AN ECONOMETRIC ANALYSIS OF SOCIOECONOMIC AND DEMOGRAPHIC DETERMINANTS OF FISH AND SHELLFISH CONSUMPTION IN THE UNITED STATES

BY

JONATHAN S. PERRY

A DISSERTATION PRESENTED TO THE GRADUATE COUNCIL
OF THE UNIVERSITY OF FLORIDA IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

1981

To my mother and father -- who taught me the important things.

ACKNOWLEDGMENTS

The author expresses sincere appreciation to Dr. F.J. Prochaska, Dr. J.C. Cato, and Dr. J.A. Koburger for taking time from their schedules to serve on his Advisory Committee. Their comments, criticisms, and suggestions upon reviewing the drafts of this manuscript served to make it a more scholarly work and were appreciated. A special note of thanks is due F.J. Prochaska, Chairman of the Advisory Committee, for his suggestions and guidance throughout the course of the authors graduate career.

A special note of gratitude must be extended to Ramona Rochester, Renelle Phillips, and Shirley Harris, for typing the numerous drafts of this dissertation. A debt is also owed Carolyn Almeter and Debbie Miller for their aid with the computational aspects of this work. Appreciation must also be expressed to Dr. Leo Polopolus, Department Chairman, and Dr. F.J. Prochaska, for their aid with financial support throughout the author's graduate study.

Finally, the author is indebted to his family and wife for their support, understanding, and cooperation throughout the course of his graduate work.

TABLE OF CONTENTS

LIST OF TABLES

Abstract of Dissertation Presented to the Graduate Council
of the University of Florida in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy

AN ECONOMETRIC ANALYSIS OF SOCIOECONOMIC AND DEMOGRAPHIC DETERMINANTS OF FISH AND SHELLFISH CONSUMPTION IN THE UNITED STATES

By

Jonathan S. Perry

August 1981

Chairman: Frederick J. Prochaska
Major Department: Food and Resource Economics

Weekly household expenditures on fish and shellfish products in the United States were analyzed through estimation of an Engel curve relationship. Expenditures on five product groups (canned fish, shellfish, whole fish, filleted and steaked fish, and total expenditures) were expressed as a function of thirteen variables reflecting household socioeconomic and demographic characteristics. Variables included were income, race, expenditures on food away-from-home, education, occupation, urbanization and an adult equivalent scale.

Data employed were collected by the Bureau of Labor Statistics during the 1972-1974 Consumer Expenditure Diary Survey. The 23,186 households studied were segregated into four regions and three income groups. A separate equation for each expenditure category was estimated for each region and each income group. Expenditures were considered limited dependent variables and Tobit analysis used. The solution algorithm chosen was Phelps' version of LIMDEP.

Income, race, and the adult equivalent scale were consistently significant in explaining expenditures on all product groups. Income had a significant positive impact on all expenditure categories except whole fish. The Northeast tended to have the largest income coefficients, expenditure income elasticities of demand, and average weekly expenditures. Smallest elasticities occurred in the South while the North Central states had the smallest average expenditures. Among product groups the largest elasticities were associated with shellfish and the smallest with filleted and steaked products.

Race was an important determinant of expenditures with Black households often predicted to spend $2.00 per week more on fresh fish products than Whites. Whites tended to have larger expenditures on canned fish. Of the adult equivalent scale variables adult males and females, and elderly males had a larger impact on expenditures than infants or elderly females. Occupation had no consistent impact on purchases while urbanization had an impact only in the Northeast and West. Education was significant for canned fish expenditures in all regions.

CHAPTER I

INTRODUCTION

One traditional use of the world's freshwater and marine resources has been as a source of food. In particular, they have long been exploited as sources of high quality animal protein. In the United States, per capita consumption of fish and shellfish products has steadily increased during the past two decades. In 1960, per capita consumption of fish and shellfish was 10.3 pounds edible meat weight. By 1970, this had increased to 11.8 pounds. In 1978, per capita consumption reached a record level of 13.4 pounds [U.S. Department of Commerce, 1979]. These figures reflect only consumption of those products moving through commercial channels. Per capita consumption from recreational catches is estimated to be three to four pounds annually [U.S. Department of Commerce, 1980]. Thus, actual consumption of fishery products in the United States is somewhere in the neighborhood of 16 to 17 pounds of edible meat per person annually. With respect to the overall level of consumption, the United States ranks 39th of 132 countries worldwide. On a live equivalent basis, this amounts to 35.1 pounds per capita annually which compares with a high of 164.7 pounds for Japan and an annual world average of 28.9 pounds [U.S. Department of Commerce, 1979]. For the world as a whole and the United States in particular, the increases in consumption of fishery products seen in recent decades are likely to continue. The Food and Agricultural Organization of the United Nations predicts fish and shellfish consumption will probably increase through 1990 at a growth rate in excess of that seen for beef, pork, vegetables, cereal, and milk [Office of Technology Assessment, 1977]. This projection is the result of several factors. In developed countries, changes in tastes are shifting consumption patterns away from red meats to consumption of leaner protein sources including fish [Comptroller General of the United States, 1976]. Combining with this is the continued increase in population of developed and developing countries, which in itself increases overall use of these products. Thus, fish and shellfish are becoming more prominent parts of household diets and will continue to do so in the next ten to twenty years. As this trend develops, additional information about households consuming these products will be useful to many sectors.

The programs involved with the passage of the Fisheries Conservation and Management Act of 1976 (PL 94-265) require the public sector to have information about consumers of fishery products. The legislation has implications for many areas other than those directly involved in utilizing or regulating the marine resource. Expressed in the bill is the desire that the ocean resource be used to provide society maximum social, biological, and economic gain. One stated objective in achieving this is to encourage expansion of the American fishing industry. Specifically proposed goals include: ". . . [encouraging] the development of fisheries which are currently underutilized or not utilized by United States fishermen. . . . and [revitalizing] the existing fishing industry, . . ." (PL 94-265, Section 2, pp. 2,3). In line with these objectives, the Office of Technology Assessment has identified three critical areas which must be developed if PL 94-265 is to succeed. These are: 1) stock enhancement, 2) creation of markets for fish and shellfish U.S. fishermen do not currently harvest, and 3) a revitalization of the industry as a whole [Office of Technology Assessment, 1977, p.95]. The programs developed in these areas will directly affect household use of fish and shellfish products. However, just as these programs will affect households, the acceptance with which they are received by this same group will directly determine their success. In particular, household behavior will have a pronounced effect on the success of programs coming from the OTA's latter two mentioned critical areas. This relationship, that between the success of these programs and the behavior of the American consumer, arises directly from economic theory. Here it is stated that in a market economy it is the wants and desires of consumers which ultimately dictate how and where resources are utilized [Leftwich, 1976, p.19]. The prices consumers are willing to pay and the quantities they are willing to take ultimately direct production effort. Because of this, consumer behavior is of paramount importance to the success of any production or marketing program. Information giving insight into consumer's tastes, preferences, or behavior should therefore be a valuable aid. It should also assist governing bodies enacting legislation affecting production or marketing programs. Processors, packers, and other components away from the actual production process will likewise benefit. By better understanding their target markets, they will be in a position to use society's resources more efficiently. They will gain the ability to cater more directly to the whims and desires of their customers. Information of this type should eventually affect advertising programs, product development and design.

The difficulties resulting from ignoring market and consumer information have been recognized. Academic institutions frequently act as a research and development arm for private industry. When they make recommendations regarding new products and product forms they have to seriously examine information relating to potential consumers of these products. The Sea Grant program of the National Oceanic and Atmospheric Administration is an excellent example of one area in which information of this type can provide guidance. Historically, product development and work to reduce costs and streamline processing have dominated research efforts. The consumer's end of the market spectrum has often been ignored. Because of this, much Sea Grant effort to develop new products has been unproductive [Smith, n.d.]. This has resulted in part from the tendency to examine the situation from the producer's veiwpoint, ignoring the implications of consumer characteristics, desires and tastes [Smith, n.d.]. Too few conscious attempts have been made to coordinate production activities with the wants of consumers. Information about consumer behavior can be used to guide development of products and lessen the chance of wasting resources on products which are likely to fail or enjoy only limited success. In this way, knowledge of consumer desires, tastes, preferences and other characteristics can be used to enhance the possibilities of success of the products recommended by institutional research as well as those of the private sector.

The amount of information available about consumer behavior relating specifically to fishery products has been limited. The actual and potential increases in consumption of fish and shellfish foreseen because of changing preferences, continued increases in population level, and consequences of stated goals of several aspects of PL 94-265 will, in all likelihood, be substantial. Information about consumer behavior relating to these goods will therefore be a valuable aid to the various groups whose decisions will affect the production, processing, marketing and consumption of these products.

Problem Statement

Through the past twenty years, per capita consumption of fish and shellfish in the United States has increased. This has resulted in part from a shift in tastes and preferences away from red meats to leaner sources of protein including fish [Comptroller General of the United States, 1976]. Thus, markets for fishery products have strengthened gradually through these two decades. This trend is projected to continue with gains in consumption of fish and shellfish products exceeding projected growth of such traditional protein sources as beef, pork, and milk. Higher per capita consumption of fishery products is expected to continue at least through 1990.

