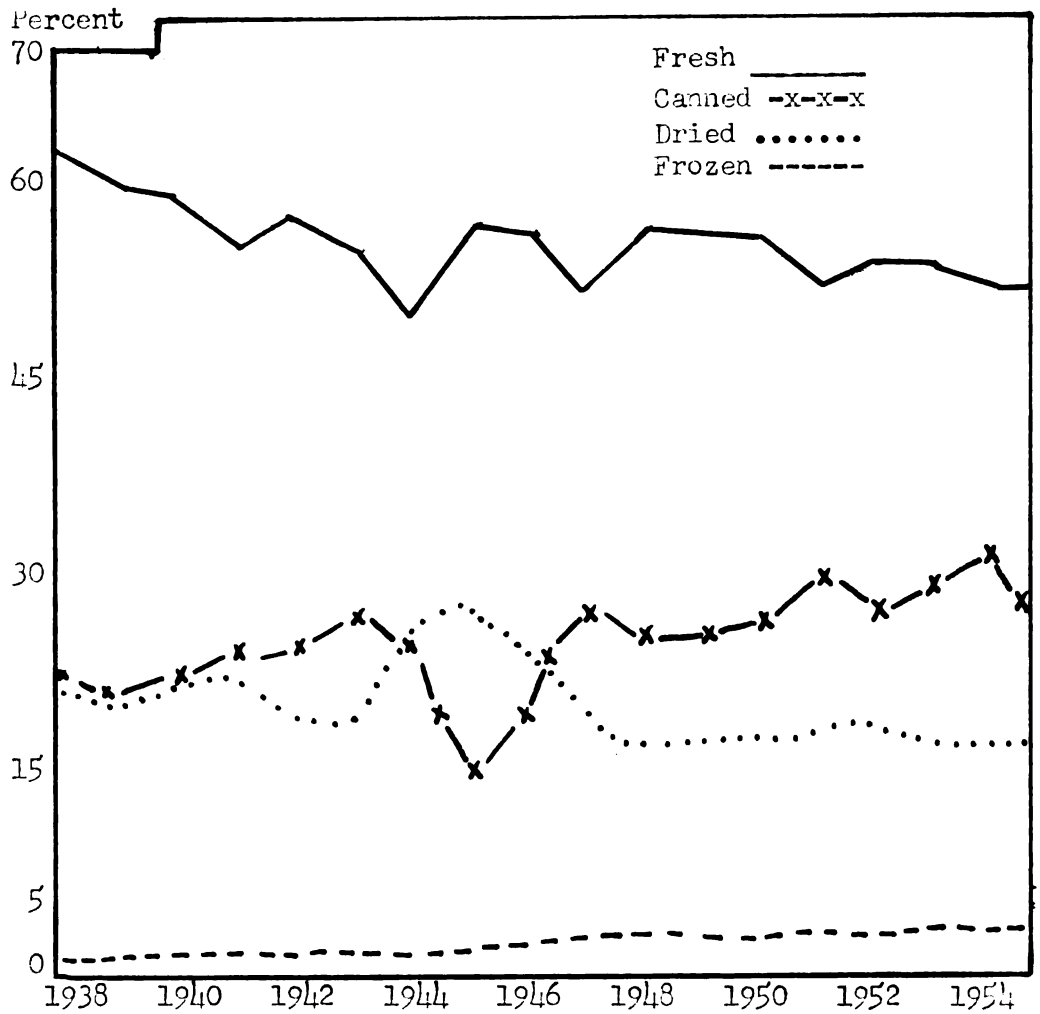

Figure III. Consumption of Fresh, Canned, Dried and Frozen Fruits (excluding citrus) as a Percentage of Total Fruit Consumption. 1937-1954. U.S.A.

retail level, this proportion was considerably smaller as more than two-thirds of the frozen fruit pack is packed in institutional sized containers.[8]

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[8] W. Bitting, "The Prospects in Frozen Foods," reprint from The 1956 Frozen Food Factbook and Directory, National Frozen Foods Distributors Assoc., New York 17, N. Y.

The array of frozen fruits which have met consumer acceptance is not nearly as formidable as that of frozen vegetables. Three fruits,

TABLE 4

CIVILIAN PER CAPITA CONSUMPTION OF SELECTED COMMERCIALLY PRODUCED FROZEN FRUITS (EXCLUDING CITRUS), UNITED STATES 1954

Commodity	Per Capita Consumption Lbs.*	Percent of All Frozen Fruits*	Percent of Total Production Sold in Frozen Form**
Strawberries	1.39	55.6	41.1
Sour cherries	0.52	20.8	22.4
Peaches	0.17	6.8	1.1
Raspberries	0.13	4.6	---

*Frozen weight.
**Based on fresh weight equivalent.

Source: The Fruit Situation, Agricultural Marketing Service, U. S. Dept. of Agric., October 28, 1955.

strawberries, sour cherries, peaches, constitute over 80 percent of all non-citrus frozen fruit production. Of these, strawberries are by far the most popular with over 55 percent of the total followed by cherries (20%) and peaches (7%).

Strawberries are the only frozen non-citrus fruit of very great commercial importance that show a positive post-war trend in per capita consumption. More than 46 percent of the total strawberry production in 1954 was consumed in the frozen form as compared to about 25 percent in 1947. In absolute terms, per capita consumption of frozen strawberries has increased steadily from .73 lbs in 1947 to 1.39 lbs in 1954 (fresh weight). This has compensated for the decline in fresh

strawberry consumption over the same period from 1.9 to 1.3 lbs per capita. On the other hand, consumption of frozen cherries has fluctuated at around 20 per cent of total cherry production since 1947. In absolute terms, consumption of frozen cherries has remained relatively stable. Frozen peaches have apparently lost favor with consumers both in absolute terms and as a percentage of total production. The per capita consumption of frozen peaches averaged .38 lbs in 1945 to 1947 as compared with the 1952-54 average of .20 lbs (fresh weight). In these latter years this accounted for just over one percent of all commercial peach production.

Citrus Fruits. Frozen citrus fruits have gained more in popularity in recent years than any other frozen product. It was not until the late 1940's that technical innovations permitted the successful freezing of citrus products. As shown in Table 5, in 1948 the frozen product held but .5 per cent of the total citrus market. Six years later in 1954, over 30 per cent of citrus products was sold in the frozen form. It is noted that the increase in consumption of frozen citrus juices has been accompanied by a rapid decline in consumption of the fresh and canned products. Indications are that the decline in canned consumption is largely due to substitution of the frozen product. To a certain extent this may be true for fresh oranges although a downward trend in fresh consumption is evident prior to the advent of frozen citrus juices.

TABLE 5

CIVILIAN PER CAPITA CONSUMPTION OF COMMERCIALLY PRODUCED FRESH AND PROCESSED CITRUS FRUIT. UNITED STATES 1937-1954*

Year	Total	Fresh		Canned**		Frozen**	
			Percent		Percent		Percent
	lbs.	lbs.	Total	lbs.	Total	lbs.	Total
1937	49.8	43.9	88.2	5.9	11.8		
1938	54.8	48.4	88.3	6.4	11.7		
1939	70.3	60.5	86.1	9.8	13.9		
1940	66.0	55.9	84.7	10.1	15.3		
1941	71.3	56.9	79.8	14.4	20.2		
1942	71.4	56.9	79.7	14.5	20.3		
1943	71.1	59.5	83.7	11.6	16.3		
1944	88.1	67.3	76.4	20.8	23.6		
1945	86.9	65.7	75.6	21.2	24.4		
1946	93.9	58.3	62.1	35.3	37.6	0.3	0.3
1947	93.0	61.3	65.9	31.5	33.9	0.2	0.2
1948	88.5	53.5	58.5	34.5	41.0	0.5	0.5
1949	80.6	47.1	58.4	26.9	33.4	6.6	8.2
1950	72.6	40.6	55.9	21.4	29.5	10.6	14.6
1951	81.7	44.5	54.5	22.2	27.2	15.0	18.3
1952	83.4	43.8	52.5	18.2	21.8	21.4	25.7
1953	84.3	42.8	50.8	17.3	20.5	24.2	28.7
1954	84.7	40.6	47.9	17.4	20.5	26.7	31.6

*Civilian consumption only after 1941.
**Fresh Weight Equivalent.

Source: The Fruit Situation, Agricultural Marketing Service, U. S. Dept. of Agric., Oct. 28, 1955.

In 1954, frozen orange juice alone accounted for over 80 per cent of the total market for all frozen citrus products. Frozen orange juice provides an excellent example of how, in a comparatively short time, the marketing of a single commodity can be radically changed through product innovations meeting widespread consumer approval. In the crop year of 1954-55, 53 per cent of the domestic market for oranges and orange products was for the frozen juice. Thirty-five per cent was sold in the fresh form with only 12 per cent sold in a processed form other than frozen.

CHAPTER III

EXPENDITURES FOR FROZEN FRUITS AND VEGETABLES MICHIGAN STATE UNIVERSITY CONSUMER PANEL 1953-1955

In this study, per capita expenditures have been used as an indicator of purchases of frozen fruits and vegetables by families of the Michigan State University Consumer Panel.[1] Hence a direct comparison with the United States Department of Agriculture statistics described in Chapter II cannot be made. The latter source records per capita quantities and includes production in the institutional size pack. In some instances, an approximate comparison might be made on a relative basis both as to the comparative importance of a particular frozen product to other frozen fruits and vegetables, and as to consumer acceptance of a frozen product compared to the fresh and canned counterparts of the same commodity. However, such comparisons must be broadly interpreted.

In analyzing consumer expenditures for frozen fruits and vegetables from panel data it is possible to extend the analysis beyond annual data. Expenditures can be broken down on a seasonal basis in an effort to indicate the movement of frozen fruits and vegetables into consumption within the year.

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[1] For analyses requiring inter-commodity comparisons, comparison between the different product forms or aggregation of commodities, expenditures serve as a common denominator partly overcoming problems of quality, variety and different degrees of bulkiness which arise in quantity comparisons.

D. Johnston, Agricultural Economist, United States Department of Agriculture, stated that:

> Many food packers, distributors, and brokers have indicated that information on the movement of their products into consumption would be a definite aid to an understanding of the market.[2]

It is assumed that this reasoning might also apply to retailers to whom a knowledge of seasonal fluctuation in consumer expenditures might be of assistance in planning space allocation and promotion in a given period.

Annual Per Capita Expenditures for Frozen Fruits and Vegetables

Families of the Michigan State University Consumer Panel spent 6.5 percent of all vegetable expenditures, 4.9 percent of all fruit expenditures and 66.4 percent of all fruit juice expenditures for the corresponding frozen products in 1955.

As shown in Table 6, averaged over the three year period of 1953 to 1955, over one-half the expenditure for all frozen fruits and vegetables were made for frozen fruit juices with frozen orange juice alone accounting for approximately one-half the total. Frozen strawberries and frozen peas were easily the most popular frozen items of all fruits and vegetables respectively.

A wide variety of frozen vegetables appears to have met with considerable consumer acceptance. Frozen peas, broccoli, snap beans,

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[2] Dehard Johnson, "Frozen Food Movement into Retail Outlets," Agricultural Marketing Service, United States Department of Agriculture, Washington, D. C., March 1955.

TABLE 6

FROZEN FRUITS, VEGETABLES AND FRUIT JUICES RANKED IN ORDER OF PER CAPITA EXPENDITURES. MICHIGAN STATE UNIVERSITY CONSUMER PANEL, 1953-1955

Commodity	1953	1954	1955	1953-1955 Average	1953-1955 Average Percent of All Expenditures for Frozen Fruits and Vegetables
All fruits	$.74	$.75	$1.01	$.83	15.8
Strawberries	.57	.59	.70	.62	11.7
Raspberries	.04	.04	.12	.07	1.3
Sour cherries	.05	.05	.09	.06	1.1
Peaches	.02	.01	.03	.02	0.4
Other	.06	.06	.07	.06	1.3
All vegetables	1.35	1.27	1.40	1.34	25.3
Peas	.35	.33	.32	.33	6.2
Broccoli	.16	.16	.18	.17	3.2
Snap beans	.15	.11	.14	.13	2.5
Lima beans	.10	.10	.12	.11	2.1
Brussel sprouts	.10	.08	.09	.09	1.7
Corn	.09	.08	.10	.09	1.7
Cauliflower	.08	.08	.08	.08	1.5
Squash	.07	.10	.09	.08	1.5
Spinach	.06	.06	.08	.07	1.3
Asparagus	.04	.06	.07	.06	1.1
Other	.15	.11	.13	.13	2.5
All fruit juices	3.16	2.97	3.23	3.12	58.2
Orange juice	2.61	2.44	2.64	2.56	48.4
Lemon juice	.24	.18	.26	.23	3.6
Other	.31	.35	.33	.33	6.2
All fruits and vegetables	5.25	4.99	5.64	5.29	100.0

and lima beans were the most popular in that order. Over the three year period, annual per capita expenditures for frozen peas averaged .33 cents or about 25 percent of all expenditures for frozen vegetables.

Annual expenditures for frozen strawberries averaged 62 cents per person over the three years considered, representing almost 75 percent of all expenditures for frozen fruits other than citrus. Other frozen fruits do not appear widely popular with relatively small per capita expenditures made for frozen cherries, raspberries and peaches.

Over the three years examined, it is difficult to establish any evidence of a trend in expenditures for a single product or group of products. Aggregate expenditures for all frozen fruits and vegetables declined slightly from 1953 to 1954 but increased again in 1955.

As an indication of the competitive relationships existing between the different product forms of a particular commodity, in Table 7 per capita expenditures for each product form is expressed as a percentage of total expenditures for each commodity over the years 1953 to 1955.

The vegetables, broccoli, brussels sprouts, cauliflower and squash, while relatively unimportant in the total fruit and vegetable market, show a comparatively high proportion of expenditures made for the frozen product. It is noted that negligible expenditures were made for these four vegetables in a processed form other than frozen. Thus intra-commodity competitiveness existed only with the fresh

TABLE 7

PER CAPITA EXPENDITURES FOR FRESH, FROZEN AND CANNED FRUITS AND VEGETABLES RANKED ACCORDING TO PERCENTAGE OF EXPENDITURES FOR FROZEN. AVERAGE 1953-1955. MICHIGAN STATE UNIVERSITY CONSUMER PANEL

	Percentage of Expenditures for Product			
	Frozen	Fresh	Canned*	Total
All Vegetables	6.5	51.9	41.6	100.0
Broccoli	68.0	32.0	-	100.0
Brussel Sprouts	56.2	43.8	-	100.0
Lima Beans	36.7	6.6	56.7	100.0
Cauliflower	32.0	68.0	-	100.0
Squash	30.8	69.2	-	100.0
Peas	30.0	1.8	68.2	100.0
Spinach	24.2	37.9	37.9	100.0
Snap Beans	14.3	16.5	69.2	100.0
Asparagus	12.8	38.3	48.9	100.0
Corn	7.6	28.2	63.8	100.0
All Fruits	4.9	67.1	28.0	100.0
Oranges & Orange juice	54.5	36.2	9.3	100.0
Strawberries	41.9	45.9	12.2	100.0
Sour Cherries	21.4	21.4	57.2	100.0
Raspberries	12.5	73.2	14.3	100.0
Peaches	1.5	47.4	51.1	100.0
All Fruit Juices	66.4	-	33.6	100.0

*Including dried, jams, and jellies, excluding baby foods and soup.

product and would obviously be more intense during certain seasons of the year.

