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USING PANEL DATA IN ANALYZING CONSUMER DEMAND FOR MEAT

by

Ayers Brinser, Harry Allison, and Charles Zwick

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PREFACE

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This report was prepared by Harvard University under a contract with the U. S. Department of Agriculture. It deals with the possibilities of using data collected from a panel of consumers in conducting studies of the demand for food. It is being made available in this form primarily as a working tool for those concerned with analyses of the demand for agricultural products. The usefulness of consumer-panel data is tested primarily on the basis of purchases of meat, fish, and poultry reported by consumers in a New England community. The study on which the report is based is part of a program of research designed to evaluate and improve methods of determining the importance of various factors affecting the volume of farm products sold.

Mrs. Eleanor Taylor, Mrs. Rosemary C. Coward, and Mrs. Carolyn Bell participated in designing and operating the panel. Trienah Meyers and Winn F. Finner represented the U. S. Department of Agriculture in discussions concerning methods used in the study. Armour and Company, Cudahy Packing Company, Swift and Company, and Wilson and Company made helpful suggestions during the initial phases of the project. The Great Atlantic and Pacific Tea Company, First National Stores, Incorporated, Star Market Company, and Stop and Shop, Incorporated, provided data, particularly with respect to prices. Finally, the authors are indebted to the panel families without whose cooperation the study would have been impossible.

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SUMMARY

This study had two major objectives: (1) to evaluate the consumer panel as a research technique in demand analysis, and (2) to test hypotheses concerning consumer demand for meat, fish, and poultry items. The study was based on data from a limited number of families in one community for a period of about one year.

Consumer Panel Data in Demand Analyses

Consumer panel data provide a large number of observations useful for both cross-sectional and time series analyses and additional analyses are made possible by the "moving cross-section" nature of the data. Economic relationships which would otherwise be indeterminate because of the high degree of multicollinearity can be examined. Furthermore, these data make it possible to compare parameters estimated from the same population based on between-family variation and in the other on within-family variation. Thus, consumer panels should provide information on the compatibility of time series and cross-sectional data.

On the other hand, a number of problems are associated with the use of consumer panel data. First, both the collection and the analysis of the data require large expenditures. Because of the great number of observations involved, automatic computing equipment is a necessity. Second, the possibility of biases resulting from families refusing to participate and changes in purchase behavior associated with panel participation create problems in generalizing from the sample results for certain objectives. Third, obtaining additional observations by spacing the observations closer together increases the intercorrelation in the data, and as a result, degrees of freedom are not increased as rapidly as the number of observations is increased.

The following types of bias may enter consumer panel data: (1) Families who cooperate over time may have different family characteristics from those who do not cooperate. If these family characteristics are related to variation in the data collected, the sample will yield biased estimates for the population. (2) Families who cooperate may have different purchasing behavior patterns than families who do not cooperate. (3) Keeping a record may cause a family to adjust its purchase behavior. (4) Inaccurate reporting may occur either from unintentional inaccuracies or from an intentional attempt by the recordkeeper to create a false impression.

Families with the better educated meal planners cooperated more effectively over time than families with less educated meal planners. However, this bias should have affected the population estimates in this study by no more than 2 or 3 percent. Over- or under-reporting should be diminished as the recordkeeping period increases. The effects of the other biases could not be measured. Approximately 20 percent of the panel families were of the opinion, however, that keeping records had in some manner affected their family's pattern of purchases or consumption of meat, fish, or poultry.

The advantages and disadvantages of panel data must be weighed with respect to the goals of the particular study. Consumer panel data are relatively expensive. But, if data over time or subaggregates of a population are required, this method may not be as costly as other methods. The alternative of taking repeated or new samples at different points in time quickly becomes expensive and adds sampling variation to the analysis. In this project, this added sampling variation would have been large. Coefficients of variation among families for purchases of individual kinds of meat, fish, and poultry ranged from 40 to 175 percent. Hence, a technique based on repeated samples of families from the same population would add a great amount of sampling variation which would have weakened the tests of differences in price and income elasticities among the subgroups of the population.

Consumer Purchase Behavior Analysis

Family size was the most important factor causing variation among families in purchase behavior, and family income was the next most important factor.

Older families bought more lamb and fish and less beef than younger families. Education of the meal planner was negatively related to total purchases. Families with Italian ethnic backgrounds purchased more veal. Religious differences had no influence on total purchases of meat, fish, and poultry items. Families with housewives working away from the home tended to buy more meat, fish, and poultry items than families in which the housewife was not working away from the home. However, there was no evidence that the families with working housewives purchased a different composition of meat, fish, and poultry items than all panel families.

The decline of 31.0 percent in the price of beef during the period observed was matched by an increase of 22.1 percent in beef purchases, giving an estimated short-run price elasticity of demand for beef of -.71. No other variable was related to the remaining variation in beef purchases. Similarly there was an increase of 24.8 percent in the price of pork during the period, and pork purchases declined by 26.8 percent, yielding a short-run price elasticity of demand for pork of -1.08. Again, no other variable tested helps explain any additional variation in the purchases of pork.

Purchases and prices of lamb, poultry, fish, and veal remained at roughly the same level over the period observed, and hence no relationships between prices and purchases were obtained. However, some of the other variables measured apparently affected the purchases of these items. For poultry, the most important influences were three holidays--Thanksgiving, Christman, and Easter (table 14). Weekly variation in lamb purchases was related to variation in nonprice selling practices of stores for lamb and veal items. Lamb purchases increased as featuring of lamb increased and decreased as featuring of veal increased. Weekly variation in veal purchases was related to variation in the nonprice selling practices of stores for veal and lamb items. This information suggests that the elasticity of substitution between minor purchase items such as lamb and veal is relatively large and that purchases can be influenced.

Tests were applied to see if price and income elasticities of demand for beef or pork varied with family characteristics. Variation in age level was the only variation that was found to be related to differences in price or income elasticities. The higher the age level, the lower was the short-run price elasticity and the higher was the income elasticity.

The more probable explanation of the difference between the two age groups in income elasticities is that younger families have high income elasticities for consumer durables and, as a result, additional purchases of such items as meat are assigned a low priority. However, as the family builds up its stock of consumer durables, purchases of meat are assigned a higher priority. This explanation is consistent with the findings that families of different age groups had different expenditure and savings patterns. Young families tended to save less and buy more consumer durables.

Younger families had higher price elasticities than older families. As younger families had lower income elasticities than older families, the difference between the age groups in terms of elasticity of substitution was greater than the difference in price elasticities. For example, the 30 percent reduction in price of beef represented, for the families observed, an increase in real income of approximately one percent. (Using the income elasticities estimated in this report,) the elasticity of substitution for the families in the 25-year age group was -1.25 and for the families in the 60-year age group the elasticity of substitution was -.058.

Purchases of meat, fish, and poultry items in restaurants represent an important addition to purchases for home consumption and may not be in the same proportion as purchases for home consumption. The home purchase data understated the relative position of seafood items, particularly shellfish, in the overall purchases of the panel families. The position of other items eaten in restaurants but not usually served at home may be more the result of a preference for a different method of preparation from that used at home rather than a different distribution of choice of meat, fish, and poultry items. Turkey seems to be the most likely exception to such a generalization.

Soup, eggs, and spaghetti or macaroni were the important substitutes for meat, fish, and poultry at major meals. There was no decline in the number of meals at which substitutes were served in response to the decline in the price index for all meat, fish, and poultry items.

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I. INTRODUCTION

Objectives

The research project on which this report is based had two objectives: The first was to evaluate the consumer panel--a sample of consumers who keep daily records of purchases or consumption or both over a period of time--as a technique of research in demand analyses. The second was to test specific hypotheses concerning consumer purchase behavior as reflected in the demand for meat, fish, and poultry in a selected community. The hypotheses tested concerned the influence on purchase behavior of prices, income, family size, age, education, ethnic background, religion, and occupational status of the housewife. In addition, interrelations between demographic variation and price and income elasticities were investigated.

Quantitative research may be divided into three parts--a model, quantitative data, and procedures for estimating from the available data the quantitative properties for the model specified. The research described in this report placed major emphasis on the first two. In this respect this project differs somewhat from most current research on consumer behavior which is concerned with obtaining improved quantitative information through the application of newer estimating procedures. These new techniques are usually employed in conjunction with previously analyzed data such as annual time-series and one of a number of competing models available to explain consumer behavior. The rationale to justify emphasizing the aspects of quantitative research stressed in this study was: (1) Until a better understanding of consumer behavior is obtained, there is no logical way of discriminating among the various available models of consumer behavior; (2) being able to discriminate among various models of consumer behavior is the necessary first step in improving quantitative information about such behavior; and (3) to increase our understanding of consumer behavior, new sources of data will probably have to be exploited.

It was decided that the best basis for testing hypotheses dealing with the effect of price changes on consumer behavior was to collect cross-sectional observations from the same families over a period of time long enough to include changes in the price relationships of major meat, fish, and poultry items. A review of previous studies of the demand for meat, fish, and poultry revealed significant variation in the purchase data for individual families after the influence of major factors such as family composition and income had been eliminated. This large, unexplained variation indicated the desirability of securing data from the same families over time. This, in turn, suggested the consumer panel technique as a source of data. Furthermore, the large residual variation required that any starting panel should be of sufficient size to yield enough observations of purchase data for the proposed analysis without using substitute families or data from nonparallel time periods. The actual choice of the panel technique (and its suggested potential as a source of data on consumer behavior) led to the formulation of the other major objective of the study--that of evaluating the use of consumer panels in demand analyses.

The population studied was restricted to a particular segment of the families in the town of Medford, Mass. This restriction made it possible to hold a number of variables constant and thereby to identify with greater accuracy the effects of the factors that did vary within the framework of the study. Limiting the population studied was consistent with the second objective of the study, which was not to collect data to represent a particular geographic area but rather to test hypotheses concerning variation in purchase and consumption behavior for meat, fish, and poultry.

Organization of the Report

The report is divided into four sections. Following this introduction, section II outlines the analysis of the consumer panel as a research technique. Section III details the analysis of consumer behavior that was carried out using the data generated by the consumer panel. The last section summarizes the study's major findings and inferences drawn from the analyses carried out in sections II and III.

Those who are primarily interested in the analysis of the consumer panel as a research technique will find that sections II and IV are of most interest. Similarly, those more concerned with the analysis of the purchase data will want to devote more time to sections III and IV. It must be recognized, however, that there is a close interrelationship between sections II and III. Clearly, any evaluation of a consumer panel as a source of demand data must rest heavily on the uses to which the data can be put. Thus some knowledge of the analysis carried out in section III is necessary before the panel technique can be evaluated relative to alternative methods of obtaining data. Also the inferences drawn as a result of the analysis carried out in section III depend on, among other things, the data employed. Hence, intelligent use of these inferences requires, at a minimum, a cursory review of section II.

The Population Studied

At the outset of the study it was recognized that the panel would be smaller than that needed for an adequate statistical testing of the proposed hypotheses if all variables considered were observed over their total range. Two possible procedures were available to offset this problem. First, certain variables, which previous studies indicated have an effect on meat, fish, and poultry purchases but which could be expected to yield too few panel observations in some of their possible values to permit acceptable statistical treatment, could be eliminated from or suppressed in the sample. Second, certain other variables--particularly income and family size--might be examined by concentrating the panel observations within selected segments spaced over the range of their possible values.

On the basis of the above consideration and the tabulations of an initial interview, the population sampled was restricted to families in Medford, Mass., who fitted the following eligibility criteria: 1/

1. The family income during the previous calendar year had to be between $1,500 and $10,500 after Federal income taxes. Family income was defined as the income of those who gave all their earnings to the family plus the actual contributions of those who gave only part of their earnings plus all other income to the family in the form of rents, pensions, bonuses, interest, business profits, allotments, welfare aid, relief, and unemployment compension. 2/

2. The family had to have at least 2 but not over 4 persons 2 years of age and over, normally eating at least a total of 7 noon or evening meals per week prepared in the home. Some minimum number of meals eaten in or from the home was necessary in order to assure that each member was significant in food purchase decisions. Breakfasts were excluded in such an evaluation because of the relative unimportance of meat, fish, or poultry items consumed at the morning meal. 3/ Children under 2 years of age were excluded in measuring the size of the family for consumption of meat, fish, and poultry items because their consumption of such items was negligible except when purchased in the form of baby foods. Purchase data on baby foods were not included in the weekly records unless eaten by family members 2 years of age or over.

1/ At the start of the panel recruiting a two-interview approach was used. During the first interview, family characteristic data were collected along with some general information on meat, fish, and poultry purchases. A second contact was then made to discuss panel membership with eligible families. As the study progressed, a one-interview was substituted for the two-phase technique.

2/ The total earnings of both male and female heads were always considered as going into the family pool. In defining the income most relevant to decisions to purchase meat, fish, and poultry, it seemed more realistic to include only the actual contributions of other members rather than their total earnings.

3/ Meat, fish, and poultry items, such as bacon, purchased for breakfast were reported and analyzed along with the purchases for the noon and eve--

3. The normal number of home-prepared noon or evening meals per week at which guests were present could not be more than two. 4/ The frequent presence of guests would distort both the size of the family and the quality of meals served. Owing the latter effect, the restriction was placed on the number of meals at which guests were present and not on the number of guests.

4. The family's purchases of meat, fish, and poultry had to be made from regular retail outlets. If more than 10 percent in quantity came from wholesale sources or was received as gifts, the family was not eligible.

5. The family had to belong to the white race. Cultural differences between white and nonwhite families frequently give rise to differences in food habits. Since there were not enough nonwhite families to permit a separate statistical treatment of that category, it was decided to exclude them.

These criteria eliminated the variable of race and suppressed the variability in meat, fish, and poultry purchases associated with purchases made from wholesale sources, the number of meals at which guests were present, and the number of meals normally eaten in, or from the home (packed lunches) by the family members. The extreme ranges of both the income and family-szie variables were eliminated. 5/

4/ Guests were considered to be those who were not regular family members and who were not present for more than 14 consecutive or nearly consecutive noon and evening meals. Any new person eating more than 14 more or less consecutive noon and evening meals, in or from the home, was considered an addition to the family rather than a guest. It was felt that upgrading of meals because of a guest was some function of the number of consecutive meals at which the particular guest was present. The actual figure of 14, i.e. one week, was arbitrarily chosen as the point where upgrading would become unimportant.

5/ The extremes of the income range were eliminated owing to the difficulty of measuring such incomes and to their relative unimportance in the population. The extremes of the range in family size were eliminated for three reasons. First, the abandonment of the selective segment approach created the necessity of reducing the data on purchases by families of different sizes to a common base in order to make pooled evaluations of the effects of the other family characteristics on these purchases. In the actual analysis an adult-meal equivalent unit was established to account for differences in family size. While this unit seemed to be preferable to a straight per capita approach, it was recognized that the unit was by no means a perfect adjustment and that any distortions resulting from the imperfections in the unit could be minimized by reducing the differences among the family sizes being pooled. Second, the problem of reducing family data to a common

The possibility of concentrating panel observations within smaller segments of the ranges of such variables as income and family size however, was largely abandoned. 6/

Sampling Procedure

The unit of observation for the study was the family, which was defined as a group of persons living in the same dwelling, sharing a common table, and depending upon the pooled income of the group for most of its support. The families for the sample were drawn by serial selection from the 1950 City of Medford directory, which listed all persons 20 years of age and over. 7/ Family groupings were approximated for sampling purposes first by house numbers and then by grouping individuals living at the same house number on the basis of surnames--a new family grouping being made for every set of two or more similar surnames listed under a given house number.

The basic sample was secured by taking every eighth family after the initial family within the first set of eight had been chosen at random. This process yielded 2,097 families, which were later supplemented with 454 families secured partly by sampling new areas that had developed since the 1950 directory had been compiled and partly by taking every family within similarly numbered precincts in all wards.

5/continued--base existed between family size and income as well as between family size and the observed purchase data. Any family-size variable that attempted to weight family members relative to meat, fish and poultry consumption could not be equally satisfactory for reflecting the relationship between family size and income. Again, reducing the range of the family-size variable would minimize any distortion. Third, the restrictions on family size were further supported in that larger families tended to distort the comparability of the values assigned to the income variable itself; e. g., the problem of how to deal with income earned by family members other than the family heads.

6/ The selective segment approach was dropped because initial interviews indicated that there was little possibility of getting a concentration of panel families statistically large enough within realistically restricted segments to permit analyzing the effects of other variables on the purchase data while holding income or family size constant at particular levels through the grouping technique.

7/ Serial sampling offered both a simplified sampling procedure and the assurance of geographic dispersion. The resulting initial sample was treated as being random.

The final disposition of the 2,551 families with respect to the recruiting interview is given in table 1.

Table 1.--Final classification of the total sample at the completion of recruiting efforts, 2,551 families, October 1954.

Final classification	Families	
	Number	Percent
Ineligible	569	22
Panel member 1/	492	19
Gave first interview and eligible but refused panel	444	18
No contact 2/	437	17
Refused to give any interview	411	16
Gave first interview and eligible but never interviewed for panel	75	3
Other 3/	123	5
Total	2,551	100

1/ Any family that orginally agreed to become part of the panel was considered a panel member, regardless of the number of weekly records actually submitted.

2/ Interviewer failed to secure a definite response from the family either because no one was at home or the family member or members relevant to the interview were either not at home or not able to devote time to the interview.

3/ Includes such categories as: Moved since the first interview; empty house; address not located; neighbors supplied data to indicate family was either unwilling to give an interview or was ineligible for panel; address actually a business, garage, office, or rest home; family actually ineligible now; left off second interviewing list by mistake; did not speak English; interviewer suggested another visit but it was never made; started interview but could not complete it.

Only 492 families, or 19 percent of the total sample, indicated that they were willing to participate in the panel. These 492 families, however, were actually 49 percent of the 1,011 families listed in the final classification as being eligible for the panel. The latter figure omits the eligibles among the "no-contact," "refused to give any interview," and "other" groups. It would be more realistic to consider that the "no-contact," "refused to give any interview," and "other" groups contained about the same proportions of eligible and ineligible families as did those giving sufficient information to

determine eligibility. 8/ Sixty-four percent of the 1,580 families giving sufficient data for eligibility determination were eligible. Thus, 621 of the 971 families whose eligibility could not be judge might be assumed to have been eligible. This would give an estimated total of 1,632 eligible families of whom 492, or 30 percent of the population, agreed to cooperate. 9/

Although some of the 492 panel members were recruited as early as the first week of June in 1952, the price and quantity data were analyzed only for the 32-week period extending from October 12, 1952, through May 23, 1953. To be a part of the purchase data analysis, a family had to submit a usable weekly record for at least 26 of these 32 weeks. A "usable weekly record" was defined as a record that was judged to be complete and accurate either upon arrival or after editing. Thirty-one percent of the panel families (i.e., 154 of the 492 families) met these requirements for the analysis. Seventy-nine percent of these 154 families submitted a complete set of 32 records for the analysis period and 10 percent had no more than one record missing (table 2). The missing records tended to be concentrated at the beginning and end of the analysis period owing to a few families not starting with the others and a few losing interest toward the end of the period.

Table 2.--Percentage of families in the purchase data analysis that submitted the indicated number of usable records during the 32-week analysis period, 154 families, October 12, 1952-May 23, 1953

Number of usable records submitted per family (Total records 4,844)	Percentage of families in the purchase data analysis	Number of usable records submitted per family (Total records 4,844)	Percentage of families in the purchase data analysis
	Percent		Percent
32	79	27	3
31	10	26	2
30	2		
29	3	Total	100
28	1		

8/ Fifty-three of the 123 families in the "other category were actually listed as eligible families by the initial interview data and were in the "other" grouping as a result of their reclassification by the recruiting interview. The final classification of these families was taken as the appropriate one for this discussion of eligibility.

9/ An offer of a reward for participation was made in order to encourage panel membership. During the recruiting, both the reward and the research contribution of the panel were stressed. Budget limitations required that the reward be little more than a token. The amount decided upon was $10 for one year of panel participation. No payments were made directly to the panel family in cash; instead, the family was given the choice of selecting

The Data Collected

The data collected were primarily the price and quantity observations on all meat, fish, and poultry items purchased or received as gifts for consumption in home-prepared meals. Lunch meats and canned, frozen, and otherwise processed meat, fish, and poultry items were included. Items bought specifically for pets were excluded even though such items were in categories normally purchased for table consumption by other families. In addition to the price and quantity information, data were collected on the main dish served at each noon and evening meal--the types of meat, fish, or poultry and how they were prepared--and where there were guests present, and the number, age, and sex of persons two years old and over who were present at each meal.

These data were collected on record forms which were submitted at the end of each week by the reporting families. A single page of the record was assigned to the data for each day of the week. 10/

9/continued a gift, valued at $10 including handling costs, from a prize catalog, or of designating a charity organization to which $10 would be sent in the family's name. The $10 was prorated by a point schedule so that a higher premium was earned for cooperation over a long period of time. No payment could be earned for any term of cooperation of less than 3 months.

10/Copy of the research form is included in the appendix.

Reliability of Panel Data

One of the major criticisms usually made against data secured from consumer panels is that these data contain a high degree of bias; therefore, it is held that generalizations made from such data are subject to considerable qualification. Actually four types of bias can exist in panel data.

1. A family characteristic bias--if the decision to participate and to cooperate over time is associated with family characteristics which, in turn, are related to purchase decisions, biases will exist in the sense that the data collected will not be representative of the population originally sampled.

2. A panel-conditioned bias--the process of keeping a record may cause a family to adjust its purchase behavior.

3. A reporting bias--over- and under-reporting may occur either as a result of improper recordkeeping techniques giving rise to unintentional inaccuracies or to an intentional attempt on the part of the recordkeeper to create a false impression.

4. A willingness-to-cooperate bias--families that will keep records may have different purchase patterns than families that will not cooperate despite a similarity in measured family characteristics.

Family Characteristic Bias

The analysis of family characteristic biases has been restricted to the families in the 2 interview approach.[11/] Families in the 1-interview approach have been omitted owing to the general failure to secure

11/ Three points should be kept in mind. First, the eligibility criteria were rather restrictive with respect to certain characteristics. To the degree that the extremes of such characteristics were more positively or negatively associated with panel cooperation than the ranges included as eligible, the restrictiveness of the eligibility criteria would tend to bias the results of any test for a relationship between cooperation and a family characteristic toward insignificance. Second, no tests can be made for biases involved in those groupings from which no data were secured. Third, a particular family characteristic bias is of interest from the point of view of the data in a given study only if that particular family characteristic is strongly enough associated with purchase behavior for the bias to have an appreciable effect on the representativeness of the panel purchase data with respect to the population sampled.

data on family characteristics from noncooperating families. The analysis for panel participation biases--both in willingness to cooperate and in actual cooperation over time--is by definition further restricted to eligible families in the 2-interview approach because they were the only families who were requested to become members. The distribution of the 896 eligible families from the 2-interview approach with respect to the panel participation interview is given in table 3. Hypotheses of no relationship between the response of these eligible families to panel participation and their major family characteristics were tested by the use of chi-square. The number of families for the chi-square tests was further reduced to a maximum of 852 by omitting the 44 families in the "other" category.

Table 3.--Distribution of eligible families from the initial interview classified by their response to the panel recruiting interview and to cooperation over time, 896 families, May 1952-May 1953

Classification	Families	Percentage of families
	Number	Percent
Refused to join panel	401	45
Joined panel:		
Submitted less than 26 weekly records	237	26
Submitted 26 or more weekly records	130	15
No contact for panel 1/	2/ 84	9
Other 3/	44	5
Total	896	100

1/ Interviewer failed to secure a definite response from the family either because no one was at home or the family member or members relevant to the interview were either not at home or not able to devote time to the interview.

2/ Includes 75 families on which recruiting visits were attempted and 9 families that were omitted from the interviewing list by mistake.

3/ Includes such categories as: Moves since the exploratory interview, family actually ineligible at time of panel participation interview, family not located and neighbors supplied data to indicate that the family was unwilling to participate in the panel.

The chi-square tests for family characteristic bias were carried out in several stages:

First, the hypothesis of no relationship between response to panel participation and a particular family characteristic was tested in a contingency table for all of the 852 families on which data were available (table 4). This test was to indicate whether a particular response was independent of the family characteristic, i.e., were the proportions in each class of the family characteristic for the specific response group significantly different from those expected on the basis of a random assignment of the indicated number of families to that response group?

Second, for one phase of this test the 237 families submitting less than 26 records and the 130 families submitting 26 or more records were combined into one grouping to check whether the indication of a willingness to cooperate was related to any of the family characteristics.

Third, tests were made in contingency tables to see if there was a relationship between the number of weekly records submitted and the family characteristics when the family had expressed willingness to participate in the panel.

These latter tests were carried out at two levels for characteristics on which data were collected during the initial interview--first, for the 367 panel members recruited by the two-interview approach; second, for all 492 recruited panel members. Tests on the relationship between the number of records submitted and family characteristics, which were not determined in the exploratory interview and, therefore, were not available for that portion of the 852 families which did not cooperate, were carried out only for the 492 recruited panel members. In all cases that were feasible, checks were made when the data suggested that joint relationships between the family characteristics were perhaps reflected in the chi-square tests.

Tables 4, 5, and 6 present the computed chi-squares for the relationships between the family characteristics and response to panel participation. The extreme right column of table 4 and both columns of table 6 represent tests of whether two or more classifications have significantly different distributions of the relevant family characteristic--i.e., a test of differences between all of the subclassifications of the parent group. The other columns of table 4 and table 5 are the result of testing whether one particular classification has a distribution of the family characteristic that is significantly different from what would be expected on the basis of the given distribution of the characteristic within the immediate parent group and on the basis of random assignment from that group.

The significant relationships between the family characteristics and response to panel participation may be summarized as follows: 12/

12/ Significant at the 0.05 level.