The passage of the Fisheries Conversation and Management Act of 1976 may affect the trend in seafood consumption. As a component to meeting the stated objective of revitalizing the U.S. fishing industry it encourages increased usage of the food potential of the nation's ocean resource. The strengthening of existing markets and development of markets for new products are essential if this is to be accomplished. The success of the programs designed to affect this increase in consumption depend directly on consumer motivations and their attitude toward the resulting products. Consumer behavior plays a critical role in determining the products they select in the market. Knowledge of consumer characteristics, motivations, preferences, and the implication these factors have on behavior can aid those designing programs to carry out policy goals by providing insight into how consumers can be expected to react to alternative program schemes. This information can give valuable guidance in program formulation and in selecting for implementing those which will be most effective and efficient and likely to succeed.

Coupled with this specific need for information about consumer behavior and expenditure patterns on fishery products is a more fundamental need for basic fish and shellfish consumption information. In the past, basic information relating to parameter magnitudes has been infrequently available for broad aggregates of these products at the national and regional level. As fish and shellfish become a more significant part of the American diet, such information will be useful in providing more knowledge about consumption of these goods. Possibly of even more value, it will allow comparisons with similar parameters of other consumer products. The understanding gained through comparisons of this type is one avenue through which knowledge is increased. An increased level in the store of basic information places the research, production, marketing and consumption coalition in better position to make even greater improvement in the efficient utilization of this and other food resources.

Objectives

The purpose of this dissertation was to provide basic information relating to household consumption of fish and shellfish products in the United States. Specifically, the objectives of the research were to:

1) Develop an econometric model relating household expenditures on fishery products to the household's socioeconomic and demographic characteristics.
2) Determine behavioristic parameters (elasticities), quantifying consumer response to changes in given variables both in the

household and in the market place for broad aggregates of fishery products.

3) To determine the significance of food stamps on fishery product expenditures for those households receiving them in the 1972-1974 Bureau of Labor Statistics diary survey sample.

4) To allow comparisons with previous research, a tabular analysis of average fish and shellfish expenditures made by households included in the Bureau of Labor Statistics, survey is made after the sample was stratified by a series of socioeconomic and demographic factors.

CHAPTER II

PREVIOUS WORK RELATING SOCIOECONOMIC AND DEMOGRAPHIC FACTORS TO FISH AND SHELLFISH CONSUMPTION

Demand Analysis of Fish and Shellfish Products

Previous analyses examining the income consumption relationship specifically for fishery products have not been available with great frequency. The balance of previous work has examined the Engel relationship only for particular species or groups of species [Johnston and Wood, 1974]. Other research has examined characteristics affecting consumption of fish and shellfish products by households in given cities or regions of the country. Work relating to consumption of broad aggregates of these products by households at the national level has been provided [Nash, 1970] but has not been available with the regularity of literature on other comparable food commodities such as milk products, red meats or poultry.

Purcell and Rauniker [1968] analyzed household demand for fish and shellfish focusing on consumer reactions to changes in prices, price relations, income, and other socioeconomic factors. The data were obtained from a consumer panel in Atlanta made up of 160 housholds from 1958 through 1962. Pooling of the cross-sectional and time series data yielded 3,200 observations on which their analysis was based. The authors divided their analysis into two parts. The first involved a cross-tabulation of socioeconomic effects on the consumption and expenditures for various fishery products; the second involved the effects of various explanatory variables on consumption and expenditures for selected fish and shellfish products.

Included in the cross-tabulation was information for both household and per capita quantity consumed, average value of consumption, quantity purchased by income groups, quantity purchased by household size, expenditure by household size, and quantity purchased and expenditure by race. Twenty-seven fish and shellfish categories were examined for each of the socioeconomic characteristics considered. The results were reported in dollars for each commodity and as a percent of total expenditure. All information considered related to five-year averages.

Purcell and Rauniker's [1968] second analysis centered around four different models and seventeen different variables. All models were based on the simple linear form with the differences involving the income variables. The four forms of the income variable considered were linear, squared, square root, and cubed root. Other variables included were race, five age categories of household members, quarters of the year, quantities received as gifts, a time trend and a single variable representing the price of the given fishery product category. Summary statistics (weighted average purchases by quarter, by income, etc.) were reported for price, race, trend, number of persons, income and season coefficients. The information reported involved thirteen different fish and shellfish categories.

The cross-tabulations showed the quantity of fresh fish purchased per household to be 14.53 pounds, which was the largest for any category or product considered. Total average annual expenditure for all fish and shellfish by household was $17.46. On a per capita basis, annual expenditure and quantity consumed of all fish and shellfish were $5.24

and 11.33 pounds, respectively. The largest total expenditure for all fish and shellfish occurred in the highest income category ($12,000 or more per year). This translated into an average per capita expenditure on fishery products of $8.56 for this income group. Per capita consumption of fishery products was lowest in households with more than six members and highest in one-person households. The quantity of fish and shellfish purchased by non-white households (51.55 pounds) was 82 percent higher than the quantity purchased by White households (28.31 pounds). Comparably, expenditures for fish and shellfish by non-white households were 36 percent greater than the expenditures by White households.

Appropriate negative signs were obtained for the net effect of own-price on the quantity purchased for all categories of products with the exception of fresh fish. The categories on which the effect of price was statistically significant were salmon, other fish, oysters, fresh shrimp, frozen shrimp, and all shrimp. Differences of quantity and expenditure level attributable to race were found for all fish and shellfish groups except tuna. The greatest differences were for fresh fish: White households spent $2.20 less and consumed 7.73 fewer pounds per quarter than non-white households. Purchases of fresh fish, tuna, and sardines in oil decreased significantly throughout the twenty quarters of the study. Quantity and expenditure for other fish, frozen shrimp, and total shrimp increased throughout the study period. Age was found to have a considerable impact on consumption. The 6-10 and 11-18 age groups had the greatest effect on the quantity purchased for total fish and shellfish. For expenditures, however, the greatest effect for total fish and shellfish was found for 18 years and older (adult) groups. For all fish and shellfish categories except one, quantities and expenditures per quarter increased as income increased. Purchases during the winter were generally greater than in other quarters except for tuna, sardines in oil, and oysters. The categories in which expenditures differed most from winter quarter expenditures were fresh fish and total fish and shellfish (spring), other fish and total fish (summer), and oysters (spring and summer).

Nash and Bell [1969] in a working paper compiled a set of demand equations which were estimated for fishery products. The paper resulted from a 1968 conference sponsored by the Division of Economic Research of the Bureau of Commercial Fisheries. The purpose of the conference was to draw together, on a species basis if possible, all of the statistical demand relationships which had been estimated in past research. Fish consumption was mathematically related to demand determinants such as per capita income and prices. It was the conference's task to determine the function for each species which could be expected to give the best performance in future research. The equations presented in the working paper were selected as the most representative of all those submitted. Equations were presented for twenty-three species. Information relating to the product, the geographic area of the data, the market level to which the equation related, the econometric approach used, the form of the equation, the researcher, and a statistical measure of fit were provided. Also, in each case the variables used, their t-values, and regression coefficients were reported.

Consumption Studies of Fish and Shellfish Products

Nash [1970] published the results of one of the first comprehensive studies examining purchasing patterns for fresh and frozen fish and shellfish products through a tabular analysis of national data. The report's primary aim was to present data collected from 1,500 households from February 1969 to January 1970. The goal of the survey was to obtain a complete record of the fishery product expenditures of the participants. With this knowledge, information about consumer buying habits across a broad range of social, economic, and regional characteristics was provided. The 1,500 households represented nine geographic regions and eight social, economic and ethnic groups.

Several household characteristics were found to significantly affect purchases of fish and shellfish products for use in the home. Specific characteristics considered were race, religion, region, seasonality, income, and other household characteristics such as size, age of head, and number of children. Race was found to be the "singularly important" ethnic factor determining fish and shellfish consumption. Black households purchased twice the quantity of fresh and frozen shrimp and more oysters, crabs, ocean perch, red snapper, catfish, and whiting than did White households. White households tended to purchase more lobster and halibut. Expenditures on the given categories of products also differed by race. Whites tended to pay higher prices for salmon and red snapper while Blacks reported higher prices for lobsters, clams, and crabs.

Religious factors also had a pronounced effect in some cases. Jewish households, as opposed to Catholics and Protestants, were the "unquestioned leader" in consumption of flounder-sole, salmon, and the miscellaneous fish groups. Their purchases of shrimp, crabs, scallops, halibut, and cod were also "measurably higher." Catholic households purchased more shrimp, lobster, lobster tails, clams, scallops, haddock, flounder-sole, and cod. Oysters, red snapper, catfish and whiting showed higher consumption among Protestant households.