For those vegetables which the frozen and canned products are competitive throughout the year, in no instance did expenditures for the frozen form exceed that of the canned. Frozen lima beans and spinach competed with the canned products most favorably in this regard. Frozen peas, while the most popular frozen vegetable item, accounted for approximately one-half as much of all pea expenditures as did the canned product.

Consumer expenditures for frozen strawberries were slightly less than expenditures for the fresh product although the latter was purchased in quantity only in the fresh production period.

For sour cherries, well over one-half of all expenditures were made for the canned product. The remainder of the consumer market for sour cherries was divided evenly between the frozen and fresh forms.

On an annual basis, frozen orange juice accounted for more than one-half of all expenditures for oranges and orange products.[3]

Variations in Seasonal Expenditures for Frozen Fruits and Vegetables

The consumption of fresh fruits and vegetables is generally concurrent with seasonal production. It is expected then that

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[3] Although not directly comparable, the 54.5 percent of all orange expenditures for frozen orange juice by families of the Michigan State University Consumer Panel approximates the 53 percent of 1954-1955 United States orange production that was consumed as frozen orange juice.

expenditures for the frozen and canned products would vary according to the competitive relationships existing in a given period.

As shown in Figure IV, the seasonal variations in expenditures for both frozen fruits and vegetables appeared to follow a similar pattern with peak expenditures in the early months of the year, falling to a seasonal low in August and September.

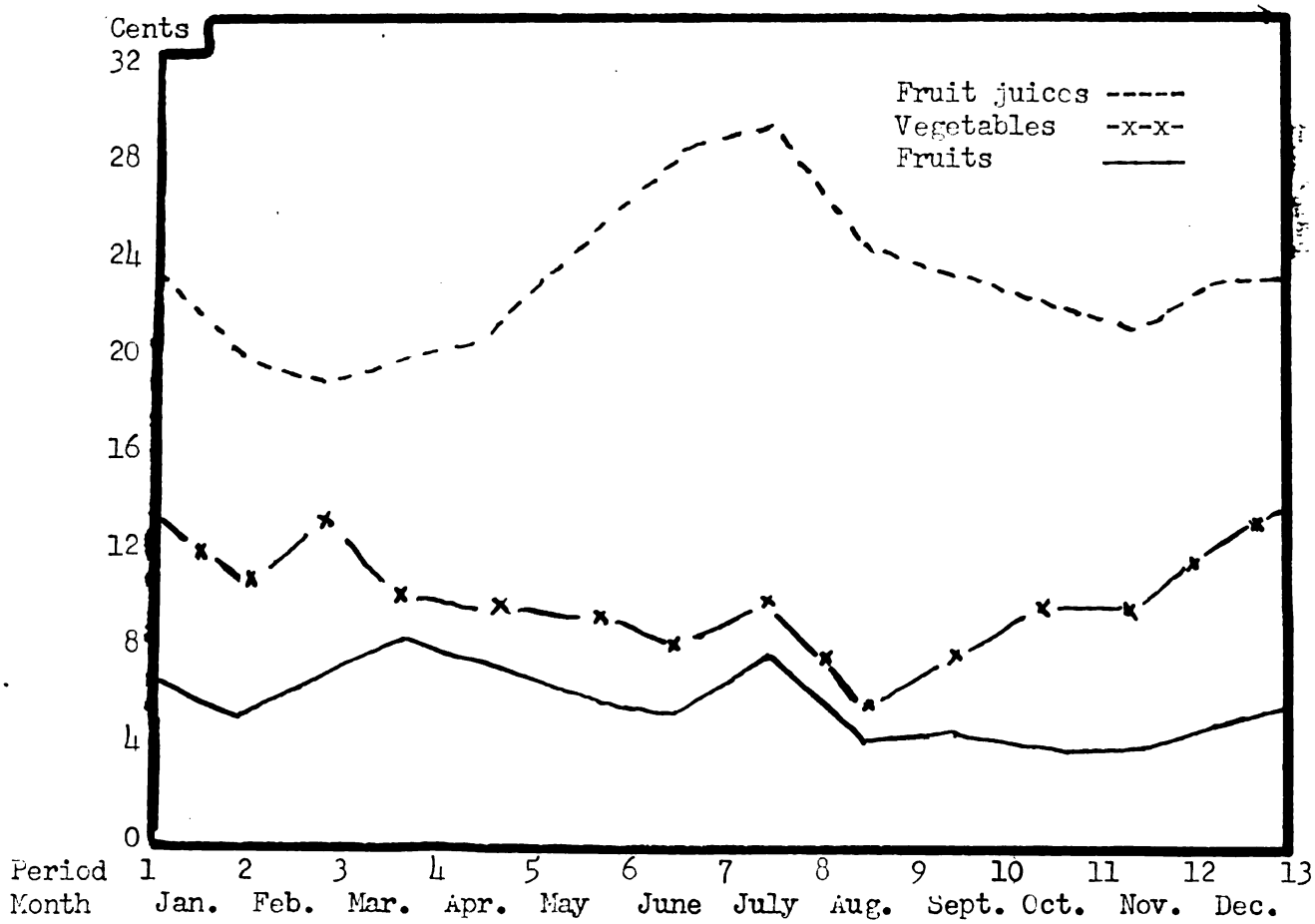


Figure IV. Per Capita Expenditures for Frozen Fruits, Vegetables, and Fruit Juices Plotted by Four Week Periods; Michigan State University Consumer Panel, Average 1953-1955.

Averaged over the three year period 1953 to 1955, expenditures for frozen fruits ranged from less than five cents per person in consecutive four-week periods in September, October and November to a maximum of nine cents in the fourth four-week period (March-April). For frozen vegetables the range was even more extreme. In the third four-week period (February-March) per capita expenditures for frozen vegetables exceeded thirteen cents. In the ninth period (August-September) purchases of frozen vegetables averaged approximately six cents per person.

For both frozen fruits and vegetables, increased expenditures occurred during a four-week period in mid-summer. It is believed that this variation is possibly a result of family purchases for home freezer supplies.

Expenditures for frozen fruit juices reach a maximum throughout the summer months indicating that summer temperatures have considerable influence on the consumption of frozen fruit juices. A secondary peak is apparent at the end and beginning of the year, approximately coinciding with the holiday season.

Limited expenditures for most products prevented breaking down annual expenditures into four-week periods to indicate seasonal patterns. Only expenditures for peas, strawberries and orange juice were large enough to exhibit seasonal relationships from which valid conclusions could be drawn.

Peas. Season of the year appears to have considerable effect on consumer expenditures for frozen peas. From a January peak, expenditures declined slowly to a summer low followed by a return to normal in the fall months. Consumer purchases of canned peas appeared to follow a similar pattern. The fresh product did not enter into the competitive structure to any great extent with limited expenditures in only a few periods of the year.

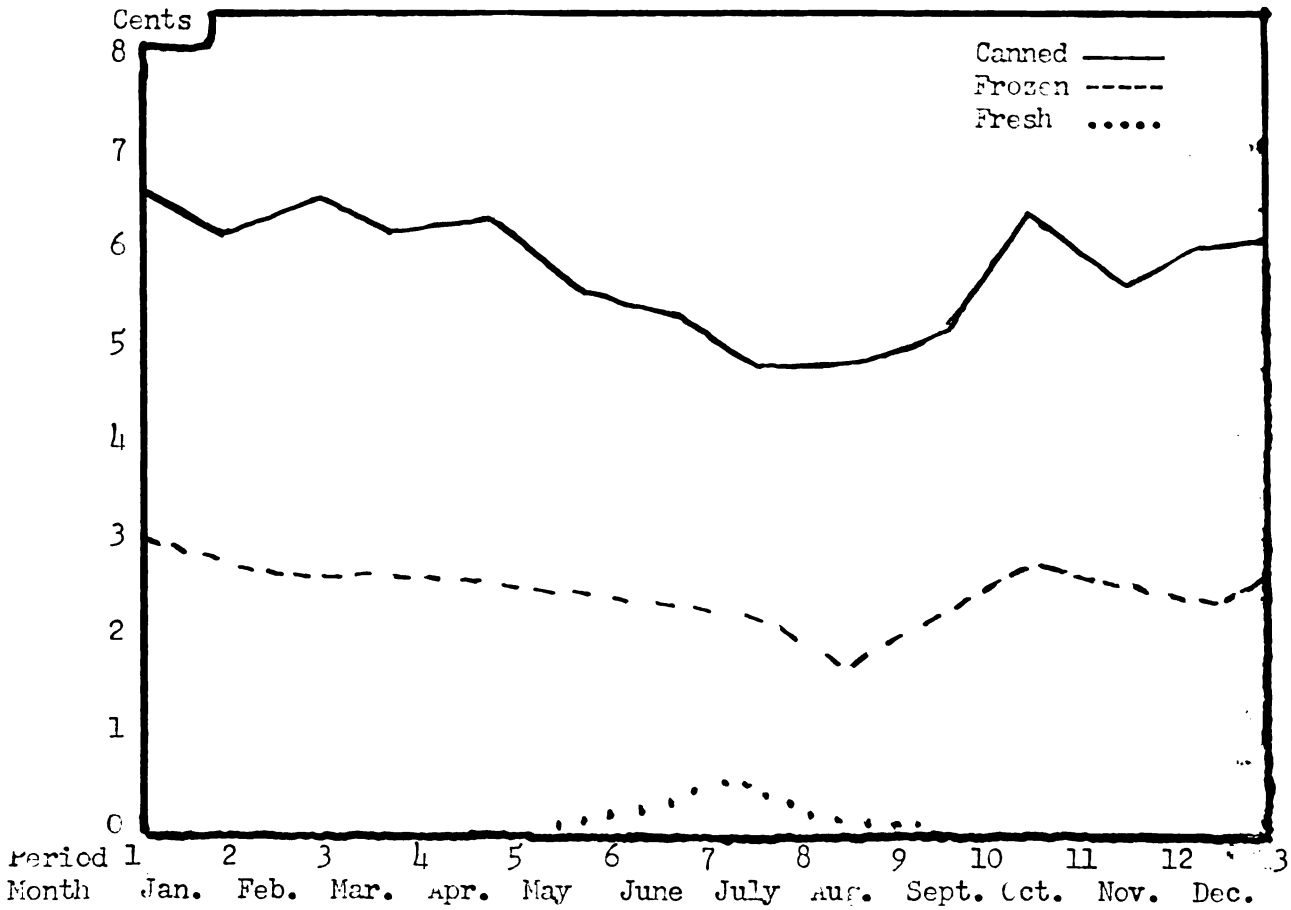


Figure V. Per Capita Expenditures for Frozen, Fresh and Canned Peas Plotted by Four-Week Periods. Average 1953-1955, Michigan State University Consumer Panel.

The decline in consumer purchases of both the frozen and canned products through the summer months requires no explanation. It is assumed that these processed products are substituted for by the array of fresh produce available in season.

Strawberries. Expenditures for frozen strawberries reach a distinct peak in March and April. Averaged over the three year period per capita expenditures in the fourth four-week period (March-April) were

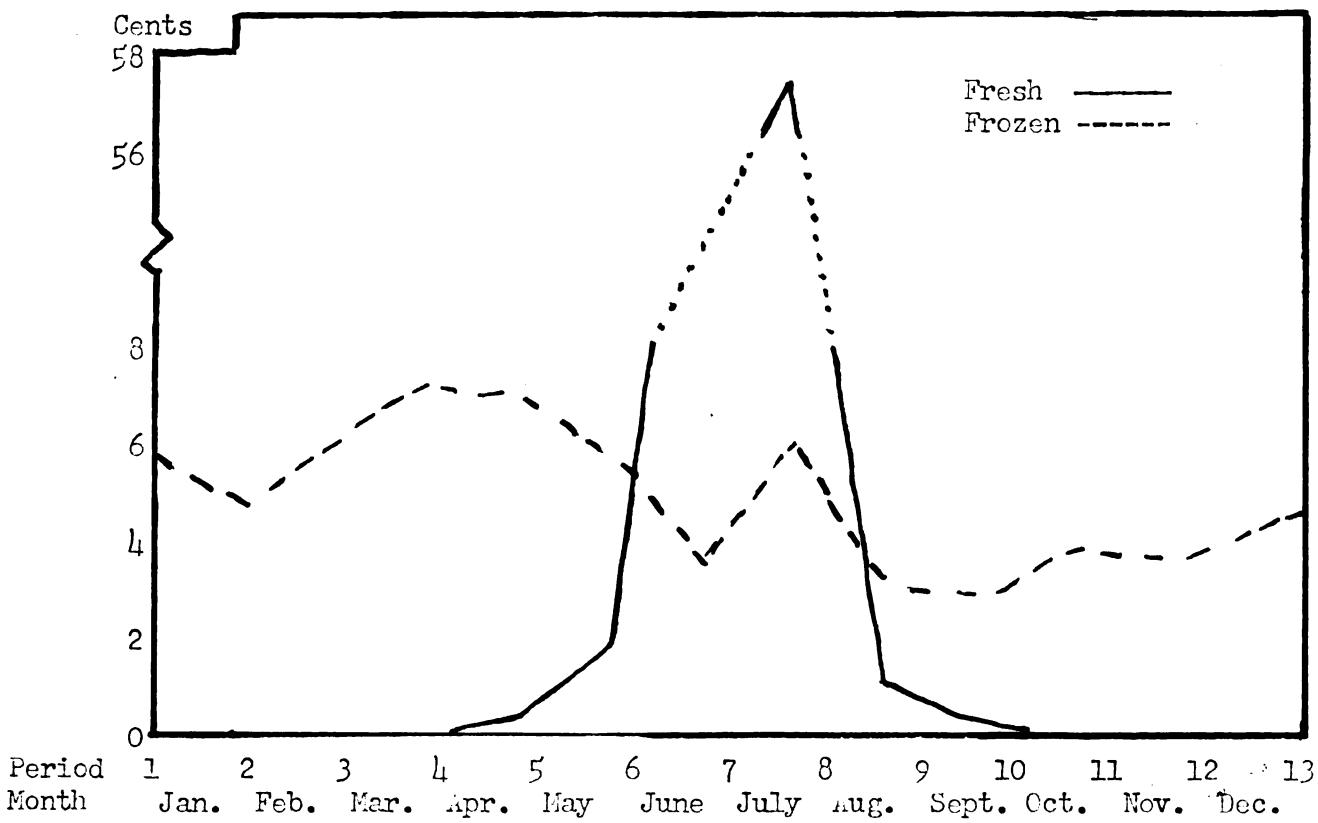


Figure VI. Per Capita Expenditures for Fresh and Frozen Strawberries Plotted by Four-Week Periods. Average 1953-1955. Michigan State University Consumer Panel.

approximately twice as great as in the seventh period (June-July). It was expected that a highly competitive relationship would exist between fresh and frozen strawberries. However, the frozen product appeared to maintain a fairly consistent volume in the market throughout the fresh season. Expenditures for frozen strawberries during the fresh season did not differ greatly from expenditures through the late summer and fall months when many other fresh fruits are available for consumer choice. This suggests that frozen strawberries are little more competitive with fresh strawberries than with many other fresh fruits.