Table 4.--Chi-square values computed to test hypotheses of no relationship between response to panel participation and the listed family characteristics, 852 eligible families from the 2-interview approach, May 1952 - May 1953 1/

Family characteristic	Panel participation response grouping 2/				
	Refused to join panel (401)	Submitted less than 26 weekly records (237)	Submitted: 26 or more weekly records (130)	No contact (84) 3/	All eligible families (852) 4/
	Chi-square				
Education of meal planner 5/	0.20	3.64	14.79**	3.60	6/22.23**
Refused to give income 7/	9.37**	7.14**	8.07**	1.78	8/23.36**
Income 9/	2.92	.67	1.97	9.63*	6/15.19
Occupational status of housewife 10/	.37	2.38	3.62	36.59*	11/42.96**
Persons in family 12/	2.43	6.29*	1.65	7.43*	11/17.80**
Family type 13/	11.46*	23.07**	8.43	16.55**	14/59.51**
Age of meal planner 15/	16.24**	19.19**	5.61	1.20	11/42.24**

* Significant at the 0.05 level. ** Significant at the 0.01 level.

1/ Forty-four of the 896 eligible families in the 2-interview approach were in the "other" category. These 44 families were omitted from the chi-square tests because of insufficient numbers.

2/ Numbers in parentheses show the number of families in group when data were complete.

3/ Interviewer failed to secure a definite response from the family either because no one was at home for the second interview or the family member or members relevant to the second interview were either not at home or not able to devote time to the interview.

4/ Includes 715 families for income; 822 for education of meal planner; 849 for family type, and 852 for the other characteristics.

5/ Classified as: No high school, high school incomplete, high school completed, and vocational school after high school or some college.

6/ Nine degrees of freedom; individual categories have three degrees of freedom.

7/ Classified as: Gave income data and refused income data.

8/ Three degrees of freedom; individual categories have one degree of freedom.

9/ Classified as: $1,500-$2,999, $3,000-$3,999, $4,000-$4,999, and $5,000-$10,499; income after Federal income taxes.

10/ Classified as: Working less than 12 hours per week, working 12 hours or more but not full time, and working full time.

11/ Six degrees of freedom; individual categories have two degrees of freedom.

12/ Classified as: 2-, 3-, and 4-or-more-person families. Person was here defined as 2 years of age and over and normally eating at least 7 noon and evening meals a week in or from the home.

13/ Classified as: 2 adults only; 2 or 3 adults with 1 child under 10 years; 2 adults and 2 children under 10, or 1 child under 10 and 1 over 10 but under 16; 2 or 3 adults and 1 or 2 children over 10 but under 16; 3 or 4 adults; and over 4 members.

14/ Fifteen degrees of freedom; individual categories have five degrees of freedom.

15/ Classified as: Under 30 years, 30 through 49 years, and 50 years and over.

Table 5 --Chi-square values computed to test hypotheses of no relationship between an indicated willingness to cooperate in the panel and the listed family characteristics, 367 families when data were complete, May 1952-May 1953 1/

Family characteristic	Chi-square value	Family characteristic	Chi-square value
Education of meal planner 2/	3/ 4.08	Persons in family 2/	5/ 1.67
Refused to give income 2/	4/ 14.73**	Family type 2/	6/ 22.09**
Income 2/	3/ .57	Age of meal planner 2/	5/ 21.56**
Occupational status of housewife 2/	5/ 5.15		

* Significant at the 0.05 level. ** Significant at the 0.01 level.

1/ Includes 335 families for income, 361 for education of meal planner, 365 for family type, and 367 for the other characteristics. The 367 families include all panel members recruited from the eligible families in the 2-interview approach.

2/ See table 4, footnotes 5, 7, 9, 10, 12, 13, and 15.

3/ Three degrees of freedom.

4/ One degree of freedom.

5/ Two degrees of freedom.

6/ Five degrees of freedom.

Table 6.--Chi-square values computed to test hypotheses of no relationship between the number of weekly records submitted and the listed family characteristics, families agreeing to panel membership, May 1952 - May 1953 1/

Family characteristics	Panel families from eligible families in 2-interview approach (367) 2/	All panel families (492) 2/
	Chi-square	Chi-square
Education of meal planner 3/	14.01**	4/ 17.21**
Refused to give income 3/	0.81	5/ 3.18
Income 3/	1.98	4/ 4.11
Occupational status of housewife 3/	1.11	6/ 2.70
Persons in family 3/	7/ 5.97	6/ 4.30
Family type 3/	9.17	8/ 6.54
Age of meal planner 3/	2.86	6/ 0.99
Where family heads were brought up 9/	----	5/ 0.34
Religion 10/	----	6/ 19.02**
Ethnic background 11/	----	4/ 13.63**

* Significant at the 0.05 level.
** Significant at the 0.01 level.

1/ Classified as: Submitted less than 26 weekly records and submitted 26 of more weekly records.

2/ Includes 335 and 444 families for income, 361 and 485 for education of meal planner, 486 for ethnic background, 365 and 487 for family type, and 367 and 492 for the other characteristics.

3/ See table 4, footnotes 5, 7, 9, 10, 12, 13, and 15.

4/ Three degrees of freedom for both groupings.

5/ One degree of freedom for both groupings.

6/ Two degrees of freedom for both groupings.

7/ A chi-square of 5.99 is significant at the 0.05 level.

8/ Five degrees of freedom for both groupings.

9/ Classified as: Both family heads brought up in New England and all other. Refers to where they were raised after 6 years of age.

10/ Classified as: Both family heads Catholic; both family heads Protestant; and other, including family heads with other religions and family heads that did not have the same religion.

11/ Based on birthplace of the meal planner's parents. Classified as: Both parents, United States; one parent or both parents, Italy; both parents, northern Europe or Canada or parents from United States, northern Europe, or Canada but not both from same place; and all others.

1. Families with the better educated meal planner cooperated more fully over time than families with the less well educated meal planner.

2. Families that refused to give income data also refused to participate in the panel more frequently than families giving income data.

3. Families with higher incomes were found at home less frequently than families with lower incomes.

4. Two-person and two-adult families were found at home less frequently than other types of families.

5. Four-or-more-person families dropped out of the panel more frequently than smaller families when compared with the distribution of all eligible families. The same tendency was evident in tests dealing only with the 367 panel families from the 2-interview approach.

6. Families with housewives who worked outside the home were found at home less frequently than families with housewives who did not work outside the home.

Interrelationships between the family-type classification and age of the meal planner distorted the basic tests, which on the surface appeared to reflect strong family-type and age biases in response to panel participation. Likewise, interrelationships among religion, ethnic background, and education were apparently reflected in the results of the basic testing. Subclassifying to hold certain of the interrelated factors constant, while testing the effect of varying another, indicated that the effect of religion in the original testing was a reflection of ethnic background and of educational level of the meal planner. In addition, such subclassifying procedures suggested the following tendencies in the case of the other interrelationships:

1. Families with children tended to be more willing to participate in the panel than all-adult families; however, after a family agreed to participate, there was apparently no relationship between family-type and the number of weekly records submitted.

2. Families with older meal planners tended to refuse to participate in the panel more frequently than families with younger meal planners; however, after a family agreed to participate, there was apparently no relationship between age of the meal planner and cooperation over time.

3. Families with meal planners whose parents were born in Italy tended to drop out more than other ethnic background groups.

The 130 panel families who were interviewed twice and who submitted 26 or more records differed significantly from all 852 eligible families only with respect to the educational level of the meal planner and refusal to give income data (table 4). Only the former of these two family characteristics was in the group of characteristics included in the purchase data analysis.

The effect of a given bias in the distribution of a variable within the panel is a function of the size of this bias and the relationship between the variable and the data being analyzed. Educational level of the meal planner had a significant regression relationship at the 5-percent level only with total expenditures for all meat, fish, and poultry, pounds of all beef items, and pounds of fresh beef items (table 11). If the amount of educational bias indicated by the analyzed families is assumed to be the true amount in the panel data and if the regression estimate of the effect of educational level on purchases is assumed, the effect of the educational bias on the panel estimate of average total expenditures on all meat, fish, and poultry is about 2.4 percent. 13/ A similar procedure indicates that the educational bias in the pounds of all beef items was 2.5 percent and of fresh beef items 2.7 percent.

Panel-Conditioned Bias

A portion of the final interview, taken just before the closing of the panel in May 1953, concerned the influence of the recordkeeping process on the family's purchase pattern. As the rapport between office personnel and the panel families at that juncture was quite strong, it was decided to approach the analysis of the effects of recordkeeping by asking the families a series of self-evaluation questions suggesting possible areas of study-initiated changes. If a family indicated that it believed a change had occurred within a certain area as a result of recordkeeping, it was then asked to describe the nature of the change. This elaboration served a double purpose. First, the type of change was of interest in itself. Second, the elaboration tended to eliminate changes

13/ This percentage was computed by taking the regression estimate of the educational relationship and applying it to the relative educational distribution of the 852 eligible families and to the relative educational distribution of the 130 families interviewed twice and submitting 26 or more weekly records. Thus, other things being equal, total expenditures were generated for a composite family from the 852 eligible families and for a composite family from the 130 panel families. The estimated total expenditures for the latter were $5.14 lower for the 32-week period than for the former. Taking the upper 95-percent confidence limit value for the partial regression coefficient raised this 2.4 percent suggested bias to 4.1 percent.

from the analysis which had occurred but which had not affected family purchase or consumption patterns. For example, a family could not have recorded purchase data for at least 26 weeks without having a more complete knowledge of prices and total expenditures; however, such knowledge did not necessarily initiate any changes in purchase or consumption habits.

Responses to the self-evaluation questions are presented in detailed form in tables 7 and 8 in order to indicate how recordkeeping may affect panel families. However, the detail should not be interpreted as an attempt to establish these indicated changes as a serious weakness of the panel approach. The answers tabulated are based entirely on the family's opinion, with no objective criteria to judge the correctness of the responses. Some families actually making a change owing to recordkeeping may have come to consider that change as a normal part of their prepanel behavior pattern by the time of the final interview. Thus, the changes would not be reported by the family. On the other hand, families believing that changes had occurred may have made these same changes had they not been keeping records; that is, the family may be mistakenly attributing a normal evolutionary change in shopping habits, meal planning, or meal preparation to the recordkeeping. Other families indicating a change may have made no change at all; but rather as a result of recordkeeping they are conscious of certain of their actions. In addition, a family may have made certain changes such as now watching the newspapers for store specials, but this action may have had no effect on purchases, because once in the store the shopper may have bought the special anyway. Also, a family may have changed its menu entirely through changes in methods of preparation without altering its purchase pattern.

Of the 154 families meeting the requirements for the purchse data analysis 36 thought that keeping records had in some manner affected their family's purchase or consumption pattern for meat, fish, or poultry (table 7). Seventeen percent of the families thought that they now gave more consideration before going to the store to the meat, fish, or poultry items they would buy; 8 percent believed that they had made changes in they way they prepared these items for serving; and 6 percent indicated that they had changed the manner in which they selected these items at the store.

Seventeen of the 36 families expressing the opinion that recordkeeping had caused them to change their shopping habits, meal planning, or meal preparation described those changes in terms fitting into the general grouping of "more conscious of price and of total cost" (table 8). This category included such responses as, now watches papers for specials, gives more consideration to prices and to cheaper cuts, more conscious of prices and to some degree now picks store by price, now buys less out-of-season items, now buys for less waste or less fat, now compares the canned meat, fish, and poultry items for weight and price, now prepares more casseroles and meat loaves, and now uses more of the less expensive cuts.

"More variety in purchases on preparation" represents a general category cited by 16 of the 36 families attributing changes to recordkeeping. This grouping was made up of replies such as, more variety, now remembers what was served better than before, more conscious of lack of variety, more variety in preparation so that it is not necessary to record the same thing all the time, and now varies order of items to secure variety.

Table 7.--Percentage of families in the purchase data analysis that attributed indicated changes in buying habits or meal preparation to recordkeeping, 154 families, May 1953

Type of change	Percentage making change as result of recordkeeping
	Percent
Now gives more consideration before going to store to meat, fish, or poultry items they will buy	17
Changes in types of meat, fish, and poultry items they buy	3
Changes in manner of selecting meat, fish, and poultry items at store	6
Changes in way of preparing meat, fish, and poultry items	8
Changes in store at which they buy their meat, fish, and poultry items	1
All families expressing the opinion that recordkeeping had changed their meal planning, shopping habits, or meal preparation	23

Table 8.--Percentage of families attributing specified changes in shopping habits, meal planning, or meal preparation to recordkeeping, May 1953

Type of change	Percentage of all families (36) indicating a change as result of recordkeeping	Percentage of all families (154) in purchase data analyses 1/
	Percent	Percent
More conscious of price and of total cost 2/	47	11
More variety in purchases or preparation	44	10
Plans ahead more	28	6
Broils more	17	4
Other 3/	11	3

1/ Double-counting occurs between groups but has been eliminated within groups.

2/ Includes only those families who thought that this had actually affected their purchase or consumption patterns.

3/ Includes: now buys broilers instead of other chickens; now careful to check price, weight, and total cost because errors have been found; sometimes made a point of getting things packaged so that weight and price would be available for recordkeeping; and writing down left-over chuck roast brought about the realization that leftovers could be avoided by cooking only half of the roast at once.

Ten of the 36 families suggested that recordkeeping had caused changes under the heading of "plans ahead more." This grouping included such answers as, now shops more all at one time, now plans to get just what is needed and no extras which may be wasted, and now plans menus ahead more than before.

Reporting Bias

The study yielded little information on a reporting bias; spot checkup interviews to evaluate recording accuracy and completeness were not made. The tabulation of the number of times families were contacted to correct or clarify diaries gives an indication of the frequency of the more obvious inaccuracies in recording; however, no record was kept of the quantities of and expenditures for the meat, fish, and poultry items involved. It is believed that the editing procedure and repeated stressing of accuracy kept unintentional over-or under-reporting to a minimum. The prolonged reporting period should have reduced any intentional over- or under-reporting to a minimal amount.

Willingness-to-Cooperate Bias

Willingness to continue to submit purchase records over prolonged periods of time is in itself suggestive of a type of outlook or activity pattern of the individual. Such a pattern might be associated with discriminating purchase practices, interest in housekeeping, and general concern about and knowledge of food purchasing and preparation. These characteristics may, in turn, be associated with a somewhat different pattern of decisions on purchases from the pattern that would exist in other families. However, no data were available from the study to indicate the existence of a willingness-to-cooperate bias in the panel

Evaluation of Panel Data

The preceding discussion indicates that the panel approach does contain biases although these biases may not be serious for certain types of purchase data. If the goal were merely to measure the effect of various family characteristics on purchase behavior, holding time constant, other methods which are able to employ much larger samples may be superior to a panel-type study 14/. An argument can be made that having observations over a longer time period on given families permits a more accurate derivation of the relationships between purchase behavior and family characteristics. However, the cost of this additional accuracy would appear to be prohibitive in many instances relative to its contribution and to improved understanding of the relationships being measured. 15/.

14/ The number of observations can be increased either by taking more observations on a given unit or by observing more units. The between-family variation of the purchase data is greater than the within-family variation over time; therefore, within limits, it would seem to be more effective to increase the number of families observed.

15/ See the appendix for a brief discussion of the recruiting of the maintaining for this study.

A stronger case can be developed for the panel technique if observations are desired over time to measure the influence of changes in a variable such as price. Table 9 gives some indication of the amount of variation in the pounds of meat, fish, and poultry purchased by the panel families in the purchase data analysis. The first grouping of means, standard deviations, and coefficients of variation presents the variation over time for the average family. The particular time period observed by these data is the 32 weeks covered in the purchase data analysis. The second grouping also gives the variation over time for the average family but only includes a period of 29 weeks--the 32 weeks of the purchase data analysis minus the 3 holiday weeks of Thanksgiving, Christmas, and Easter. The third grouping presents the variation among families in an average week. In the latter case, the data from all 32 weeks covered by the purchase data analysis were used.

The pounds per week data differ between the first and last groupings of table 9, though both are based on 32-week data. Five panel families normally made their purchases for a consumption period that extended over more than 1 week. These families could not be included in the analysis of week-to-week variation, given the population under study, but they were included in the among-family calculations. The total of the individual categories in table 9 do not add to the total pounds of meat, fish, and poultry because the total includes lunch meats, frankfurters and canned or processed meat, fish, and poultry items. Such purchases averaged about 1 pound per week per family; no standard deviations or coefficients of variation were computed for these purchases.

The addition of the 3 holiday weeks greatly increased the variation over time within specific types of meat, fish, and poultry although the variation over time in total pounds was actually decreased. Poultry purchases were very high during the Thanksgiving and Christmas weeks, and ham purchases increased substantially for Easter. The effect on poultry purchases can readily be seem from a comparison of the coefficients of variation for the two groupings of week-to-week variation. The holiday shifts in purchases toward poultry or ham were partially offset by decreases in purchases of other meat, fish, or poultry items. As a result, all coefficients of variation over time for the 32-week period are larger than those for the 29-week period with exception of the coefficient for total pounds of meat, fish, and poultry.

In the actual analysis of the purchase data over time the variation resulting from Thanksgiving, Christmas, and Easter was largely eliminated by omitting the 3 holiday weeks from the analysis. Thus, to evaluate the relative importance of variation among families as compared with variation over time in the data presented in the following sections, it is preferable to compare the data on the pounds for the average family per week for the 29 weeks rather than data on the pounds for the average week per family. As indicated by the coefficients of variation, the variation among families was considerably greater than the variation over time--from about 3 to 6.8 times as large.

In making the above comparison, it must be remembered that the variation among families includes differences in actual family size, in the proportion of noon and evening meals eaten in or from the home by the family members, in the frequency guests are present for meals, and in the

Table 9.--Means, standard deviations, and coefficients of variation for the indicated classifications of pounds purchased by families in the purchase data analysis, October 12, 1953 - May 23, 1954

Classification	Pounds per average family per week for 32 weeks 1/			Pounds per average family per week for 29 weeks 3/			Pounds per average week per family for 32 weeks 4/		
	Mean	Standard deviation 2/	Coefficient of variation 2/	Mean	Standard deviation 2/	Coefficient of variation 2/	Mean	Standard deviation 5/	Coefficient of variation 5/
	Pounds	Pounds	Percent	Pounds	Pounds	Percent	Pounds	Pounds	Percent
All meat, fish & poultry 6/	9.24	0.26	3	8.92	0.46	5	9.07	3.05	34
Beef 7/	2.96	.41	14	3.06	.28	9	2.91	1.15	40
Pork 7/	1.99	.43	22	1.97	.34	17	1.93	1.08	56
Poultry 7/	1.68	1.68	100	1.22	.20	16	1.69	.94	56
Fish 7/	.73	.10	14	.73	.09	12	.70	.56	80
Lamb 7/	.69	.23	33	.73	.20	27	.67	.57	85
Veal 7/	.19	.07	37	.20	.06	30	.19	.33	174

1/ Includes 146 families in the purchase data analysis; excludes 5 families that normally bought for more than 1 week, and 3 families that did not satisfy the income data requirements.

2/ Measures of variation over time.

3/ Includes 146 families in the purchase data analysis; excludes the 3 holiday weeks of Thanksgiving, Christmas, and Easter; and excludes 5 families that normally bought for more than 1 week; and 3 families that did not satisfy the income data requirements.

4/ Includes 151 families in the purchase data analysis; excludes 3 families that did not satisfy the income data requirements.

5/ Measures of variation among families.

6/ Includes lunch meats, frankfurters, and canned or processed meat, fish, and poultry items.

7/ Excludes lunch meats, frankfurters, and canned or processed meat, fish, and poultry items.

number of records submitted. 16/ The variation over time, on the other hand, only includes the effect of week-to-week changes in these factors within the average family rather than the differences in the absolute level of the factors from family to family for the average week. 17/

As indicated earlier (footnote 5 page 4), the purpose of setting up the adult-meal equivalent measure of family size was to adjust as well as possible for these between-family discrepancies in actual size, in the meals eaten in or from the home by the family members, in the frequency guests are present for meals, and in the number of records submitted. Thus deflating the total pounds of a purchase category for a particular family by the total adult-meal equivalent size of that family for the purchase data period removed a substantial amount of the variation attributable to the above factors.

Such a deflating operation was carried out for the between-family variation in the total pounds of meat, fish, and poultry. The resulting coefficient of variation of 25 percent still reflects a rather high degree of variation among families despite the adult-meal equivalent adjustment 18/. While some part of the remaining variation can be attributed to the imperfections of this adjustment, the calculation points up the desirability of having the same families--or at least families matched in a purchase-data sense--for any analysis involving observations over time. The low correlations secured in the analysis of the variation among families (table 11) suggest that any efforts to match families in a purchase-behavior sense through matching the major family characteristics cannot be expected to be very productive in the case of meat, fish, and poultry purchases. Families similar with respect to the family characteristics usually employed in matching families are not similar with respect to certain types of purchase decisions. This point was the basis for choosing the panel approach for this study.

Several additional points should be added to the above discussion of variation among families and over time. First, implicit in the statements about the desirability of the panel approach is the thought that observations over time should come not only from the same individual families but also from the same time periods. While not as large as the variation among families, the variation over time was considerable and would enter into any comparisons of families from different time periods. The data in table 9 do not include a coefficient of variation that could be expected if data from both different families and different time periods were compared. The one type of coefficient presented deals with an average family between time periods and the other with an average time-period between families. If both time and families were permitted to vary simultaneously, the data would contain variation from both sources.

16/ The restrictiveness of membership in the panel and of qualifications for the purchase data analysis would greatly decrease the effect of the factors mentioned on variation among families as compared to that which might be expected with a more inclusive panel.

17/ Actually, the effect of differences in the number of records submitted has been removed from the data over time by basing each weekly average for the average family on the number of records received for the particular weeks rather than on all families in the purchase data analysis.

18/ The calculations yielded an average of 4.15 pounds per average week per meal unit with a standard deviation of 1.04 pounds.

Second, little attention has been given to the actual factors that might be causing the variation. The between-family variation would be a function of the several family characteristics already cited; the family's tastes and preferences; any price change that occurred during the period of observation, if price elasticity varied among families; measurement errors; and additional relationships not explicitly considered. The variation over time would be a function of price changes, advertising campaigns, seasonal changes, changes in the family characteristics--particularly in the factors included in the adult-meal equivalent measure, changes in tastes and preferences, measurement errors, and other relationships. In addition, if the choice of a week as the time span for purchase data analysis were not realistic with respect to the time cycle of such purchases, the data would still not be distorted if the sample were sufficiently large and families were randomly distributed at any one time or at least between weeks with respect to their position in their purchase cycle.

Third, it should not be concluded that the panel approach will always be the most expensive of the several alternatives. If continuous observations are needed over a long period, the high fixed cost of recruiting a panel can be spread over enough observations so that it may then be cheaper in both time and money than some method which required new observation units for each set of observations in the series.

Data collected by methods other than the panel approach are also subject to serious biases. The problem of up- or down-grading actual purchases to conform to the respondent's conceptual norm are much more serious in one-time or short-period contacts on either a record or recall basis. Recall approaches have the additional problem of memory errors both with respect to weight and cost of items actually included and with respect to the completeness of the listing. Short-period records have a somewhat similar type of problem in that a certain period of time is necessary for the recordkeeper to become familiar with the format of the record and to establish acceptable methods for securing the required data in its desired form.

When each panel member was recruited, an attempt was made to secure a recall listing of meat, fish, and poultry items purchased during the previous seven-day period. It was hoped that each of these recalls could later be compared with record data from the same family and that the recall technique evaluated. The large number of incomplete recall records--even after extended editing--points up the memory problem in the recall technique. A limited investigation of the completed recalls did not, however, give support to any over-or under-reporting biases relative to group averages for a later recordkeeping period. The check was made only for those panel members who were in the purchase data analysis and who had also completed their recall--116 families in all. The recall data for the various families were for scattered weeks extending from the last of May to the middle of October, while the record data were the average weekly purchases of each family over the 32-week period of the purchase data analysis. Such a comparison included a considerable degree of price and seasonal change.

III. ANALYSIS OF CONSUMER PURCHASER BEHAVIOR

This section reports the testing of hypotheses concerning the observed variation in purchases of meat, fish, and poultry items. A 32-week period starting October 12, 1952, and extending until May 23, 1953, was used as the basis for the analysis of purchase behavior. Weekly observations of individual family purchases were obtained. As table 9 indicates, the purchase data exhibited variation both over time and among families for a given time period.

Variation in Purchase Behavior Among Families

The hypothesis advanced to explain the variation in purchase behavior among families was that this variation, observed at a given time, was related to variation in family size, income, age, education, occupational status of the housewife, ethnic background, and religion. As these family characteristics can vary independently of each other both over time and from area to area at a given time, their influences on purchase behavior must be known if variation in purchase behavior is to be forcasted successfully. Data on these family characteristics were collected before the 32-week recordkeeping period was started, and additional checks were made for changes in those family characteristics were collected before the 32-week recordkeeping period was started, and additional checks were made for changes in those family characteristics which could change during the recordkeeping period; income, family size, and occupational status of the housewife.

As a measure of family size, an index of adult-meal-equivalents was constructed. This index made the family-size measure a function of the number of individual meals prepared in the home. Individual meals were weighted by the type of meal and age and sex of persons eating the meal. The weighting system used for differences in age and sex of persons eating meals prepared in the home was based on differences in recommended weekly meat, fish, and poultry requirements of a moderate cost food plan for moderately active groups as outlined in the United States Department of Agriculture publication Helping Families Plan Food Budgets. 19/ The following are the weights used: Males 10 years or over were weighted by 1; females 10 years or over were weighted by 0.9; children under 10 were weighted by 0.4. Only noon and evening meals were used in constructing the adult-meal equivalent index. The Sunday noon meal and the evening meals for the other 6 days of the week were considered the major meals for consumption of meat, fish, and poultry items. They were therefore weighted twice as heavily as the Sunday evening meal and the noon meals for the other 6 days of the week, which were considered secondary meals for consumption of meat, fish, and poultry items. 20/ Breakfast and food eaten at times other than the noon and evening meals were excluded from the index. Thus, the weighted number of noon and evening meals came closer to quantifying

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19/ U. S. Department of Agriculture, Helping Families Plan Food Budgets, Misc. Pub. 662. 1948.