Regional effects on consumption were pronounced in some cases, yet of no consequence in others. Shrimp was the one product showing the most even consumption across all geographic regions considered. Crab and oyster consumption were highly regional--declining rapidly as distance from the areas of production increased. These products were "virtually unknown" in interior regions. Because of their use in frozen fish sticks and portions, ocean perch and groundfish were consumed in all regions. Income was not found to be as important in explaining purchases as economic theory would indicate. There was a general, though not steady, increase in purchases as income increased through the sample. Regarding the effects of occupational classes, significant differences attributable to this factor were not noticed.

The effects of household characteristics were found to be important seafood consumption determinants. Except for catfish, red snapper, and whiting, greater consumption levels were associated with higher age classes of the household's head. Nash states that in nearly every case consumption fell as household size increased.

Away-from-home consumption was also considered. Here a great deal of specificity was found. Comparisons for lobsters and clams indicated that these products are consumed more frequently away-from-home. Also, in the away-from-home market, income seemed to have a more pronounced effect than in determination of at-home consumption. Age of household head was also found to increase the frequency with which fish and shellfish meals were consumed away-from-home. Regarding race and religion, away-from-home consumption followed the same general pattern as that identified for home purchases. As would be expected, Nash found regional patterns to closely follow those found for home consumption. Seasonal effects on away-from-home purchases were not pronounced for any product considered.

Miller and Nash [1971] present additional results of the 1969 to 1970 survey of 1,500 households. This analysis focuses on several characteristics affecting shellfish consumption. All major shellfish species were included in their report. Five aspects of consumption were examined: geographic concentration and distribution patterns, seasonality, comparison between volumes consumed at home and away from home, relationships between size of incomes and volumes consumed, and the effects of age on consumer preferences.

Regional factors were found to have a profound effect on consumption. At-home per capita shellfish consumption in the New England area was found to be more than twice the national average. The West South Central states had per capita consumption of shellfish which was well below average. The rate of finfish consumption in the West South Central region exceeded the national average by 75 percent.

Oysters were found to show a great deal of regionality in consumption. The South Atlantic states from Maryland south consumed almost 30 percent of the total oysters eaten at home, yet ranked only fourth nationally in population. Per capita oyster consumption in this region was nearly double the national average. The regional pattern indicates oyster consumption is largely confined to major production areas, probably because of cultural influences and the fact that a large proportion of this product is consumed in the fresh form. Two other areas, the South Central and Mountain states, had consumption levels exceeding the national average. Despite the pronounced regional concentration in consumption, oysters were known and consumed in all parts of the country.

Clams were also found to be highly regionalized in consumption. The New England, Middle Atlantic, and Pacific states were the areas of heaviest use. These three regions accounted for some 37 percent of the U.S. population, but accounted for 85 percent of the nation's clam consumption during the 1969 to 1970 time period. Tradition was identified as a major factor influencing this regionality. New England was again the undisputed leader with an average consumption some nine times the national average. This region alone accounted for 50 percent of consumption of these products at home. By comparison, the two other regions of heavy home use of clam products -- the Middle Atlantic and Pacific regions -- consumed 18 percent and 6 percent of the national total, respectively. In all other areas per capita consumption was less than half the national average.

Crab consumption was heavily concentrated in the Pacific Coast area. The per capita rate of consumption (King and Dungeness crabs) was greater than three times the national average, amounting to more than 40 percent of the U.S. total. Outside this region, consumption in all remaining areas was approximately proportional to the area's population, thus yielding a consumption level of about the national per capita average. The top three regions in at-home consumption were the Pacific, South Atlantic, and Middle Atlantic states.

Regarding American lobster consumption, New England households showed the highest levels accounting for almost two-thirds of the nation's purchases for at-home use. The largest part of the remaining one-third was made by households in the Middle Atlantic and South Atlantic regions. Use of this product at home in almost all other regions was found to be almost insignificant. Tradition and high shipping costs are identified as the primary factors contributing to this regionality. Nash [1970] postulates that the local market is so strong for the product that the incentive for opening markets in other areas for the relatively limited supplies is not great.

In contrast to the above fishery products, shrimp, which are marketed largely in the frozen form, were consumed relatively evenly throughout the country. Four regions were above average in at-home consumption, one was about average, and four were below average. The Middle Atlantic states consumed 24 percent of the total purchased for at-home use. South Atlantic households were second with 19 percent of the total, while the East North Central was third with 15 percent.

Like shrimp, scallops are marketed largely in a frozen form, but here at-home consumption showed geographic concentration. Highest per capita consumption was found in New England and the Middle Atlantic regions, which accounted for nearly half the scallops consumed at home. The Central and Southern states consumed the smallest percentages of the total. Relative to their percent of the total population, the Mountain area states were high consumers of scallops with a consumption level two and a half times the national average.

Frozen lobster tails are most heavily consumed in the Middle Atlantic region, which accounted for 29 percent of the national total. The East North Central and East South Central states were also high consumers of this product, accounting for 27 percent and 16 percent of the nation's total, respectively.

In a summary of aggregated finfish and shellfish consumption the authors showed that the Middle Atlantic states who rank second in population were the nation's leading market for fishery products. These states ranked first or second in per capita quantity consumed of four out of the seven individual specied considered. The South Atlantic region was just behind the Middle Atlantic in consumption which Nash [1970] states was consistent with its population. The West North Central states ranked fifth in population but third in fish and shellfish consumption. The East North Central region was the nation's most populous area, but ranked fourth in consumption of fishery products. New England was eighth in population, but ranked seventh in consumption of fishery products, thus providing the high per capita levels found in this region for some species. Of the four remaining areas, the Pacific region ranked above the remaining three in consumption of these products. All of the above comparisons relate to per capita levels of consumption for both finfish and shellfish product.

Miller and Nash [1971] also investigated the effects of seasonality on consumption and found oysters with the most pronounced pattern with highest consumption found in the months in which most of the catch is landed. Clam consumption also showed a seasonal swing which complemented the shift in oyster consumption. Crab consumption was variable, but not to the extent found of oysters and clams. Here consumption peaked in July and again in the winter during January--February. Scallops and shrimp showed almost no seasonality at all relative to the above three groups. Both products did show a mild winter peak with a gradual but steady decline through to November. Nash [1970] found that proportionally more shellfish meals are eaten away-from-home than finfish meals. Lobster and clams are more likely to be eaten out than the other products considered. Nash's survey "indicated that 59 percent of lobster consumption and 48 percent of clam consumption occur away-from-home." Shrimp and oyster consumption away-from-home accounts for 21 percent and 19 percent of the total, respectively. Of the finfish he examined, the proportions of halibut and flounder eaten out were 11 percent each, while that for haddock was only 7 percent of total consumption.

In all cases, except oysters, a clear tendency to consume more of the product as income increased was revealed. The income spread considered ran from $5,000 and under to $10,000 and over. Regarding ages, a similar effect was identified. During their survey 50 percent of U.S. household heads were 45 years or older. However, this group consumed 72 percent of the oysters, 68 percent of the clams, and 70 percent of the scallops. Conversely, households with the head younger than 35 years consumed only 20 percent of the oysters, 14 percent of the clams, and 13 percent of the scallops. Shrimp consumption was found to be even across all age groups. For the finfish, 59 percent was consumed by families with the head 45 years or older, while those with a head younger than 35 years consumed 23 percent of the total.

Pippen and Morrison [1975] examined the effects of various economic and demographic factors on purchases of farm raised catfish. Regarding income the highest group (annual gross income of $10,000 and above) tended to purchase the product more often than those in the $5,000 to $9,999 group or the $4,999 and below group. They state that the differences were significant and support the idea that as incomes increased homemakers tend to increase their purchases. In line with this those households whose head was in a "socially higher occupation" (white collar as opposed to blue collar, unskilled, or retired) were found to purchase more catfish. Differences in purchases were significant between all groups except for unskilled or retired household heads possibly indicating those groups belong to a common occupation class. In view of the results obtained for income these conclusions seem consistent.

Regarding size and composition, households with one or two members were found to purchase catfish more often than those with three, four, five, or more than five members. For the composition variable it was found that homemakers with children less than twelve years old tended not to purchase these products as opposed to those with children 17 and above. The authors felt the abundance of small bones to be the reason homemakers with smaller children discriminated against the product.

The relationship between the level of formal education of the homemaker, who presumably makes the purchase, and the level of purchases of this product was found to be positive. The reasoning behind this may be that homemakers who have attained a higher level of education place a greater value on maintaining nutritional diversity in the meats making up this portion of the diet. The effect of race on purchases was unexpected. Those purchasing were classified as either White or Black since no other races were prevelant in the Little Rock area when the data were collected. Of the sample taken 77.6 percent of the sales were to White households, while Blacks made up the remaining 22.4 percent. When compared with 1970 census figures for this area it was found, however, that Black household's purchases of this product was significantly greater than expected. The analysis indicated that race did not have as great an effect in determining number of purchases as that of other economic and demographic factors.