Oranges and Orange Juice. The seasonal pattern of expenditures for frozen orange juice appeared fairly constant throughout the entire year, ranging only from a low of approximately eighteen cents per person in the third four-week period (February-March) to a high of approximately twenty-two cents in the tenth period (September-October). Expenditures for canned orange juice did not vary greatly throughout the year while expenditures for the fresh product dropped off considerably during the summer months.

It is noted that the seasonal patterns for frozen orange juice and fresh oranges followed opposite trends with the seasonal high for orange juice coinciding with the seasonal low for oranges and vice versa. Although it would seem that the fresh and frozen products differ as to consumer use and that to a large extent different factors would influence consumer choice a certain degree of substitution is indicated.

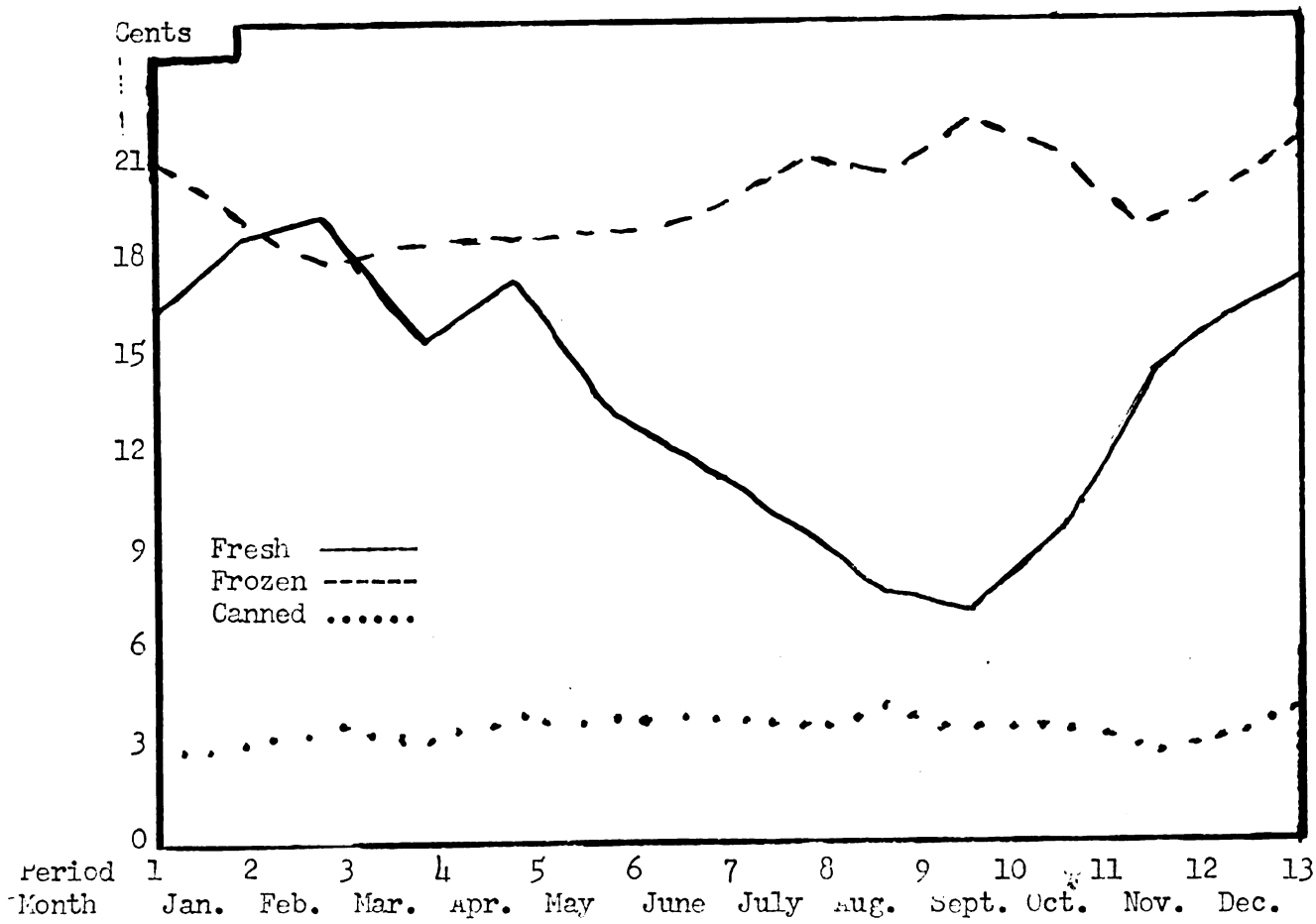


Figure VII. Per Capita Expenditures for Fresh Oranges, Frozen and Canned Orange Juice Plotted by Four-Week Periods. Average 1953-1955. Michigan State University Consumer Panel.

The possibility that seasonal variations in the prices of the frozen products, peas, strawberries and orange juice, might bear some relationship to seasonal variations in expenditures was considered. The prices paid for these three items were averaged for each four-week period for the three years 1953 to 1955. As indicated in Figure VIII, seasonal price variations were such that it is difficult to draw conclusions or to relate prices to expenditures. The prices

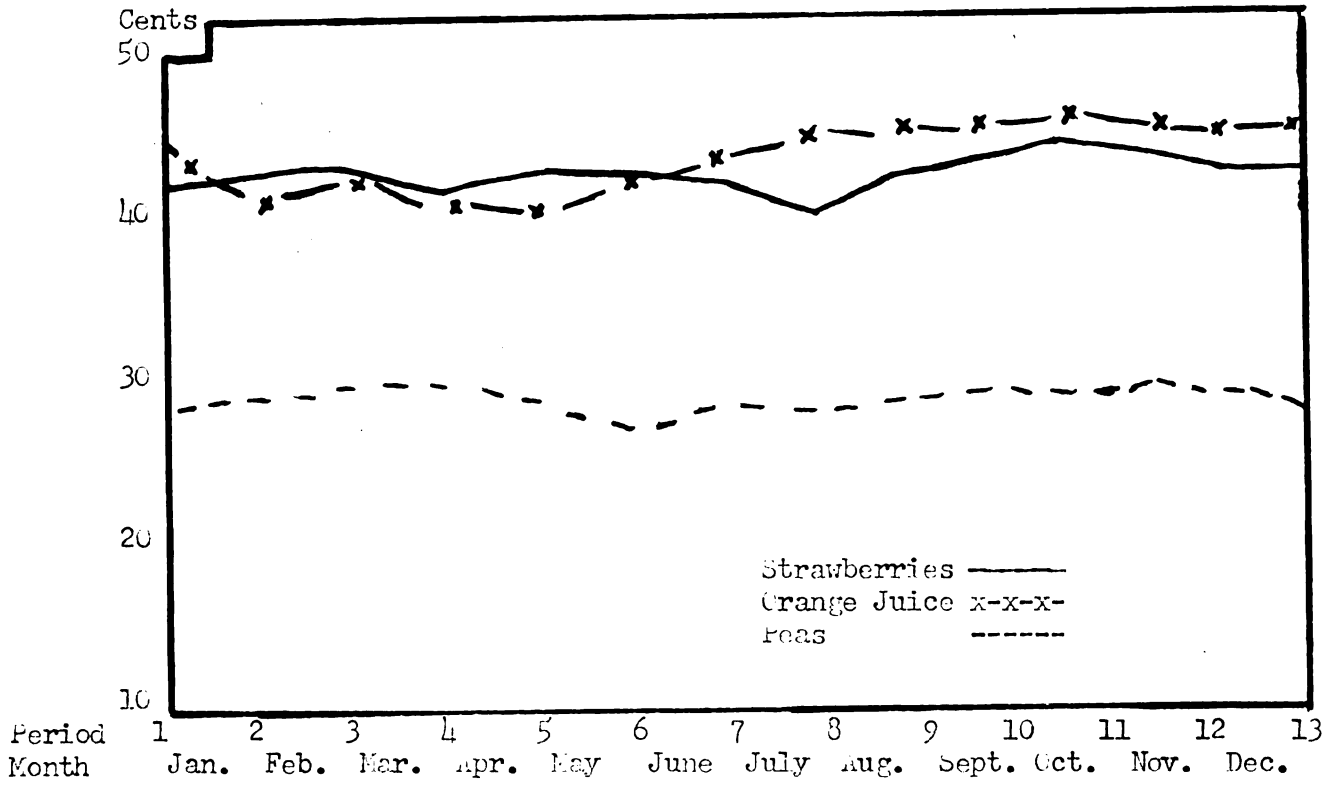
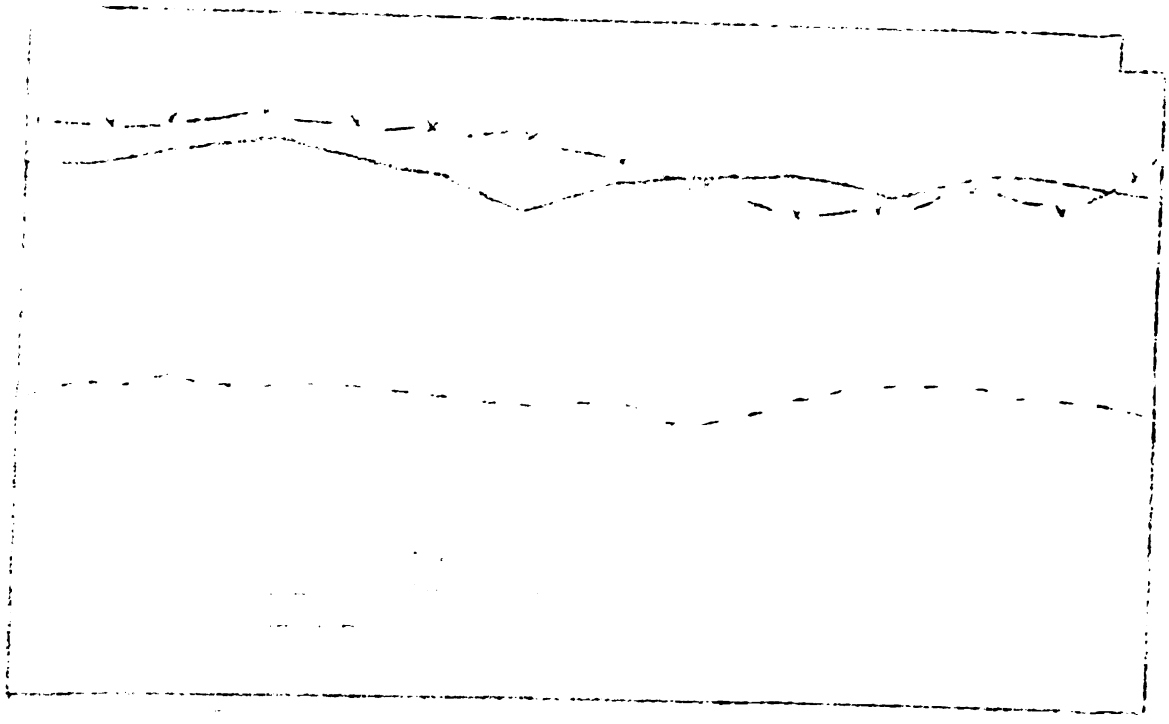


Figure VIII. Prices Paid per Pound, Frozen Peas, Strawberries and Orange Juice, Averaged by Four-Week Periods 1953-1955, Michigan State University Consumer Panel.

paid for frozen orange juices appear to increase during the latter half of the year, thus the seasonal pattern of expenditures previously illustrated for frozen orange juice may not be entirely indicative of the movement into consumption throughout the year. It does not appear that variations in prices paid for frozen peas or frozen strawberries follow a consistent pattern, nor that price could be considered as a major factor in explaining seasonal variations in consumer expenditures for these items.



Price Relationship, Fresh, Frozen, and Canned Fruits and Vegetables

The objective of this portion of the study is to compare the prices paid by panel consumers for fresh, frozen, and canned fruits and vegetables on a fresh weight basis.

It is a controversial question in the minds of many consumers whether the particular advantages of frozen products are more than offset by the cost of the services required in marketing fruits and vegetables in the frozen form. In a consumer survey made by "Quick Frozen Foods" in 1953, 36 out of 100 non-buyers of frozen foods gave high prices as the reason for not buying.[4] Since commencing this study, several comments have been made to the author that it was felt frozen fruits and vegetables were too expensive as compared to fresh and canned produce. Thomson[5] made the following observation regarding frozen food prices:

> In view of the advantages, many of which tend to reduce the cost of frozen compared with fresh fruits and vegetables, it may be wondered why many consumers find that frozen fruits and vegetables are the more expensive to use. The reason is partly to be found in the costs of processing, freezing, and holding at low temperatures throughout the marketing system. These costs offset some or all of the savings referred to above. However, another reason is the comparatively small volume of business in frozen foods to date, the fact that they have been looked upon by many dealers as specialty items warranting a comparatively high mark-up.

Several possible sources of error exist in comparing fresh, frozen and canned prices through conversion of per capita quantities

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[4] Quick Frozen Foods, New York, Vol. 16, No. 5, p. 44.

[5] Thomsen, op. cit., p. 143.

purchased to a fresh basis. Quality is not considered. Consumers report quantities in physical terms which are standardized into pounds. Although conversion to pounds is done on as objective a basis as possible, inexact measurements and reporting errors may be present in certain instances.

Conversion factors as published by the Production and Marketing Administration, United States Department of Agriculture, were used.[6,7] It is pointed out in this publication that relationships between fresh and processed weights for most commodities vary widely from season to season and between localities. Conversion factors represent average relationships for all producing areas.