20/ Two families had their main meal at noon; in these two instances noon meals were weighted twice as heavily as evening meals.

family size differences that were related to variations in family purchases of meat, fish, and poultry for home preparation than alternative formulations did.

The income series used represented pooled family income after Federal income taxes had been deducted. This income included all current earnings of the heads of the family, plus additional amounts contributed by other family members and available to the decision makers for family expenditures on food, housing, and other household inputs used jointly by the family. 21/ Thus, if the husband and wife earned $5,000 a year after Federal income taxes, and a third member earned $2,000 a year after Federal income taxes but contributed only $1,000 of this to a family income pool, the family income figure used was $6,000.

An alternative method of computing family income would have been to include all income received by family members after Federal income taxes. In the above example, such a method of calculating family income would have resulted in an income of $7,000 for the family. However, the additional $1,000 in income earned by the third member of the family was not available to the family as a whole and therefore could not be allocated for buying items used jointly by the family members. As a result, the use of a family income figure of $7,000 would overstate the family income on which purchase decisions for meat, fish, and poultry were based. On the other hand, the additional $1,000 earned by the third member of the family was available to that family member for personal expenditures which would otherwise have had to come from the pooled family income. Hence, the allocation of income available to individual family members probably affects decisions with regard to the pooled family income. Thus, the income measure used probably understates the income level of a family in which some family members contribute only part of their income to a pooled family income. It was decided, however, that the family income measure used came the closest to disposable family income available to that member of the family who bought the meat, fish, and poultry for home consumption.

In addition to the income data collected before the 32-week record period started, income information was recorded on the weekly records. At the end of the recordkeeping period, additional income information was obtained. The income figure used in the analyses was an estimate of the yearly pooled family income.

21/ Normally, the heads of the family were the husband and wife, but in some instances it was other combinations of family members who pooled their incomes and made decisions in allocating the family's income.

The formal education of the meal planner was used as a measure of the educational level of the individual panel families. In most cases the meal planner was the housewife, but in several instances another family member planned the meals. Four educational levels for the meal planner were categorized: (1) No high school training, (2) some high school training, (3) High school completed but no additional formal educational training, and (4) some vocational, business school, or college training in addition to a high school education. Similarly, the age used in the analysis was that of the meal planner.

The occupational status of the housewife was included as a variable that might affect the level and composition of meat, fish, and poultry purchases. If housewives who work away from the home have less time available for meal preparation, this may cause their purchases to be different from those of housewives who do not work away from home regularly. As the time available for meat preparation was the reason for expecting differential purchase behavior among families, the number of hours per week the housewife worked away from home was taken as the measure of the occupational status of the housewife.

Ethnic background differences among the panel families were one possible source of the observed variation in purchase behavior among families. However, deriving a useful measure of differences in ethnic background is difficult. As variability in the rate with which families adopt new cultural patterns is large, any measure of ethnic background based on time alone serves only as an imperfect measure of the desired variable. Using the birthplace of the parents of the heads of the family leaves the possibility of a combination of four different ethnic backgrounds for any one family. The measure finally employed was the birthplace of the meal planner's parents. Again the assumption was made that the meal planner was the significant influence within the family on purchase of meat, fish, and poultry.

Religion was considered as a variable that might affect the relative importance that various meat, fish, and poultry items are of the total purchases of these items. The religion of the heads of the family was used in the analysis. The composition of the panel was such that tests of religious differences were essentially a Catholic versus a Protestant comparison. In more than 90 percent of the panel families the heads of the family were either both Catholic or both Protestant. Because of the dietary restrictions associated with their religion, Catholics might purchase meat, fish, and poultry items in different proportions than non-Catholics.

Table 10 presents the distribution of the 151 panel families employed in purchase data analysis by these family characteristics. 22/

22/ Although 152 families met the requirements for the purchase data analysis, one family was excluded from the analysis because of its high income. This family had an income of over $10,000 after Federal income taxes. As the next highest family income was $8,100, the former family would be given undue weight in the regression procedures.

Table 10.--Distribution of 151 panel families by family characteristics, October 12, 1952-May 23, 1953

Family characteristic	Families	Family characteristic	Families
	Number		Number
Family size: 1/		Occupational status of housewife:	
30.0 to 59.9	58	Less than 12 hours of work per week away from home	131
60.0 to 89.9	65	12 or more hours a week but less than full-time work away from home	9
90.0 to 120.0	28	Full-time work away from home	11
Income: 2/		Ethnic background: 4/	
$1,400 to $2,999	29	Non-U. S.	88
$3,000 to $3,999	42	U. S.	63
$4,000 to $4,999	46	Religion of family heads: 5/	
$5,000 to $8,100	34	Catholic	69
Age of meat planner:		Non-Catholic	82
Under 30	34		
30 to 39	34		
40 to 49	34		
50 to 59	25		
60 and over	24		
Education of meal planner:			
Below high school	13		
High school incomplete	21		
High school complete	67		
Above high school 3/	50		

1/ Represents the number of adult-meal equivalents the family had over the 32-week period.

2/ Family income after Federal income taxes.

3/ Education of the meal planner included some formal training in addition to high school such as college, business school, vocational school, etc.

4/ Birthplace of the meal planner's parents.

5/ Religion of the heads of the family.

An additional family characteristic that might affect purchases of meat, fish, and poultry was the type of occupations of family members. In most analyses, when type of occupation is related to purchase data, the degree of physical activity associated with an occupation is used as the criterion of classification. However, social or cultural pattern differences associated with particular occupations may also affect the purchases of meat, fish, and poultry items.

Data on the occupation of the family's principal income earner were collected before the recordkeeping period started. However, it was difficult to group into meaningful classes, the many diverse job descriptions reported from the information obtained. It was concluded that the data were sufficiently inaccurate to create serious questions about the validity of results based on them. For this reason, the occupation variable was dropped from further quantitative analysis after the following analysis was carried out.

An attempt was made to group the occupational data based on the degree of physical activity associated with a particular occupation. This classification was tested by chi-square for independence from other family characteristic classifications. At the 5-percent level of significance, the hypothesis of independence between the occupational classification and other family characteristic classifications was rejected in two instances. Age and education appeared to be related to the occupational classification. The higher the age or educational level, the more sedentary was the job. The educational level and the age of panel families also displayed a significant negative correlation with each other. Hence, the three negative correlations among the three variables had to be low to allow two variables to be correlated negatively with a third variable and still be correlated negatively with each other.

Possible bias in the succeeding analysis owing to the omitted occupational variable cannot be explicitly determined, but the following indicates the direction of bias one might expect. If a positive relationship between purchases of meat, fish, and poultry items and degree of physical activity involved in various occupations were assumed and there was a negative relationship between purchases of meat, fish, or poultry items and age or education, leaving the occupational variable out of the analysis biased the relationship between purchases of these commodities and age or education toward larger negative values. If there were positive relationships between purchases of meat, fish, or poultry items and age or education, leaving the occupational variable out of the analysis biased the relationships between purchases and age or education toward smaller positive values. However, the above argument concerning the direction of bias would be true only if the occupational classification employed was a valid measure of differences in physical activity and if there were some relationship between these purchases and degree of physical activity associated with various occupations.

Statistical Model

As indicated previously, the hypothesis presented as an explanation of the variation in purchase behavior among panel families was that this variation was associated with variation in seven family characteristics. The following single equation shock model was employed:

$$(2) \quad Q = a \left(\sum_{i=1}^{7} b_i x_i \right) \varepsilon$$

where Q was aggregate purchases by a panel family over the 32-week period of a particular kind of meat, fish, or poultry, the x_i's were the seven family characteristics, family size, income, education, age, ethnic background, religion, and occupational status of the housewife, and the ε represented disturbances due to the effect of variables not included in the model. The ε was treated as a random variable having an expected value of zero and being normally and independently distributed from the x_i's in the model.

The equations were fitted by least squares procedures with deviations minimized in the direction of the purchase series. Minimization in this direction will produce estimates of the parameters that will be biased toward zero if there are significant errors of observation associated with the independent variables. Observations on 151 families were available to estimate parameters and to test the hypothesis.

In the attempt to fit these equations, several problems were encountered. First, the use of regression analysis presented a problem of ranking for several of the variables. For example, there appeared to be no a priori way to rank the various ethnic backgrounds into a meaningful series. The decision to use a bi-serial series in which a United States ethnic background was coded 0 and non-United States enthnic background was coded 1 provided such a wide classification that many ethnic differences with regard to purchases of meat, fish, and poultry items may have been averaged within each group. The religion variable was also entered into the regression analysis as a bi-serial series with non-Catholics coded zero and Catholics coded one. Again, this classification created some heterogeneity in the non-Catholic class. As more than 90 percent of the panel families had family heads who were either both Protestant or both Catholic, the within-class heterogeneity was probably less important in this instance than in the ethnic variable. The problem of multi-collinearity did not present a major obstacle to the cross-section analysis. However, several of the family characteristics were intercorrelated and as a result standard errors on the regression coefficients of these variables were increased. 23/

Table 11 presents the computed multiple correlation coefficients and the estimated regression coefficients between the seven family characteristics and aggregate purchases of each kind of meat, fish, or poultry over the 32-week period. 24/ Regression coefficients were

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23/ Appendix table 26 gives the zero-order correlation coefficients between the seven family characteristics used as explanatory variables in the regression analysis.

24/ Leaving variables in the equations that were not significant at the 5-percent level increased the probability of committing type II errors. However, rejecting the variables that were not significant at the 5-percent level would have been done at the risk of making type I errors. As the intercorrelations among the explanatory variables were not large, the results of equations fitted with only the significant variables included would be quite similar to those obtained with the seven variables included.

Table 11.--Regression coefficients and standard errors estimated by cross-sectional analysis of the aggragate purchases of 151 families over a 32-week period, October 12, 1952 - May 23, 1953 (con't.)

Kind of meat, fish, or poultry X_1	R^2	Family size 1/ X_2	Income 2/ X_3	Occupational status of housewife 3/ X_4	Ethnic background 4/ X_5	Age 5/ X_6	Education 6/ X_7	Religion 7/ X_8
Poultry purchases:								
Pounds	.36	23.69*	.57*	4.53	-6.98	.33	-4.09	6.78
		(3.24)	(.16)	(3.68)	(4.50)	(.78)	(2.60)	(4.20)
Expenditures	.28	12.19*	.46*	3.31	-5.83	-.04	-2.88	4.42
		(2.37)	(.12)	(2.69)	(3.28)	(.57)	(1.90)	(3.07)
Lamb purchases:								
Pounds	.10	1.71	.08	-.16	-1.01	2.11*	2.67	1.21
		(2.31)	(.11)	(2.61)	(3.20)	(.56)	(1.85)	(2.99)
Expenditures	.10	.42	.09	.30	-1.05	1.38*	2.02	1.40
		(1.55)	(.08)	(1.76)	(2.15)	(.37)	(1.24)	(2.01)
Fish purchases:								
All fish:								
Pounds	.28	15.83*	.21	.68	-1.28	1.48*	1.33	2.70
		(2.48)	(.12)	(2.81)	(3.44)	(.60)	(1.99)	(3.21)
Expenditures	.27	8.74*	.26*	.51	-.27	.88*	.53	2.04
		(1.58)	(.08)	(1.79)	(.69)	(.38)	(1.26)	(2.04)
Excluding prepared items:								
Pounds 13/	.24	10.93*	.14	1.15	-.52	1.64*	1.11	4.84
		(2.11)	(.10)	(2.39)	(2.92)	(.51)	(1.69)	(2.73)
Expenditures	.20	5.02*	.13*	1.10	-.49	.78*	-.00	1.38
		(1.21)	(.06)	(1.37)	(1.68)	(.29)	(.97)	(1.57)
Veal purchases:								
Pounds	.15	3.28*	.02	4.20*	1.26	-.58	-1.75	3.95*
		(1.29)	(.06)	(1.46)	(1.79)	(.31)	(1.04)	(1.67)
Expenditures	.14	1.74	.02	3.22*	.01	-.54	-2.15*	3.44*
		(1.19)	(.06)	(1.35)	(1.65)	(.29)	(.95)	(1.54)
Combination meat product purchases: 14/								
Expenditures	.06	-.46	-.00	-.12	.75	.11	.25	-.35
		(.38)	(.02)	(.43)	(.53)	(.09)	(.30)	(.49)

Table 11.--Regression coefficients and standard errors estimated by cross-sectional analysis of the aggregate purchases of 151 families over a 32-week period, October 12, 1952 - May 23, 1953

Kind of meat, fish, or poultry X_1	R^2	Family size 1/ X_2	Income 2/ X_3	Occupational status of housewife 3/ X_4	Ethnic background 4/ X_5	Age 5/ X_6	Education 6/ X_7	Religion 7/ X_8
All meat, fish and poultry purchased:								
Pounds 8/	.56	108.85	1.24*	17.73	-10.66	-.59	-11.94	23.17
		(8.65)	(.43)	(9.80)	(11.99)	(2.09)	(6.94)	(11.22)
Expenditures 9/	.48	68.07	1.51*	15.62	-12.66	-.62	-11.50*	17.02
		(7.10)	(.35)	(8.05)	(9.84)	(1.71)	(5.70)	(9.20)
Beef purchases:								
All beef:								
Pounds	.43	38.11*	.52*	7.83	-5.47	-2.74*	-6.56	1.18
		(4.09)	(.20)	(4.64)	(5.67)	(.99)	(3.28)	(5.30)
Expenditures	.34	28.19*	.75	9.18	-7.23	-1.80	-5.76	-.06
		(4.13)	(.21)	(4.69)	(5.74)	(1.00)	(3.32)	(5.37)
Excluding prepared items:								
Pounds 10/	.41	32.55*	.57*	9.59*	-5.85	-1.80*	-6.18*	-.59
		(3.80)	(.19)	(4.30)	(5.26)	(.92)	(3.04)	(4.92)
Expenditures	.32	24.72*	.76*	10.18*	-7.72	-1.14	-5.37	-1.19
		(3.99)	(.20)	(4.53)	(5.54)	(.96)	(3.21)	(5.18)
Pork purchases:								
All pork:								
Pounds	.23	26.38*	-.14	-.30	3.31	-1.05	-4.27	7.13
		(4.24)	(.21)	(4.80)	(5.88)	(1.02)	(3.40)	(5.50)
Expenditures	.21	15.32*	-.03	.34	1.52	-.66	-3.44	6.36
		(2.76)	(.14)	(.31)	(3.82)	(.67)	(2.24)	(3.57)
Excluding prepared items:								
Pounds 12/	.19	23.56*	-.15	.45	.63	-.48	-2.83	3.13
		(4.17)	(.21)	(4.73)	(5.78)	(1.01)	(3.35)	(5.40)
Expenditures	.17	13.54*	.02	-.33	1.19	-.10	-1.92	4.13
		(2.59)	(.13)	(2.93)	(3.58)	(.62)	(2.07)	(3.35)

* Coefficient significantly different from zero at the 5 percent level.

1/ Coded in number of adult-meal equivalents. (One adult-meal equivalent equals one adult male eating all noon and evening meals during the 32-week period in or from the home.)

2/ Family income in hundreds of dollars after Federal income taxes.

3/ Occupational status of the housewife was coded as follows: No regular employment away from the home, 0; part-time work, 1; and full-time employment away from the home, 2.

4/ Birth-place of housewife's parents: non-U.S. and U.S. were coded 0 and 1, respectively.

5/ Age of the housewife coded in 5-year intervals.

6/ Housewife's education below high school, 0; high school incomplete, 1; high school completed, 2; above high school, 3.

7/ Non-Catholic and Catholic coded 0 and 1, respectively.

8/ Quantity series coded in whole pounds.

9/ Expenditure series coded in dollars.

10/ Frankfurters, beef-based luncheon meats, and canned beef products were excluded.

11/ Includes both fresh and smoked pork items.

12/ Pork-based luncheon meats and canned pork products were excluded.

13/ Canned tuna, crabmeat, salmon, and other canned or dried fish were excluded.

14/ Fish or meat cakes, hashes, stews, meat pies, and other items containing significant amounts of ingredients that were not meat, fish, or poultry were grouped in this category.

estimated for both pounds purchased and expenditures on kinds of meat, fish, or poultry. Table 12 presents income elasticities for purchases of kinds of meat, fish, or poultry estimated by evaluating the regressions between income and purchases of these commodities at the means of the data.

Table 12.--Income elasticities estimated by cross-sectional analysis of the aggregate purchases of 151 families over a 32-week period, October 12, 1952-May 23, 1953

Kind of meat, fish, or poultry	Income elasticity	Kind of meat, fish, or poultry	Income elasticity
All meat, fish, and poultry purchases:		Lamb purchases:	
Pounds	.1501	Pounds	3/.1606
Expenditures	.3022	Expenditures	3/.2560
Beef purchases:		Fish purchases:	
All beef:		All fish:	
Pounds	.2076	Pounds	3/.2793
Expenditures	.3122	Expenditures	.5124
Excluding prepared items: 1/		Excluding prepared items: 5/	
Pounds	.2463	Pounds	3/.2556
Expenditures	.3728	Expenditures	.4284
Pork purchases: 2/		Veal purchases:	
All pork:		Pounds	3/.1235
Pounds	3/-.0873	Expenditures	3/.1571
Expenditures	3/-.0271	Combination meat product purchases: 6/	
Excluding prepared items: 4/		Expenditures	3/.0095
Pounds	3/-.1042		
Expenditures	3/ .0191		
Poultry purchases:			
Pounds	.4047		
Expenditures	.5100		

1/ Frankfurters, beef-based luncheon meats, and canned beef products were excluded.

2/ Includes both fresh and smoked pork items.

3/ Item which did not have a significant regression coefficient between purchases and income at the 5-percent level.

4/ Pork-based luncheon meats and canned pork products were excluded.

5/ Canned tuna, crabmeat, salmon, and other products were excluded.

6/ Fish or meat cakes, hashes, stews, meat pies, and other items containing significant amounts of meat, fish, or poultry ingredients were grouped in this category.

With the seven explanatory variables included in the equations, the equations accounted for from 5.5 to 56.5 percent of the family-to-family variation in the purchase data. 25/ In all instances, there was a higher correlation between the family characteristics and the pounds purchased than between the family characteristics and expenditures for the same meat, fish, or poultry item. The seven family characteristics had higher correlations with the aggregate purchases of all meat, fish, and poultry items than for any one of them separately. Also, the higher the proportion the kind of meat, fish, or poultry was of the total purchases, the higher was its correlation with the family characteristics.

Effect of Family Size Differences

Family size as reflected by the adult-meal equivalent series was a significant variable at the 5-percent level in 17 of the 21 equations. Only in pounds of lamb purchased and expenditures for lamb, veal, and combination meat products did the number of adult-meal equivalents not display a significant relationship with the purchase series. These results are consistent with the logic of the situation. Lamb, veal, and combination meat products were relatively minor purchases of panel families. Hence, the large variability in purchases among families tended to mask any relationship between family size and pounds of lamb purchased or expenditures on lamb, veal, or combination meat products. Also, in all 21 equations, the ratios of regression values to their standard errors for the coefficients between number of adult-meal equivalents and pounds purchased were consistently higher than the corresponding ratios for coefficients between number of adult-meal equivalents and expenditure for the same kind of meat, fish, or poultry. This higher correlation between family size and pounds purchased than between family size and expenditures was a consistent and expected phenomenon.

Effect of Income Differences

Family income was a significant variable at the 5-percent level in 10 of the 21 equations. As expected, income was more highly correlated with expenditures than with pounds purchased. Also, the estimated income elasticities for expenditures on kinds of meat, fish, and poultry were consistently higher than the estimated income elasticities for pounds purchased of the same kind of meat, fish, or poultry. With the exception of pork, those kinds of meat, fish, or poultry that were relatively large purchase items were the purchases that had significant relationships with the income variable. For the minor purchase items, a positive income elasticity may have been masked by the large variability among families in purchases of these items. While their regression coefficients were not

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25/ The original eligibility criteria for panel membership probably restricted the variation observed in the purchase data. Hence, the seven family characteristics employed in the equations probably would have explained a smaller percentage of variation in purchase data for a representative sample of the town of Medford.

significant at the 5-percent level, the minor purchase items had consistent positive regression coefficients with income; hence, the data were compatible with positive income elasticities. However, in 3 out of 4 pork purchase equations the income variable had a negative sign and in the fourth equation it had a very small positive partial correlation. Thus, the data are not compatible with a positive income elasticity for the aggregate of pork purchases.

As a group, the estimated income elasticities were quite low. The estimation procedure employed yields estimates that are biased toward zero if there are errors of observation in the income figures. However, considering the large variation in incomes the bias resulting from these errors should be small. If an average error of $1,000 in income is assumed, the resulting bias would be less than 10 percent.

Expenditures on poultry and all fish items had the two highest income elasticities. For beef, excluding prepared items, the income elasticities for both pounds purchased and expenditures were higher than the corresponding income elasticities for all beef purchases. Thus, the income elasticity for the aggregate of prepared beef items, such as frankfurters, beef-based luncheon meats, and canned beef products, was low. In fact, the regression coefficient between pounds of beef purchased excluding prepared items and income was slightly larger than the regression coefficient between pounds of all beef purchased and income. Thus, the regression coefficient between pounds of prepared beef items and income was slightly negative. In the case of expenditures for fish, income elasticity for all fish items was higher than for fish excluding prepared items. Hence, the income elasticity for expenditures on the aggregate of prepared fish items, such as canned tuna, lobster, crabmeat, and salmon was relatively high.

Effects of Other Demographic Differences

Age was a significant variable in 8 of the 21 equations. Educational level was significantly related to purchases in 4 of the 21 equations. The occupational status of the housewife and the religion variables were significant at the 5-percent level in 4 and 3 equations, respectively. The ethnic background variable was not significant at the 5-percent level in any of the equations.

Further testing indicated that the three significant relationships between purchases and the religion variable were actually ethnic differences. The largest single ethnic group in the panel was the group with an Italian background--13 percent of the families in this category. These families were predominantly Catholic. By defining the ethnic variable used in the analysis as U.S. or non-U.S., this intercorrelation between the religion and ethnic classifications was masked. When the families with Italian background were removed from the analysis, the religion variable became insignificant.

The occupational status of the housewife was only significant at the 5-percent level in 4 of the 21 equations. These 4 equations were quantities of and expenditures for beef excluding prepared items and for veal. However, in 15 of 19 equations, the occupational status variable had a positive regression coefficient with the purchase series. 26/ In the 4 equations in which the occupational status variable had a negative sign, the ratio of the regression coefficient to its standard error was very small. If these 19 regression analyses were considered as 19 individual samples and the relevant dependent variable was purchases of meat, fish, and poultry items, the probability is very small of getting 15 positive correlations between the two variables in 19 samples when no relationship exists. Hence, there seems to have been some tendency for families with housewives who work away from home to make larger purchases of meat, fish, and poultry items. The regression coefficients between the occupational status variable and pounds purchased or expenditures on all meat, fish, and poultry items were consistent with this tendency of larger amounts purchased by families having housewives working away from the home. While the null hypothesis was not rejected at the 5-percent level, it would have been rejected at the 6-percent level in the case of expenditures for all meat, fish, and poultry items and at the 7-percent level for pounds purchased of all meat, fish, and poultry items.

However, the main reason for including the occupational status of the housewife variable in the analysis was that those families in which the housewife worked away from the home might have purchased specific items in different proportions than the panel families as a whole. The argument went as follows: Housewives who work away from the home have less time to prepare meals, therefore, it would be expected that their families would purchase more frequently items that could be prepared quickly than they would items requiring more time to prepare.

Table 13 compares the proportions of specific retail cuts in the total purchases of beef, pork, lamb, and veal for the 20 families with housewives working more than 12 hours a week away from home with the proportions for all panel families.

The following test was applied to see if purchases of families with working housewives differed, in terms of cuts purchased, from those of the panel as a group.

$$(3)\quad Z = \frac{p-P}{\sqrt{\frac{P.Q}{n} \cdot \frac{M-n}{M-1}}}$$

where P is the proportion that a specific cut was of the pounds purchased of a kind of meat for all panel families, p was the proportion that a cut was of the pounds purchased of a kind of meat for the 20 families

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26/ Excluding the two equations in which all meat, fish, and poultry purchases were the dependent variable.

Table 13.--Percentage distribution of purchases of beef, pork, lamb, and veal by retail cut, all panel families and those with working housewives

Retail cut	Purchases by all families in panel	Purchases by 20 families with housewife working more than 12 hours a week away from home
	Percent	Percent
Beef:		
Roasts	32.2	42.6
Steaks	26.1	24.8
Ground Beef	26.7	22.4
Other	15.0	11.2
Total	100.0	100.0
Pork:		
Chops and cutlets	16.2	15.1
Ham slice	2.7	1.7
Roasts 1/	51.7	55.4
Bacon	16.5	13.8
Sausage	8.3	8.5
Other	4.6	5.5
Total	100.0	100.0
Lamb:		
Chops	28.2	30.8
Other	71.8	69.2
Total	100.0	100.0
Veal:		
Chops	15.0	15.0
Cutlets	36.0	23.3
Liver	10.1	8.0
Other	38.9	53.7
Total	100.0	100.0

1/ Includes loins and fresh or smoked shoulders and hams.

with housewives working more than 12 hours per week away from home, Q = 1-P, n is the number of families in which the housewife works more than 12 hours per week away from the home, and M is the total number of families in the panel. In all tests, the purchases of families with working housewives were not significantly different at the 5-percent level from those of the

panel families as a group. Thus, if the specific cuts or groups of cuts compared were representative of all meat, fish, and poultry cuts, families with housewives who worked more than 12 hours a week away from the home apparently did not purchase meat, fish, and poultry items in proportions different from those of all families in the panel.

Variation in Purchase Behavior Over Time

During the 32-week period both individual families and the total panel exhibited week-to-week variation in purchase behavior. 27/ The level of pounds purchased remained relatively constant over the period, but varied significantly from week to week. During the period considered, the pounds of beef purchased increased and the pounds of pork declined. Lamb purchases declined slightly and displayed large week-to-week variation. Veal purchases increased slightly during the 32-week period. Although exhibiting week-to-week variation, the level of pounds of poultry and fish purchased remained quite constant.