Focus of the Present Research

The balance of previous work examining household expenditures and consumption of fish and shellfish products has been tabular in nature and has provided information relating to average levels of consumption by consumer units possessing certain characteristics. Studies of this type allow characterization of households using fishery products but do not provide a mechanism through with the partial effects of these characteristics can be examined. Likewise this type of analysis includes no mechanism through which causality among the factors included in the consumption relationship can be explored. Specification of an econometric model relating household expenditures on this product category to the socioeconomic and demographic characteristics of the household allows the above mentioned partial effects as well as causality among the variables included in the study to be examined.

The analysis undertaken in this dissertation has endeavored to provide information at the national and regional level for broad aggregates of fishery products allowing consideration of causality among the variables included in the relationship as well as the opportunity for examination of their partial effects on observed expenditure behavior. In this, and any other research involving development of models examining relationships of this type, neoclassical consumption theory should serve as the foundation of the analysis.

CHAPTER III

THEORETICAL FRAMEWORK

Neoclassical theory begins with a series of axioms, or assumptions, the most fundamental of which is the existence, for each consumer, of a continuous real valued utility function. To insure the existence of this function some restrictions are placed on the behavior of the consumers to which it applies. In addition, a series of assumptions are also made endowing the function with properties making its behavior, upon maximization, applicable to the observed marketplace behavior of consumers. Beyond the existence of the utility function the axioms commonly considered are: 1) comparability, which insures that the consumer will always be able to make comparisons between bundles of goods, 2) transitivity, insuring that the rankings the consumer makes are consistent, 3) continuity, insuring against a lexicographic or other ordering which cannot be represented by a real valued function, 4) dominance, insuring that the utility function will be a strictly increasing function of quantities consumed, 5) strict convexity, implying that the utility function is at least strictly quasi-concave, and 6) differentiability, which insures that the utility function's first- and second-order partial derivities exist. The first two stated axioms are sufficient to establish a preordering of all possible bundles a consumer may face in the market. With the addition of the axiom of continuity to this group, the existence of a utility function capable of assigning real number values to all commodity bundles reflecting the consumer's underlying preferences is defined. The aim of the remaining three axioms is to insure the function will monotonically increase as quantities are increased, provide convex indifference curves, and have first- and second-order partial diversitives which exist.

Depending on the available data, and the aims of the individual researchers, a variety of functional forms have been proposed as candidates to represent this underlying ordering. On purely theoretical grounds only those forms satisfying the above axioms are legitimate candidates. Generally the utility function of a given consumer, for a defined period of time can be represented as follows

$$U_i = U_i(X_1, X_2, X_3, \ldots, X_n, M_i) \qquad (1)$$

where U_i is the utility derived by the ith individual from consumption of the n goods X_j $(j = 1, \ldots, n)$. The utility function is an open ended monotonically increasing relation providing information about what bundles a consumer would prefer over others if all were equally available. The question of behavior, as determined by this raw function based on preferences, is trivial. Through the assumption of dominance, the consumer always prefers more of a good to less, and the assumption of differentiability, which specifies that marginal utilities must always be positive, the consumer will always desire as much of a good as possible. In this form the utility function provides no mechanism through which the consumer can interact with the conditions he faces in the market. To accurately represent observed behavior these preferences must be allowed to interact with market conditions and the constraint represented by the consumer's income. The relevance of the utility function to observed market behavior is dependent upon its interaction with the consumer's available income and market prices. The income or budget constraint is, therefore, an integral component in the determination of consumer behavior. If P_j represents the price of the jth commodity and X_j the quantity of the jth commodity consumed by the ith consumer, then the budget constraint can be represented by the following:

$$M_i = \sum_{j=1}^{n} P_j X_j \tag{2}$$

where M_i is the scaler quantity representing total expenditure or income of the ith consumer. This constraint contains information relating to market prices as well as dividing the set of all available bundles into two subsets, those the consumer can affort to purchase and those he cannot. To depict consumer activity as it is found in the market the preference ordering, via the utility function, and the budget constraint must be considered simultaneously. The conventional mechanism allowing interaction between the utility function and budget constraint is the formation of a Lagrangean equation from (1) and (2). This provides the following form which can be optimized to give the necessary constrained utility maximization

$$L = U_i(X_1, X_2, X_3, \ldots, X_n, M_i) + \lambda(M_i - \sum_{j=1}^{n} P_j X_j) \tag{3}$$

where all variables are as defined and λ is the Lagrangian multiplier. Partial differentiation of (3) with respect to the n commodities and λ gives n + 1 first order conditions necessary for the maximization of the function

$$\frac{\partial L}{\partial X_1} = U_i^1 - \lambda P_1 = 0$$

$$\frac{\partial L}{\partial X_2} = U_i^2 - \lambda P_2 = 0$$

$$\begin{aligned}
\frac{\partial L}{\partial X_3} &= U_1^3 - \lambda P_3 = 0 \\
&\vdots \qquad \vdots \qquad \vdots \qquad \vdots \\
\frac{\partial L}{\partial X_n} &= U_i^n - \lambda P_n = 0 \\
\frac{\partial L}{\partial \lambda} &= M_i - \sum_{j=1}^{n} P_j X_j = 0
\end{aligned} \tag{4}$$

where all variables are as previously defined and U_i^j $(j=1, \ldots, n)$ represents $\frac{\partial U_i}{\partial X_j}$, the first order partial derivitive of the ith individual utility function.

The sixth axiom on which preference orderings and neoclassical consumption theory are based insures that the utility function is twice differentiable. The first order conditions outlined by (4) are used to locate a stationary value satisfying both budget constraint and utility function. To insure that this extreme value is the desired maximum the second order, or sufficient conditions, must also be fulfilled. From total differentiation of (4) the Hessian matrix of second-order partial and cross-partial derivatives can be obtained

$$\begin{bmatrix}
0 & P_1 & P_2 & P_3 & \cdots & P_n \\
P_1 & U_i^{11} & U_i^{12} & U_i^{13} & \cdots & \vdots \\
P_2 & U_i^{21} & U_i^{22} & U_i^{23} & \cdots & \\
P_3 & U_i^{31} & U_i^{32} & U_i^{33} & \cdots & \\
\vdots & \vdots & \vdots & \ddots & & \vdots \\
P_n & U_i^{n1} & U_i^{n2} & U_i^{n3} & \cdots & U_i^{nn}
\end{bmatrix} \tag{5}$$

where U_i^{rk} (r and k = 1, . . ., n) represents $\frac{\partial^2 U_i}{\partial X_r \, \partial X_k}$, the second order partial derivatives of the ith individual's utility function. For a constrained maximization involving a single constraint the sufficient conditions dictate that the determinant of the broadened hessian matrix have sign of $(-1)^n$ where n is the number of choice variables in the utility function. The determinant of the largest principal minor should have sign the opposite of this with the determinants of each successively smaller principal minor alternating in sign down to the principal minor of order two. If these conditions are satisfied the stationary value identified by the first order conditions (4) will be the desired maximum.

Consumer expenditure behavior as detailed by neoclassical theory is outlined by the first order conditions. Through manipulation of the first n conditions a series of ratios can be obtained which describe a consumer's behavior in allocating his income among the n goods entering his utility function. When the consumer is able to establish himself in equilibrium he will allocate his expenditures in such a way that the rate of commodity substitution (RCS) between any pair of goods (here 1 and m) will equal the ratio of the prices of these same goods. This can be represented as

$$RCS_{1m} = \frac{P_1}{P_m} \tag{6}$$

where RCS = $\frac{\partial U_i}{\partial X_1} / \frac{\partial U_i}{\partial X_m}$, the ratio of the marginal utilities of the two goods for consumer i. Equation (6) states that in order to put himself in the most favorable position, with respect to the maximization procedure described above, the consumer will substitute among expenditures on the various goods to the point that the ratio of the marginal utilities will equal the ratio of the prices of the goods. The n + 1 first order conditions can be manipulated into n demand equations with quantities expressed as functions of the prices of all goods and income. The general form of these equations can be represented as

$$X_{ij} = X_{ij}(P_1, P_2, P_3, \ldots, P_n, M_i) \qquad (7)$$

where X_{ij} represents the quantity of the jth good consumed by the ith consumer and $P_j (j=1, \ldots, n)$ the prices of the n goods entering the consumer's utility function. Therefore, the general demand relation delivered by neoclassical theory from maximization of (3) relates quantities consumed to prices faced by the consumer in the market and the consumers available income.

The Level of Aggregation

All computations and analyses made in this dissertation were performed at the household level as opposed to examination of models specified for the behavior of individual consumers. No loss of generality or applicability of the theory is encountered as a consequence of this change in emphasis. Prais and Houthakker [1971] have examined the implications and benefits of working at this level of aggregation from a theoretical standpoint and encourage analysis along these lines. Lancaster [1966] has also provided an extensive examination of consumption theory interpreted at the household level.

Most data available for examination of income consumption relationships relate to observed household expenditure behavior and do not provide expenditure detail for individual family members. Likewise, governmental legislation designed to alter consumption of given components of the population is often directed at households as the basic behavioral unit. Thus by conducting the analysis at the household level the guidance provided by theory is still available, the analysis corresponds more directly with the variables on which information is available in data sources, and the information provided may be more directly applicable to the needs of legislative bodies.