Table 8 contains the average prices paid per pound for particular fresh, frozen, and canned fruits and vegetables as reported by families of the Michigan State University Consumer Panel, 1953 to 1955. For the frozen and canned products both actual prices and prices of the fresh equivalent are given.

For most vegetables, canned and frozen prices were quite similar when compared on a fresh weight basis although considerable variation appeared to exist in the relative values of frozen and canned products from one vegetable to another. The prices of the fresh equivalent for frozen peas and corn were slightly less than that of the canned

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[6] Conversion Factors and Weights and Measures for Agricultural Commodities and Their Products, Production and Marketing Administration, United States Department of Agriculture, May, 1952.

[7] See Table 35 in Appendix B for summary of conversion factors used.

TABLE 3

AVERAGE PRICE PER POUND, FRESH, FROZEN, AND CANNED FRUITS AND VEGETABLES, ACTUAL AND ADJUSTED TO FRESH EQUIVALENT* MICHIGAN STATE UNIVERSITY CONSUMER PANEL 1953-1955

Commodity	Fresh	Frozen		Canned	
		Price Frozen Weight	Price Fresh Equivalent	Price Canned Weight	Price Fresh Equivalent
Peas	17.1	29.7	26.4	18.4	27.5
Broccoli	25.2	37.7	21.1	-	-
Snap beans	15.7	36.2	23.6	20.2	27.5
Lima beans	20.1	38.3	34.9	18.1	26.2
Corn	3.3	17.3	6.3	29.9	7.2
Cauliflower	25.9	40.2	12.1	-	-
Squash	7.4	23.6	15.3	-	-
Spinach	29.5	26.7	14.7	16.2	14.0
Asparagus	21.3	53.0	26.5	31.2	23.7
Strawberries	36.2	42.6	52.6	-	-
Sour cherries	19.3	22.4	20.9	23.3	22.5
Oranges and Orange Juice	3.9	42.6	5.9	11.6	6.1

*Calculated from total per capita quantities purchased and per capita expenditures made. Quantities adjusted to a fresh equivalent basis using conversion factors published in Conversion Factors and Weights and Measures for Agricultural Commodities and Their Products, Production and Marketing Administration, United States Department of Agriculture, Washington, D. C., May, 1952.

products. The reverse was true for snap beans, asparagus and lima beans. For the latter vegetable, the price of the fresh equivalent for frozen appeared considerably higher than that of canned.

A comparison of fresh and frozen vegetable prices revealed considerable variation from commodity to commodity. This might be expected due to different degrees of perishability existing with the fresh produce and differences in transportation, handling and other marketing charges from one fresh vegetable to another. Frozen prices on a fresh weight basis were considerably below fresh prices for broccoli, cauliflower and spinach but above for peas, snap beans, lima beans, corn, squash, and asparagus. It is noted, however, that frozen prices were averaged from quantities purchased and expenditures made for commodities available the year round while for the most part, consumer purchases of fresh produce are made only during a limited fresh production period.

A direct comparison of the fresh weight equivalent of fruits on a value basis is difficult. The frozen weight of strawberries includes sugar at a rate of generally around 3 fruit to 1 sugar and of cherries approximately 4 to 1. Canned fruit products may vary greatly as to actual fruit content and method of preservation.

Averaged over the three year period, it appeared that frozen strawberries on a fresh weight basis cost approximately one-fifth more than the fresh commodity. In the eyes of the frozen strawberry consumer, this is the amount paid for convenience, availability throughout the year and other desirable features of the frozen product.

Converted to fresh equivalent, the price of frozen orange juice appeared slightly less than that of the canned product. The average price of fresh oranges appeared less than either of the processed products. However, this latter relationship may be considerably in error as fresh orange purchases were reported in numbers and the size factor was not taken into consideration in conversion to pounds.

Although the price comparisons outlined above must be interpreted broadly because of quality variations and possible reporting and conversion errors, for the most part frozen prices appeared to compare favorably with canned prices on a fresh weight basis. As previously mentioned, a comparison of frozen and fresh prices is extremely difficult to evaluate. Reporting and conversion errors may be large for fresh produce. Seasonality of production, degree of perishability and geographical dispersion of production are factors that influence fresh prices. In addition, as indicated by the seasonal pattern of expenditures for frozen fruits and vegetables, the frozen products are competitive with the vast array of fresh fruits and vegetables available through the fresh production period.

In summary, it has been indicated in this chapter that the proportion of the consumer's fruit and vegetable dollar spent on the various frozen items is not large. For only frozen orange juice did expenditures for a frozen item exceed expenditures for a comparative canned form. It is suggested that most frozen products have yet to achieve the consumer recognition accorded the corresponding canned products.

Quality and price are presumably the major factors influencing consumer choice. It is generally accepted that the preservation of fresh qualities is an attribute of frozen fruits and vegetables superior to that of the canned products and that a comparison on a quality basis favors the former. Thus, if the price comparisons shown in Table 8 are valid, it would appear that many frozen products merit a larger share of the consumer market for fruits and vegetables than is indicated in this study.

CHAPTER IV

VARIATIONS IN EXPENDITURES AMONG FAMILIES

Introduction

The very rapid rise in the commercial production of frozen fruits and vegetables reflects widespread consumer acceptance. Yet, both in the aggregate and for many individual commodities, the frozen form has attained a relatively small share of the total fruit and vegetable market.

Two basic conditions, related to family purchase patterns, may exist resulting in a given product or product form commanding only a small portion of the potential market. Either comparatively few families in the population are consumers of the product or families may make only spasmodic or occasional purchases. For food products other than staples it can safely be said that both these conditions would exist to a greater or less degree. In particular, they may be more in evidence for products such as frozen fruits and vegetables which have been widely available for consumer selection only a short period of time.

It is the objective of this portion of the study to point out the distribution of expenditures for frozen fruits and vegetables among the families of the Michigan State University Consumer Panel. The

data used were based upon reports from all panel families reporting 40 weeks or more in each of the years 1953 and 1954.[1]

Percentage of Families buying. Table 9 discloses that in each of the years 1953 and 1954 over 10 percent of the sample families made no expenditures for either frozen fruits or frozen vegetables. Similarly over 15 percent of the families were non-purchasers of frozen fruit juices.

An intra-commodity comparison between the percentage of families buying fresh, frozen, and canned products provided an indication of the competitive relationships existing between the different product forms. For most fruits and vegetables, the consumer is faced with a choice of fresh or frozen produce throughout the fresh production periods. Frozen and canned products are competitive throughout the year. A high proportion of families buying a given product in the fresh or canned form with few families choosing the frozen product indicates that the latter has not been as widely accepted as it might be.

Approximately 60 percent of all the sample families purchased frozen peas in each of the two years considered. In this respect, the popularity of frozen peas far exceeded that of any other frozen product. However, in comparison to the 90 percent of the families who purchased the canned product, there were many consumers of peas who had not

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[1] Two hundred and ten families in 1953 and 215 families in 1954 reported 40 weeks or more. Per capita expenditures for families reporting less than a full year were adjusted to a 52 week level.

TABLE 9

PERCENTAGE OF FAMILIES BUYING FRESH, FROZEN AND CANNED FRUITS AND VEGETABLES*
MICHIGAN STATE UNIVERSITY CONSUMER PANEL
1953-1954

	Fresh		Frozen		Canned	
	1953	1954	1953	1954	1953	1954
All fruits and vegetables	--	--	88.5	87.6	--	--
Peas	15.2	10.2	59.5	60.8	90.0	91.1
Broccoli	29.1	31.9	35.7	37.8	--	--
Squash	63.8	59.7	27.6	32.4	--	--
Snap beans	41.9	44.4	30.0	28.1	75.7	73.2
Lima beans	10.5	6.9	29.5	27.6	60.0	57.4
Cauliflower	59.5	56.9	25.7	26.4	--	--
Corn	76.2	80.1	24.8	23.5	88.6	90.3
Spinach	33.3	27.8	23.8	21.2	39.5	40.3
Asparagus	58.6	54.6	14.3	18.5	45.7	44.0
Strawberries	82.4	70.0	67.6	66.8	31.3	37.7
Raspberries	58.6	55.3	14.3	10.6	20.0	31.6
Sour cherries	15.7	9.3	10.0	10.1	42.3	46.9
Peaches	88.6	86.5	8.1	4.6	56.2	56.8
Oranges and orange juice	94.8	93.6	73.3	76.5	41.3	52.6
All fruit juices	--	--	84.6	83.4	87.1	87.9

*Based on all families reporting 40 weeks or more in each year, Michigan State University Consumer Panel.

selected the frozen product at least once during the year. On the other hand, it is apparent that there were many families who were consumers of both the canned and frozen products to at least some degree.

Using percentage of families buying as a criteria of consumer acceptance, frozen corn was not nearly as widely accepted as the fresh and canned products. Less than 25 percent of the families in each year purchased frozen corn as compared to approximately 80 percent purchasing fresh and 90 percent choosing the canned product.

Broccoli is the only vegetable for which more families bought the frozen product than any other form. The 35 percent of all families buying frozen broccoli exceeded the proportion buying the fresh product. No other frozen vegetable was purchased by more than 30 percent of the families in either of the two years.

Frozen strawberries were the most widely accepted by panel families of all the frozen fruits. Frozen raspberries, sour cherries and peaches have met with only limited consumer acceptance with few families selecting these products throughout the year.

Approximately 75 percent of all families in each year purchased frozen orange juice. In view of the fact that this product has only been available for a few years, its widespread acceptance is remarkable. However, as nearly 95 percent of all families were buyers of fresh oranges there were many fresh orange-consuming families who were not yet consuming frozen orange juice.

Family expenditure patterns. In this and succeeding parts of this study, expenditures for frozen fruits and vegetables have been aggregated and analyzed separately from expenditures for frozen orange juices. For the purpose of evaluating inter-family expenditures it was believed that these two classes of frozen products are considered differently by consumers. Thus, influences underlying family expenditure patterns may differ to a certain extent. It is beyond the scope of this study and in many instances beyond that of the data to pursue this analysis on an individual commodity basis. For the purposes of this portion of the study, it is assumed that similarities existed with respect to consumer acceptance for the various frozen fruits and vegetables such that expenditures for these could be aggregated.

In Table 10, per capita expenditures for frozen fruits and vegetables and for frozen fruit juices have been broken down into six groups. For each group is indicated the percentage of reporting families and percentage of total expenditures made by families in each group. It is apparent from this table that considerable variation existed among families in acceptance of the frozen products. For both frozen fruits and vegetables and frozen fruit juices a large proportion of total expenditures is made by a relatively small proportion of all families.

In both 1953 and 1954 almost 65 percent of all frozen fruits and vegetables were purchased by less than 25 percent of the families. At the other extreme, approximately 40 percent of the families made but 7 percent of all expenditures in 1953 and 6 percent in 1954.

TABLE 10

PERCENTAGE OF FAMILIES BUYING AND PERCENTAGE OF ANNUAL EXPENDITURES CLASSIFIED ACCORDING TO FAMILY PER CAPITA EXPENDITURES MICHIGAN STATE UNIVERSITY CONSUMER PANEL 1953-1954

A

Expenditures (dollars)	Frozen Fruits and Vegetables			
	Percentage of Families Buying		Percentage of Annual Expenditures	
	1953	1954	1953	1954
over 5.00	9.7	12.4	37.2	41.2
3 to 4.99	13.9	12.4	25.6	23.1
2 to 2.99	14.5	13.6	17.1	15.6
1 to 1.99	19.4	31.3	13.1	14.1
.01 to .99	30.9	27.8	7.0	6.0
0	11.5	12.4	0	0
	100.0	100.0	100.0	100.0

B

	Frozen Fruit Juices			
	Percentage of Families Buying		Percentage of Annual Expenditures	
	1953	1954	1953	1954
over 5.00	18.3	19.0	62.2	62.3
3 to 4.99	14.2	12.4	17.9	17.6
2 to 2.99	13.6	12.4	10.5	10.6
1 to 1.99	13.0	12.4	6.4	6.1
.01 to .99	25.5	27.2	3.0	3.4
0	15.4	16.6	0	0
	100.0	100.0	100.0	100.0

*Families reporting 40 weeks or more in each year, Michigan State University Consumer Panel.

For frozen fruit juices the distribution of expenditures was even more diverse. Approximately 32 percent of the families made 80 percent of the expenditures in both years. On the other hand, but 3 percent of all expenditures were accounted for by over 40 percent of the families.

The average family per capita expenditure for frozen fruits and vegetables was $2.26 in 1953 and $2.18 in 1954. For frozen fruit juices the corresponding values were $3.15 and $3.04. In 1953 the peak family per capita expenditures were $16.81 for fruits and vegetables and $38.80 for fruit juices. In 1954 corresponding maximum family per capita expenditures were $13.72 and $31.81.[2]

As an indication of the stability of consumer purchases from year to year, a comparison was made between per capita expenditures of the sample families in 1953 with the per capita expenditures of the same families in 1954. One hundred and sixty-nine families of the consumer panel reporting 40 weeks or more for the two consecutive years served as the basis for this comparison.

As shown in Table 11, the top 9.7 percent of the families making 37.2 percent of all expenditures in 1953 made 30.6 percent in the following year. At the opposite extreme the 11.5 percent of the families who were non-purchasers in 1953 accounted for only 1.8 percent of all expenditures in 1954.

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[2] In statistical terms, an indication of the wide variance in family per capita expenditures is given by a standard deviation of 2.41 from the mean for frozen fruits and vegetables and 4.16 for frozen fruit juices in 1954.

TABLE 11

COMPARISON OF FAMILY EXPENDITURES IN 1953 WITH EXPENDITURES FOR THE SAME FAMILIES IN 1954 CLASSIFIED ACCORDING TO PER CAPITA EXPENDITURES IN 1953*

Per Capita Expenditures 1953 (dollars)	A Frozen Fruits and Vegetables Percent Families 1953	Percent Expenditures 1953	Percent Expenditures 1954
Over 5.00	9.7	37.2	30.6
3.00 to 4.99	13.9	25.6	23.2
2.00 to 2.99	14.5	17.1	19.2
1.00 to 1.99	19.4	13.1	13.8
.01 to .99	30.9	7.0	11.4
0	11.5	0	1.8
	100.0	100.0	100.0
	B Frozen Fruit Juices Percent Families 1953	Percent Expenditures 1953	Percent Expenditures 1954
Over 5.00	18.3	62.2	61.7
3.00 to 4.99	14.2	17.9	13.7
2.00 to 2.99	13.6	10.5	8.3
1.00 to 1.99	13.0	6.4	8.0
.01 to .99	25.5	3.0	6.6
0	15.4	0	1.7
	100.0	100.0	100.0

*Based on all families reporting 40 weeks or more in both 1953 and 1954. Michigan State University Consumer Panel.