Among the many possible competing hypotheses available to explain this variation over time, the following seem to be the most important: (1) The variation was associated with variation in prices. (2) Variation in nonprice selling practices, such as store specials and advertising in general, caused the variation in purchases. (3) Holidays and other events caused the observed variation in purchases. (4) Family characteristics of the panel families, such as income, had varied over the period and hence affected purchase behavior. (5) Consumer preferences that change seasonally caused the purchase variation. (6) Nonseasonal shifts in consumer preferences over time caused the observed variation.

As noted previously, data on seven family characteristics were obtained. During the period studied only three of these characteristics--size and composition of the family, family income, and occupational status of the housewife--could logically be expected to show much variation. In fact, for the panel as a whole, these three characteristics were quite stable during this period. While individual families changed in size and composition, the individual changes offset one another; so for the whole panel the week-to-week variation in adult-meal equivalents was small. Weekly income data were collected during the recordkeeping interval from those families who normally received income in regular patterns, but such data could not be obtained from families whose income was received in irregular payments. It was impossible to discern any significant week-to-week variation in income for the whole panel. Changes in the occupational status of housewives were insignificant and, for the panel as a whole, the variable was quite stable.

27/ Appendix table 27 presents the data on average weekly purchases of kinds of meat, fish, and poultry per family for 146 families over the 32-week period. Five families making infrequent purchases of large quantities of meat, fish, and poultry during the 32-week recordkeeping period were dropped from the analysis of variation over time.

In analyzing seasonal changes in purchases, two distinct elements must be recognized. The first elements is the result of consumers' adjusting their purchase patterns on the basis of fixed and given preferences, to supply and price conditions which vary seasonally. This adjustment is a function of selling practices and is not a seasonal shift in consumer preferences. The second element is the effect of preferences patterns that vary with the seasons. The summer period, with its shifts among purchases of meat, fish, and poultry items including a general shift away from pork, seems to present the more important seasonal variation in preferences. By observing the panel's purchase behavior from October 12 to May 23, the more important seasonal changes in preference patterns for these commodities were eliminated.

In addition to seasonal shifts, there is the possibility that preference patterns shifted owing to other factors during the time observed and caused the measured variation in purchases. Two reasons suggest that these shifts did not occur. First, the time period was relatively short. Second, during the period under study there were no important events that would be expected to cause shifts in consumer preferences for expenditures or savings. Hence, it appears reasonable to assume that preferences remained constant.

To summarize, price variation, variation in the nonprice selling practices, and holidays or other events were the three important factors causing variation in the purchase behavior of the panel families during the 32-week recordkeeping period.

Three holidays that occurred during the recordkeeping period appear to have exerted major influences. These were Thanksgiving, Christmas, and Easter. Table 14 compares the average weekly purchases of meat, fish, and poultry per family by the 146 families during the weeks in which Thanksgiving, Christmas, and Easter fell with their purchases during the other weeks in the recordkeeping period. 28/ Poultry purchases were high during these 3 weeks, and pork purchases were high during the week before Easter Sunday. These increases mainly represent increased purchases of turkey and hams. As there was no satisfactory way of adjusting the purchase data for the influences of these three holidays, the 3 weeks in which they occurred were dropped from succeeding analysis.

Statistical Model

With the variation associated with holidays and other events largely eliminated, the remaining variation over time in the purchase data was assumed to be mainly a function of variations in prices and in nonprice selling practices. To test these hypotheses, the following single equation shock model was employed:

$$(4) \quad Q = a + \sum_{i=1}^{n} b_i x_i + \sum_{j=1}^{m} b_j Z_j + \epsilon$$

28/ See also figure 3 for week-to-week variation in purchases and the effects of Thanksgiving, Christmas, and Easter on purchases.

Table 14.--Comparison of average weekly purchases of meat, fish, and poultry per family in weeks which included Thanksgiving, Christmas, and Easter and their purchases in other weeks of recordkeeping period, 146 families, October 12, 1952-May 23, 1953 1/=

Kind of meat, fish, or poultry 2/	Average weekly purchases in--			
	29-week period	Thanksgiving week	Christmas week	Easter week
	Pounds	Pounds	Pounds	Pounds
All meat, fish, and poultry	7.91	12.56	12.91	8.79
Beef	3.06	1.96	1.95	2.07
Pork	1.97	1.48	1.69	3.48
Poultry	1.22	8.25	7.79	2.12
Lamb	.73	.29	.50	.25
Fish	.73	.49	.89	.77
Veal	.20	.09	.09	.10

1/ Both Thanksgiving and Christmas occurred on Thursday so that most of the purchases for those holidays were made during the same week. For Easter, the purchase figure is for the week before Easter Sunday.

2/ Quantities do not include prepared items such as luncheon meats, frankfurters, canned meat, fish, or poultry products, or combination meat, fish, or poultry products such as meat and fish cakes, hashes, stews, meat pies, and other items containing significant amounts of ingredients that are not meat, fish, or poultry.

where Q was the average family purchase for a given week of a particular kind of meat, fish, or poultry, and x_i's were the six price indexes for beef, pork, lamb, veal, poultry, and fish; the Z_j's were the nonprice selling practice indexes, and the E represented disturbances due to the effect of variables not explicity included in the model. The E was treated as a random variable having an expected value of zero and being normally and independently distributed from the x_i's and Z_j's in the model.

In particular, it is believed that the regresssion coefficients between the quantity series and the price indexes measure demand relationships independently of supply effects. Several reasons seem to justify the belief that this identification has been achieved: (1) On the basis of the information available it would seem safe to assume that during the short period observed, the panel's preferences remained constant and, therefore, the price-quantity observations represent intersections on a given and stable demand function. (2) As the families observed were only a small segment of the total market, adjustments in their purchases would not affect the market price. More explicitly, the question is whether or not the disturbances in the equation are correlated with the included price indexes. On the assumption that the major disturbances are due to local conditions -- weather, local events, sales activities, etc., -- not explicitly allowed for in the model, their impact on

meat prices which are influenced by national supply and demand conditions is negligible. (3) Even if the disturbances in the equation do affect meat prices, the short-time period employed will negate the correlation; that is, a disturbance in any week would normally not affect the price until the following week--the disturbance in week i may be related to the price in week i / 1 but this will not cause any bias in the estimation procedure. Because of the above reasons prices were assumed as given data to which the panel adjusted its purchases.

Price Indexes

A price index was constructed for each kind of meat, fish, and poultry purchased. These indexes were based on price data collected from stores located in Medford. Prices paid by the individual families could have been used but this procedure would have raised two major problems. First, if a simple average was taken, for example, all beef purchases or all pork purchases for a particular family during a given week, the price index would vary from week-to-week depending on the beef or pork cuts purchased. If price indexes were constructed for each family based on a weighted average of particular cuts for each kind of meat, fish, or poultry, a major problem of estimating prices of cuts not purchased by a family in a given week would be encountered. Since for a given family in a particular week a large percentage of the cuts would not be purchased, the errors involved in estimating the missing data would be great. It was, therefore, decided to collect price data from stores in tha area and to assume that all the families in the panel were facing the same prices. 29/

The major problem in constructing any index is the determination of the weights to be given to individual items in the index. The composition of and weighting for an index depends, of course, on the particular use for which the index has been constructed. Within the context of this study, the index for a particular kind of meat, fish, or poultry should be an average with each cut weighted by the relative importance of that cut in a family's purchase decisions. The problem is that it is impossible to determine these subjective weights for the individual cuts. Two alternative weighting systems were considered. Both had more of the characteristics of a value index. As value indexes probably diverge from the criteria desired, either one of the alternative indexes served only as an imperfect measure of the desired variable.

One procedure considered was to weight each item by the proportion that item was of the total purchases of that kind of meat, fish, or poultry. For example, in the beef index, the various cuts of beef would be weighted by the proportion the purchases of that particular cut were of the total pounds of beef purchased. This index, of course, is a value index and gives no weight to prices of cuts considered but not purchased at the time the purchase was made.

29/ See pages 45 and 46 for a discussion of the possible biases that might arise out of this assumption.

The second alternative was to weight the individual cuts by the proportion they represent of the total yield from a typical carcass. Again, this is a value index. If all cuts from a carcass had to be sold in the market, this procedure would be equivalent to the first procedure and both methods would come close to approximating the desired index. For studies of large geographic areas such as the entire United States, this measure probably works quite well. However, this study was restricted to a particular segment of one town's population. In such a case, there is no a priori reason to expect that the families studied had to clear the market of all cuts from a typical carcass.

The importance of the error introduced by using an imperfect measure of a desired variable is also a function of the degree of aggregation involved. For example, if all price series displayed positively correlated proportional price movements, the weighting problem would disappear. Any weighting system would yield the same results. To the degree price series diverage from the above criteria, it is clear that the degree of aggregation will affect the amount of error introduced. Because they are a function of joint supply, prices of individual cuts of a particular kind of meat would be expected to exhibit a higher positive correlation than prices for different kinds of meat, fish, and poultry. Hence, constructing a price index for a particular kind of meat, for example beef, involves less error than constructing a price index for all meat, fish, and poultry items. Figure 1 shows the prices of individual beef cuts during the 32-week period observed. Figure 2 shows the constructed price indexes for kinds of meat, fish, and poultry during the same period. It is readily seen that price movements of the individual cuts of beef are much more highly correlated than the movements of the price indexes for the different kinds of meat, fish, and poultry.

From the above reasoning, it was concluded that the system of weighting involved in constructing the price indexes for individual kinds of meat, fish, and poultry was not of major importance. As prices were highly correlated, any weighting system would have generated an index that would show the same absolute changes. A system of weights will, however, affect the level of price indexes and therefore affect price elasticities in which percentage changes are involved. For indexes of which the component items do not exhibit high positive correlations, the system of weighting is of major importance as it affects both the level and changes of the index. Hence, the price indexes for individual kinds of meat, fish, and poultry are presented with much greater confidence than the price index for all meat, fish, and poultry items.

For the price indexes for beef, pork, lamb, and veal, the individual cuts were weighted by the percentage each cut represents of a typical U.S. Choice carcass. 30/ For the poultry price index a simple average of

30/ Data on typical yields were based on cutting test information for the Boston area supplied by the Atlantic and Pacific Tea Company and First National Stores, Inc. Table 29, appendix, presents data on the cuts and weights used in constructing the price indexes.

Figure 1.

Prices of retail beef cuts, October 12, 1952 - May 23, 1953

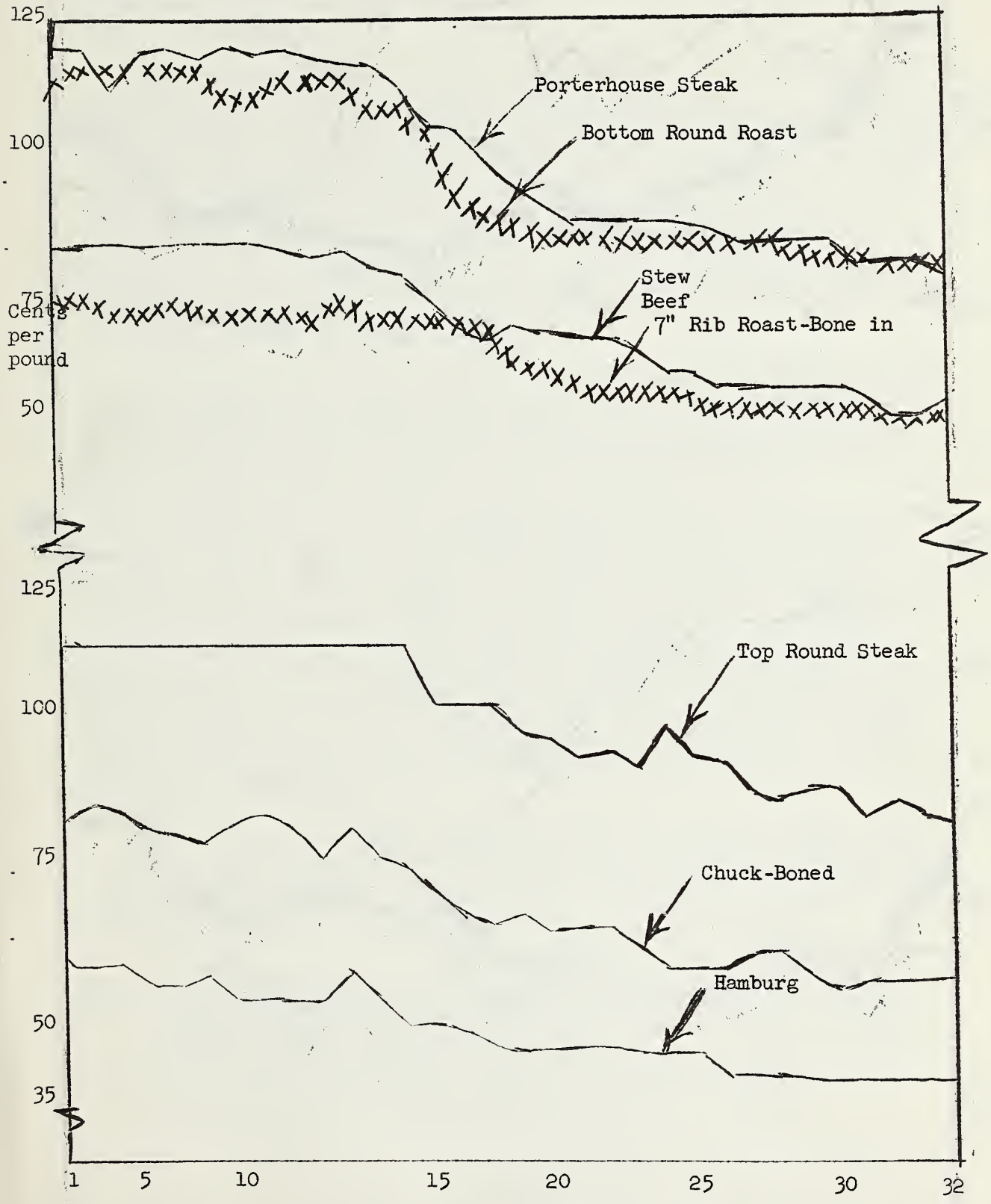
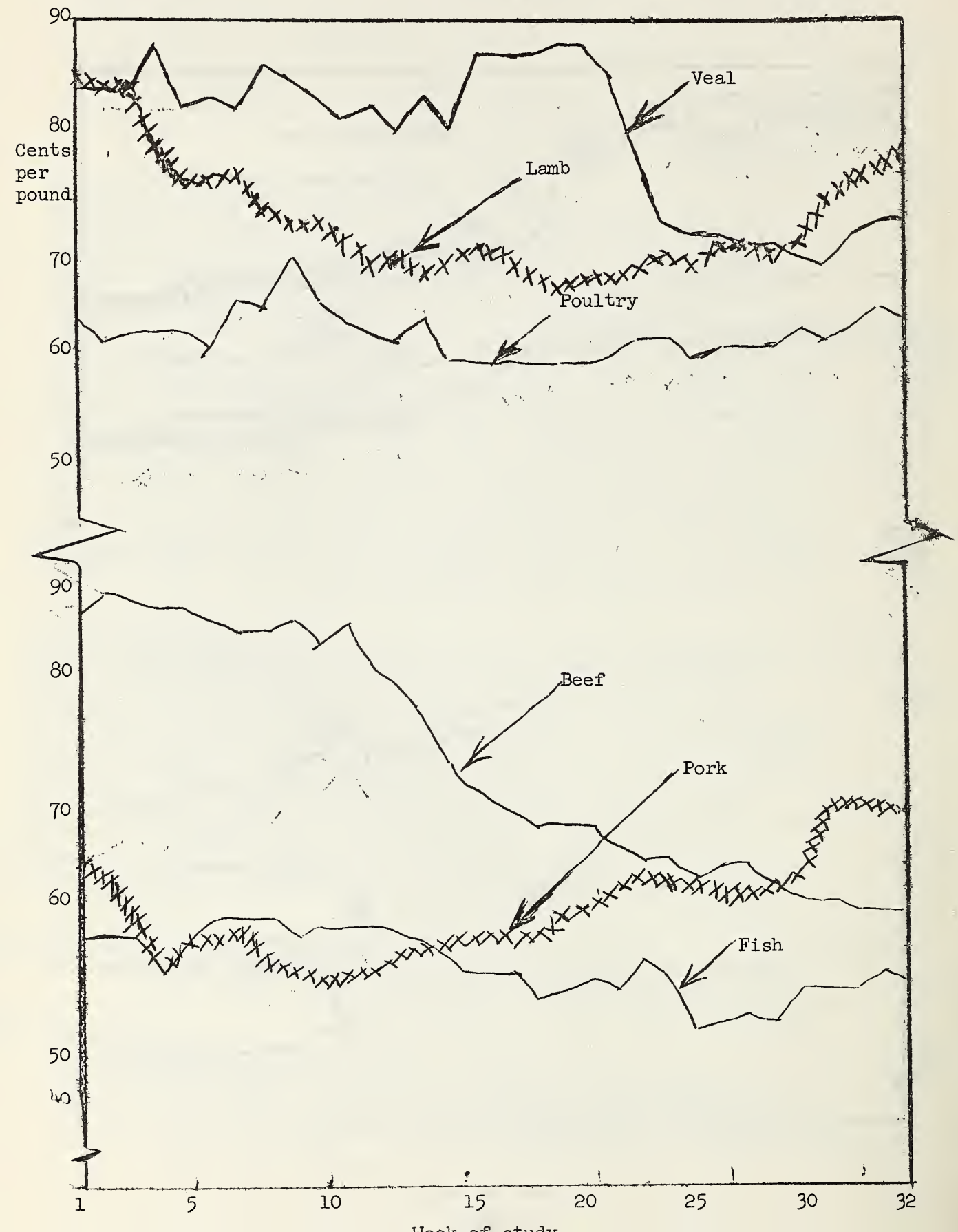


Figure II

Price indices for kinds of meat, fish and poultry, October 12, 1952 - May 23, 1953



fryer and fowl prices was used. The price was used. The price index for fish was a simple average of the prices of haddock fillet and swordfish steak. For the price index for all meat, fish, and poultry items, the weights applied to the individual indexes were based on the panel's purchases over the 32-week recordkeeping period. 31/

The data for the price indexes were collected from the four major chainstores operating in the town of Medford. Stores were visited once a week, on Wednesday morning, and prices for specific U.S. Choice cuts were recorded. As the normal pricing pattern for the area was to change prices on Mondays and Thursdays, prices recorded on Wednesday were taken as being indicative of the prices for Monday through Wednesday of that week. Weekend specials which ran from Thursday through Saturday were taken from the newspaper advertisements of the companies from which price data were collected. Prices for the last 3 days of the week were weighted by 7, and prices for the first part of the week were weighted by 3, as approximately 70 percent of the panel's purchases were made during the latter part of the week.

In appraising the price indexes used, two possible sources of bias should be noted. The first of these was the use of chainstore price data as indicative of the prices facing all families in the panel. 32/ The second possibility of bias results from weighting the individual cuts in a price index by their yield from a typical carcass.

Using chainstore prices could bias the indexes in the following respects: (1) Chainstore prices might be more variable than prices in other stores. If this were true, the resulting indexes would exhibit greater absolute changes than the price movements that panel families on the average actually faced. (2) The level of chainstore prices might be lower than the average for all the stores serving the panel member. An index which exhibited both greater absolute price movements and a level of prices which was lower than the actual price situation would be biased in the direction of having greater percentage changes than the prevailing price behavior during the period studied. Hence, price elasticities of demand estimated on the basis of these indexes would be biased toward zero.

If the families observed do not consider all cuts in making purchase decisions, the weighting of individual cuts in an index by their yield from a typical carcass introduces error. Whether this will cause systematic error will depend on the particular segment of the population studied.

31/ See appendix table 30, for weights used in constructing the price index for all meat, fish, and poultry items. Table 31 appendix, presents data on the constructed price indexes for kinds of meat, fish, and poultry items.

32/ Approximately 70 percent of the panel families indicated that a chainstore was the major source of their meat purchases.

In this study, where the lower segment of the income distribution was excluded from panel membership, the index might have a lower average level than the actual price pattern the families consider in making purchase decisions. 33/ Again, the lower average level of the price index would bias the price index toward greater percentage changes. Hence, estimated price elasticities of demand will be biased toward zero.

It is impossible to gauge the size of the bias because of the difficulty of determining the prices and factors considered by panel families in making purchase decisions. However, the constructed price indexes could be contrasted with a series which was probably biased in the other direction; namely, the average price paid for meat, fish, or poultry. The amount of their divergence should indicate whether there is a possibility of important bias in the price indexes.

To repeat, several types of errors are associated with a price series based on average prices paid. First, the series varies from week-to-week depending on the variation in cuts purchased. Second, if as prices fall, there is an upgrading in quality and type of cuts purchased, the average price per pound paid will not fall as much as the actual price movements. Finally, the series does not give weight to cuts considered but not purchased in making purchase decisions. For beef, the following difference was found between the average price paid and the constructed beef price index: The average price paid for beef over the whole 32-week period was $0.85 per pound; the average index price per pound over the whole period was $0.75. For all meat, fish, and poultry items, the average price paid over the whole 32 weeks was $0.74 per pound; the average index price was $0.67 per pound.

Regressions between pounds of beef purchased and either the beef price index or the average price paid for beef were fitted to the data. Price elasticities were evaluated at the means of the data. The estimated price elasticity of demand for beef using the beef price index was - .50. Using the average price paid for beef, an estimated price elasticity of -.68 was derived. The divergence of .18 does not seem to be unduly large, and an unbiased estimate probably lies somewhere between the two.

Indexes of Nonprice Selling Practices

Nonprice selling practices were the second type of independent variable in the model presented to explain variation in the panel's purchase behavior over time. To the degree that stores employ newspaper and radio advertising, displays featuring particular items within the store, and other similar practices independently of price movements, it should be possible to obtain some measure of the influence of these practices. If they do affect consumer purchase behavior, estimating their effects simultaneously with the effects

33/ Seventy-eight percent of the families ineligible for panel membership because of their family income were families with incomes below the minimum level for panel participation.

of price movements should increase the efficiency with which both are measured. On the assumption that advertising, store displays, and other nonprice selling practices are highly correlated methods used by a store to influence sales, it was decided to use items featured in the weekly newspaper advertisements of individual stores as the variable to include in the regression equation to represent nonprice selling practices. Therefore, the regression coefficient between the included variable and quantities purchased will measure the aggregate effect of all the nonprice selling practices. By weighting equally each newspaper feature of a kind of meat or poultry by any one of the four stores from which price data had been collected, a simple index of nonprice selling practices was constructed. (As a result, the index for a particular kind of meat or poultry shows for any given week how many stores were featuring this kind of meat or poultry in their weekly newspaper advertisement.) Table 32, appendix, presents the indexes of nonprice selling practices for meat and poultry by kind.

In addition to assuming that nonprice selling practices by a particular store are highly correlated, the use of the above indexes involved the assumption that families not buying from the four stores from which data were collected were also subject to the same level of nonprice selling practices during a given week. This assumption can be rationalized on two grounds. First, as featuring is related to the general supply situation for a kind of meat, fish, or poultry there may be a positive correlation between kinds of meat and poultry featured by the four stores considered and the other stores servicing panel members. Second, panel members not buying from these four stores might nevertheless be influenced in their purchase decisions by the newspaper and radio advertisements of the four stores considered. While the indexes were undoubtedly subject to error, they did represent easily obtainable, useful measures of the variation in nonprice selling practices experienced by the panel families during the 32-week recordkeeping period.

Testing and Estimating Procedures

The equations were fitted by least-squares procedures with the deviations minimized in the direction of the purchase series. As pointed out before, minimization in the direction of the purchase variable will produce estimates of the regression coefficients which are biased toward zero if there are significant errors of observation associated with the explanatory variables.

In summary, the model outlined to explain variations in the purchase series contained 11 explanatory variables. Six of these were price indexes for the individual kinds of meat, fish, and poultry, and five were indexes of nonprice selling practices for kinds of meat and poultry. Twenty-nine weekly observations were available to estimate parameters and test the hypothesis presented.

In attempting to test the model with the data available, the problem of multicollinearity was encountered. The individual price indexes tended to exhibit slowly-moving smooth patterns, and the purchase data tended to show more week-to-week variation. As a result,

the price series were in general more highly correlated with each other than with the purchase series. (See figure 2, and figure 3 for a comparison of the week-to-week variability of the two types of series.) Table 15 presents the zero-order correlation coefficients between the price indexes along with their zero-order correlation coefficients with the quantity of beef purchased. Introducing all six of these explanatory variables into one equation increased the standard errors of the estimated regression coefficients so that none of the regression coefficients were significant at the 5-percent level. Also, the indexes of nonprice selling practices for beef and pork were more highly correlated with the price indexes for beef and pork than were those for other kinds of meat and poultry. This situation tended to aggravate the multicollinearity problem. As the major objective of this study was to test for the significant influences on consumer behavior during the period observed, rather than to estimate parameters for a given model, the method of analysis was revised to provide a more discriminating test procedure.

The following alternative approach was adopted. Variables were entered into the equations in an order based on a priori judgment of their importance and the size of their zero-order correlation with the dependent variable. As a consequence, the first two variables entered into any equation were the price of the commodity under consideration and the index of nonprice selling practices for that particular commodity. For example, the first two explanatory variables entered into the beef equation were the price index for beef and the index of nonprice selling practices for beef. If both their zero-order correlation coefficients became insignificant with both variables in the equation, it would be concluded that it was indeterminate which variable was the true causal variable. If one became insignificant and the other remained significant, the variable that became insignificant would be rejected. 34/ The process was then repeated with the other nine explanatory variables added in various combinations to see if any of them would have a significant effect on the dependent variable.

Beef Purchases

During the 32-week period, there was a general increase in the average weekly purchases of beef (fig. 4). For example, during the first 6 weeks of the period, the average weekly purchase per family was 2.72 pounds; for the last 6 weeks, it was 3.32 pounds. During the 32 weeks, the price index for beef fell from an average of approximately 89 cents per pound for the first 6 weeks to an average of approximately 62 cents per pound for the last 6 weeks of the study.