The General Expenditure Income Relationship

Most data sources currently available contain information on household expenditures on given commodities and not actual quantities consumed. With this the dependent variable of equation (7) becomes E_{ij} (where $E_{ij} = P_j X_{ij}$), expenditures of the ith household on the jth commodity rather than simple quantity (X_{ij}).

The Engle curve relates expenditures on a given commodity and the income of the household for a specified period of time. Because the emphasis of this analysis was on the variation in expenditures occurring at different income levels the effects of price variation are not of prime importance. With this type of study the data employed are collected from cross sectional surveys involving a time frame designed to be short enough to preclude the possibility of price variations influencing expenditures. With this assumption the model delivered by neoclassical theory in equation (7) simplifies to

$$E_{ij} = E_{ij}(M_i) \tag{8}$$

where the emphasis is on expenditures rather than quantities consumed.

Modification of the General Engle Curve Model

As discussed to this point the general neoclassical model describing the Engel relationship is not applicable to available data and empirical research. In many respects the theory provides insufficient guidance in the development and examination of applied relationships. Extensive research (Allen and Bowley [1935], Brown [1954], Prais and Houthakker [1971], Brown and Deaton [1972], and Phlips [1974]) has identified and addressed the fact that other factors, not included in the general theoretical model represented by (8), impinge significantly on household expenditure decisions. The theory is defined and operates in terms of consumer units which are assumed to be identical in all factors except income. Variation in observed expenditures between households in the empirical world can be attributed to different income levels as well as other factors such as family size, education level, ethnic influences, location, and region. Prais and Houthakker [1971] have stated that observed expenditure variation is the result of these factors working in concert on preferences which would prompt the consumer units to react, if in the same circumstances, in substantially the same manner. The _ceteris paribus_ condition present in the theoretical development of the Engel relation allows it to focus exclusively on income as the primary agent generating expenditure variations. Some explicit modifications must be made in the empirical analysis to account for the _ceteris paribus_ assumption allowing application of the theory in applied investigations.

Empirically there are two means through which the characteristics of a household can be incorporated in an analysis to account for their effect on household expenditure decisions. The first is to implicitly account for these sources of variation as done by Brown and Deaton [1972] and many other early investigators. The data used were subdivided into groups by factors felt to impinge on consumption decisions. The intent was to obtain data sets composed of consumer units which were as homogeneous as possible with respect to these sources of variation. The Engle relation was then examined within each homogeneous set with the income variable now isolated as responsible for the majority of the remaining variation.

The second approach is to explicitly introduce the factors identified as responsible for the expenditure variation in the estimated model as variables included in equation (8). This has been the procedure followed by Phlips [1974], Prais and Houthakker [1971], and Brown and Deaton [1972]. This approach is somewhat different from that discussed above. Rather than removing the variation due to these factors prior to the examination of a relationship they are allowed to remain and their partial effect quantified in the estimated model.

The Modified Expenditure Income Model

The social and demographic factors commonly considered are those relating to the ethnic background, social class, and location (region, urbanization, etc.) of the household. Additionally a measure of relative household size is often incorporated in the model through some form of adult equivalent scale. Inclusion of these factors in (8) yields an expenditure income relation for the jth good consumed by the ith household given by

$$E_{ij} = E_{ij}(M_i,B_i,L_i,E_i,A_i) \qquad (9)$$

where M_i is the income of the ith household for a given time period, B_i variables reflecting the social class of the household, L_i variables reflecting the household's location, E_i variables reflecting the ethnic characteristics of the consumer unit, and A_i variables incorporating some measure of the household's size and age/sex composition. The variables making up B_i, L_i, E_i, and A_i explicitly incorporate the socioeconomic characteristics of the household.

Elements of both approaches discussed above were incorporated in this dissertation. Phlips [1974] stated that preferences are expected to change across income groups and between households with differing socioeconomic characteristics just as much, if not more, than tastes may be expected to change through time. To allow for these differences the data in this research have been segregated along two dimensions: region and income class. The data employed in the research contained information on household expenditures rather than actual quantities consumed. If the product categories are broad, such as total expenditures on fish and shellfish, expenditures on whole fish, etc., the number and type of products included in the commodity classes can be great. The number of products is large because of the many different fish and shellfish species involved and the fact that most species are capable of yielding several different consumption products. Fishery products included in these expenditure categories include some of the most basic and simple sources of protein, through a broad spectrum of goods to some of the most luxurious foods available. Because of the potential for a wide range of goods to be included in any one expenditure category, regional and income effects on household consumption should be pronounced.

Regional differences in consumption of more highly processed fishery products will not be as great as those observed for fresh forms because these products are somewhat standardized, have long shelf lives, and are easily transported with little loss of quality. Products included here are canned tuna, breaded frozen fish portions, fish sticks, frozen scallops, and breaded frozen shrimp. For many available fishery products transportation over great distances is prevented by deterioration of the product. With this limitation on shipping it is not uncommon for 90 percent of the annual catch of some species to be consumed within 200 miles of the port landed [Miller and Nash, 1971]. Oysters, some crabs, and fresh clams are examples of products in this category. In other instances, as with the American lobster, local markets for the available catch are so strong that little of the annual harvest is available for shipment to distant markets. Because of these factors and the regionality of production of many fish and shellfish species, products consumed in one given region of the United States should not be expected to be greatly similar to those consumed in another. The danger with this situation is that the differences in products consumed may warrant that allowances be made for the coefficients of different regions to vary accordingly. Running one model for all regions restricts the estimated coefficients to be the same when in fact the variations in products consumed may demand that they differ.

The situation with income is somewhat similar. There is normally a wide spectrum of fishery products available for consumption in any given area and the household's income will directly affect where in this spectrum it is able to consume. With the income situation and the impacts described above for regional effects, the fish and shellfish products consumed by a low income household located in the South may have little in common with those products consumed by a household with high income in the Northeast. The effect within the same region but at different levels of income should be similar. The products consumed by households in the lower half of the income spectrum may differ from those consumed by households in the upper half.

It is difficult to determine the exact manner in which the above effects will enter the estimated relationship. They may enter through changes in intercept, changes in slope, or both. This uncertainty justifies breaking the data into subsets based on income and region and estimating the proposed relationship separately within each subset. In this way the restrictions placed on the estimated coefficient's behavior are reduced.

Socioeconomic variables were included in the model to examine the influence of other household characteristics on expenditure levels. The general form of the Engel relations given in (9) can be respecified as

$$E_{ij} = E_{ij}(M_i, B_i, E_i, Z_i, A_i) \qquad (10)$$

All variables are as defined in (9) with Z_i composed of the same variables making up R_i in equation (9) but without those relating to the region of the household which has been treated implicitly in the grouping of the data. Specific inclusion of these variables not only accounts for consumption variations between households due to factors other than income but it also provides empirical estimates of their partial effects.

CHAPTER IV

EMPIRICAL CONSIDERATIONS

Functional Form

The functional form selected for equation (10) is influenced by empirical considerations. Several studies investigated the proper functional form for estimated Engel curves. Prais [1953], Allen and Bowley [1935], Nicholson [1949], Leser [1963], Houthakker [1957], Salathe [1979], and Chang [1977] compared the performance of various specifications for this relation with the same data and examined the effects on estimated income elasticities. Other authors, Aitchison and Brown [1955] and Fisk [1959], reported in detail the properties and performance of particular specifications they used for this relationship. The specification is important because of the volatility of the elasticities provided by different models and the problem that some forms propose elasticity behavior which is implausible on theoretical and empirical grounds.

If the income variable in the data represents a wide range of values, the Engle curve for a normal good on constant quality would be expected to assume a sigmoid shape given the *ceteris paribus* assumptions [Aitchison and Brown, 1955, p. 37]. The lower regions of the curve should provide income elasticities of greater magnitude than those found in higher regions. In the lower portion of the curve the good may be held as a luxury with income elasticity greater than 1.0. In middle regions where the curve's slope is more constant a normal good will come to be held as a necessity providing income elasticities greater than 0.0 but less than 1.0. At extremely high income levels the curve becomes concave and eventually provides an income elasticity less than 0.0 indicating that the commodity is not considered an inferior good with expenditures declining as income increases. With most data the observed variation in income is not wide enough to capture all stages of the signoid curve but only particular regions. In these cases, Prais and Houthakker [1971] have suggested use of functional forms capable of approximating the portion(s) of the overall curve the data represent.

As stated above, a wide spectrum of products and qualities of goods are available within a given fish and shellfish commodity class. As incomes increase, substitution of different goods and different qualities of the same good, all falling in the same fish and shellfish class, are easily accomplished.[1] Because of this substitution, the range in income necessary to transcend each of the luxury-necessity-inferior good classes is broadened considerably. Thus, the curve specified for total household expenditures on a given fishery product class need not necessarily have the capability of representing all three regions of the sigmoid curve detailed above.