For frozen fruit juices, the corresponding percentages indicated that year to year family expenditures are even more consistent than for frozen fruits and vegetables. The same 18.3 percent of the families accounting for 62.2 percent of all expenditures in 1953 made 61.3 percent of the total in 1953. The 15.4 percent of the families who were non-consumers in 1953 accounted for only 1.7 percent of all expenditures in 1954.[3]

The analyses contained in this chapter suggest that a potential market exists for both frozen fruits and vegetables and frozen fruit juices. Many of the sample families were non-users or made small annual expenditures for the frozen products. A high proportion of all expenditures was made by a minority of the families indicating the existence of an untapped market. In addition, for most individual commodities, fewer families bought the frozen products in the years considered than bought the competitive canned or fresh counterparts.

Yet, the apparent stability of consumer expenditures for both frozen fruits and vegetables and frozen fruit juices implies that, at least over the two years considered, consumer attitudes towards the frozen products remained relatively fixed. In view of the widely divergent expenditure patterns among families outlined in this chapter, it can be concluded that there are motivating factors involved which strongly influence consumer selection of the various frozen items.

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[3] Simple correlation between per capita expenditures in 1953 and per capita expenditures for the same families in 1954 yielded an R^2 of .69 for frozen fruits and vegetables and an R^2 of .80 for frozen fruit juices.

CHAPTER V

ANALYSIS OF FACTORS RELATED TO PER CAPITA EXPENDITURES FOR FROZEN FRUITS AND VEGETABLES AND FRUIT JUICES

Introduction

An indication of the variance which existed among families in expenditures for frozen fruits and vegetables and fruit juices gives rise to the question of who buy and why. This part of this study represents an attempt to cast some light on the first part of this question.

Brunk points out that:[1]

> The knowledge that consumers react in a given way can greatly contribute to the effectiveness of our marketing mechanism and mean dollars in the pockets of marketing agencies and growers as well as greater customer satisfaction. The necessity for identification of a customer is one of the first problems that confronts a researcher in observing purchases in a store.

Material collected from the Consumer Panel furnishes no data for the analysis of buying motivations or the effect on behavior of information or misinformation about frozen products. No direct knowledge is provided as to why there are non-purchasers nor why a given product or group of products is but occasionally purchased. It is possible through panel data however, to make a distinction among

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[1] Brunk, Max E., "Discussion of Research on Consumer Behavior and Preferences." A Report of the Marketing Research Workshop, Michigan State College, July 1951, p. 39.

families or households on the basis of certain socio-economic variables which may both directly and indirectly influence consumer choice.

The factors considered in this study as influencing family per capita expenditures were: 1) Family income; 2) Size of family; 3) Age of homemaker, and 4) Education of homemaker. For frozen fruits and vegetables the factor of whether or not the homemaker was employed outside the home was also considered.

The analysis was based on the per capita expenditures and socio-economic characteristics of 210 families reporting 40 weeks or more in the Consumer Panel in 1954.[2]

Methods of Analysis

Preliminary examination of the data revealed that the pattern of expenditures among families for frozen fruits and vegetables differed considerably from that of frozen fruit juices. These two groups were analyzed separately.

As a means of analyzing the data, the primary method used was that of tabular analysis. For both frozen fruits and vegetables and frozen fruit juice a least squares multiple regression equation was also considered in relating family characteristics to per capita expenditures.

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[2] All family per capita expenditures were adjusted to a 52 week level. Although 216 families reported 40 weeks or more in 1954, for 6 families income was not reported.

In order to ascertain if the variations in expenditures as associated with changes in family characteristics were significant, they were tested statistically. The customary procedure in tabular analysis is to test relationships between averages by means of analysis of variance. This assumes that observations being tested have been drawn from a normal distribution. For both frozen fruits and vegetables and frozen fruit juices, a significant proportion of the families made no expenditures. Thus, in order that inferences might be made without any assumptions as to the form of distribution of family expenditures, the non-parametric or distribution free chi-square test was used.[3] This test necessitated the use of frequencies, thus all tabular presentation contains the frequency of families in each category rather than averages. As this method is relatively wasteful of data, a restriction was imposed on the refinement of the tabular analysis.

Marked interrelationships existed among the factors considered as influencing family per capita expenditures. Table 12 shows the simple coefficients of correlation between these variables. Because of these interrelationships, in certain instances tabular analysis may lead to erroneous conclusions concerning the relative effects of each variable. This may be partly overcome by two or three-way classifications holding one or more variables constant at different levels. However, the limitations imposed by the scope and nature of the data restricted this desired refinement in tabular form.

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[3]For description of chi-square test see Appendix C.

TABLE 12

COEFFICIENTS OF SIMPLE CORRELATION BETWEEN FAMILY CHARACTERISTICS*

Family Characteristics	Family Income	Size of Family	Age of Homemaker
	r	r	r
Family income	---	.3779	-.4744
Size of family	.3779	---	-.6298
Age of homemaker	-.4744	-.6298	---
Education of homemaker	.5926	.2890	-.3672

* All families reporting 40 weeks or more, Michigan State University Consumer Panel, 1954.

Class breakdowns of expenditures, family income, size of family, age and education of homemaker were made with the objective of maintaining sub-samples as large as possible. For expenditures, only two classifications were considered. That is, those families making expenditures of over $1.50 and those less than $1.50 per person.

For each family characteristic considered, a one-way table is presented indicating the relationship of that variable to per capita expenditures. A two-way table with an interrelated variable held relatively constant is also presented for each factor considered.

Frozen Fruits and Vegetables

Family Income. Family income was broken down into three classifications, over $5,600, from $4,400 to $5,599 and $4,399 and under. As shown in Table 13A, more families in the highest income group tended to make larger per capita expenditures for frozen fruits and vegetables than did families in the medium and lower family income groups. It is

TABLE 13

A. NUMBER AND PERCENTAGE OF FAMILIES MAKING EXPENDITURES OVER AND UNDER $1.50 PER PERSON FOR FROZEN FRUITS AND VEGETABLES GROUPED ACCORDING TO FAMILY INCOME

Per Capita Expenditure	Family Income: $5,600 and Over Number	Percent	$4,400 to $5,599 Number	Percent	$4,399 and Under Number	Percent
Over $1.50*	40	57.1	26	38.8	34	46.6
Under $1.50	30	42.9	41	61.2	39	53.4
Total	70	100.0	67	100.0	73	100.0

*Significant at the 10 percent level of chi-square.

B. NUMBER AND PERCENTAGE OF FAMILIES MAKING EXPENDITURES OVER AND UNDER $1.50 PER PERSON FOR FROZEN FRUITS AND VEGETABLES GROUPED ACCORDING TO FAMILY INCOME WITH SIZE OF FAMILY HELD CONSTANT AT TWO LEVELS

Size of Family	Per Capita Expenditure	Family Income: $5,600 and Over Number	Percent	$4,400 to $5,599 Number	Percent	$4,399 and Under Number	Percent
3 and under	Over $1.50*	20	69.0	12	46.2	31	50.8
3 and under	Under $1.50	9	31.0	14	53.8	30	49.2
Over 3	Over $1.50*	20	48.8	14	34.1	3	25.0
Over 3	Under $1.50	21	51.2	27	65.9	9	75.0

*Not significant at the 10 percent level of chi-square.

significant to note that there appears to be little difference in the expenditure patterns of the two lower income groups. Indications are that significant differences in expenditures for frozen fruits and vegetables occurred only at an upper income level.

The income effect on per capita expenditures holding size of family constant at two levels is examined in Table 13B. As family income is positively correlated with size of family ($r = .3779$) the income-expenditure relationship is modified considerably. Only between the upper and medium income groups for the larger sized families did there appear to be a significant difference in family expenditure patterns.

Size of family. A negative relationship existed between size of family and per capita expenditures for frozen fruits and vegetables. As shown in Table 14A, many more families of three persons or less made greater per capita expenditures than did the larger sized families. With family income held relatively constant as in Table 14B, this relationship became less evident but is still fairly significant for both the upper and lower income groups. However, it should be mentioned that the lower income group contained a number of retired or low income one-person families who undoubtedly influenced the association revealed within this group.

Age of housewife. Contrary to the generally held opinion that younger housewives have accepted frozen fruits and vegetables to a greater extent than older housewives, it was indicated in this sample that the

TABLE 14

A. NUMBER AND PERCENTAGE OF FAMILIES MAKING EXPENDITURES OVER AND UNDER $1.50 PER PERSON FOR FROZEN FRUITS AND VEGETABLES GROUPED ACCORDING TO SIZE OF FAMILY

Per Capita Expenditures	Size of Family: 3 and Under Number	3 and Under Percent	Over 3 Number	Over 3 Percent
Over $1.50*	63	54.3	37	39.4
Under $1.50	53	45.7	57	60.6
Total	116	100.0	94	100.0

*Significant at the 5 percent level of chi-square.

B. NUMBER AND PERCENTAGE OF FAMILIES MAKING EXPENDITURES OVER AND UNDER $1.50 PER PERSON FOR FROZEN FRUITS AND VEGETABLES GROUPED ACCORDING TO SIZE OF FAMILY WITHIN FAMILY INCOME GROUPS

Family Income	Per Capita Expenditures	Size of Family: 3 and Under Number	3 and Under Percent	Over 3 Number	Over 3 Percent
$5,600 and Over	Over $1.50*	20	69.0	20	48.8
	Under $1.50	9	31.0	21	51.2
$4,400 to $5,599	Over $1.50**	12	46.2	14	34.1
	Under $1.50	14	53.8	27	65.9
$4,399 and Under	Over $1.50*	31	50.8	3	25.0
	Under $1.50	30	49.2	9	75.0

*Significant at the 10 percent level of chi-square.
**Not significant at the 10 percent level of chi-square.

reverse is true. Significantly more of the older homemakers appeared to make larger expenditures for the frozen product than did younger homemakers. However, the age of the homemaker was highly correlated with family income (r = .4764) and size of family (r = -.6298). Thus, it can be assumed that holding these variables constant would considerably modify the difference in age groups. This hypothesis could not be tested satisfactorily. The limited number of observations prevented holding two variables constant at different levels. However, as per capita income is a composite of family income and size of family, the age of the homemaker groups were tested with this variable held constant at three different levels.

Partially removing the effect of income and size of family modified the difference in expenditures between age groups. In the lower per capita income group, there appeared to be a difference in the expenditure patterns of the two age groups. A partial explanation of this relationship arises from the fact that this group contained a number of single, low income homemakers whose purchase patterns may have differed considerably from other families.

Education of homemaker. The education of the homemaker was not found to be associated with family expenditure patterns for frozen fruits and vegetables. As shown in Table 16, variations did exist, but as education was positively correlated with family income (r = .5926) it can be concluded that these variations were those associated with variations in family income.

TABLE 15

A. NUMBER AND PERCENTAGE OF FAMILIES MAKING EXPENDITURES OVER AND UNDER $1.50 PER PERSON FOR FROZEN FRUITS AND VEGETABLES GROUPED ACCORDING TO AGE OF HOMEMAKER

Per Capita Expenditures	Age of Housewife: Over 25 Number	Over 25 Percent	Under 45 Number	Under 45 Percent
Over $1.50*	60	55.0	40	39.6
Under $1.50	49	45.0	61	60.4
Total	109	100.0	101	100.0

*Significant at the 5 percent level of chi-square.

B. NUMBER AND PERCENTAGE OF FAMILIES MAKING EXPENDITURES OVER AND UNDER $1.50 PER PERSON FOR FROZEN FRUITS AND VEGETABLES GROUPED ACCORDING TO AGE OF HOMEMAKER WITHIN PER CAPITA INCOME GROUPS

Per Capita Income	Per Capita Expenditures	Age of Housewife: Over 45 Number	Over 45 Percent	Under 45 Number	Under 45 Percent
Under $1,200	Over $1.50*	10	50.0	13	26.5
	Under $1.50	10	50.0	36	73.5
$1,200 to $1,800	Over $1.50**	16	47.1	17	45.9
	Under $1.50	18	52.9	20	54.1
Over $1,800	Over $1.50**	34	61.8	10	66.7
	Under $1.50	21	38.2	5	33.3

*Significant at the 10 percent level of chi-square.
**Not significant at the 10 percent level of chi-square.

TABLE 16

NUMBER AND PERCENTAGE OF FAMILIES MAKING EXPENDITURES OVER AND UNDER $1.50 PER PERSON FOR FROZEN FRUITS AND VEGETABLES GROUPED ACCORDING TO EDUCATION OF HOMEMAKER

Per Capita Expenditures	Education of Homemaker (Years)					
	Over 12		12		Under 12	
	Number	Percent	Number	Percent	Number	Percent
Over $1.50*	28	57.1	40	45.5	32	43.8
Under $1.50	21	42.9	48	54.5	41	56.2
Total	49	100.0	88	100.0	73	100.0

*Not significant at the 10 percent level of chi-square.

TABLE 17

NUMBER AND PERCENTAGE OF FAMILIES MAKING EXPENDITURES OVER AND UNDER $1.50 PER PERSON FOR FROZEN FRUITS AND VEGETABLES GROUPED ACCORDING TO OCCUPATION OF HOMEMAKER

Per Capita Expenditures	Homemaker Not Working At Outside Employment		Homemaker Working At Outside Employment	
	Number	Percent	Number	Percent
Over $1.50*	75	44.6	25	59.5
Under $1.50	93	55.4	17	40.5
Total	168	100.0	42	100.0

*Significant at the 7 percent level of chi-square.

Occupation of homemaker. The statement has frequently been made that the convenience of frozen fruits and vegetables has resulted in the utilization of this product form by homemakers employed outside the home. The breakdown of families according to per capita expenditures and employment of the homemaker substantiated this statement to a certain extent. Proportionately, significantly more families with the homemaker employed outside the home made larger expenditures for frozen fruits and vegetables. However, the families in this category were of both a smaller size and had a higher family income than the average. Thus, the effect of this variable was difficult to isolate. The small number of families in the sample with homemakers working at outside employment prevented any further breakdown within income or size of family groups to more completely analyze this factor.

Least squares multiple regression analysis.[4,5] The effects of the various factors were considered in the form of a least squares regression analysis of the linear form $Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4$ where:

Y = per capita expenditure for frozen fruits and vegetables in 1954
x_1 = average family income in 1954
x_2 = average size of family in 1954
x_3 = average age of homemaker in 1954
x_4 = education of homemaker

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[4] Least squares regression analysis in this instance has limitations such that the accuracy of the results might be questioned. A normal distribution of the dependent variable was assumed. No examination was made of the data to evaluate other conditions under which the regression coefficients might be biased. A linear relationship between the dependent and independent variables was assumed.