34/ Variables not significant at the 5-percent level were rejected at the risk of committing type 1 error. However, considering the nature of the data, committing type 1 error seemed to be the most probable outcome if the variables were left in the equation. Also, the disturbances in the equation were not completely random and, as a result, the tests were biased toward rejecting the null hypothesis.

Average weekly purchases of kinds of meat, fish and poultry per family for 146 families, October 12, 1952 - May 23, 1953

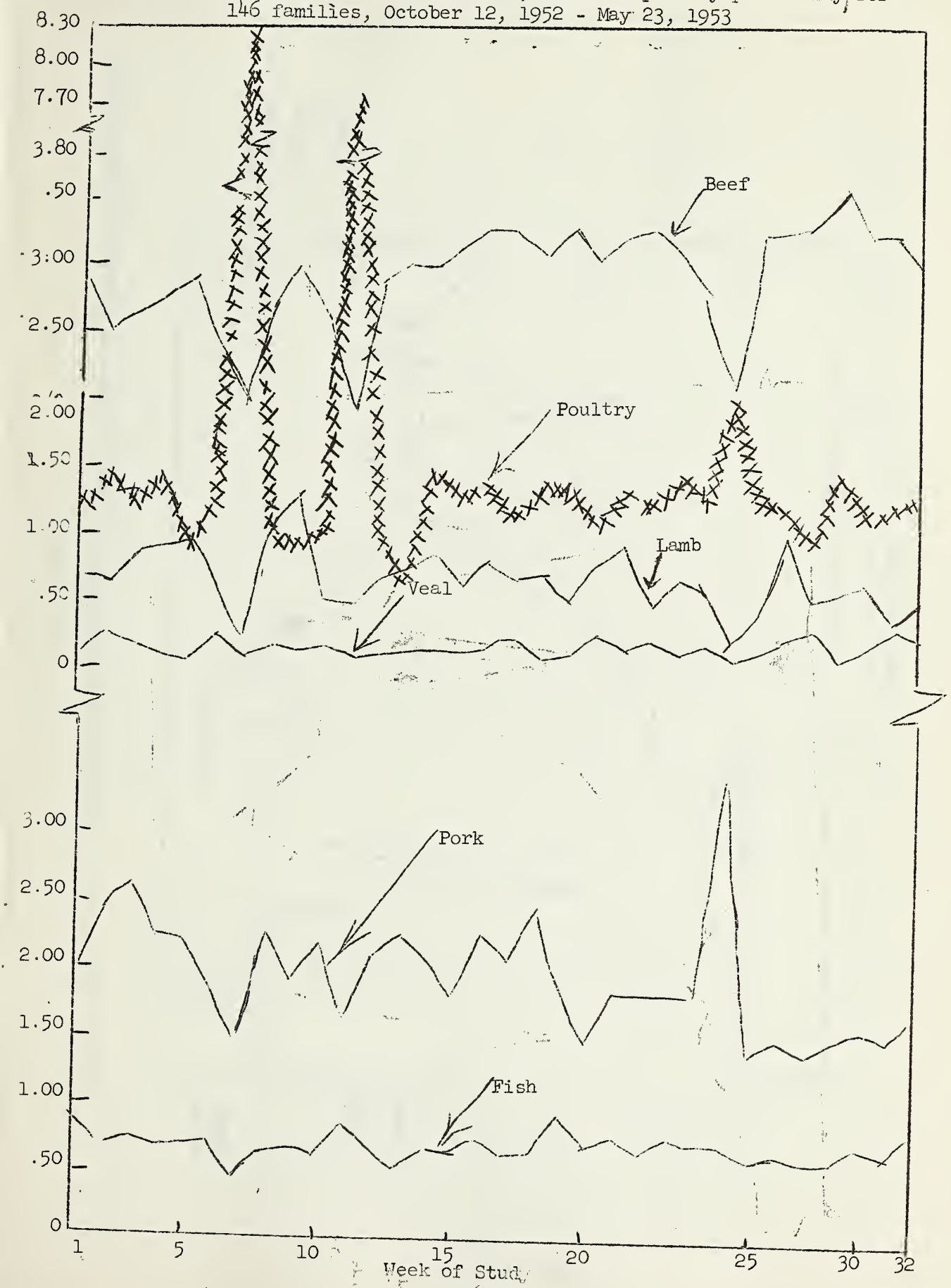


Figure IV.

Average Weekly Purchases of beef per family for 146 families, October 12, 1952 - May 23, 1953.

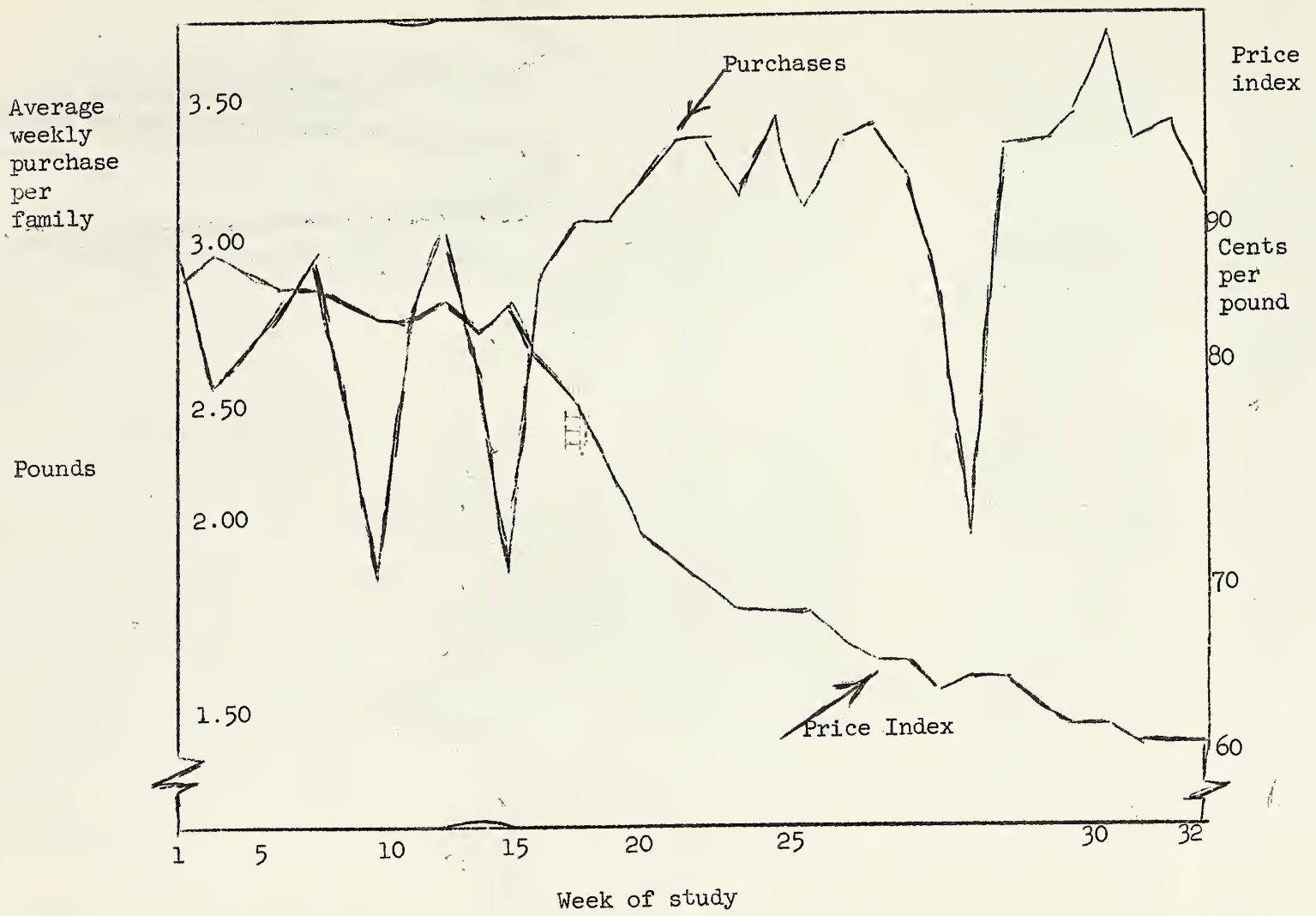


Table 15--Zero-order correlation coefficients between the price indexes for kinds of meat, fish, and poultry and their zero-order correlation coefficients with the quantity of beef purchased, October 12, 1952-May 23, 1953 1/

Price indexes for kinds of meat, fish, or poultry	Price Indexes						Quantity of beef
	Beef	Pork	Lamb	Fish	Poultry	Veal	
Beef	1.0000	-.6361	.4664	.8220	.3836	.6532	-.7998
Pork	---	1.0000	.3081	-.4360	-.0714	-.6624	.4313
Lamb	---	---	1.0000	.4134	.3627	.0218	-.5388
Fish	---	---	---	1.0000	.5408	.5296	-.5778
Poultry	---	---	---	---	1.0000	.0126	-.2520
Veal	---	---	---	---	---	1.0000	-.3842

1/ Twenty-nine observations.

Both the price index and the index of nonprice selling practices for beef had significant zero-order correlation coefficients at the 5-percent level with beef purchases. However, when both were entered into the same equation, the index of nonprice selling practices for beef became insignificant. Also, none of the other nine variables gave any significant explanation of the variation remaining after the price index for beef had been entered into the equation. The zero-order correlation between quantity of beef purchased and the price index for beef was -.7998. The linear regression coefficient between pounds of beef per family and the price index of beef was -.0203 with a standard error of .0029. Estimating a short-run price elasitcity of demand for beef at the means of the price index and quantity series gave an elasticity of -.50. 35/

However, it is doubtful that this is the relevant measure of the short-run price elasticity of the panel families over the period observed. The period was one in which the price of beef was relatively stable for a time and then fell continuously to a new level. This fall in price level was paralleled by an increase in beef purchases to a new purchase level. The relevant question therefore is: Over the whole period how much had the price of beef fallen and purchases of beef increased from the level of prices and purchases at the beginning of the period? Average family purchases per week increased by 0.60 pounds in the last 6 weeks of the period from the 2.72 pounds during the first 6 weeks. This was an increase in beef purchases of 22.1 percent. Similarly, the price of beef fell 27.7 cents per pound between the two periods, a decrease of 31.0 percent. 36/

By dividing this 22.1 percent increase in quantity purchased by the 31.0 percent decrease in price, an estimated shor-run price elasticity of demand for beef of -.71 is obtained. Similarly, using the linear regression line fitted by least-squares but estimating the elasticity at the average price level during the first 6 weeks of the period yields a short-run price elasticity of demand for beef of -.66. These last two estimates, -.71 and -.66, seem to be the more relevant statistics.

Pork Purchases

Over the 32 weeks that the purchase data were analyzed, there were two general patterns in the panel's pork purchases. For the first 18 weeks, pork purchases varied from week-to-week, around a fairly constant level. For the remaining 14 weeks, there was a continuous decline in pork purchases. This general decline, starting with the 19th week of the study, matched quite closely the general increase in the pork price index starting also with week 19 (fig. 5).

35/ Tests were applied to determine if there was a change in the composition of beef purchases as the price of beef declined. The results indicated that the proportion of specific cuts did not change significantly between the beginning and end of the 32-week period.

36/ The actual average of the price index of beef for the first 6 weeks was 89.33 cents per pound. For the last 6 weeks, the new level of price was 61.67 cents per pound.

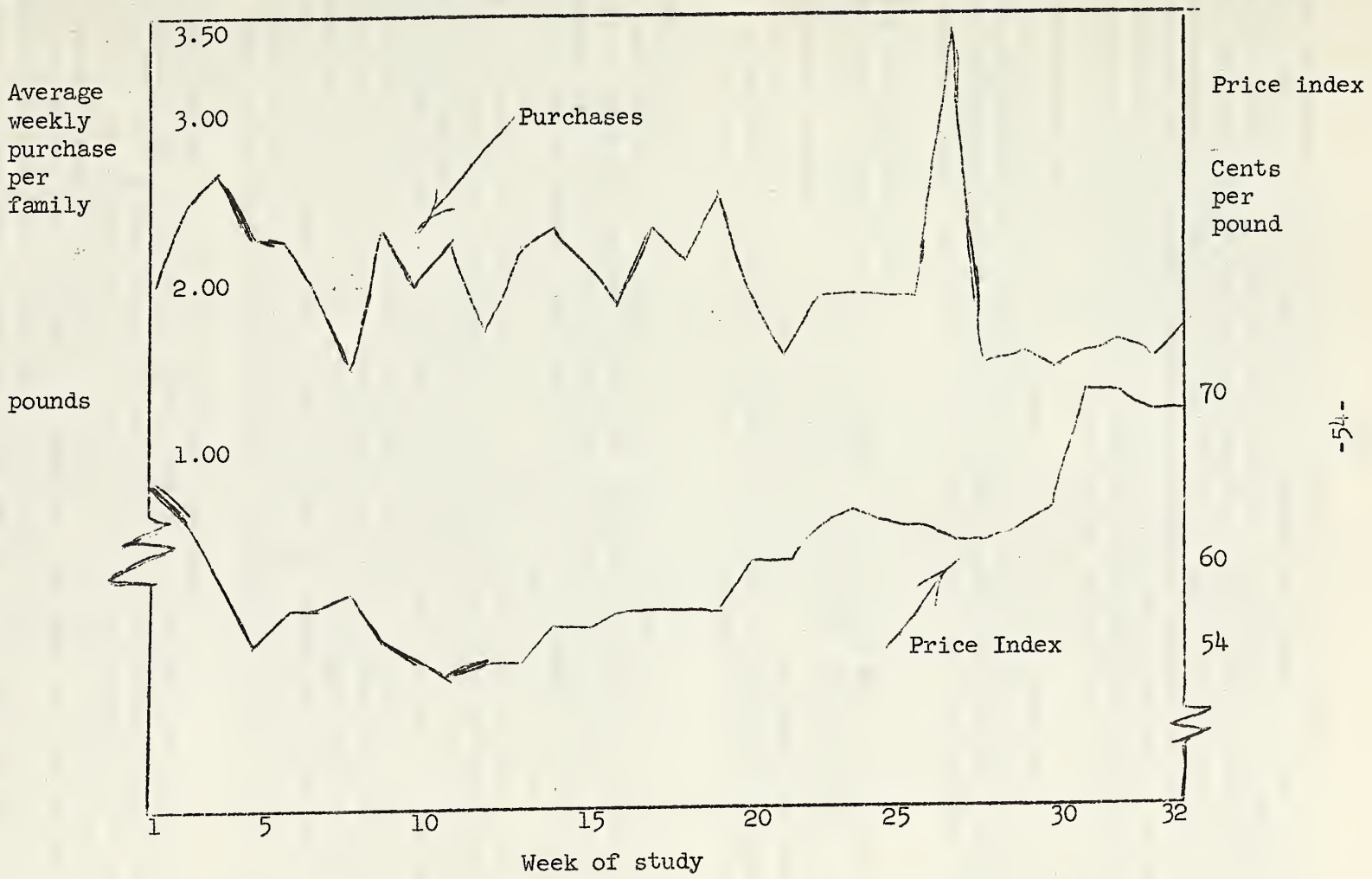
Both the pork price index and the index of nonprice selling practices for pork had significant zero-order correlation coefficients with pork purchases at the 5-percent level. However, when both entered into the same equation, the index of nonprice selling practices for pork became insignificant. Also, 8 of the 9 other variables were of no significant value in explaining the remaining variation in the pork purchase data. However, when the price of beef was entered into the equation, the price of pork became insignificant at the 5-percent level, and the price of beef was the lone explanation of pork purchases during the period observed. In this equation, the regression coefficient between pounds of pork and the beef price index was .0173, with a standard error of .0051. By evaluating at the means, an estimated short-run cross-elasticity of .66 between the price of beef and the quantity of pork purchased was derived.

Two sources of information tend to discredit the conclusion that the price of beef was the significant influence on purchases of pork during the period observed. First, figure 5 shows the close association between the time that pork purchases started to decline and pork prices started to move upward. On the other hand, beef prices had started to fall in week 12 with little observable effect on the level of pork purchases. Second, examination of individual family behavior, which is discussed more fully on page 1, indicated no correlation between those families who increased their beef purchases and those families who decreased their pork purchases--the families who increased their beef purchases tended to increase their purchases of all meat, fish, and poultry items, whereas, families who decreased their pork purchases also tended to decrease their purchases of all meat, fish, and poultry items. If, in fact, there was little or no substitution of beef for pork by individual families, positive cross-elasticities would seem to have been nonexistent during the period studied.

If the cross-elasticity between pork purchases and the price of beef is rejected, the price of pork is the only explanatory variable left in the equation with the quantitiy of pork. The linear regression coefficient between purchases of pork and the price index for pork was -.0410 with a standard error of .0104. Evaluating the regression line at the mean quantity and price provides a short-run price elasticity of demand for pork of -1.27.

However, as in the case of beef, it is doubtful that the mean value of the regression line is in this instance the correct point to estimate the price elasticity. Starting from a low price--high purchase situation for pork the price of pork increased. The relevant question is what was the percentage change in the panel's purchase behavior from the original position on the demand curve. If the 6-week period from week 12 through 17 is taken as indicative of the average price-quantity situation before the increase in pork prices and it is compared with the last 6 weeks of the period, the following results are obtained: Purchases of pork declined from an average family purchase of 2.145 pounds per week to 1.570 pounds per week, a decline of 26.8 percent. The price of pork increased from 57.2 cents to 71.3 cents per pound, or 24.8 percent. These data yield a short-run price elasticity of demand for pork of -1.08. Similarly, if the estimated regression line is evaluated at the average price during

Figure V.
Average weekly purchase of pork per family for 146 families,
October 12, 1952 - May 23, 1953



the period between weeks 12 and 17, an estimated short-run price elasticity of demand for pork of -1.10 would be obtained.

Lamb Purchases

Over the 32-week period analyzed, lamb purchases exhibited a slight downward trend. In addition, the week-to-week variation in lamb purchases was large, with a coefficient of variation over time of 27 percent (a standard deviation of .20 pounds). Figure 6 presents data on the average weekly purchase of lamb per family and the price index for lamb.

The zero-order correlation between lamb purchases and the lamb price index was not significant at the 5-percent level, but the index of nonprice selling practices for lamb did exhibit a significant zero-order correlation with lamb purchases. Neither entering the lamb price index into the same equation with the index of nonprice selling practices for lamb nor combining it with any other explanatory variables would make the lamb price index show a significant relationship with lamb purchases at the 5-percent level. After the index of nonprice selling practices for lamb had been entered into the equation, the only additional variable that explained some of the remaining variation in the purchase data was the index of nonprice selling practices for veal. With both variables in the equation the following regression coefficients were obtained. Between pounds of lamb and the index of nonprice selling practices for lamb, a regression coefficient of .1347 with a standard error of .0222 was obtained. Between pounds of lamb and the index of nonprice selling practices for veal a regression coefficient of -.0842 with a standard error of .0406 was obtained. It would therefore appear that the large week-to-week variation in lamb purchases can be attributed in a large degree to the nonprice selling activities of stores. 37/ This suggests that the substitution between lamb and veal is relatively elastic and that purchases can be readily influenced by nonprice selling practices of stores.

Poultry Purchases

The level of poultry purchases remained quite constant over the 32-week period. However, poultry purchases did show extreme fluctuations during the 3-weeks in which major holidays occurred (fig. 7). For example, the average weekly purchase per family was 1.22 pounds of poultry for the other 29 weeks. For Thanksgiving week, the average purchases were 8.25 pounds; for Christmas week, 7.79 pounds, and for the week preceding Easter, 2.12 pounds. 38/

Both the poultry price index and the index of nonprice selling practices for poultry had zero-order correlations with poultry purchases

37/ With the two significant variables entered into the equation, an R^2 of .6444 was obtained.

38/ See table 14 for this and additional data on the effects of Thanksgiving, Christmas, and Easter on the purchases of meat, fish, and poultry.

Figure VI.
Average weekly purchases of lamb per family for 146 families, October 12, 1952 - May 23, 1953

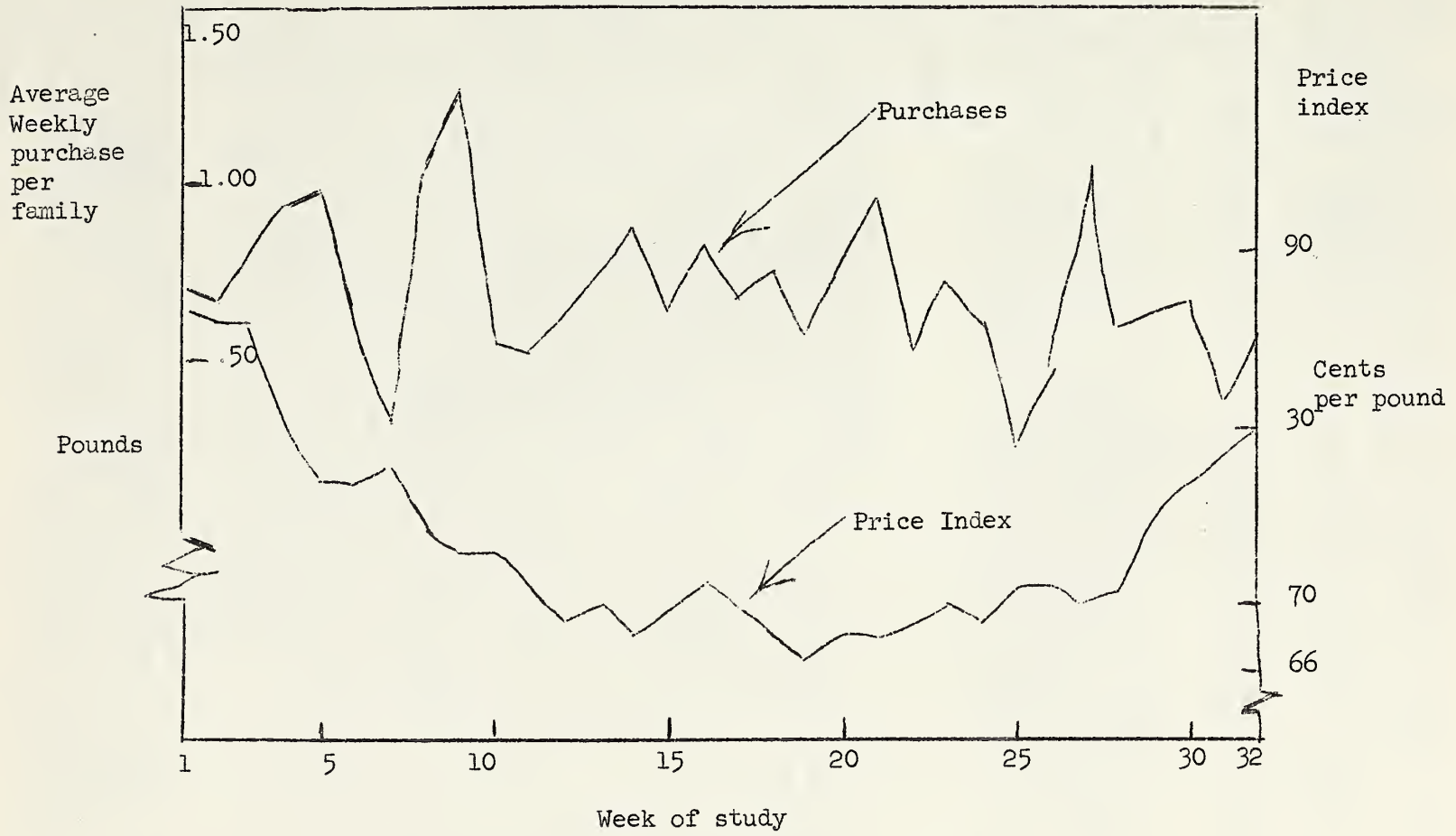
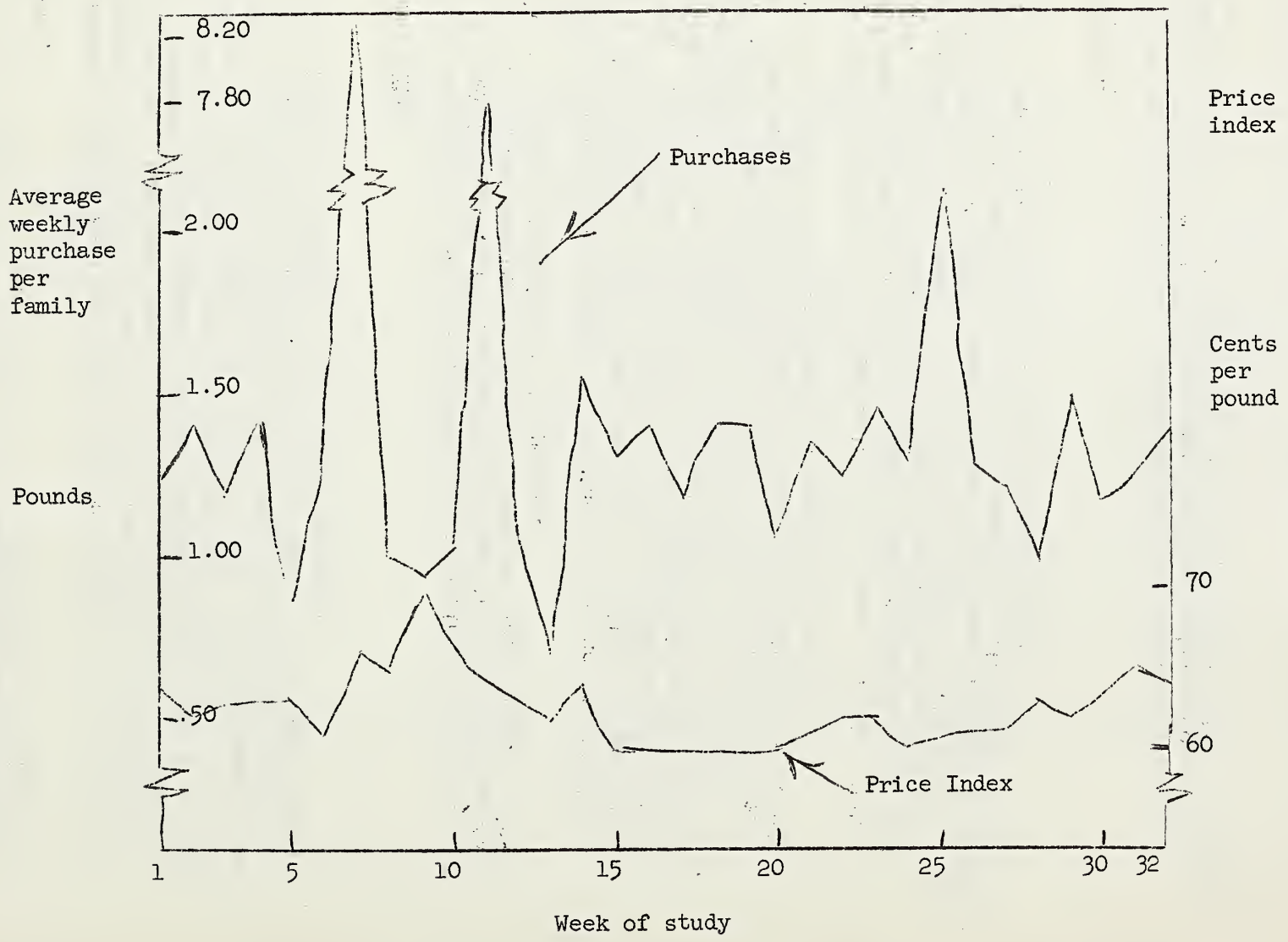


Figure VII.
Average weekly purchases of poultry per family for 146 families,
October 12, 1952 - May 23, 1953



that were insignificant at the 5-percent level. Entering them into the same equation did not make their first-order regression coefficients significant. Also, none of the other nine explanatory variables had a significant correlation coefficient of any order with the poultry purchases.