The proportion of households sampled which would hold the balance of available fishery products as luxuries is not likely to be large in any given data source. Likewise, the proportion holding them as inferior goods is not likely to be great. The regions in which these goods are

---

[1] The data used in this research contained expenditure information on broad aggregates of fishery products composed of a variety of individual items. Categorization of expenditures on the individual commodities making up the classes were not reported.

held as necessities is, therefore, likely to predominate in most data. The functional form these conditions imply would be convex to the origin, have first derivative with respect to income which is positive, and have positive intercept to avoid the possibility of negative expenditure levels.

The Data

In any applied research the move from theoretical considerations to empirical estimation must be concerned initially with the data to be used in the analysis. An attempt must be made to secure a data source meeting as many of the peculiar needs of the study as possible. The data should represent the population the research hopes to address and hold information on those variables which are felt to be important in determining expenditures on the products of interest. In selection of a data base for a study of the Engel relationship several specific factors must be considered. The length of the survey generating the data must be sufficiently short so variation in product price is minimal. This must be balanced, however, with the desire that the survey be of sufficient duration to allow an accurate record of expenditures. The nature of the good in question will therefore have a great bearing on the time frame considered appropriate in meeting these opposing desires. Ideally, the data selected should cover a period of time sufficient for an accurate representation of consumer purchasing behavior but not so long that variation in prices becomes significant.

The Bureau of Labor Statistics (BLS) 1972-1974 Consumer Expenditure Diary Survey (CEDS) meets these data requirements for use in cross sectional analysis. The data are representative of the entire U.S.

population. Information was collected on a broad spectrum of socioeconomic and demographic factors, and involves a time frame allowing an adequate understanding of expenditures on fishery products without great danger of fluctuations in commodity prices. The CES presents information collected in the diary portion of the BLS 1972-1974 consumer expenditure survey. The data relate to expenditures of 23,186 households who participated in the survey. The survey was designed to determine expenditures for two consecutive one week periods. The diary portion of the survey was executed over a two year period between the fourth week of June 1972 and the third week of June 1973 and the fourth week of June 1973 and the third week of June 1974. The principal motivation behind the survey was to obtain the necessary data for updating the Consumer Price Index. It was pointed out however, by the designers of the survey, that the data:

> Provides the only comprehensive body of income and expenditure information available for satisfying a broad range of analytical activities. . . . The data can be used in examination and analysis of consumer demand and income . . . in market research analysis of demand for different products or market areas. . . . [U.S. Department of Labor, 1974, p. 1]

The diary data were collected with two different questionnaires. A household characteristics questionnaire was designed to gather information on the race, marital status, region, location of residence, education and age/sex composition of the household. The second component was a self reporting daily expense record to be used by respondents in recording expenditures made during the two week period. The diary survey was initiated with an interview in which the household characteristics questionnaire was used by an interviewer to obtain descriptive information about household members. During this initial interview, a daily expense record for one week's expenditures was placed with the homemaker in each participating household. After the first week, the interviewer returned, reviewed the diary with the homemaker, reconciled any discrepencies, and left an expense record for the second week. At the end of the second week, the interviewer again returned and cleared any questions in the record. At this time the household characteristics questionnaire was completed by the interviewer. Information regarding the occupations and industries of the working members of the household, retirement status, earning from family members' wages and salaries, and various other measures of income were collected.

To collect the sample and insure that it was representative of the underlying population, the nation was divided into 216 geographic areas defined in accordance with the framework used for the current population survey. Of these 216 geographic areas, thirty were self-reporting (selected with certainty) because of their population sizes. Of these units, half were included in the first survey year and the remainder in the second year. The remaining 186 less populated and nonmetropolitan areas were divided into two 93-area groups, each of which was also covered in one of the survey years. For each of these geographic areas, a primary sampling unit was randomly selected using a controlled sampling procedure to insure proper geographic distribution. These survey units included both urban and rural areas as well as farm and non-farm areas [U.S. Department of Labor, 1974, p. 5]. Housing units falling in the 216 primary geographical areas were assigned to housing unit strata. Occupied units were stratified by income level, housing tenure, and size of primary family. Vacant units were assigned to other strata as were individuals living in rooming or boarding houses or in doctors or nurses quarters of hospitals (institutional persons).

The actual sample of housing units was selected by computer from the 1970 census 20 percent sample data file which included those households completing the long form questionnaire. Augmenting this were a number of newly constructed housing units selected to update the sample for the three-year period from the census to the time of the diary survey. These were chosen from reports of building permits issued for privately financed residential construction and were sampled independently within each primary sampling unit. The placement of the diaries was distributed throughout the two-year period of the survey. They were not all distributed in one given quarter or portion of a year, but were placed continuously throughout the two years of the survey. Because of this, the danger of the data providing a biased view of expenditures, because of seasonality in availability of products, was substantially reduced. Some fish and shellfish products are highly seasonal. This character of the data helps to reduce the inflated or depressed impact on expenditures which would result if the entire sample were collected before of after the harvest.

Buse [1979] reformulated the BLS public use tape and checked the information for accuracy. A total of 15 tests and checks for consistency, outliers and coding errors were performed on the information recorded for each household. Reformulating the tape included the addition of some 50 subtotals which are summations of two or more expenditure fields from the BLS tape. To increase convenience and allow all information to fit on one 2,400 foot reel at 1,600 BPI all expenditure categories, where appropriate, were summed together and relate to expenditures over a two-week period rather than two consecutive single weeks. In addition, expenditure fields were combined. In all cases where aggregation of expenditure fields occurred, it involved only the lowest levels of expenditure reported for a particular commodity class. Thus the actual loss of expenditure detail was minimized while the managability of the data were greatly increased. A breakdown of the observations on the tape by survey year is as follows:

Table 1. Number of observations in BLS CEDS data by survey year

Survey year	Number of observations
Survey year 1 (1972-1973)	11,065
Survey year 2 (1973-1974)	12,121
Total (1972-1974)	23,186

Of the 23,186 reporting, 963 households reported expenditures for only the first week of the survey while 934 reported information only for the second week. Some 20,477 households reported expenditure information for both weeks while 812 reported no expenditures at all. To allow the model to relate to as much of the sample as possible, and avoid the problem of possibly biasing the results by omitting those households reporting expenditures for only one week, the expenditures reported and summed for two weeks were divided so the analysis could be carried out on a weekly basis. Households make expenditures on food commodities at least once a week and it was felt that the weekly time frame was long enough to accurately reflect expenditure levels while avoiding significant variations in price.[1]

Expenditure levels on a wide variety of products were included in the BLS tape. Information on all major food groups is provided as well as purchases of many non-food items. Included in the expenditure information are five expenditure categories relating to fishery products. These are expenditures on fish purchases as fillets or steaks, expenditures on whole fish, expenditures on shellfish, expenditures on canned fish, and a category summing these for total expenditures on fish and shellfish products.

The Tobit Model

The nature of most cross sectional data precludes the straightforward application of least squares analysis in the estimation of the chosen model. In cross sectional data, for a variety of reasons, many households report zero expenditures on one or more of the items included in the survey. The incidence of zero expenditures in the data will normally increase, for a given commodity, the shorter the period of time covered by the survey. Depending on how narrowly the commodity of interest is defined, a substantial proportion of the households included are likely to have zero expenditures due to the time frame of the

---

[1] During the two years spanned by the BLS survey the CPI for food rose almost 31 percent [Salathe, 1979, p. 3n]. Because of this a time frame of more than one week risks introduction of significant price variation. Regarding the stability of parameters obtained from this data, Salathe [1979, p. 4] found the parameters did not vary significantly between the survey years.

survey. This is especially true for smaller, frequently purchased items, such as fish and shellfish food products. A dichotomy exists because as the time frame is shortened to avoid price variations the incidence of nonresponses by survey participants increases. Because of these data characteristics least squares analysis cannot be employed due to violation of assumptions regarding behavior of the error term. Specifically, the assumption of a homoskedastic error structure is not fulfilled. The variance of the disturbance will not be constant but can be shown to vary with the data yielding a heteroskedastic error. For the simple regression model with expenditures E_{ij} of the ith household on the jth commodity expressed as a linear function of M_i, the households income, and u_{ij} the error term expenditure behavior can be described as follows:

$$
\begin{array}{lll}
E_{ij} = \beta M_i + u_{ij} & \text{if } E_{ij} > 0 & (11) \\
E_{ij} = \beta M_i + u_{ij} & \text{if } \beta M_i + u_{ij} > 0 \text{ or } u_{ij} > - \beta M_i & \\
E_{ij} = 0 & \text{if } \beta M_i + u_{ij} \leq 0 &
\end{array}
$$

Regarding the behavior of the error

$$
\begin{array}{ll}
u_{ij} = E_{ij} - \beta M_i & \text{if } E_{ij} > 0 \\
u_{ij} = \beta M_i & \text{if } E_{ij} \leq 0
\end{array}
$$

$E(u_{ij}) = 0$ is assumed, however, with the above behavior present in any cross sectional data, with zero expenditures prominent, the following is obtained[1]

---

[1] To avoid confusion to notation, the double subscripted variable E_{ij} refers to the expenditure level of the ith household on the jth commodity. E( ), unsubscripted, refers to the statistical expectation of the expression in parentheses.

$$E(u_{ij}) = 0 \text{ assumed}$$

$$E(u_{ij}) = \beta - M_i f(-\beta M_i) + (E_{ij} - \beta M_i) + (E_{ij} - \beta M_i)\ f\ (E_{ij} - \beta M_i) = 0$$

where f is the density function of the normal distribution.