[5] See Table 36 in Appendix D for summary of correlation results.

Of the regression coefficients calculated only those of the size of family and family income differed significantly from zero. The other variables were dropped from the analysis and an equation with only family income and size of family as independent variables was calculated. This equation yielded a coefficient of determination of .135 suggesting that 13.5 percent of the variations in per capita expenditures for frozen fruits and vegetables about the mean was explained by these two variables. The form of the equation was $X_1 = a + .0026X_2 - .7477X_3$ suggesting that for every $100 increase in family income, an increase of 26 cents in per capita expenditures would be expected. Similarly, for every unit increase in size of family, on the average a decrease of 75 cents would be expected.

Frozen Fruit Juices

Family income. Table 18A shows that, at the upper income level, proportionately more families made larger per capita expenditures for frozen fruit juices. As with frozen fruits and vegetables, there did not appear to be a great deal of difference between the expenditure patterns of the two lower income groups, indicating that above a certain income level families tended to make larger per capita expenditures.

Partially holding size of family constant did not alter the income-expenditure relationship to any great extent. As shown in Table 18B, a significant income effect existed within both size of family groups.

TABLE 13

A. NUMBER AND PERCENTAGE OF FAMILIES MAKING EXPENDITURES OVER AND UNDER $1.50 PER PERSON FOR FROZEN FRUIT JUICES GROUPED ACCORDING TO FAMILY INCOME

Per Capita Expenditures	Family Income: $5,600 and Over Number	Percent	$4,400 to $5,599 Number	Percent	$4,399 and Under Number	Percent
Over $1.50*	46	65.7	30	44.8	26	35.6
Under $1.50	24	34.3	37	55.2	47	64.4
Total	70	100.0	67	100.0	73	100.0

*Significant at the 5 percent level of chi-square.

B. NUMBER AND PERCENTAGE OF FAMILIES MAKING EXPENDITURES OVER AND UNDER $1.50 PER PERSON FOR FROZEN FRUIT JUICES GROUPED ACCORDING TO FAMILY INCOME WITHIN SIZE OF FAMILY GROUPS

Size of Family	Per Capita Expenditure	Family Income: $5,600 and Over Number	Percent	$4,400 to $5,599 Number	Percent	$4,399 and Under Number	Percent
Under 3	Over $1.50*	13	62.0	9	34.6	24	39.3
	Under $1.50	11	38.0	17	65.4	37	60.7
Over 3	Over $1.50**	28	68.3	21	51.2	2	16.7
	Under $1.50	13	31.7	20	48.8	10	83.3

*Significant at the 5 percent level of chi-square.
**Significant at the 5 percent level of chi-square.

Size of family. Table 19 indicates that there was a tendency for larger families to make greater expenditures for frozen orange juice, although this association was not statistically significant. When family income was partially controlled there was little variance evident between the size of family groups. Indications are that the correlation between income and size of family may have been the major factor responsible for the positive relationship of expenditures and size of family.

Age of homemaker. The age of the homemaker did not appear to be associated in any way with per capita expenditures for frozen fruit juices. For all families, a variation existed indicating that younger homemakers tended to make larger per capita expenditures. However, this was statistically non-significant and tended to disappear when family income was partially controlled.

Education of homemaker. Over all families, there was a direct association between the education of the homemaker and per capita expenditures for frozen fruit juices. As shown in Table 21, the homemakers with more education tended to make larger per capita expenditures. However, similar to previous analyses of other variables, the correlation of this factor with family income was such that within each family income group there did not appear to be any association between per capita expenditures and education of the homemaker.

TABLE 19

A. NUMBER AND PERCENTAGE OF FAMILIES MAKING EXPENDITURES OVER AND UNDER $1.50 PER PERSON FOR FROZEN FRUIT JUICES GROUPED ACCORDING TO SIZE OF FAMILY

Per Capita Expenditures	Size of Family			
	3 and Under		Over 3	
	Number	Percent	Number	Percent
Over $1.50*	51	44.0	51	54.3
Under $1.50	65	56.0	43	45.7
Total	116	100.0	94	100.0

*Not significant at the 10 percent level of chi-square.

B. NUMBER AND PERCENTAGE OF FAMILIES MAKING EXPENDITURES OVER AND UNDER $1.50 PER PERSON FOR FROZEN FRUIT JUICES GROUPED ACCORDING TO SIZE OF FAMILY WITHIN FAMILY INCOME GROUPS

Family Income	Per Capita Expenditures	Size of Family			
		3 and Under		Over 3	
		Number	Percent	Number	Percent
Over $5,600	Over $1.50*	13	62.1	28	68.3
	Under $1.50	11	37.9	13	31.7
$4,400 to $5,599	Over $1.50*	9	34.6	21	51.2
	Under $1.50	17	65.4	20	48.8
$4,399 and Under	Over $1.50*	24	39.3	2	16.7
	Under $1.50	37	60.7	10	83.3

*Not significant at the 10 percent level of chi-square.

TABLE 20

A. NUMBER AND PERCENTAGE OF FAMILIES MAKING EXPENDITURES OVER AND UNDER $1.50 PER PERSON FOR FROZEN FRUIT JUICES GROUPED ACCORDING TO AGE OF HOUSEWIFE

Per Capita Expenditure	Age of Housewife: Over 45 Number	Over 45 Percent	Under 45 Number	Under 45 Percent
Over $1.50*	49	45.0	53	52.5
Under $1.50	60	55.0	48	47.5
Total	109	100.0	101	100.0

*Not significant at the 10 percent level of chi-square.

B. NUMBER AND PERCENTAGE OF FAMILIES MAKING EXPENDITURES OVER AND UNDER $1.50 PER PERSON FOR FROZEN FRUIT JUICES GROUPED ACCORDING TO AGE OF HOUSEWIFE WITHIN FAMILY INCOME GROUPS

Family Income	Per Capita Expenditure	Age of Housewife: Over 45 Number	Over 45 Percent	Under 45 Number	Under 45 Percent
$5,600 and Over	Over $1.50*	23	63.9	23	67.6
	Under $1.50	13	36.1	11	32.4
$4,400 to $5,599	Over $1.50*	8	40.0	24	51.1
	Under $1.50	12	60.0	23	48.9
$4,399 and Under	Over $1.50*	18	34.0	9	45.0
	Under $1.50	35	66.0	11	55.0

*Not significant at the 10 percent level of chi-square.

TABLE 21

A. NUMBER AND PERCENTAGE OF FAMILIES MAKING EXPENDITURES OVER AND UNDER $1.50 PER PERSON FOR FROZEN FRUIT JUICES GROUPED ACCORDING TO EDUCATION OF HOMEMAKER

Per Capita Expenditure	Education of Homemaker (Years)					
	Over 12		12		Under 12	
	Number	Percent	Number	Percent	Number	Percent
Over $1.50*	29	59.2	46	53.5	27	37.0
Under $1.50	20	40.8	40	46.5	46	63.0
Total	49	100.0	86	100.0	73	100.0

*Significant at the 5 percent level of chi-square.

B. NUMBER AND PERCENTAGE OF FAMILIES MAKING EXPENDITURES OVER AND UNDER $1.50 PER PERSON FOR FROZEN FRUIT JUICES GROUPED ACCORDING TO EDUCATION OF HOMEMAKER WITHIN FAMILY INCOME GROUPS

Family Income	Per Capita Expenditure	Education of Homemaker (Years)					
		Over 12		12		Under 12	
		Number	Percent	Number	Percent	Number	Percent
Over $5,600	Over $1.50*	15	71.4	24	63.2	7	63.6
	Under $1.50	6	28.6	14	36.8	4	36.4
$4,400 to $5,599	Over $1.50*	10	62.5	14	51.9	8	33.3
	Under $1.50	6	37.5	13	48.1	16	66.7
$4,399 and Under	Over $1.50*	4	33.3	10	43.5	12	31.6
	Under $1.50	8	66.7	13	56.5	26	68.4

*Not significant at the 10 percent level of chi-square.

Least Squares Multiple Regression Analysis.[6] Least squares regression analysis relating family characteristics to per capita expenditures for frozen fruit juices was considered in a form similar to that for frozen fruits and vegetables.

An equation including the four independent variables; family income, size of family, age of homemaker, and education of homemaker yielded a coefficient of determination of but .02%. None of the regression coefficients differed significantly from zero.[7] Hence, this analysis was of little value in obtaining a measure of the relationships between family characteristics and per capita expenditures for frozen fruit juices.

Summary of the Analyses of Family Characteristics

Family income appeared to be related to per capita expenditures for both frozen fruits and vegetables and frozen fruit juices. In both instances, at the higher income level proportionately more families fell in the upper per capita expenditure classification. For both groups no apparent difference existed between the medium and lower family income levels. Thus, it appears that at a certain fairly high

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[6] See Table 36 in Appendix D for summary of correlation results.

[7] An explanation of the failure of regression analysis to explain variations in consumer expenditures for frozen fruit juices is possibly revealed on examination of the distribution of family per capita expenditures. Approximately 14 percent of the families made no expenditures and 5 percent made per capita expenditures of over $10 with individual families as high as $31 per person.

level of family income, the frozen products are more widely accepted.

The expenditure patterns for frozen fruits and vegetables and frozen fruit juices differed most with respect to size of family. For the former, significantly higher per capita expenditures were found for smaller families, particularly in the highest income group. This relationship was not found for frozen fruit juices. Conversely, a positive relationship between size of family and expenditures was indicated although this was not statistically significant.

Age and Education of homemaker could not be conclusively related to expenditures for either commodity group. Older housewives tended to make larger expenditures for frozen fruits and vegetables but smaller expenditures for frozen fruit juices. Education of homemaker appeared to be directly related to per capita expenditures for both frozen fruits and vegetables and frozen fruit juices. However, these relationships largely disappeared when income was held partially constant.

Least squares regression analysis relating family expenditures to per capita expenditures for frozen fruits and vegetables yielded significant regression coefficients for the variables, family income and size of family. These factors explained 13.5 percent of the variations in per capita expenditures for frozen fruits and vegetables and supported the positive income-expenditure and negative size of family-expenditure relationships revealed by tabular analysis.

Least squares regression analysis was not successful in relating family characteristics to expenditures for frozen fruit juices.

Less than 3 percent of the variations in family expenditures could be explained by the factors considered. None of the regression coefficients in this analysis differed significantly from zero although the results of tabular analysis indicated that family income was directly related to frozen fruit juice expenditures.

CHAPTER VI

SUMMARY AND CONCLUSIONS

This survey of the demand for frozen fruits and vegetables was made with the interrelated objectives: To obtain an indication of the extent of family expenditures for frozen fruits and vegetables, both in the aggregate and for selected individual commodities; to evaluate variations in expenditures for frozen fruits and vegetables among families of the Michigan State University Consumer Panel, and, to indicate any association which might exist between family expenditures and specific socio-economic characteristics of the household.

The primary source of information used in this study was data obtained from the tabulated food records of families constituting the Michigan State University Consumer Panel. Weekly observations on quantities and expenditures were obtained for each family in the sample and aggregated relevant to the analysis made.

As an indication of the growth of the frozen fruit and vegetable industry and of per capita consumption at the national level, a brief survey of secondary data was included in this study.

In 1955, families of the Michigan State University Consumer Panel spent 6.5 percent of their vegetable dollar on frozen vegetables, 4.9 percent of all fruit expenditures for frozen fruits (excluding fruit juices) and 66.4 percent of all fruit juice expenditures for frozen fruit juices.

Averaged over the three years 1953 to 1955, annual consumer purchases of the different frozen products were analyzed according to the percentage they were of expenditures for all fruits and vegetables and the percentage they were of the particular commodity purchased in the frozen form.

Ranked according to percent of all expenditures for frozen fruits and vegetables, frozen orange juice (48.4 percent), frozen strawberries (11.7 percent) and frozen peas (6.2 percent) were easily the most popular of all frozen products. A wide variety of frozen vegetables, other than peas, combined to make up approximately 20 percent of all expenditures for frozen fruits and vegetables. Other frozen fruits and fruit juices made up the remaining small percentage of the total.

Data on the proportion that expenditures for frozen items were of all expenditures for each commodity provided an indication of the competitive relationship between the frozen and other product forms. Frozen orange juice and frozen strawberries compared most favorably in this regard as did the vegetables, broccoli, brussel sprouts, cauliflower, and squash. None of these frozen vegetables had an important competitive counterpart in the canned form, nor is it believed that frozen strawberries are highly competitive with the canned product. Although frozen peas was the most widely purchased frozen vegetable, expenditures for the frozen form were only approximately one-half those for the canned product.

For each of the years 1953 and 1954, an analysis was made of the percentage of families buying the different frozen products. Frozen orange juice, peas, and strawberries were again the leaders in this respect. However, it is significant to note that more families bought fresh oranges and strawberries and canned peas than bought the corresponding frozen products.

Consumer expenditures for both frozen fruits and frozen vegetables followed similar seasonal patterns. Peak expenditures were made in the early months of the year (March-April) followed by a seasonal low through the summer months presumably as a result of substitution by many of the fresh products available in season. The seasonal expenditures for frozen fruit juices followed an opposite pattern with peak expenditures during the summer months.

A wide variation existed among families with regard to annual per capita expenditures for frozen fruits and vegetables and frozen fruit juices. In each of the years 1953 and 1954, almost 65 percent of all expenditures for frozen fruits and vegetables (excluding fruit juices) were made by less than 25 percent of the families. At the other extreme, approximately 40 percent of the families accounted for only 6 to 7 percent of all annual expenditures. For frozen fruit juices, 32 percent of the families made 80 percent of the expenditures. Only 3 percent of all expenditures were accounted for by 40 percent of the families at the other extreme.

A comparison of the per capita expenditures by families in 1953 with the corresponding expenditures by the same families in 1954

revealed that families were consistent in their expenditure patterns for both frozen fruits and vegetables and frozen fruit juices from year to year. Indications were that those families making high per capita expenditures in 1953 made correspondingly high expenditures in 1954 and non-consumers in 1953 remained for the most part non-consumers in 1954.

Families with an annual income of over $5,600 tended to make higher per capita expenditures for both frozen fruits and vegetables and frozen fruit juices than did families with lower incomes. It was indicated that smaller families made higher per capita expenditures for frozen fruits and vegetables. This relationship did not exist for frozen fruit juices. Other socio-economic variables could not be conclusively related to per capita expenditures for either commodity group. However, it is believed that these, as well as many other family attributes, are to a large extent hidden within the income variable.