Several reasons tend to support these findings of no significant relationship between the variation in the observed series during the 32-week period. Both the level of purchases and the level of poultry prices remained fairly constant over the period studied with the result that the regressions were based on small week-to-week variations in the two series. Also, the effects of the three major holidays probably were not completely removed by dropping from the analysis the 3-weeks in which the holidays occurred, with the result that some of this week-to-week variation was a function of the three holidays.

Fish Purchases

Purchases of fish over the 32-week period remained at a fairly constant level (fig. 8). Furthermore, purchases of fish were the next to most stable purchase item in terms of absolute week-to-week variation with a standard deviation of .09 pounds.

With a stable purchase pattern for fish, it was not surprising to find that none of 11 explanatory variables exhibited a significant zero-order correlation at the 5-percent level with the series on fish purchases. Nor did any combination of the explanatory variables help to account for the small variation that did exist in the purchase data. While the price of fish displayed a downward trend over the whole period, this decline was highly correlated with the decline in beef prices. When compared with the price of beef, the relative price of fish did not decline over the 32-week recordkeeping period.

One possible source of variation in the purchase data for fish was the Lenten period before Easter Sunday. The average purchase per family for the 7-weeks before Easter Sunday was 0.80 pounds, compared with an average of 0.70 pounds for the other 23-weeks in the period. 39/ While purchases were somewhat higher during this 7-week period, no analysis between the purchase and price series was attempted with these 7-weeks removed in view of the stability of the purchase series.

Veal Purchases

Veal purchases increased a little during the 32-week period, but measured in absolute terms, they had the greatest week-to-week stability (a standard deviation of .06 pounds) of any kind of meat, fish, or poultry purchased (fig. 9).

39/ Excluding the weeks of Thanksgiving and Christmas.

Figure VIII.

Average weekly purchases of fish per family for 146 families,
October 12, 1952, 1952 - May 23, 1953

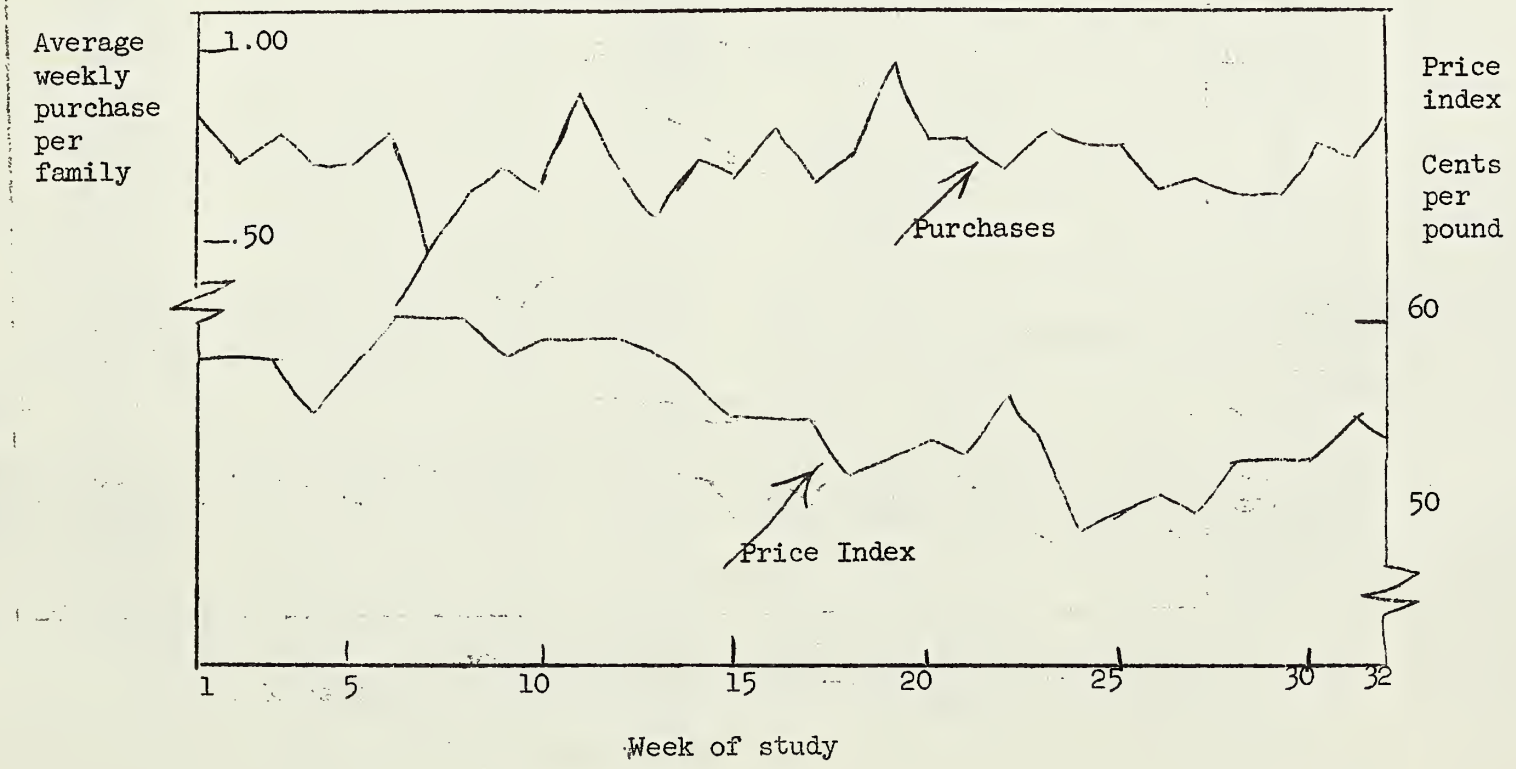
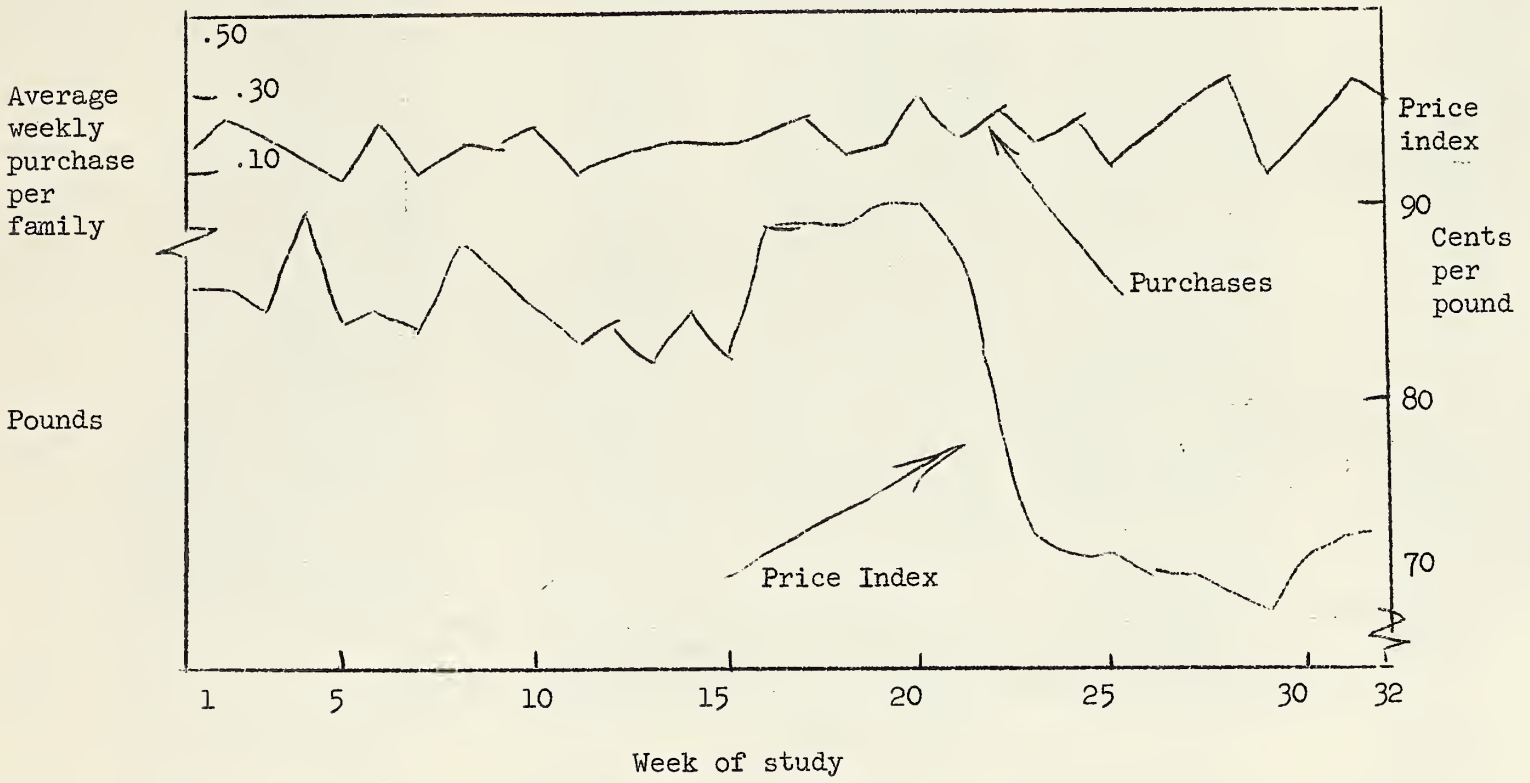


Figure IX.

Average weekly purchases of veal per family for 146 families,
October 12, 1952 - May 23, 1953



Again the stability of the veal purchases over time offered little hope of finding any significant correlation between any of the explanatory variables and veal purchases. However, two sources of information did suggest that some correlation might exist between the series. First, the price of veal fell quite sharply in the last 10-weeks of the period, and veal purchases increased by a small amount near the end of the period. Second, the index of nonprice selling practices for veal was a significant variable in the equation explaining purchases of lamb. If families were substituting between these relatively minor purchase items, the indexes of nonprice selling practices for veal and lamb should be related to veal purchases.

None of the explanatory variables had a significant zero-order correlation with veal purchases at the 5-percent level. Nor did any combination of them provide a significant relationship with veal purchases. However, the three variables that would be expected to have the largest probability of being related to veal purchases did exhibit sizable correlations with purchases. The zero-order correlations between veal purchases and the veal price index and the indexes of nonprice selling practices for veal and for lamb were -.3454, .3327, and -.2924. When entered into one equation, the regression coefficients still exhibited the expected signs but they were not significant at the 5-percent level.

Although the data available did not reject the null hypothesis at the 5-percent level of significance, the data were consistent with the hypotheses presented as an explanation of the observed purchase variation.

All Meat, Fish, and Poultry Purchases

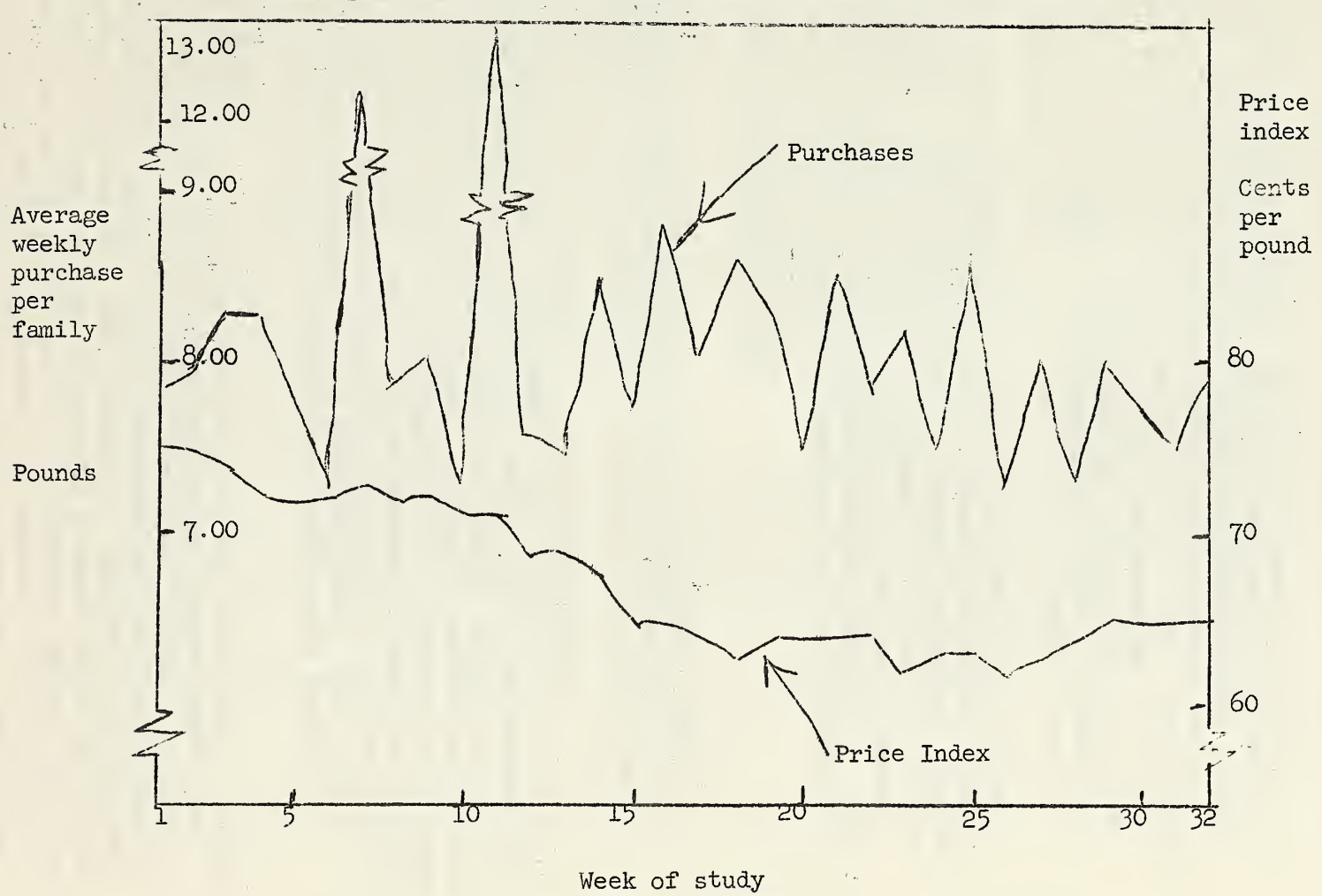
Over the 32-week recordkeeping period, the level of purchases for all meat, fish, and poultry items remained relatively constant. While the week-to-week variation of total purchases was absolutely greater than for any of the individual kinds, purchases of all meat, fish, and poultry exhibited a lower coefficient of variation (5-percent) than any of the individual purchase items. Figure 10 shows the average weekly purchases and the price index for all meat, fish, and poultry items.

As the purchase series for all meat, fish, and poultry items is simply the aggregate purchases of the individual kinds of these items, the relatively stable purchase level over the whole period reflected the fact that the increases in beef and veal purchases were to a large extent offset by reduction in purchases of pork and lamb. The purchases of poultry and fish had remained at a fairly constant level over the whole period. In fact, the increase in veal and the reduction in lamb purchases were rather minor shifts, the more important shifts being the increase in beef purchases and the reduction in purchases of pork.

As the level of purchases for all the items remained fairly stable over the whole period, it was obvious that the total purchases would not be highly correlated with a rather smooth, slowly-moving price index. The zero-order correlation between purchases of all the items and the price index for all the items was not significant at the 5-percent level.

Figure X.

Average Weekly Purchases of all meat, fish and Poultry
Items per Family for 146 Families, October 12, 1952 - May 23, 1953



In the general discussion of price indexes, it was concluded that the weighting system used in constructing a price index for all items was of major importance because the prices of individual kinds were not all positively correlated. Hence, to check the price index for all meat, fish, and poultry items, it was compared with the average price paid for all the items. The two series followed the same general pattern; but as expected, the average price paid displayed smaller percentage changes than the price index. The zero-order correlation between purchases of all meat, fish, and poultry items and the average price paid for these items was not significant at the 5-percent level.

However, the data do suggest that total purchases were responsive to the decline in price. Observation of the weekly purchases (appendix, table 29) shows that: (1) The average purchase of all meat, fish, and poultry items for the first 12 weeks excluding (Thanksgiving and Christmas) weeks was 7.82 pounds; for weeks 13-19 the average purchase was 8.23 pounds; and for the remaining 13-weeks excluding Easter week, the average purchase was 7.78 pounds. In short, as the price of beef fell, purchases increased by roughly 0.4 of a pound. (2) Starting with week 19, the price of pork rose and purchases again fell off. The three averages are not significantly different when tested by analysis of variance, but the pattern of change suggests that total purchases are price responsive. Hence, this hypothesis should not be completely rejected because the null hypothesis could not be rejected at the 5-percent level. (3) The analysis of individual family behavior reported on pages _ _ and tends to confirm the conclusion that total purchases were responsive to price changes.

Differences in Price and Income Elasticities Among Subgroups of the Panel

The research reported in this section was to test whether or not the hypothesis that price and income elasticities vary with demographic variation is consistent with the available data. The testing procedure was carried out in two stages. First, income elasticities were computed for different levels of age, family size, and educational, and tests were applied to see if income elasticity varied significantly among the various classes. Second, variation in price elasticities was analyzed to determine if it was related to demographic variation.

Family characteristice can vary independently of each other both over time and from area to area at a given time; therefore, knowledge of the relationships between family characteristics and income and price elasticities is needed to predict variation in purchase behavior. Also, from a methodological standpoint, if there are significant relationships between family characteristics and these elasticities, these relationships must be incorporated into both the typical time series and cross-sectional analysis to measure correctly demand parameters. For example, the usual procedure in cross-sectional analysis is to estimate an income elasticity on the basis of differences in consumption or purchases among income groups at a given time, assuming that the effect of price has been eliminated if all income groups are facing the same prices. However, in situations where price elasticity varies with income level, the estimated income elasticity will depend on the relative prices at the time the data were collected.

For example, assume that the higher the income level, the lower is the price elasticity of the demand for meat.40/ In such a situation an estimated income elasticity for meat based on cross-sectional differences among income groups will be lower when the relative price for meat is low than when it is high. At a low relative price for meat, the lower income groups with the higher price elasticities will increase purchases proportionately more than the high-income group. The effect of such a differential price adjustment is to reduce the slope of the income-consumption curve.41/ Both this reduction in slope and the increased level of the whole income-consumption curve at low relative prices for meat will tend to reduce the estimated income elasticity. 42/

This reasoning would also apply to cross-sectional analysis of differential purchase behavior associated with other family characteristics. For example, if different age groups have different price elasticities, the estimated differences in purchase behavior among the groups based on cross-sectional differences in age level will vary with prices in existence at the time the data are obtained.

Demographic Variation and Income Elasticities

Income elasticities were estimated on a cross-sectional basis. The three demographic classifications used were age, family size, and educational level. Intercorrelations among the various classifications were not particularly large. However, there was a relationship between age and educational level and also between educational level and income. The higher the age, the lower was the educational level; higher educational levels were associated with higher income levels. Therefore, it was necessary to adjust for these interrelationships by adding variables to the regressions between purchases and income. When stratifying by age level, purchases were related to income, family size, and educational level; when stratifying by family size, purchases were related to income, age, and educational level; and when stratifying by educational level, purchases were related to income, family size, and age level.

40/ For a commodity with an income elasticity of less than 1.0, the income effect of a price change is relatively larger for low-income groups than for high-income groups.

41/ There is the possibility that a larger proportional increase in purchases by the lower income groups will still be an absolutely smaller increase than for the higher income groups and hence the slope of the income-consumption curve will be increased rather than decreased. However, the upward shift in the curve will still reduce the income elasticity.

42/ The case of the inferior good is not considered here. In the more nearly normal situation where there is a positive income elasticity and hence all income groups have negative price elasticities, the effect of a price decline will be to shift the whole income-consumption curve upwards.

In order that the hypothesis could be subjected to data and thus tested, the following single equation shock model was employed:

$$Q = A + \sum_{i=1}^{3} B_i + \epsilon$$

where Q was the aggregate purchases by a family over the 32-week period, the x_i's were three of the four family characteristics (depending on how the families were classified), and the ϵ represented disturbances due to the effects of variables not included in the model. The ϵ was treated as a random variable having an expected value of zero and being normally and independently distributed from the x_i's in the model.

An equation for each of the eight demographic classes (2 age, 3 family size, and 3 educational level) was fitted for beef purchases and for the total meat, fish, and poultry purchases, making a total of 16 regressions. The equations were fitted by least squares procedures with deviations minimized in the direction of the purchase series. One hundred and fifty-one observations were available to estimate parameters and to test the hypothesis presented.

Table 16 presents the computed income elasticities and regression coefficients between purchases and income. As beef purchases were 42 percent of the total purchases of meat, fish, and poultry items, the estimated regressions for the two purchase series are highly interrelated. Thus, income elasticities and regression coefficients between total-minus-beef purchases and income were computed. The estimates of these regression coefficients were obtained by subtracting the regression coefficients between beef purchases and income from the regression coefficients between total purchases and income. 43/ Income elasticities were evaluated at the means of the purchase and income series.

The data suggest that, of the three variables investigated, only variation in age was related to variation income elasticities. For

43/ Let $AB_b = Y_b$ be the least squares normal equations for beef purchases and similarly, let $AB_t = Y_t$ and $AB_{t-b} = Y_{t-b}$ the normal equations for total purchases and total-minus-beef purchases respectively.

Then $B_b = A^{-1} Y_b$

$B_t = A^{-1} Y_t$

$B_{t-b} = A^{-1} Y_{t-b}$

however $Y_b + Y_{t-b} = Y_t$

therefore $B_t = A^{-1} Y_b + A^{-1} Y_{t-b}$

$B_t = B_b + B_{t-b}$

$B_{t-b} = B_t - B_b$

both beef purchases and total-minus-beef purchases, the 40-and-over age group had higher income elasticities than the under-40 age group. While the null hypothesis could not be rejected at the 5-percent level,

Table 16.--Regression coefficients between purchases and income and income elasticities by various demographic classifications

	Regression coefficients 1/			Income elasticities		
	Total	Beef	Total-minus-beef	Total	Beef	Total-minus-beef
Age 2/						
Under 40	-3.620	1.999	-5.619	-.05	-.06	-.13
40 and over	27.835	13.916	13.919	.32	.39	.27
Family size 3/						
30.0-59.9	19.022	8.647	10.375	.31	.32	.29
60.0-89.9	27.838	19.458	8.380	.31	.51	.16
90.0-120.0	12.703	13.777	-1.074	.03	.32	-.02
Educational Level 4/						
High School Incomplete	-11.186	11.039	-22.225	-.11	.26	-.37
High School Completed	21.687	6.910	14.777	.27	.20	.33
Above High School	26.908	5.376	21.532	.37	.16	.52

1/ Regression coefficients relate additional yearly purchases in dollars to each additional thousand dollars in income.

2/ Age of the housewife in 5-year intervals.

3/ Number of adult-meal equivalents. (One adult-meal equivalent equals male eating all noon and evening meals during the 32-week period in or from the home.)

4/ Housewife's education below high school, 0; high school incomplete, 1; high school completed, 2; above high school, 3.

it appears that these differences in income elasticities are not the result of sampling error but do represent different behavior patterns for the two age groups. 44/ First, while the differences between the income elasticities were not inconsistent with the null hypothesis, the differences between the regression coefficients were inconsistent with the null hypothesis. 45/ Second, this finding is consistent with

44/ t = .6 and .7 for the difference in income elasticities between age groups for beef purchases and total purchases respectively. Standard errors for the estimated income elasticities were computed in the following manner:

$$\frac{\overline{e}^2}{e^2} = \frac{\overline{m_1}^2}{m_1^2} + \frac{\overline{b}^2}{b^2}$$

where e is the estimated income elasticity, m_1 is the mean of the quantity series. $\overline{m_1}^2$ is the square of the standard error of estimate divided by N, and b and $\overline{b}$ are the estimated regression coefficient and its standard error respectively. This method of computing standard errors for estimated income elasticities was based on the work of Mosak. (See Mosak, Jacob L. The Least-Squares Standard Error of the Coefficient of Elasticity of Demand. Jour. Amer. Statis. Assoc. vol. 34. 1939.)