The above implies

$$f(-\beta M_i) = E_{ij} - \beta M_i$$

$$F(E_{ij} - \beta M_i) = \beta M_i$$

$$\text{var}(u_{ij}) = E(u_{ij}) = (-\beta M_i)^2 (E_{ij} - \beta M_i) + (E_{ij} - \beta M_i)^2 \beta M_i$$

$$= (\beta M_i)^2 - (\beta M_i)^3 + \beta M_i - 2(\beta M_i)^2 + (\beta M_i)^3$$

$$\text{var}(U_{ij}) = (\beta M_i) - (\beta M_i)^2 = \beta M_i(1-\beta M_i)$$

The final simplification of the variance of the disturbance is a function of M_i and thus the variance will not be constant but will vary with the data.

A similar problem exists if the zero observations are discarded and the analysis carried out only on the households reporting positive expenditures. If this is done, the possibility of obtaining biased coefficients is pronounced, the most prevalent bias being that the coefficients obtained from the analysis will be overestimated. Coupled with this, the assumption of zero expectation of the disturbance around the estimated line will not be realized. This arises because of the fact that with constant variance of the disturbance, which would be realized in this case, as the curve approaches the abscissa corresponding to expenditures made by lower income households, the constant variance of the disturbance demands that certain of the predicted values fall outside the first quadrant, which cannot occur. Thus, in this region the assumption that $E(u_{ij}) = 0$ will be violated. Because of these effects and the heteroskedastic problem discussed above, least squares cannot appropriately be used.

Tobin [1958], working with cross-sectional data, developed a maximum likelihood method of estimation, allowing inclusion of the zero observations which avoids the heteroskedastic problem associated with the least squares approach. The procedure Tobin proposes is an elaboration of Probit analysis [Cornfield and Mantel, 1950], in that it addresses the magnitude as well as the probability of responses above some limiting value. The dependent variable's behavior can be characterized as that of a limited dependent variable. The limiting variable L in the present research behaves as a lower bound on expenditures represented by zero since negative expenditures are not considered. In situations of this type, the data can be characterized as consisting of two types of observations: those households which, because of the nature and value of the variables making up their underlying preference ordering, are concentrated at the limit (zero response) and those distributed above the limit (positive response).[1]

The variable W_{ij} is defined to represent the value of the limited dependent variable of the ith household for the jth commodity. It will equal the limit (L) for those households reporting zero expenditures on fishery products and equal some positive expenditure level for those purchasing fish or shellfish. The behavior of W_{ij} is related by hypothesis to Y_{ij}, expenditures by the ith household on the jth commodity. The variable Y_{ij} is defined to be a linear combination of independent variables, X_{1i}, X_{2i}, . . ., X_{ni}; which affect the probability of limit versus nonlimit responses as well as the magnitude of observed responses above the

---

[1] In the BLS data, 49.7 percent of the households surveyed had positive expenditures on one or more of the four fishery product categories while 50.3 percent reported no fish or shellfish purchases.

limit. In the present research Y_{ij} and $X_{1i}, X_{2i}, \ldots, X_{ni}$ are comparable to the E_{ij} and M_i, B_i, E_i, Z_i and A_i, respectively, of equation (10). With the inclusion of an error term, assumed to be distributed normally with zero mean and constant variance, the relationship for E_{ij} can be expressed as

$$E_{ij} = \beta_0 + \beta_1 M_i + \beta_2 B_i + \beta_3 E_i + \beta_4 Z_i + \beta_5 A_i + u_{ij} \tag{12}$$

With these relationships the behavior of the limited dependent variable W_{ij} can be defined:

$$W_{ij} = L \text{ if } \beta_0 + \beta_1 M_i + \beta_2 B_i + \beta_3 E_i + \beta_4 Z_i + \beta_5 A_i < L \tag{13}$$

$$W_{ij} = \beta_0 + \beta_1 M_i + \beta_2 B_i + \beta_3 E_i + \beta_4 Z_i + \beta_5 A_i$$
$$\text{if } \beta_0 + \beta_1 M_i + \beta_2 B_i + \beta_3 E_i + \beta_4 Z_i + \beta_5 A_i \geq L \tag{14}$$

This relationship can be equivalently expressed in terms of the stochastic error u_{ij}

$$W_{ij} = L \qquad \text{if } E_{ij} - u_{ij} < L \tag{15}$$

$$W_{ij} = E_{ij} - u_{ij} \qquad \text{if } E_{ij} - u_{ij} \geq L \tag{16}$$

With these descriptions of household behavior, household expenditures on any selected commodity can be expressed as follows. The observed level of expenditure of the ith household will equal the limiting value of expenditures for that good if the systemic part of equation (12) is such that the dependent variable in the relation would fall below the limiting value, equation (13). If the relationship among the variables in the systemic part of equation (12) is such that expenditures will fall exactly at or above the limit, the limited dependent variable is allowed to assume that value, equation (14). To obtain the likelihood function which will feed into the algorithm providing the estimates of the coefficients, the n observations included in the sample are ordered so the first q observations correspond to those which are at the limiting value. The remaining r observations ($r = n-q$) correspond to those with values above the limit. For the first q observations each consists of the limiting value L to which the limited dependent variable W_{ij} is equal. Associated with this is the set of explanatory variables (M_i', B_i', E_i', Z_i', A_i') for each of the $i = 1, . . . q$ observations. The remaining r observations consist of a value for the limited dependent variable which exceeds the limiting value by some positive amount. These observations may be described as (W_{ij}, L, M_i, B_i, E_i, Z_i, A_i) where $i = 1 . . . r$. Tobin [1958] defines the vector (a_0, a_1, a_2, . . ., a_m, a) to be estimates of the normalized coefficients ($\beta_0/\sigma, \beta_1/\sigma$, . . ., $\beta m/\sigma$, $1/\sigma$) and redefines equation (12) for both limit and non-limit observations as follows:

$$I_i' = E_{ij}a = a_0 + a_1M_i' + a_2B_1' + a_3E_i' + a_4Z_i' + a_5A_i' \qquad (17)$$

$$I_i = E_{ij}a = a_0 + a_1M_i + a_2B_i + a_3E_i + a_4Z_i + a_5A_i \qquad (18)$$

with these the likelihood of the sample becomes

$$\phi(a_0,a_1,a_2, . . ., a_n,a) = \prod_{i=1}^{q} F(L_i'; E_i', L_i') \prod_{i=1}^{r} f(W_i; E_{ij}, L_i)$$

$$= \prod_{i=1}^{q} Q(\frac{E_{ij}' - L_i'}{1/a}) \prod_{i=1}^{r} aZ(\frac{E_{ij} - W_i}{1/a})$$

$$= \prod_{i=1}^{q} Q(I_i' - aW_D') \prod_{i=1}^{r} aZ(I_i - aW_{ij}) \qquad (19)$$

where F and f are the distribution and density functions of the normal distribution respectively, Q one minus the value of the cumulative standard normal distribution function and Z the standard normal probability density function. Upon taking natural logarithms of (19) the likelihood function becomes

$$\ln = \sum_{i=1}^{q} \ln Q(I_i^{'} - aW_{ij}^{'}) + r\ln a - \frac{r}{2}\ln 2\Pi - \frac{1}{2}\sum_{i=1}^{r}(I_i - aW_{ij})^2 \qquad (20)$$

This form of the likelihood function feeds into the algorithm chosen for its maximization and provides the coefficients and an estimate of the variance. The algorithm used in this dissertation was Phelps' 1972 version of LIMDEP from the Rand Corporation. The Rand algorithm proceeds essentially through the same procedure outlined by Tobin.

With the estimated coefficients the user may calculate an expected value locus for the limited dependent variable through the following relation provided by Phelps

$$E(W_{ij}) = P\left(\frac{\beta_0 + \beta_1 M_i + \beta_2 B_i + \beta_3 E_i + \beta_4 Z_i + \beta_5 A_i - L}{\sigma}\right) + (1-P)(L) +$$

$$f\left(\frac{\beta_0 + \beta_1 M_i + \beta_2 B_i + \beta_3 E_i + \beta_4 Z_i + \beta_5 A_i - L}{\sigma}\right) \qquad (21)$$

where P is the probability of observing $W_i > L$ for given X_i and f is the density function of the normal distribution. The expected value locus is of principal interest to the investigation as it encorporates the desired homoskedastic properties and avoids the danger of predicting expenditures outside the third quadrant. The Rand LIMDEP package provides elasticities for the expected value locus as well as equation (12); both are computed at mean values of all independent variables. The relationship between the expected value locus and the probability that the limited dependent variable is above the limiting value for a given vector of independent variables and coefficients is illustrated by Figure 1.