The period of time over which this survey was conducted was too short to provide indications of trends or of changes in consumption. The data obtained did not yield observations which would indicate intra-commodity substitution over time nor could an appraisal of consumer responses to price changes be made. However, as the Consumer Panel operates over a longer period of time, some worth-while information should be obtained concerning changes in consumer purchase patterns relative to the frozen products. On a commodity basis,

there are indications that consumer demand for certain frozen items merits a more refined analysis than is presented in this study.

The socio-economic characteristics of the family did not make a great contribution towards explaining variations in expenditures among families. It seems reasonable to suggest that broad generalizations might be made concerning the characteristics of the consumer market for frozen fruits and vegetables with respect to family income and size of family and for frozen fruit juices with respect to family income. However, even if a full description of the characteristics of the families who made varied expenditures for the frozen products had been possible, such observations would provide little knowledge of why families are non-users or only occasional purchasers of the frozen items. Underlying these factors are many influences such as tastes, habits, opinions and knowledge. Information on these is beyond the scope of panel data. Yet, the apparent diversity of inter-family expenditure patterns for the frozen products suggests that research in this area might provide information of value to those interested in the market acceptance of frozen fruits and vegetables.

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APPENDICES

APPENDIX A

TABLES SUPPLEMENTARY TO CHAPTER I

TABLE 22

CIVILIAN PER CAPITA CONSUMPTION OF COMMERCIALLY PRODUCED VEGETABLES UNITED STATES 1937-1954*

Year	Total	Fresh		Canned**		Frozen**	
	Pounds	Pounds	Percent Total	Pounds	Percent Total	Pounds	Percent Total
1937	164.9	110.0	67.3	52.9	32.1	1.0	.6
1938	171.5	114.3	66.7	56.3	32.8	.9	.5
1939	175.8	117.2	66.7	57.4	32.6	1.2	.7
1940	180.7	117.4	65.0	61.9	34.2	1.4	.8
1941	182.1	114.4	62.8	66.0	36.3	1.7	.9
1942	193.8	119.6	61.7	71.7	37.0	2.5	1.3
1943	185.2	116.1	63.7	67.5	36.4	1.6	.9
1944	197.9	127.1	64.2	67.0	33.9	3.8	1.9
1945	225.0	138.5	61.6	82.2	36.5	4.3	1.9
1946	229.0	136.8	59.6	88.0	38.4	4.6	2.0
1947	208.6	126.3	60.6	76.4	36.6	5.9	2.8
1948	203.4	128.3	63.1	68.4	33.6	6.7	3.3
1949	197.2	121.1	61.4	69.4	35.2	6.7	3.4
1950	205.9	122.9	59.7	75.7	36.8	7.3	3.5
1951	206.0	119.1	57.8	77.7	37.7	9.2	4.5
1952	206.7	120.2	58.2	75.3	36.4	11.2	5.4
1953	027.3	118.5	57.2	77.2	37.2	11.6	5.6
1954	204.9	117.5	57.3	75.2	36.7	12.2	6.0

*Civilian consumption only after 1941.
**Fresh equivalent.

Source: The Vegetable Situation, Agricultural Marketing Service, U. S. Dept. of Agric., Nov. 29, 1955.

TABLE 23

TOTAL PRODUCTION AND PRODUCTION IN RETAIL AND INSTITUTIONAL SIZED CONTAINERS--FROZEN VEGETABLES, UNITED STATES 1944-1953

Year	Total Production	Retail-size Containers		Institutional Bulk Containers	
	Percent Production 1944 = 100	Percent Production 1944 = 100	Percent Annual Production	Percent Production 1944 = 100	Percent Annual Production
1944	100.0	100.0	43.7	100.0	56.3
1945	129.9	132.3	44.5	128.0	55.5
1946	189.8	245.0	56.5	146.9	43.5
1947	146.0	193.3	57.9	109.3	42.1
1948	188.3	274.4	63.7	121.3	36.3
1949	237.7	350.7	64.5	149.8	35.5
1950	247.6	375.8	66.4	148.0	33.6
1951	324.3	503.7	68.5	181.8	31.5
1952	377.8	573.9	66.4	225.4	33.6
1953	454.1	672.9	64.8	284.0	35.2

Source: The Vegetable Situation, Agricultural Marketing Service, U. S. Dept. of Agric., April. 26, 1955.

TABLE 24

CIVILIAN PER CAPITA CONSUMPTION OF FRESH AND PROCESSED PEAS
UNITED STATES 1937-1954*

Year	Total	Fresh		Canned**		Frozen**	
	Pounds	Pounds	Percent Total	Pounds	Percent Total	Pounds	Percent Total
1937	10.38	2.3	22.16	7.66	73.79	.42	4.05
1938	10.58	2.1	19.85	8.06	76.18	.42	3.97
1939	11.20	2.3	20.54	8.28	73.93	.62	5.53
1940	11.83	2.1	17.76	9.14	77.26	.59	4.98
1941	13.10	2.0	15.27	10.23	78.09	.87	6.64
1942	13.40	1.7	12.68	10.58	78.96	1.12	8.36
1943	12.06	1.6	13.27	9.73	80.67	.73	6.06
1944	12.04	1.7	14.12	8.77	72.84	1.57	13.04
1945	15.13	1.5	9.91	11.89	78.58	1.74	11.51
1946	15.71	1.4	8.91	12.65	80.52	1.66	10.57
1947	13.06	1.1	8.42	9.71	74.35	2.25	17.23
1948	13.06	.9	6.89	9.64	73.81	2.52	19.30
1949	11.72	.8	6.83	8.84	75.43	2.08	17.74
1950	12.13	.7	5.77	9.04	74.53	2.39	19.70
1951	12.18	.5	4.11	8.87	72.82	2.81	23.07
1952	12.22	.5	4.09	8.52	69.72	3.20	26.19
1953	12.08	.4	3.31	8.22	68.05	3.46	28.64
1954	12.43	.4	3.22	8.15	65.57	3.88	31.21

*Civilian consumption only after 1941.
**Fresh equivalent.

Source: The Vegetable Situation, Agricultural Marketing Service, U. S. Dept. of Agric., Nov. 29, 1955.

TABLE 25

CIVILIAN PER CAPITA CONSUMPTION OF FRESH AND FROZEN BROCCOLI UNITED STATES 1937-1954*

Year	Total	Fresh		Frozen**	
	Pounds	Pounds	Percent Total	Pounds	Percent Total
1937	.61	.6	98.36	.01	1.64
1938	.73	.7	95.89	.03	4.11
1939	.83	.8	96.38	.03	3.61
1940	.61	.6	98.36	.01	1.64
1941	.74	.7	94.59	.04	5.41
1942	.64	.6	93.75	.04	6.25
1943	.74	.7	94.59	.04	5.41
1944	1.04	1.0	96.15	.04	3.85
1945	1.01	.9	90.11	.11	10.89
1946	1.17	1.0	85.47	.17	14.53
1947	1.04	.9	86.54	.14	13.46
1948	1.13	.9	79.64	.23	20.36
1949	1.18	.9	76.27	.28	23.73
1950	1.28	1.0	78.12	.28	21.88
1951	1.10	.7	63.64	.40	36.36
1952	1.47	.9	61.22	.57	38.78
1953	1.37	.8	58.39	.57	41.61
1954	1.41	.8	56.74	.61	43.26

*Civilian consumption only after 1941.
**Fresh equivalent.

Source: The Vegetable Situation, Agricultural Marketing Service, U. S. Dept. of Agric., Nov. 29, 1955.

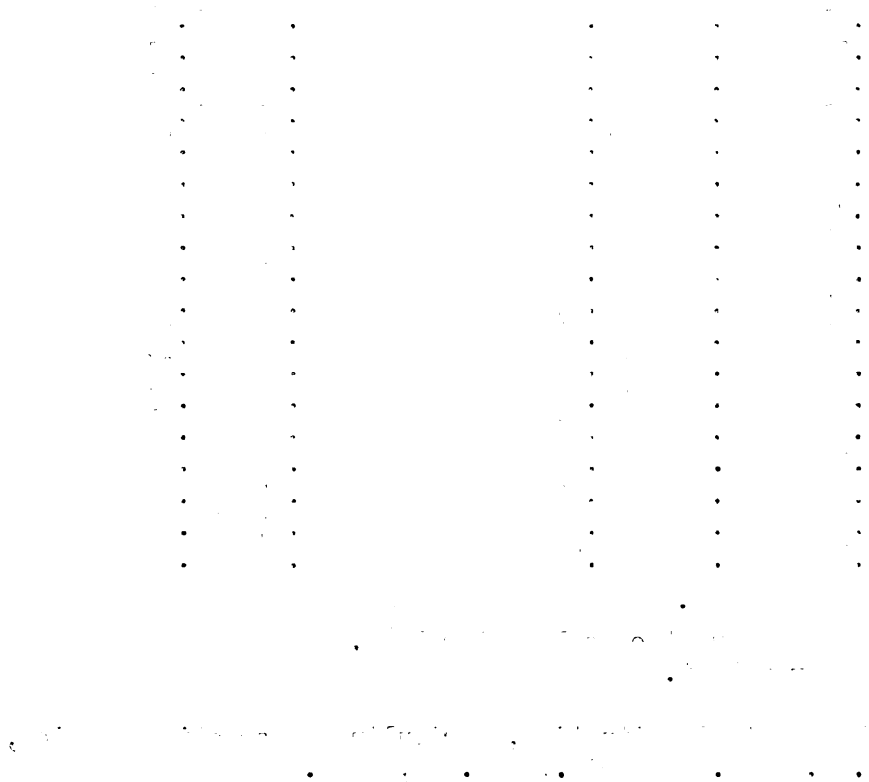

TABLE 26

CIVILIAN PER CAPITA CONSUMPTION OF FRESH AND PROCESSED SPINACH UNITED STATES 1937-1954*

Year	Total	Fresh		Canned**		Frozen**	
	Pounds	Pounds	Percent Total	Pounds	Percent Total	Pounds	Percent Total
1937	3.51	2.6	74.07	.87	24.79	.04	1.14
1938	3.25	2.4	73.85	.81	24.92	.04	1.23
1939	3.72	2.9	77.95	.80	21.51	.02	0.54
1940	3.74	2.7	72.19	.97	25.94	.07	1.87
1941	3.42	2.6	76.02	.80	23.39	.02	0.59
1942	3.86	2.5	64.77	1.12	29.01	.24	6.22
1943	3.25	2.3	70.77	.75	23.08	.20	6.15
1944	3.84	2.3	59.90	1.23	32.03	.31	8.07
1945	3.74	2.3	61.50	.97	25.94	.47	12.57
1946	3.90	2.1	53.85	1.44	36.92	.36	9.23
1947	3.28	1.9	57.92	.99	30.18	.39	11.89
1948	3.15	1.7	54.97	.90	28.57	.55	17.46
1949	3.10	1.6	51.61	.99	31.94	.51	16.45
1950	2.99	1.5	50.17	.82	27.42	.67	22.41
1951	3.25	1.3	40.00	1.06	32.62	.89	27.38
1952	2.81	1.0	35.59	.92	32.74	.89	31.67
1953	2.93	1.0	37.54	.90	30.72	.93	31.74
1954	2.56	1.0	39.06	.63	24.61	.93	36.33

*Civilian consumption only after 1941.
**Fresh equivalent.

Source: The Vegetable Situation, Agricultural Marketing Service, U. S. Dept. of Agric., Nov. 29, 1955.

TABLE 27

CIVILIAN PER CAPITA CONSUMPTION OF FRESH AND PROCESSED SNAP BEANS
UNITED STATES 1937-1954*

Year	Total	Fresh		Canned**		Frozen**	
	Pounds	Pounds	Percent Total	Pounds	Percent Total	Pounds	Percent Total
1937	5.23	3.9	74.57	1.27	24.28	.06	1.15
1938	6.23	4.7	75.44	1.47	23.60	.06	0.96
1939	6.48	4.9	75.62	1.53	23.61	.05	0.77
1940	6.73	5.0	74.29	1.68	24.96	.05	0.74
1941	6.25	4.5	72.00	1.66	26.56	.09	1.44
1942	6.93	4.9	70.71	1.90	27.42	.13	1.87
1943	7.47	5.5	73.63	1.91	25.57	.06	0.80
1944	7.29	5.0	68.59	2.10	28.91	.19	2.60
1945	7.85	5.2	66.24	2.41	30.70	.24	3.06
1946	7.81	5.2	66.58	2.36	30.22	.25	3.20
1947	6.80	4.5	66.18	1.98	29.12	.32	4.70
1948	7.12	4.7	66.01	2.06	28.93	.36	5.06
1949	7.08	4.6	64.97	2.13	30.08	.35	4.95
1950	7.30	4.4	60.27	2.46	33.70	.44	6.03
1951	7.29	4.4	60.36	2.33	31.96	.56	7.68
1952	7.04	3.9	55.40	2.48	35.23	.66	9.37
1953	7.25	4.0	55.17	2.54	35.03	.71	9.80
1954	7.43	4.0	53.84	2.63	35.40	.80	10.76

*Civilian consumption only after 1941.
**Fresh equivalent.

Source: The Vegetable Situation, Agricultural Marketing Service U. S. Dept. of Agric., Nov. 29, 1955.

TABLE 28

CIVILIAN PER CAPITA CONSUMPTION OF FRESH AND PROCESSED ASPARAGUS UNITED STATES 1937-1954*

Year	Total	Fresh		Canned**		Frozen**	
	Pounds	Pounds	Percent Total	Pounds	Percent Total	Pounds	Percent Total
1937	1.95	1.2	61.54	.69	35.38	.06	3.08
1938	1.80	1.1	61.11	.60	33.33	.10	5.56
1939	2.11	1.3	61.61	.75	35.54	.06	2.85
1940	2.42	1.5	61.98	..82	33.88	.10	4.14
1941	2.41	1.5	62.24	.81	33.61	.10	4.15
1942	2.29	1.3	56.77	.91	39.73	.08	3.50
1943	2.14	1.2	56.07	.82	38.82	.12	5.61
1944	2.23	1.2	53.81	.83	37.22	.20	8.97
1945	1.86	1.1	59.13	.48	25.82	.28	15.05
1946	2.62	1.1	41.98	1.28	48.85	.24	9.17
1947	2.07	1.1	53.14	.75	36.23	.22	10.63
1948	2.11	0.9	42.65	.93	44.07	.28	13.28
1949	1.99	0.9	45.23	.85	42.71	.24	12.06
1950	2.00	0.9	45.00	.86	43.00	.24	12.00
1951	1.99	0.8	40.20	.93	46.73	.26	13.07
1952	2.07	0.9	43.48	.87	42.03	.30	14.49
1953	2.14	0.8	37.38	1.02	47.66	.32	14.96
1954	2.10	0.8	38.09	.98	46.67	.32	15.24

*Civilian consumption only after 1941.