The above method of estimating standard errors assumes large sample characteristics. An alternative method of computing standard errors of estimating income elasticities is outlined by Girshick. (See Girshick, M. A. The Application of the Theory of Linear Hypothesis to the Coefficient of Elasticity Demand. Jour. Amer. Statis. Assoc. vol. 37. 1942.)

45/ The t value for the difference between the beef regression coefficients was 1.7 For the difference between the total purchases regression coefficients, the t value was 2.8. A t value for the difference between the regression coefficients for the total-minus-beef purchases was not directly available as the method of computing these regression coefficients did not yield an yield an estimate of their standard errors.

However, by assuming that the variance of the disturbances in the total purchases equation was equal to the sum of the variances of the disturbances in the beef purchases and total-minus-beef purchases equation, standard errors of total-minus-beef purchases regression coefficients can be estimated. As the variance of the total purchases was equal to the sum of the variances of its two components (assuming no covariance between the two components), the variance of the disturbances

in the total purchases equation will equal the sum of the variances of the disturbances in the two component purchase equations if the coefficient of nondetermination is equal for all three equations. This assumption would seem to be compatible with the data. In brief, assuming

$$y_t \cdot x = y_b \cdot x + y_{b-t} \cdot x, \text{ it then follows that}$$

$$B_{t-b} = B_t - B_b .$$

Let $M_{ij} = \sum_{k=1}^{n} (X_{ik} - \bar{X}_i)(X_{jk} - \bar{X}_j)$ be the elements in the moment matrix of the independent variables.

Then $S^2_{B_i} = M^{ii} S^2_{y.x_i}$ where M^{ii} is the ith element of the principal diagonal of $[M_{ij}]^{-1}$, the inverse of the moment matrix of independent variables.

Then $S^2_{B_i} = Mii S^2_{y.x_i}$ where Mii is the ith element of the principal diagonal of M_{ij}^{-1}, the inverse of the moment matrix of independent variables.

then $S^2_{B_b} = Mii \cdot S^2_{y_b \cdot x}$

$S^2_{B_t} = Mii \cdot S^2_{y_t \cdot x}$

$S^2_{Bt-b} = Mii \cdot S^2_{yt-b/x}$

but $S^2_{y_t \cdot x} = S^2_{y_{t-b} \cdot x} + S^2_{y_b \cdot x}$

therefore $S^2_{Bt} = S^2_{Bb} + S^2_{Bt-b}$

and $S^2_{B_{t-b}} = S^2_{B_t} - S^2_{B_b}$

Thus to obtain an estimate of the standard errors of the regression coefficients in the total-minus-beef purchases equations the standard errors of the regression coefficients in the beef purchase equations were subtracted from the standard errors of the regression coefficients for the total purchases equations. The t value for the difference between the regression coefficients for the two age groups was significant at the 1-percent level.

findings by Fisher and Lydall that younger families made larger expenditures on consumer durables than older families. 46/ It would seem to be a reasonable hypothesis that young families would have uses for additions to income which would be given higher priority than additional meat purchases. However, as a family with the passage of time builds up a stock of durable consumer goods, additional purchases of such items as meat may become more important alternatives for additions to income.

Neither differences in family size nor in educational level appear to have been related to variation in income elasticities. For both family size and educational level, the patterns of change in the income elasticities and regression coefficients are inconsistent between beef purchases and total-minus-beef purchases. Also, in all but one instance, the data are consistent with the null hypothesis. 47/ Futhermore, as was the case in the differences between age levels, no additional information is available to rationalize the observed differences.

Demographic Variation and Short-Run Price Elasticities

The data made it possible to test whether variation in age, family size, educational level, income, and occupational status of the housewife were related to differences in short-run price elasticities.

Occupational status of the housewife was considered as a variable that might affect a family's responsiveness to price. It was assumed that housewives working away from the home might be restricted in their choice of meat, fish, and poultry items by the time available for meal preparation. If this restriction in choice does exist, families with working housewives would have relatively inelastic demands.

A covariance technique was employed to provide a test of the hypothesis that there is a relationship between price elasticities and the five variables listed above. The panel was stratified by family characteristics, and individual linear regression lines between pounds of beef purchased and the beef price index were fitted to the observations in each stratum. Tests were then applied to check for homogeneity among the price elasticities estimated at the means of the regression lines in the various strata. 48/

46/ Fisher, Janet A., "Spending and Saving Patterns of Consumer Units in Different Age Groups," Studies of Income and Wealth, Vol. 15, Nat. Bur. Econ. Res., Inc., New York, 1952.
Lydall, Harold, "The Life Cycle in Income, Savings, and Asset Ownership," Econometrica, Vol. 23, No. 2, April 1955.

47/ The null hypothesis would be rejected for the differences in income elasticities of total-minus-beef purchases between the high school incomplete and the above high school groups.

48/ See footnote 44 for the method of computing standard errors of the price elasticities.

This covariance analysis was applied, stratifying the panel successively by the following characteristics: Income, age, education, family size, and occupational status of the housewife.

Age was the only family characteristic found to be significantly related at the 5-percent level to the degree of price elasticity. The older the housewife, the lower was the price elasticity. However, in some cases the family characteristic classifications used were intercorrelated and, hence, differences found among the price elasticities in the various age strata may have been a function of educational level which was related to age.

To adjust for the intercorrelations among the family characteristics and to develop a more discriminating test of the hypothesis that differences in price elasticity are related to variations in family characteristics, a second testing procedure was employed. Beef and pork purchases were analyzed. Variation among percentage changes in purchases of individual families between 6-week intervals was employed in this procedure. As all families were assumed to have experienced the same price changes, testing for differences in percentage changes in purchases was an indirect test of differences in price elasticities.

Three 6-week intervals were chosen for the analysis (table 17). Period I represented a high price-low purchase situation for beef and a low price-high purchase period for pork. During the second 6-week period the price of beef fell and purchases of beef increased. By the third period the price of pork had increased and purchases had decreased, while the price of beef remained relatively low and purchases were relatively high.

Table 17.--Average prices and weekly purchases of beef and pork per family during three 6-week periods, October 12, 1952 - May 23, 1953

Period	Beef		Pork	
	Price	Purchases	Price	Purchases
	Cents	Pounds	Cents	Pounds
I Oct. 12-Nov 22	89	2.72	60	2.25
II Feb. 1 - March 14	68	3.23	61	1.96
III April 12 - May 23	62	3.32	71	1.57

The percentage change in pounds of a particular kind of meat purchased by each family was then taken as the dependent variable in a linear regression equation. Income, family size, age, educational level, occupational status of the housewife, and change in family size between the 6-week intervals were the explanatory variables included in the equation. Adding the change in family size to the equation

reduced the unexplained variation in the dependent variable and, hence, the relationships between the dependent variable and the family characteristics were more clearly identified. Also, the percentage change in purchases data was transformed to a series of absolute changes and the equations were refitted. The resulting regression coefficients between the within-family change in purchases and family size provided a comparison with the between-family coefficients of the effect of family size on purchases as estimated in the cross-sectional analyses outlined in an earlier section.

Single equation shock models of the following form were fitted to the data:

$$\frac{Q_j - Q_i}{Q_i} = a + b_1 Z_1 + \sum_{k=1}^{5} b_k X_k + \epsilon$$

and

$$Q_j - Q_i = a + b_1 Z_1 + \sum_{k=1}^{5} b_k X_k + \epsilon$$

where Q_i was the quantity purchased of a particular kind of meat during the first 6-week period, Q_j was the quantity purchased during a second 6-week period, Z_1 was the change in family size between the two 6-week period, the X_k's were the five family characteristics (i.e., income, family size, age, education, and occupational status of the housewife), and the ϵ represented disturbances due to the effects of other variables not explicitly included in the equations. The ϵ was treated as a random variable having an expected value of zero and being normally and independently distributed from the Z_1 and the X_k's in the equation.

These equations were fitted by least squares procedures for changes in purchases between periods I and II and I and III. Deviations were minimized in the direction of the purchase series. While purchases of beef in period I were subtracted from purchases of beef in periods II and III, in the pork equations purchases in periods II and III were subtracted from purchases in period I. Thus, positive regression coefficients in all equations indicate that larger-than-average values of the explanatory variable were associated with larger-than-average changes in purchases. For beef, these larger-than-average changes in purchases represented increases, while for pork they represented decreases.

Table 18 presents the computed correlation coefficients and the estimated regression coefficients for the equations in which percentage change in purchases was the dependent variable.

Only in the percentage change in beef purchases between periods I and III was there a significant relationship at the 5-percent level between a family characteristic and the percentage-change-in-purchases variable. In this equation, age was significantly related to the dependent variable. The older the respondent, the lower was the percentage change in purchases. While in the other three equations age

Table 18.--Regression coefficients and standard errors estimated by cross-sectional analysis of the percentage change in pounds purchased between 6-week periods by 141 families and specified variables, October 12, 1952 - May 23, 1953

Commodity and time period	Regression coefficients and standard errors						
	R^2	Change in family size 1/	Income 2/	Family size 2/	Age 2/	Education 2/	Occupational status of the housewife 2/
Beef:							
Period II-I 3/	.1035	.5952	-.1407	3.1720	-1.2270	-1.0896	-7.1126
		(.1824)	(.2998)	(6.0000)	(1.4107)	(4.4332)	(7.2593)
Period III-I 4/	.2358	.9492	.2072	-1.9072	-5.2492	8.1719	-1.9109
		(.1934)	(.3669)	(7.3472)	(1.7244)	(5.3886)	(8.9023)
Pork:							
Period I-II 5/	.0929	-.6950	-.6530	8.3168	-.3611	1.0677	3.4976
		(.2331)	(.3832)	(7.6736)	(1.8056)	(5.6713)	(9.9420)
Period I-III 6/	.1386	-.8169	.2378	5.8976	-1.8112	4.7051	-5.5053
		(.2010)	(.3817)	(7.6416)	(1.7920)	(5.6035)	(9.2615)

1/ Change in aggregate number of adult-meal equivalents between the 6-week periods.
2/ See footnotes, table 11, for definitions of family characteristics.
3/ Aggregate beef purchases during weeks 17 through 22 minus aggregate beef purchases during weeks 1 through 6.
4/ Aggregate beef purchases during weeks 27 through 32 minus aggregate beef purchases during weeks 1 through 6.
5/ Aggregate pork purchases during weeks 1 through 6 minus aggregate pork purchases during weeks 17 through 22.
6/ Aggregate pork purchases during weeks 1 through 6 minus aggregate pork purchases during weeks 27 through 32.

was not significant at the 5-percent level, the regression coefficient between percentage change in purchases and age was in all cases negative. There was, therefore, evidence of an age influence on purchases. None of the other family characteristics were significant at the 5-percent level nor were the signs of their regression coefficients consistent among the four equations. The following tabulation shows the estimated price elasticities of demand for beef by age level:

Age	Estimated price elasticity 1/
25 years	-1.2568
35 years	-.9178
45 years	-.5788
60 years	-.0704

Younger families had higher price elasticities than older families. This implies that the difference between the age groups in terms of elasticity of substitution was greater than the difference in price elasticities. For example, the 30-percent reduction in price of beef represented for the families observed an increase in real income of approximately 1 percent. If the income elasticities estimated in this report are used, the substitution effect led to an increase in beef purchases by the 25-year age group of 38.8 percent and an increase by the 60-year-old age group of only 1.8 percent. Thus, the elasticity of substitution for the families in the 25-year age group was -1.25 and for the families in the 60-year age group the elasticity of substitution was -.058. This result is consistent with the assumption that older people have more deeply imbedded habit patterns than younger people.

It was originally assumed that there was a high correlation between families who increased their beef purchases and those who decreased their pork purchases. However, further analysis failed to reveal any significant relationship between these families. The zero-order correlation between the two absolute change series from period I to period II was -.0925. Between periods I and III, the zero-order correlation was -.0472. 49/

1/ Estimated by adjusting the 22.1 percent change between periods I and III in beef purchases for the panel as a whole by the regression coefficient between percentage change in beef purchases from period I to period III and age. The 31.0-percent change in price was the same for all age levels.

49/ For these analyses, purchases of pork in period I were substracted from purchases in periods II and III. Hence, the negative relationship between the two series was an expected one, if substitution is the hypothesis.

Neither one of these two correlations was significant at the 5-percent level. Including additional variables such as change in adult-meal equivalents did not develop and significant higher order correlations between change in beef and change in pork purchases.

Both the change in beef purchases and the change in pork purchases between periods I and III were correlated with change in total pounds of meat, fish, and poultry purchases. Between change in pounds of beef purchased and change in total pounds of meat, fish, and poultry purchased a zero-order correlation of .6308 was obtained. A zero-order correlation of .4278 was computed between change in total pounds of meat, fish, and poultry purchased and change in pounds of pork purchased. A linear multiple regression equation was fitted to the data with change in pounds of beef purchased, change in pounds of pork purchased, and change in adult-meal equivalents as explanatory variables and change in total pounds of meat, fish, and poultry purchased as the dependent variable (R^2 = .6581). The following regression coefficients were estimated: Between change in total pounds of meat, fish, and poultry and change in pounds of beef, an estimated regression coefficient of 1.1250 with a standard error of .1070 was obtained. The regression coefficient between change in total pounds of meat, fish, and poultry, and change in pounds of pork was .8520 with a standard error of .1035. As a value of 1 would be within the 95-percent confidence interval for both the estimated regression coefficient for beef, and for pork, the data are consistent with a hypothesis that each increase of 1-pound of beef purchased was associated with a 1-pound increase in total purchases of meat, fish, and poultry and each decrease of 1-pound of pork purchased between two periods was associated with a 1-pound decrease in total purchases of meat, fish, and poultry. Again, the data seem to indicate that individual families did not substitute between beef and pork purchases during the 32-week recordkeeping period.

The change in the family-size variable had consistent and significant regression coefficients in all four equations. As expected, an increase in family size between two periods resulted in an increase in purchases. In the beef equations this was reflected by a larger-than-average percentage increase in purchases. In the two pork equations, this positive relationship was reflected by a smaller-than-average decrease in pork purchases.

The regression coefficients between absolute changes in purchases and changes in family size provided a comparison with the parameters estimated in the cross-sectional analysis of variation among families. Table 19 presents the within-family regression coefficients between absolute changes in purchases and family size compared with regression coefficients estimated on the basis of between-family variation in family size and purchases.

In 5 out of 6 cases the regression coefficients based upon within-family variation were smaller than those based upon between-family variation in family size. Applying "t" tests for significant differences between estimated regression coefficients resulted in the following information: (1) Only in change in family size and change in beef purchases between periods I and II was the regression coefficient based on

periods I and II was the regression coefficient based on within-family variation significantly lower at the 5-percent level than the regression coefficient based on between-family variation. (2) The regression coefficients based on changes between periods I and II were not significantly different from the regression coefficients for the same kind of meat based on changes between periods I and III. Hence, the regression coefficients estimated on the basis of within-family variation in family size and pounds purchased were consistent with each other. While only one coefficient based on within-family variation was significantly lower at the 5-percent level than the coefficients based on between-family variation, there was a tendency for the within-family adjustment to be less than would have been expected on the basis of between-family differences.

Consumption of Meat, Fish, and Poultry Items in Restaurants

It was recognized that as a result of meals which are not prepared in the home, for example, meals eaten in restaurants or at the homes of others, the weekly purchase records of the majority of the families would not include all of the meat, fish, and poultry they consumed. An adjustment could be made for the effect of meals not prepared in the home on the total pounds purchased for the family by weighting each

Table 19 --Regression coefficients and standard errors estimated on the basis of between-family variation in family size compared with regression coefficients estimated on the basis of within-family variation in family size

Kind of meat	Between-family coefficient 1/	Within-family coefficient	
		I 2/	II 3/
Beef	1.0172	.3675	.7967
	4/ (.1186)	(.1869)	(.2155)
Pork	.7363	.7386	.4135
	(.1304)	(.2149)	(.1799)
All meat, fish, and poultry	3.4015	2.9714	2.8078
	(.2714)	(.4355)	(.4065)

1/ Regression coefficients are coefficients in table 1 transformed for this comparison by dividing them by 32.

2/ Regression coefficients based on individual family changes in pounds purchased and number of adult-meal equivalents between periods I and II. See table II, footnote 1, for a definition of adult-meal equivalents.

3/ Regression coefficients based on individual family changes in pounds purchased and number of adult-meal equivalents between periods I and III. See table II, footnote 1, for a definition of adult-meal equivalents.

4/ Value in parenthesis is the standard error of the estimated regression coefficient.

family member by the number of meals prepared in the home in a given week. However, such an adjustment could not take into account the fact that meals eaten away from home may differ from meals prepared in the home. The purchase data from the weekly records would give an undistorted view of the relative position of the different meat, fish, and poultry items in the total family consumption -- at home and away from home -- only if meals eaten away from home were similar to those eaten in or from the home.

This section contains an analysis of restaurant meals eaten by the panel families. 50/ Meals such as those eaten in the homes of others were omitted. In addition, the restaurant meals analyzed were limited to evening meals on weekdays, noon and evening meals on weekends, or holidays at which two or more adult members of the family ate out together. This restriction was imposed primarily to eliminate lunches of working members. It was felt that any main dishes of meat, fish, or poultry purchased for such lunches were not looked upon by the purchaser as a supplement to his or her home prepared main dish items. In addition, it was questionable how much reasonably accurate information the individual being interviewed could supply about meals eaten by the working members. In pretesting the schedule for this phase of the study, questions were included to check on these assumptions. Most families indicated that the menus of weekday lunches purchased in restaurants rarely differed from those served at home.

Of the major family characteristics, only family size had a significant relationship with the frequency of eating in restaurants. 51/ The frequency of eating out decreased with an increase in family size.

Fifteen percent of the 71 families in which 2 or more adult members ate out together in restaurants at least once a month indicated that their members ordered about the same meat, fish, and poultry dishes as were served at home. Forty-four percent of these 71 families said their members sometimes ordered meat, fish, and poultry dishes that were not usually served at home, and forty-one percent said their members generally ordered dishes that were not usually served at home.

50/ The data analyzed in this section were secured during the final interview in May 1953, just before the closing of the panel.

51/ Zero-order correlation coefficients were computed for all characteristics except family type, which was tested by chi square. Then, a multiple regression equation was computed with frequency of eating out as the dependent variable. In all cases, family size was the only significant variable.

The 60 families indicating that their members either generally or sometimes ordered meat, fish, and poultry dishes not usually served at home listed shellfish as by far the major item ordered in restaurants but not prepared at home (table 20). Poultry items ranked second; Chinese dishes third; steak, roasts, and chops, fourth; and Italian dishes and fish other than shellfish, fifth. The main reason given for not serving these items at home was that some of the family members did not eat them. "Too much trouble to prepare at home" and "restaurants prepare the item better than can be done at home" were of equal importance and ranked next in the reasons for not serving the items at home. "Units too large" was relatively important for poultry; it was frequently the explanation for not usually preparing turkey in the home. Objections to deep frying in the home were registered in the shellfish and poultry groupings. The inability of the housewife to prepare specific dishes was, as would be expected, most common for the Chinese and Italian dishes.

In interpreting the data in table 20, it must be remembered that the questions used to obtain the data were centered on specific dishes eaten in restaurants by individual family members. Therefore, the possibility exists that a family may select restaurant meals that are distributed among the groupings of beef, pork, lamb, veal, fish, and poultry in the same proportions as those served at home, with only the method of preparation differing. In addition, if a different distribution does exist between restaurant meals and meals prepared at home, such a difference may be largely the reflection of the taste of only one family member out of several. Thus, any distortion of the family's consumption pattern through the omission of restaurant meals may be slight.

The data in table 20 support the conclusion that the panel data understate the relative position of seafood items, in particular of shellfish, in the overall consumption pattern of the panel families. The case for the other items eaten in restaurants but not usually served at home may be more the result of a different method of preparation from that usually used at home rather than of a different distribution of meat, fish, or poultry ingredients. Turkey seems to be the most likely exception to such a generalization.

Meat, Fish, and Poultry Substitutes

Data on substitutes for meat, fish, and poultry can be a valuable supplement to the analysis of the demand for these products. In this study, quantity and expenditure data on these substitutes were not

Table 20.--Reasons given by families eating out for not usually preparing in the home certain dishes that were eaten when two or more adult members ate in restaurants together, families grouped according to type of dish, May 1953 1/

Reasons	Shellfish	Poultry	Chinese dishes	Steaks, roasts, chops	Italian dishes	Fish other than shellfish	Other 2/	All dishes
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Not eaten by part of family..	40	25	8	31	20	56	36	33
Too much trouble to prepare..	38	--	31	15	--	22	21	24
Restaurants prepare it better	23	31	46	15	30	--	14	24
Cannot prepare.....	8	--	38	--	60	--	21	14
Unit too large.....	2	38	--	15	--	11	7	9
No deep frying or no seafood deep fried.....	17	12	--	--	--	--	--	9
Problems in procuring.....	10	12	--	8	10	--	7	8
Other 3/.....	4	--	8	23	20	11	--	7
Families eating dish usually only in restaurants as percent of 71 families eating out at least once a month..	73	23	18	18	14	13	20	--
Number of families.....	52	16	13	13	10	9	14	127

1/ Only families who ate evening meals on weekdays or noon or evening meals on weekends or holidays in restaurants with an annual average frequency of at least once a month were included.

2/ Includes liver, tripe and lungs, barbecued items, boiled dinners, frankfurters and cold cuts, and foreign dishes other than Chinese or Italian.

3/ Includes: Too expensive to prepare at home, never think to buy it for preparation in the home, mushroom sauce not served in the home, eat it infrequently.

obtained. However, data were collected on all main dishes served at noon and evening meals. 52/ These data indicated the importance of main dishes other than meat, fish, and poultry at major and secondary meals and also yielded a test for relationships between the frequency of evening meals without meat, fish, and poultry and family characteristics.

In evaluating the results presented in this subsection, several aspects of the data should be kept in mind. (1) The data reflect the main-dish patterns of a rather restricted area, both in a geographic and a family characteristic sense. (2) The 29-week period of data collection included Lent. (3) Main-dish items are related to purchases which, in turn, are related to prices during the period of observation and to the family characteristics of the sample observed. (4) The 29-week period of data collection excluded any observation of shifts in preferences for main-dish items during the summer. (5) If any food at all was served in the home for a particular secondary or major meal, this was counted as a meal eaten in the home regardless of the number of individuals present, and the main dish served was included in the analysis. This variation among families in the proportion of members present at given meals is particularly significant for secondary meals.

Main dishes containing no meat, fish, or poultry were served at 51 percent of the secondary meals eaten at home and at 11 percent of the major meals eaten at home. 53/ Table 21 shows the ranking containing no meat, fish, or poultry of the main dishes. Thirty percent of

52/ The main dish was defined as the central or major item of the meal as evaluated by the recordkeeper. The main dish could range from appetizer through dessert and might or might not be, or contain, meat, fish, or poultry. The number of families included in this analysis varied from 141 to 154. Most of the tabulations were based upon all 154 families submitting sufficient usable records over the period used in analyzing purchase data. However, in analyzing the relationship between family characteristics and frequency of evening meals at which no meat, fish, or poultry items were served, deletions had to be made because of incomplete data on two families and the failure of other families to fit into individual classification schemes. Main-dish items were analyzed only for the 29-weeks from October 12, 1952, through May 2, 1953.

53/ These percentages were 41 and 10 when computed on the basis of percentage of total possible secondary and major meals, no food was eaten in the home for 21 percent of the possible secondary meals and for 10 percent of the possible major meals. Even if the meal in the home consisted of nothing but a cup of tea, it was considered a meal eaten in the home. Only when no food at all was eaten in the home were meals classified in the category of "no food eaten in the home." The persons eating home-packed lunches away from home were included in the adult-meal equivalent size of the family for the week; but their packed lunches were not considered as food eaten in the home nor were their sandwiches included in the main-dish category, because this category applied only to those meals actually eaten in the home.

Table 21.--Percentage distribution of main dishes containing no meat, fish, or poultry by type of dish, 154 families, over a period of 29 weeks, October 12, 1952-May 2, 1953 1/

Type of dish	Meal 2/		
	Secondary	Major	Secondary and major
	Percent	Percent	Percent
Eggs 3/	12	13	12
Spaghetti, macaroni 4/	4	11	5
Baked beans 5/	1	9	3
Cheese	3	9	4
Pancakes, waffles	7	6	7
Vegetables	1	4	2
Soup	27	29	27
Sandwiches 6/	30	8	26
Salads	5	3	4
Other light lunch items 7/	8	3	7
All other 8/	2	5	3
Total	100	100	100
	Number	Number	Number
Number of meals	12,440	3,010	15,450

1/ 2 percent of the secondary meals and 9 percent of the major meals with main dishes not containing meat, fish, or poultry had some meat, fish, or poultry served at the meal. The percentage distributions of main dishes containing no meat, fish, or poultry for meals at which no meat, fish, or poultry was served were within 1 percent of the above distributions in all categories.

2/ Major meals include Sunday noon meals and evening meals for other days; secondary meals include Sunday evening meals and noon meals for other days.

3/ Includes all eggs except in salads.

4/ Without meat or cheese.

5/ Without frankfurters.

6/ Often includes soup; soup and sandwich meals were coded as sandwich meals.

7/ Includes items such as cereal, fruit, crackers and milk, dessert items, and toast and tea.

8/ Includes items such as nonmeat pizza and nonmeat ravioli.

the main dishes containing no meat, fish, or poultry for the secondary meal were sandwiches; second in importance was soup with 27 percent; and eggs ranked third with 1[illegible] percent. At the major meal soup (29 percent) was the most important of the main dishes containing no meat, fish, or poultry, while eggs (13 percent) had moved up to second place and nonmeat spaghetti and macaroni (11 percent) were a close third. Baked beans, cheese, sandwiches, and pancakes and waffles followed in that order.