**Fresh equivalent.

Source: The Vegetable Situation, Agricultural Marketing Service, U. S. Dept. of Agric., Nov. 29, 1955.

TABLE 29

CIVILIAN PER CAPITA CONSUMPTION OF FRESH AND PROCESSED CORN
UNITED STATES 1937-1954*

Year	Total	Fresh		Canned**		Frozen**	
	Pounds	Pounds	Percent Total	Pounds	Percent Total	Pounds	Percent Total
1937	14.88	5.00	33.60	9.71	65.26	.17	1.14
1938	15.32	5.10	33.29	10.09	65.86	.13	.85
1939	15.91	5.00	31.43	10.70	67.25	.21	1.32
1940	17.00	5.60	32.94	11.15	65.59	.25	1.47
1941	18.30	6.20	33.88	11.89	64.97	.21	1.15
1942	20.90	6.70	32.06	13.91	66.56	.29	1.38
1943	19.70	6.20	31.47	13.40	68.02	.10	.51
1944	19.62	6.60	33.64	12.54	63.91	.48	2.45
1945	22.23	7.80	35.09	13.93	62.66	.50	2.25
1946	23.83	7.60	31.89	15.60	65.46	.63	2.65
1947	23.30	7.60	32.62	14.69	63.05	1.01	4.33
1948	21.88	8.60	39.30	12.42	56.76	.86	3.94
1949	20.62	7.50	36.37	12.19	59.12	.93	4.51
1950	21.91	8.00	36.51	13.02	59.42	.89	4.07
1951	21.26	7.80	36.69	12.19	57.34	1.27	5.97
1952	21.69	8.00	36.88	12.09	55.74	1.60	7.38
1953	22.85	8.10	35.45	12.92	56.54	1.83	8.01
1954	23.02	8.30	36.05	13.02	56.56	1.70	7.39

*Civilian consumption only after 1941.

**Fresh equivalent

Source: The Vegetable Situation, Agricultural Marketing Service, U. S. Dept. of Agric., Nov. 29, 1955.

TABLE 30

CIVILIAN PER CAPITA CONSUMPTION OF FRESH AND PROCESSED LIMA BEANS UNITED STATES 1937-1954*

Year	Total	Fresh		Canned**		Frozen**	
	Pounds	Pounds	Percent Total	Pounds	Percent Total	Pounds	Percent Total
1937	1.40	.7	50.00	.48	34.29	.22	15.71
1938	1.46	.8	54.79	.46	31.51	.20	13.70
1939	1.69	.9	54.25	.55	32.54	.24	14.21
1940	1.81	.8	44.20	.72	39.78	.29	16.02
1941	1.81	.8	34.65	.77	42.54	.24	13.26
1942	2.02	.7	40.00	.79	39.11	.53	26.73
1943	1.50	.6	46.15	.59	39.33	.31	20.67
1944	1.30	.6	41.67	.32	24.62	.38	29.23
1945	1.44	.6	39.33	.46	31.94	.38	26.39
1946	1.78	.7	31.58	.48	26.97	.60	33.70
1947	1.90	.6	30.93	.48	25.26	.82	43.16
1948	1.94	.6	23.81	.51	26.29	.83	42.78
1949	2.10	.5	20.66	.51	24.28	1.09	51.90
1950	2.42	.5	17.47	.81	33.47	1.11	45.87
1951	2.29	.4	15.33	.69	30.13	1.20	52.40
1952	2.61	.4	11.76	.65	24.90	1.56	59.77
1953	2.55	.3	12.34	.65	25.49	1.60	62.75
1954	2.43	.3		.69	28.39	1.44	59.27

*Civilian consumption only after 1941.
**Fresh equivalent.

Source: The Vegetable Situation, Agricultural Marketing Service, U. S. Dept. of Agriculture, Nov. 29, 1955.

TABLE 31

CIVILIAN PER CAPITA CONSUMPTION OF COMMERCIALLY PRODUCED FRESH AND PROCESSED FRUIT. UNITED STATES 1937-1954*

Year	Total***	Fresh		Canned**		Dried**		Frozen**	
	Pounds	Pounds	Percent Total	Pounds	Percent Total	Pounds	Percent Total	Pounds	Percent Total
1937	102.5	63.4	61.85	20.3	19.80	18.3	17.85	.5	.50
1938	96.0	57.2	59.58	19.0	19.79	18.8	19.58	1.0	1.04
1939	100.6	58.5	58.15	20.8	20.68	20.2	20.08	1.1	1.09
1940	101.0	54.8	54.26	24.1	23.86	20.9	20.69	1.2	1.19
1941	102.5	58.6	57.17	24.6	24.00	18.1	17.66	1.2	1.17
1942	82.9	44.8	54.04	22.7	27.38	14.2	17.13	1.2	1.45
1943	68.3	33.9	49.63	16.7	24.45	16.7	24.45	1.0	1.46
1944	82.1	47.2	57.49	12.2	14.86	21.0	25.58	1.7	2.07
1945	91.5	51.6	56.39	17.2	18.80	20.9	22.84	1.8	1.97
1946	103.2	53.4	51.74	28.8	27.91	18.5	17.93	2.5	2.42
1947	94.7	53.8	56.81	23.7	25.02	14.4	15.21	2.8	2.96
1948	87.9	49.5	56.31	22.4	25.48	13.5	15.36	2.5	2.84
1949	89.8	50.2	55.90	23.1	25.72	14.3	15.92	2.2	2.45
1950	85.5	43.0	50.29	25.7	30.06	14.4	16.84	2.4	2.81
1951	83.5	44.7	53.53	22.9	27.43	13.7	16.41	2.2	2.63
1952	88.8	46.2	52.03	26.2	29.50	13.8	15.54	2.6	2.93
1953	88.5	44.8	50.62	27.6	31.19	13.5	15.21	2.6	2.94
1954	82.6	42.4	51.33	24.6	29.78	13.1	15.85	2.5	3.02

*Civilian consumption only after 1941.

**Fresh weight equivalent.

***Excluding citrus fruit and apples.

Source: The Fruit Situation, Agricultural Marketing Service, U. S. Dept. of Agric., Oct. 28, 1955.

TABLE 32

CIVILIAN PER CAPITA CONSUMPTION OF FRESH AND PROCESSED STRAWBERRIES UNITED STATES 1937-1954*

Year	Total	Fresh		Canned**		Frozen**	
	Pounds	Pounds	Percent Total	Pounds	Percent Total	Pounds	Percent Total
1937	3.81	3.3	86.61	.3	7.88	.21	5.51
1938	3.68	2.9	78.80	.5	13.59	.28	7.61
1939	4.08	3.3	80.88	.4	9.80	.38	9.31
1940	4.04	3.2	79.21	.4	9.90	.44	10.89
1941	4.11	3.1	75.42	.5	12.17	.51	12.41
1942	4.58	3.4	74.24	.6	13.10	.58	12.66
1943	2.52	1.8	71.43	.4	15.87	.32	12.70
1944	1.62	1.2	74.07	.1	6.18	.32	19.75
1945	1.64	1.3	79.27	.1	6.10	.24	14.63
1946	2.08	1.5	72.12	.2	9.62	.38	18.26
1947	2.93	1.9	64.85	.3	10.24	.73	24.91
1948	3.07	1.8	58.63	.5	16.29	.77	25.08
1949	3.06	1.5	49.02	.6	19.61	.96	31.37
1950	2.86	1.6	55.94	.4	13.99	.86	30.07
1951	3.00	1.8	60.00	.4	13.33	.98	32.67
1952	3.19	1.6	50.16	.4	12.54	1.19	37.30
1953	3.14	1.5	47.77	.4	12.74	1.24	39.49
1954	2.99	1.3	43.48	.3	10.03	1.39	46.49

*Civilian consumption only after 1941.

**Fresh weight equivalent.

Source: The Fruit Situation, Agricultural Marketing Service, U. S. Dept. of Agric., Oct. 28, 1955.

TABLE 33

CIVILIAN PER CAPITA CONSUMPTION OF FRESH AND PROCESSED PEACHES
UNITED STATES 1937-1954*

Year	Total	Fresh		Canned**		Frozen**	
	Pounds	Pounds	Percent Total	Pounds	Percent Total	Pounds	Percent Total
1937	16.61	14.0	84.29	2.6	15.65	.01	.06
1938	16.32	12.9	79.04	3.4	20.83	.02	.13
1939	18.46	15.1	81.80	3.3	17.88	.06	.32
1940	17.14	12.9	75.26	4.2	24.50	.04	.24
1941	21.55	18.3	84.92	3.2	14.85	.05	.23
1942	18.79	14.4	76.64	4.3	22.88	.09	.48
1943	11.58	8.2	70.81	3.2	27.63	.18	1.55
1944	19.37	7.7	91.33	1.3	6.71	.37	1.91
1945	23.36	7.9	76.63	4.9	20.98	.56	2.39
1946	22.01	6.4	74.51	5.3	24.08	.31	1.41
1947	19.13	4.6	76.12	4.3	22.42	.28	1.46
1948	15.76	11.1	70.43	4.5	28.55	.16	1.02
1949	16.46	11.6	70.47	4.7	28.55	.16	.97
1950	13.76	7.9	57.41	5.7	41.42	.16	1.16
1951	14.20	9.4	66.20	4.6	32.39	.20	1.41
1952	15.72	10.6	67.43	4.9	31.17	.22	1.40
1953	15.40	10.1	65.58	5.1	33.12	.20	1.30
1954	15.17	9.6	63.28	5.4	35.60	.17	1.12

*Civilian consumption only after 1941.
**Fresh weight equivalent.

Source: The Fruit Situation, Agricultural Marketing Service, U. S. Dept. of Agric., Oct. 28, 1955.

TABLE 34

CIVILIAN PER CAPITA CONSUMPTION OF FRESH AND PROCESSED CHERRIES UNITED STATES 1937-1954*

Year	Total	Fresh		Canned**		Frozen**	
	Pounds	Pounds	Percent Total	Pounds	Percent Total	Pounds	Percent Total
1937	2.16	1.0	46.30	1.0	46.30	.16	7.40
1938	2.19	1.0	45.66	1.0	45.66	.19	8.68
1939	2.59	1.1	42.47	1.2	46.33	.29	11.20
1940	2.72	1.0	36.77	1.4	51.47	.32	11.76
1941	2.54	1.1	43.31	1.2	47.24	.24	9.45
1942	2.48	1.1	44.35	1.1	44.35	.28	11.30
1943	1.87	.9	48.13	.7	37.43	.27	14.44
1944	2.32	1.2	51.72	.8	34.48	.32	13.80
1945	2.16	1.1	50.93	.8	37.04	.26	12.03
1946	3.14	1.0	31.85	1.8	57.32	.34	10.83
1947	2.45	.9	36.73	1.0	40.81	.55	22.45
1948	2.61	.8	30.65	1.2	45.98	.61	23.37
1949	3.00	1.0	33.33	1.5	50.00	.50	16.67
1950	3.10	.8	25.81	1.7	54.83	.60	19.36
1951	2.59	.7	27.03	1.3	50.19	.59	22.78
1952	2.82	.8	28.37	1.4	49.65	.62	21.98
1953	2.78	.7	25.18	1.5	53.96	.58	20.86
1954	2.32	.7	30.17	1.1	47.41	.52	22.41

*Civilian consumption only after 1941.

**Fresh weight equivalent.

Source: The Fruit Situation, Agricultural Marketing Service, U. S. Dept. of Agric., Oct. 28, 1955.

APPENDIX B

TABLE 35

CONVERSION FACTORS FOR CONVERTING FROZEN AND CANNED WEIGHTS TO FRESH WEIGHT EQUIVALENT

Commodity	Factors for Converting	
	Frozen Weight to Fresh Weight Equivalent	Canned Weight to Fresh Weight Equivalent
Peas	1.124	.672
Broccoli	1.818	--
Snap Beans	1.266	.733
Lima Beans	1.111	.702
Corn	1.961	2.625
Cauliflower	3.333	--
Squash	1.538	--
Spinach	1.818	.926
Asparagus	2.000	1.324
Strawberries	.810	.889
Sour Cherries	1.060	1.069
Orange Juice	7.372	1.909

Source: Conversion Factors and Weights and Measures for Agricultural Commodities and Their Products. Production and Marketing Administration, United States Department of Agriculture, Washington, D. C., May 1952.

APPENDIX C

The Chi-Square Test of Significance

The Chi-square test is used to show association between two factors by comparing their theoretical frequencies with the frequencies actually observed.

The association between per capita expenditures for frozen fruits and vegetables and size of family if used as an illustration of the chi-square test.

Per capita Expenditures		Size of Family: Over 3	Size of Family: Under 3	Total
Over $1.50	observed	63	37	
	expected	55.2	44.8	100
	deviation	7.8	- 7.8	
Under $1.50	observed	53	57	
	expected	60.8	49.2	110
	deviation	- 7.8	7.8	
Total		116	94	210

The expected theoretical frequency is found by applying the same ratio or proportion to each grouping as is found in the entire group.

$$\text{Chi-square} = \frac{(\text{Observed frequency} - \text{expected frequency})^2}{\text{Expected frequency}}$$

$$\frac{(7.8)^2}{55.2} + \frac{(-7.8)^2}{44.8} + \frac{(-7.8)^2}{60.8} + \frac{(7.8)^2}{49.2} = 4.698$$

Degrees of freedom are calculated from the formula (R - 1) (C - 1) where R equals the number of rows and C equals the number of columns in the table.

For this table (2 - 1)(2 - 1) = 1

Comparison of the calculated chi-square 4.698 (1 degree of freedom) with values of chi-square found in statistical tables, shows that between one and five percent of random samples from the hypothetical population would have values greater than 4.698. Thus, it is reasonable to assume that per capita expenditures for frozen fruits and vegetables are not independent of size of family.

APPENDIX D

TABLE 36

SUMMARY OF REGRESSION RESULTS

A. Frozen Fruits and Vegetables Equation

Statistical Measure	Variables: Family Income X_1	Size of Family X_2	Age of Homemaker X_3	Education of Homemaker X_4
b*	.1176	-.2269	.1638	-.0581
t value**	2.317	2.148	1.013	.4340

B. Frozen Fruit Juices Equation

Statistical Measure	Variables: Family Income X_1	Size of Family X_2	Age of Homemaker X_3	Education of Homemaker X_4
b*	.0377	.0739	-.0046	.1467
t value**	.3660	.6985	.0499	1.045

*Regression coefficient are in standard form.

**The values of t at the 1 percent, 5 percent, and 10 percent levels of significance are 2.576, 1.960, and 1.645 respectively.

Date Due

Nov 22 '58			
MAY 19 1962			