The analysis of the association between the various family characteristics and the frequency of evening meals at which no meat, fish, or poultry items were served yielded no significant relationships. 54/ This result plus several other considerations suggested that the frequency of evening meals at which no meat, fish, or poultry were served represents an independent family attribute. The additional considerations may be summarized as follows:

1. There was a measurable degree of stability over time in the number of evening meals without meat, fish, or poultry served by a family when the number of such meals served during the period October 12 through November 22, 1952, was related to the number served from April 12 through May 23, 1953. 55/
2. There was a statistically significant relationship between the number of meals without meat, fish, and poultry served by a family during the period October 12 through November 22, 1952, and the total pounds of meat, fish, and poultry purchased from April 12 through May 23, 1953. 55/
3. The price of beef cuts had dropped between these two periods. The panel families apparently responded to this price drop by buying substantially more beef. If the number of evening meals without meat, fish, or poultry were largely a reflection of budgetary restrictions, the increase in beef consumption in response to lower beef prices should be negatively correlated with the changes in the number of evening meals without meat, fish, or poultry. The correlation coefficient computed for this relationship had a negative sign, but it was not significant at the .05 level. 55/

54/ This analysis was based on evening meals instead of on major meals and on meals at which no meat, fish, or poultry were served instead of on meals with main dishes containing no meat, fish, or poultry. The farmer would increase the number of the observations of meals without meat, fish, and poultry for most families because of using Sunday evening meals instead of Sunday noon meals; and the latter would decrease the number of observations of meals without meat, fish, and poultry for those families who sometimes had main dishes containing no meat, fish, or poultry but served meat, fish, or poultry during the meal.

55/ The correlation coefficients were as follows: (1) .5667 with 139 degrees of freedom; (2) -.1741 with 139 degrees of freedom; (3) -.0897 with 139 degrees of freedom.

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APPENDIX

Initiating and Maintaining a Panel

Any comparison of the consumer panel approach to alternative methods of collecting data must give some weight to the effort involved in the collection of the data as well as to the possible biases in the data collected and to the analysis potentialities and limitation of cross-sectional data from the same families over the same time period. The body of this report has dealt with the latter two aspects. The discussion which follows deals with collection of data.

Recruiting

Two recruiting approaches were used--a 2-interview approach during the early recruiting phases and a 1-interview approach in the later phases. In the 2-interview approach the initial contact secured panel eligibility data and also served to establish a measure of rapport. 56/ The families in the initial interview who satisfied the eligibility criteria were then interviewed a second time to discuss panel membership. If the family was willing to participate in the panel the weekly record form was explained in detail and the family was asked to begin recordkeeping with that day. The interviewer then returned after one week on a "call-back" to answer any further questions and to check over the first record with the record-keeper.

As the interviewing for panel participation proceeded, it became apparent that the number of cooperators among the eligible families would fall short of the desired initial panel membership. 57/ In order to supplement the recordkeeping group, it was decided to make additional calls on the "no-contact" cases of the basic sample and then to expand the basic sample rather than to widen the ranges for eligibility. For these families, the first and second interviews of the 2-interview approach were combined into one unit in which eligibility data and panel membership were both covered. Later, the recruiting process was even further shortened by eliminating the call-back to go over the first weekly record. Actually the elimination of these visits--the 2 interview and the call back--meant some multiple reduction in the number of attempted visits because of the problem of finding the appropriate family member both at home and with time to devote to the interview.

Approximately 6,175 interviewing hours, including about 725 training hours were expended in recruiting the panel. These hours represented 8,263 attempted recruiting visits and yielded 492 panel members. This was an average of 12.6 hours of interviewing time (11.1 hours if training time is omitted) and 16.8 attempted visits per recruited panel member. Table 22 presents the percentage distributions of the number of attempted

56/ See pages 3 and 4 for a discussion of the eligibility criteria.
57/ The goal was to overload the starting panel enough to cover the expected drop-out and still yield sufficient families for the data analysis.

Table 22.--Percentage distribution of the number of attempted recruiting visits per family by final classification of 2,551 families at conclusion of recruiting efforts, March-October 1952

Attempted recruiting visits and number of families 1/	Final classification of families at conclusion of recruiting efforts							All families
	Ineligible	Panel member	Eligible but refused panel	No contact 2/	Refused to give any interview	Eligible but never interviewed for panel	Other 3/	
Number of visits per family:	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
1	51	12	4	7	46	---	46	25
2	24	24	21	14	24	---	16	21
3	13	20	20	22	15	---	13	17
4	7	15	15	45	9	4	12	17
5	3	10	14	9	4	9	3	8
6	1	8	9	3	2	8	2	4
7	1	4	6	4/	---	12	2	2
8	---	4	5	4/	---	18	2	2
9	---	2	2	4/	4/	20	---	2
10	4/	4/	1	---	4/	12	2	1
11 and over	4/	1	3	---	---	17	2	1
Total	100	100	100	100	100	100	100	100
Percentage of total visits	14	22	24	18	10	8	4	100
	Number	Number	Number	Number	Number	Number	Number	Number
Total visits	1,117	1,846	1,953	1,515	864	647	321	8,263
Avg. visits per family:	2.0	3.8	4.4	3.5	2.1	8.6	2.6	3.2
Families - Number	569	492	444	437	411	75	123	2,551

1/ Includes attempted visits during exploratory interview of the 2-interview approach.

2/ Interview failed to secure a definite response from the family either because no one was home or the family member or members relevant to the interview were not at home or not able to devote time to the interview.

3/ Includes such categories as: Moved since first interview; empty house; address not located; neighbors supplied data to indicate family was unwilling to give interview or ineligible for panel; address actually a business, garage, office, or rest home; family ineligible now; left off second interviewing list by mistake; did not speak English; interviewer suggested another visit, but it was never made; only part of interview completed.

4/ Less than one-half of 1 percent.

recruiting visits per family by the final classification of the 2,55. families at the conclusion of the recruiting efforts. The attempted visits that were necessary for the second interview on the 2-interview approach families created the great difference in distributions that occurs between the "ineligible" and "refused to give any interview" groupings on the one hand and the "panel member" and "gave first interview and eligible but refused panel" categories on the other. The high representation of the "no-contact" families in the cells for less than four attempted visits largely reflects the emphasis in the latter stages of recruiting on attempting at least one or two visits on all families on the expanded lists and only after that attempting at least four visits on each no-contact family.

Panel Servicing

Panel servicing included visits, telephone calls, and letters involving attritions, editing, and personal rapport-building. 58/ In Table 23 and 24, the number of attempted and actual contacts have been classified by the purpose and the type of contact and subclassified by family groupings based on the number of weekly records submitted. This subclassification had no restriction upon the time period during which the records were submitted such as was the case for the families used in the purchase data analysis. Thus, the group submitting 26 or more records includes the 154 families available for the purchase data analysis plus 16 other families who had submitted 26 or more records but who did not meet the requirements for the purchase data analysis. As would be expected, attempted and actual contacts to deal with attritions were largely concentrated on the families submitting less than 26 records. In total, 304 visits and 1,048 telephone calls were made and 74 letters were written in attempted contacts in panel servicing; contacts were actually completed in 178 of the visits, and 588 of the telephone calls, and the 74 letters. The grand total of 1,426 attempted contacts and the data in table 23 are a reflection of the time involved, while the grand total of 840 actual contacts and the data in table 24 are a better reflection of the necessary frequency of contact.

The data in tables 23 and 24 understate attempted and actual panel servicing contacts in several ways. (1) The call-back visit had the multiple purpose of rapport-building, editing, and dealing with attritions. Thus, to some degree the call-back did take the place of otherwise necessary contacts. 59/ The number of attempted contacts for the call-back visits were not noted on the interviewing card; but, on the basis of attempted and completed panel servicing visits, an estimate of

58/ The general policy was not to communicate with the recordkeeper for data which could be reasonably deduced from other sources unless they represented a frequent shortcoming.

59/ As a result of reasons given at the time of the call-back, no further attempts were made to reactivate 38 of the 222 families who dropped out after submitting not more than one record. In addition, no effort was made to reactivate 8 other families who dropped out after notifying the staff by telephone or letter of their reasons for dropping out.

Table 23.--Number of attempted contacts for panel servicing by purpose and type of contact, 492 families grouped by number of weekly records submitted, May 1952-May 1953

Purpose and type of attempted contact and number of families	Attempted contacts with--			
	Families submitting 26 or more records	Families submitting 2-25 records	Families submitting only 1 record	All panel families
	Number	Number	Number	Number
Attrition: 1/				
Visit	25	74	172	271
Telephone Call	135	193	256	584
Letter	5	5	16	26
Total	165	272	444	881
Editing:				
Visit	27	6	--	33
Telephone Call	419	34	1	454
Letter	16	3	--	19
Total	462	43	1	506
Personal: 2/				
Visit	--	--	--	--
Telephone Call	9	1	--	10
Letter	26	3	--	29
Total	35	4	--	39
Total panel servicing:				
Visit	52	80	172	304
Telephone Call	563	228	257	1,048
Letter	47	11	16	74
Total	662	319	445	1,426
Number of families	170	100	222	492

1/ Because of the reasons they gave for dropping out, no attempt was made to reactivate 44 families who dropped out after submitting 1 record and 2 families who dropped out after submitting at least 2 but not more than 26 records.

2/ Rapport-building contacts to say happy birthday, congratulate new parents, and express sympathy in cases of sickness or death.

Table 24.--Number of actual contacts for panel servicing by purpose and type of contact, 492 panel families grouped by number of weekly records submitted, May 1952-May 1953

Purpose and type of actual contact and number of families	Actual contacts with-- Families submitting 26 or more records	Families submitting at least 2 but not over 26 records	Families submitting not more than one record	All panel families
	Number	Number	Number	Number
Attritions: 1/				
Visit	13	39	100	152
Telephone call	81	110	138	329
Letter	5	5	16	26
Total	99	154	254	507
Editing:				
Visit	22	4	--	26
Telephone call	229	20	--	249
Letter	16	3	--	19
Total	267	27	--	294
Personal: 2/				
Visit	--	--	--	--
Telephone call	9	1	--	10
Letter	26	3	--	29
Total	35	4	--	39
Total panel servicing				
Visit	35	43	100	178
Telephone call	319	131	138	588
Letter	47	11	16	74
Total	401	185	254	840
Number of families	170	100	222	492

1/ As a result of their reasons for dropping out, which were stated to the interviewer during the call-back or transmitted to the office via phone or letter, 44 of the families submitting not more than 1 record and 2 of these submitting at least 2 but not over 26 records, had not attempted or actual contacts for the purpose of reactivating them even though they became attritions.

2/ Rapport-building contacts to say happy birthday, congratulate new parents and express sympathy in cases of sickness or death.

an additional 620 attempted contacts to complete the 361 call-backs is reasonable. 60/ (2) A newsletter to build rapport and to remind panel members of proper recordkeeping techniques was sent out with each monthly mailing of record forms. To the degree that either or both of these objectives were attained, attempted and actual contacts for the purposes of editing or dealing with attritions were reduced. A further attempt was made to bolster interest by sending out a small, unanticipated gift with the record forms during the early weeks of panel membership and again at Christmas time. If such gifts were effective in reducing attritions, they also reduced panel servicing contacts. (3) Just prior to closing the panel it was necessary to hold a final interview with each active or recently active panel family to check family data that may have changed during the anel period and to obtain additional information concerning restaurant meals, the effect of panel participation on purchase or consumption patterns, and the desires of each family with respect to the type of remuneration for their recordkeeping efforts. This process involved additional visits, telephone calls, and letters.

When the above three areas are combined with the panel recruiting efforts and the panel servicing efforts, the totals for attempted and actual contacts become quite formidable (table 25). About 9,467 attempted contacts were made by visit--in about 1 out of 2.7 of these visits actual contact was made. One thousand and ninety-seven attempted contacts were made by telephone--in about 1 out of 1.8 of these telephone calls actual contact was made. In addition, about 4,204 contacts were made by mail.

60/ The policy followed was that the interviewer arranged for the call-back visit during the panel participation interview, however, these appointments were not always kept by the panel members.

Table 25--Number of attempted and actual contacts classified by type and purpose of contact, March 1952-May 1953

Type and purpose of contact	Attempted contacts	Actual contacts
	Number	Number
Visit:		
Initial and recruiting interviews	8,263	1/2,759
Call-backs	2/(620)	2/(361)
Panel servicing 3/	304	178
Closing down the panel	280	169
Total	9,467	3,467
Telephone:		
Panel servicing 3/	1,048	588
Closing down the panel	49	35
Total	1,097	623
Letter:		
Pre-interview 4/	2/(1,758)	2/(1,758)
Explanation to stores and local organizations 5/	2/(160)	2/(160)
Panel servicing 3/	74	74
Mailing of record forms 6/	2/(2,000)	2/(2,000)
Closing down the Panel	212	212
Total	4,204	4,204
Total visit, telephone and letter	14,768	8,294

1/ Includes one actual contact with all of the ineligible families; one actual contact with the one-interview-approach families who (a) refused to give any interview, (b) gave an interview but refused to join the panel, and (c) joined the panel; one actual contact with the two-interview-approach families who (a) refused to give any interview and (b) were eligible but were never interviewed for panel; and two actual contacts with the two-interview-approach families who (a) gave first interview but refused to join the panel and (b) joined the panel.

2/ Figures in parentheses are estimates.

3/ See tables 24 and 25 for a further breakdown of these categories.

4/ Included notification that the family would be contacted by an interviewer and some brief statement of the purpose of the contact. This was done for all stages of interviewing except the initial interview of the two-interview approach.

5/ Included an outline of the study and a request that the store cooperate with the efforts of panel members to secure accurate price and quantity data on their purchases or a request that the organizations urge their members to participate in the study.

6/ Included in regular mailings of record supplies were newsletters, always; unanticipated prizes, twice; and a short questionnaire, once.

Day of the week ____ Dairy food record ____ Household code number ____

1. Today's Purchases of Meat, Fish, and Poultry
(Include fresh, frozen, cured, canned and dried. Also canned and prepared combinations such as stews & meat & poultry pies)

Meats What Kind? (beef, pork, veal, lamb, rabbit)	Type (rib or chuck roast: center cut chops, fresh or cured shoulder, kidney or shoulder chops, bologna. If canned write in "1 can" "2 cans," etc.)	Exact Weight (If canned: give wt on label of one can) Lbs.	Oz.	Price Per Lb. (if canned, price per can)	Total Price
				$	$

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Fish What Kind? (haddock, scallops, lobster, tuna, etc.)	Type (whole fillet, steak, if canned, write in "1 can," "2 cans" etc.)	How priced & weighed Check: canned or shelled	Not cleaned or Not shelled	Exact Weight Lbs:	Oz.	Price Per Lb	Total Price

Poultry What Kind? chicken, turkey, duck, etc.)	Type (fryers, roasters, fowl, lege or breast capon. If canned, write in "1 can" "2 cans" etc.)	How priced & weighed Check one: Drawn	Not Drawn	Live	Exact Weight Lbs:	Oz.	Price Per Lb.	Total Price
							$	$

If you bought no meat, fish, or poultry today check here /_/

Today's menu record
(food eaten in home.)

If you did not serve meat, fish or poultry: answer ques. 3,8,9,10,11

3. Write in what you served as a main dish--the main part of your meal

If you served meat, fish or poultry, answer all following ques.

4. What meat, fish or poultry did you serve? Write in kind and type, as beef chuck roast, lamb shoulder, chops, haddock, fillets, etc.

5. How was meat, fish or poultry prepared? (as fried, baked, roasted, broiled, in a sandwich, kink of casserole, etc.)

6. Check whether a left-over or served first time: /_/ Leftover /_/ First time | /_/ Leftover /_/ First time

7. Was this your main dish? (Check Yes or No) if No, write in what you served as a main dish--the main part of the meal: Yes /_/ No /_/ | Yes /_/ No /_/

8. Write in number of persons in each age group eating each meal:
- __ Men, __ Women 16&over; __ Boys, __ Girls 10-15; __ Boys, __ Girls 2-9
- __ Men 16 up, __ Women; __ Boys, __ Girls 10-15; __ Boys, __ Girls 2-9

9. Were any of the people listed in question 8? Check Yes or No. Yes /_/ No /_/ | Yes /_/ No /_/

10. Check if no food eaten in home /_/ | Check if no food eaten in home /_/

11. No. of people who ate home-packed meals away from home

If none Check here /_/ : Write in number of people in each age group (If one person ate two meals, count as two people
__ Men, __ Women 16 & over: __ Boys, __ Girls 10-15: __ Boys, __ Girls 2-9

This diary covers your Daily Food Record for the week of Sunday _____ (month) (date)

through Saturday _____ (month) (date)

Before mailing, be sure your diary is complete. Make certain you have checked (X) the spaces marked no purchases or no food eaten in home or none if these answers are appropriate.

If you have any questions, call _____ at _____ Extension _____.

FAMILY INFORMATION

1. Has there been any change during the past week in your household membership?
   (a) if no change, check here: ☐
   (b) if some new members--List below as new members only those who will be eating in your home for more than one week; otherwise consider them as guests and check Question 9. Be sure to include returning members whom you have previously listed as having left:

Relationship to head of family	Sex	Age

   (c) If some members have left--List below only members who will be away from your home for more than one week:

Relationship to head of family	Sex	Age

2. Family income Received During the Past Week:
   (a) If no income was received, check here: ☐
   (b) How much income was received by household members who give all their earnings to family support?

Write in household members, not by name but by relationship to head of household	Amount Earned	Check one: Before taxes	Check one: After taxes
Head of household	$		

   (c) How much did you receive in contributions from household members who give only a part of their earnings for family support?
   Amount $_____

   (b) How much did your family receive from roomers, rent, pensions, bonuses, interest, business profits, allotments, welfare aid, relief, unemployment compensation, etc? Amount: $_____

Table 26.--Zero-order coefficients among the seven family characteristics used in the regression analysis, October 12, 1952 - May 23, 1953 1/

Family characteristic	A.M.E. 2/	Income 3/	Occupational status of housewife 4/	Ethnic background 5/	Age 6/	Education 7/	Religion 8/
A.M.E.	1.0000	.0849	-.0227	-.0405	.0608	.0388	-.0307
Income		1.0000	.0844	.1865	-.0906	.2700	-.1036
Occupational status of housewife			1.0000	-.0226	.1132	-.0345	.0200
Ethnic				1.0000	.0677	.3535	-.1561
Age					1.0000	-.2733	-.1510
Education						1.0000	-.1528
Religion							1.0000

1/ 151 observations.
2/ One adult-meal equivalent equals one adult male eating all 14 noon and evening meals during a week in or from the home. For a more complete description of how adult-meal equivalents were computed see p.
3/ Family income in hundreds of dollars after Federal income taxes.
4/ No regular employment away from the home, part-time work, and full-time employment away from the home were coded respectively, 0, 1, 2.
5/ Birthplace of housewife's parents; non-U.S. and U.S. were coded 0 and 1, respectively.
6/ Age of the housewife coded in 5-year intervals.
7/ Housewife's education below high school, high school incomplete, high school completed, above high school coded, respectively, 0, 1, 2, 3.
8/ Non-Catholic and Catholic coded 0 and 1, respectively.

Table 27 --Average weekly purchases of meat, fish, and poultry per family by kinds, 146 families, October 12, 1952-May 23,1953 1/

Week of study	All meat, fish, and poultry	Beef	Pork 2/	Poultry	Lamb	Fish	Veal
	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
1	7.82	2.95	1.97	1.23	0.70	0.83	0.14
2	7.97	2.52	2.43	1.42	.66	.70	.24
3	8.29	2.64	2.64	1.20	.84	.78	.19
4	8.27	2.77	2.29	1.43	.94	.70	.14
5	7.81	2.92	2.24	.88	.98	.71	.08
6	7.26	2.56	1.91	1.28	.55	.77	.23
7 3/	12.56	1.96	1.48	8.25	.29	.49	.09
8	7.89	2.72	2.30	1.00	1.04	.65	.18
9	8.05	3.01	1.97	.94	1.28	.69	.16
10	7.27	2.66	2.23	1.03	.52	.63	.20
11 4/	12.91	1.95	1.69	7.79	.50	.89	.09
12	7.58	2.87	2.16	1.09	.64	.68	.14
13	7.48	3.03	2.29	.68	.73	.58	.17
14	8.50	3.02	2.16	1.53	.89	.72	.18
15	7.78	3.18	1.83	1.30	.62	.68	.17
16	8.83	3.28	2.33	1.40	.82	.80	.20
17	8.12	3.28	2.10	1.17	.68	.66	.23
18	8.60	3.11	2.51	1.39	.74	.72	.13
19	8.32	3.33	1.87	1.40	.58	.98	.16
20	7.54	3.08	1.52	1.06	.81	.78	.29
21	8.47	3.28	1.87	1.36	.96	.81	.19
22	7.86	3.31	1.86	1.24	.50	.70	.25
23	8.19	3.17	1.86	1.46	.72	.80	.18
24	7.57	2.84	1.85	1.29	.62	.76	.21
25 5/	8.79	2.07	3.48	2.12	.25	.77	.10
26	7.30	3.27	1.47	1.27	.47	.63	.19
27	8.01	3.26	1.55	1.21	1.03	.67	.29
28	7.32	3.36	1.43	.98	.59	.62	.34
29	8.01	3.62	1.57	1.48	.62	.63	.09
30	7.73	3.29	1.61	1.17	.66	.78	.22
31	7.53	3.31	1.53	1.24	.38	.73	.34
32	7.91	3.09	1.73	1.37	.57	.87	.28

1/ Quantities do not include prepared items such as luncheon meats, frankfurters, canned meat, fish, or poultry products, or combination meat, and fish cakes, hashes, stews, meat pies and other items containing significant amounts of ingredients that are not meat, fish, or poultry.
2/ Includes both fresh and smoked pork items.
3/ Week of Thanksgiving.
4/ Week of Christmas.
5/ Week of Easter.

Table 28--Individual retail cuts and weights used in constructing price indices

Retail cut	Weight	Retail cut	Weight
Beef: 1/		Pork--continued	
Porterhouse steak	7.29	Sausage	5.00
Top-round steak	4.30		
Bottom-round roast	23.97	Total	100.00
Boneless stew beef	6.59		
7" rib roast, bone in	8.90	Veal: 1/	
Chuck, boneless	25.76	Rump roast	77.79
Ground beef 2/	23.19	Cutlets	13.75
		Loin chops	8.46
Total	100.00	Total	100.00
Pork: 1/		Lamb: 1/	
Rib end, loin	37.10	Leg	78.55
Center cut chops	8.90	Rib chops	21.45
Ham, pre-cooked face half	26.60		
Bacon	22.40	Total	100.00

1/ Based on cutting test information supplies by the Great Atlantic and Pacific Tea Company and First National Stores, Inc. on average yields from U. S. Choice beef and lamb carcasses and typical pork and veal carcasses for the Boston Area.

2/ Preground beef (ground and ready for sale before customer makes purchase) containing not more than 25 percent fat or suet.

Table 29--Weights used for kinds of meat, fish, and poultry in constructing a price index for all meat, fish, and poultry items 1/

Kinds of meat, fish, and poultry	Weight	Kinds of meat, fish, and poultry	Weight
Beef	36	Lamb	8
Pork	24	Veal	2
Poultry	21	Total	100
Fish	9		

1/ Weights based on purchases of the panel families over the 32-week recordkeeping period.

Table 30.--Average weekly price per pound for meat, fish, and poultry, by kind, October 12, 1952-May 23, 1953

Week of study	All meat, fish and poultry	Beef	Lamb	Pork	Veal	Poultry	Fish
	- Cents per pound -						
1	75	89	87	66	86	64	58
2	75	91	86	64	86	62	58
3	74	90	86	60	85	63	58
4	72	89	80	56	90	63	55
5	72	89	77	58	84	63	58
6	72	88	77	58	85	61	60
7 1/	73	87	78	59	84	66	60
8	72	87	74	56	88	65	60
9	72	88	73	55	87	70	58
10	71	86	73	54	85	66	59
11 2/	71	88	71	55	83	64	59
12	69	84	69	55	84	63	59
13	69	82	70	57	82	62	58
14	68	78	68	57	85	64	57
15	65	74	70	58	82	60	55
16	65	72	71	58	89	60	55
17	64	71	70	58	89	60	55
18	63	69	68	58	89	60	52
19	64	69	67	61	90	60	53
20	64	69	68	61	90	60	54
21	64	67	68	63	87	61	53
22	64	66	69	64	79	62	56
23	62	66	70	63	73	62	54
24	63	64	69	63	72	60	49
25 3/	63	65	71	62	72	61	50
26	62	65	71	62	71	61	51
27	63	63	70	63	71	61	50
28	64	62	71	64	70	63	53
29	65	62	75	71	69	62	53
30	65	61	77	71	72	63	53
31	65	61	78	70	73	65	55
32	65	61	80	70	73	64	54

1/ Week of Thanksgiving.
2/ Week of Christmas.
3/ Week of Easter

Table 31.--Index of nonprice selling practices for meat and poultry, by kind, October 12, 1952-May 24, 1953

Week of study	Beef	Pork	Lamb	Poultry	Veal
1	1	3	-	-	-
2	-	4	-	1	-
3	3	3	1	-	-
4	1	3	3	-	-
5	1	1	2	1	-
6	-	0	-	4	-
7 1/	-	-	-	-	-
8	-	1	3	-	1
9	1	4	3	-	-
10	3	1	-	2	-
11 2/	-	-	-	-	-
12	-	3	1	1	-
13	4	-	1	-	-
14	3	-	2	-	-
15	3	-	-	3	-
16	4	-	1	-	-
17	3	-	2	1	-
18	3	-	3	1	-
19	2	2	-	4	-
20	4	1	1	1	-
21	3	1	1	2	-
22	3	-	-	2	2
23	3	-	1	-	-
24	4	-	-	1	1
25 3/	-	-	-	-	-
26	2	-	-	-	2
27	3	-	1	-	-
28	3	-	-	1	1
29	2	1	-	2	-
30	4	-	-	1	-
31	2	1	-	1	1
32	3	-	-	1	-

1/ Week of Thanksgiving.
2/ Week of Christmas.
3/ Week preceding.

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