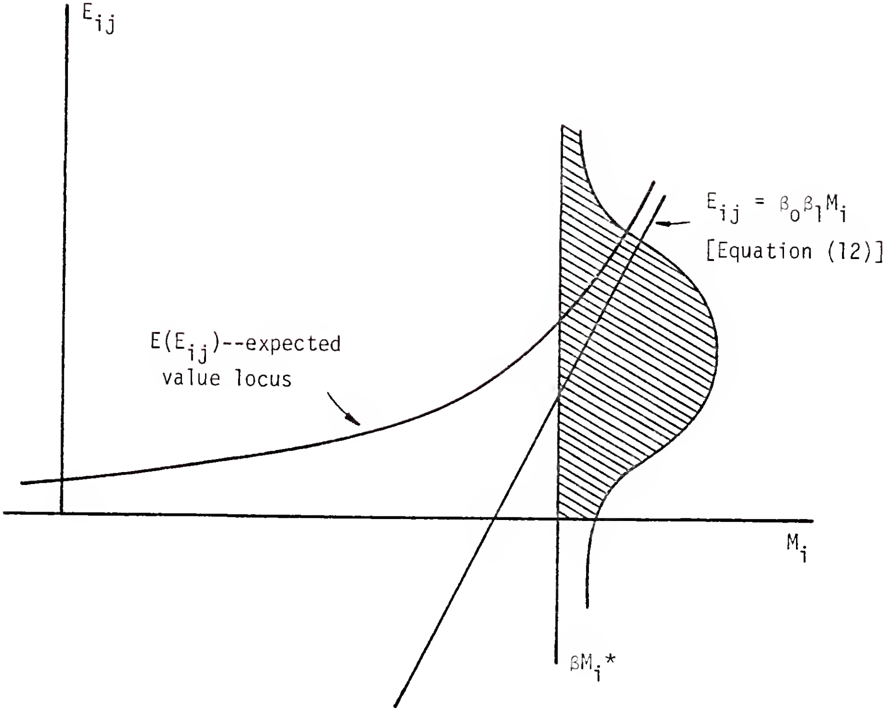

Figure 1. The total expected value locus [shaded area gives $P(E_{ij} > 0|M_i,\beta_i)$]

The Independent Variables

The general form of the Engel relations considered to this point is as stated in equation (10). With the selection of the BLS survey data for use in the analysis the general groupings of variables presented in (10), M_i, B_i, E_i, Z_i, and A_i, can be identified in greater detail. In addition the subdivision of the data may be more completely specified.

Income Measure

The variable chosen to represent M_i in the estimated models was total income from all sources coming to the household during the previous twelve-month period. Included are income from salaries, wages, interest payments from all reported investments and savings accounts, and sale of home-produced goods for all family members. Income from governmental transfer programs such as Social Security payments or retirement and unemployment benefits were also included. Total income from all sources was chosen as the measure of household income over alternatives such as income of the household head because it was felt that it provided the most accurate measure of the household's liquid wealth available for use in purchasing decisions of this type. Other measures of wealth such as home or automobile ownership were not included since they do not represent a liquid income stream immediately available for use in purchasing products.

Household Social Class

Variables included in the model for B_i, the "social class" in which the household operates, were included to capture the effect of taste and preference differences which are likely to exist between households of different social strata. In addition, households falling in different classes tend to patronize different markets and encounter products of differing quality and price. No one variable or household characteristic can be used to capture these effects singly because a series of factors and components working together define the social standing of a particular household. Because of this, a series of variables were selected. The occupation of the household head, his or her education level, and the location/urbanization in which the household finds itself were selected from the BLS tape for inclusion in B_i.

Urbanization and occupation were included as 0 -- 1 qualitative variables. Households in rural settings formed the base group of the urbanization variable while the effect group was made up those in urban situations. A great deal of detail was provided in the BLS tape with respect to the occupation of the household head. The categories included in the survey were as follows:

Salaried

1 -- Self employed, including farm operators
2 -- Salaried professional, technical and kindred workers
3 -- Salaried managers and administrators and kindred workers

Wage and Other Salaried

4 -- Clerical
5 -- Sales
6 -- Craftsmen
7 -- Operatives
8 -- Unskilled laborers and service workers including household
9 -- Retired
10 -- Other -- (armed forces living off post, unemployed)

These 10 occupational groupings were divided into salaried professionals, (1, 2, and 3 above) forming the effect group, and another group composed of wage earners, clerks, managers and other salaried personnel which formed the base group (4 through 10). Justification for including a variable of this type lies in the fact that the occupation of the household head, through salary and other factors, can often weigh heavily in determination of the social class in which the household belongs. In addition, caloric requirements of different occupations affect expenditure levels.

The level of education of the household head was included as a quantitative variable. Past research [Pippen and Morrison, 1975] indicates that homemakers with higher levels of formal education may place greater emphasis on maintaining nutritional diversity in their diets. Because of this they may be more disposed toward consumption of fishery products. Also the preparation of dishes containing fish and shellfish is often involved. The educational level of the homemaker may increase her facility with weights and measures and prompt her to try available recipes calling for use of these products more frequently than homemakers with little or no education. It would be expected that the education level of the homemaker is at least partially reflected by that of the household head. The level of education of the household head will also generally bear on the social class to which the household belongs. The values of the education variable were as follows[1]

1 -- Some grade school completed

2 -- Some high school completed

---

[1] All categories relate to the highest level of formal education attained by the household head.

3 -- High school graduate

4 -- Some college completed

5 -- College graduate, graduate work

0 -- None

Ethnic Factors

Miller and Nash [1971] identified certain ethnic groups and minorities (particularly Blacks) as consuming larger amounts of fishery products than warranted by their representation in the overall population. To capture this effect the race of the household head was included in the analysis as one of the variables making up E_i. Race entered as a 0 -- 1 qualitative variable with the reference group being White households including American Indians, Orientals and other non-Black groups. The effect group was composed of Black households. Combining with race, the occupation variable discussed above for social class will include some ethnic effects. In some regions of the country, ethnic groups and minorities tend to gravitate toward employment in particular industries and within these industries to certain occupations. Thus, the included occupation variable will incorporate some ethnic effects.

Locational Factors

The form of the locational variables included in the model has been discussed above under social class. In the BLS data households were characterized as residing within central cities of various sizes (urban households) or outside central cities (rural households).[1] Location is

---

[1] In the BLS data location of place of residence was based on standard metropolitan statistical areas (SMSA's) with populations of 1,000,000 or more; 400,000 to 999,999; 50,000 to 399,999, and households falling outside SMSA's.

felt to be important because of the effect proximity to markets will have on the kinds of fishery products available and the prices of these products. Regional price differences are also likely to exist. These have been accounted for to some degree in the segregation of the data into regions. Beyond these regional effects local variations in prices and supplies are likely to exist. Location and urbanization effects were included for this reason.

Household Size and Composition Factors

The adult equivalent scale employed was that developed by Buse and Salathe [1978]. The scale departs to a degree from those proposed by Price [1970], Prais and Houthakker [1971], and Sydenstricker and King [1921]. The scale Buse and Salathe developed differs from historical scales by being a continuous rather than a discrete function of age. Coupled with this, Buse and Salathe's scale incorporates the additional feature of allowing other market factors to bear on determination of the scale value rather than relying only on recommended nutritional or dietary requirements for certain age/sex groups. The system proposed links two cubic functions of age back to back so the effect an individual will have on household expenditures may vary continuously without discrete jumps.

The scale they define may be conceptually written as

$$A_{ij} = S_j(a_i, s_i) \qquad (22)$$

where A_{ij} represents the scale's value for the jth commodity and ith individual of age a_i and sex s_i. If S(0,1) and S(0,2) are the scale values for a male and female at birth, respectively, Buse and Salathe propose the following properties for their scale.

I. $S(0,1) = S(0,2) = c_3$

II. $\frac{\delta S(a_i,s_i)}{\delta a_i}$ exists for $a_i \geq 0$
equals 0 for $20 \leq a_i \leq 55$
and equals 0 for $a_i \geq 75$,

III. $\frac{\delta^2 S(a_i,s_i)}{\delta a_i^2}$ exists for $a_i \geq 0$
equals 0 for $\leq 20\ a_i \leq 55$
and equals 0 for $a_i \geq 75$;

IV. $S(20,1) = 1$;

V. $S(20,2) = c_2$;

VI. $S(75,1) = c_6$;

VII. $S(75,2) = c_7$.

Property I indicates that male and female scale values at birth are equal. Property IV specifies that the value for the adult male equal 1.0 while property V indicates the value for adult females equal c_2. The value of c_2 may be greater than, equal to, or less than 1.0 (adult male value) depending on the commodity. Properties VI and VII indicate that the scale value for elderly males and females ($a_i \geq 75$), respectively, equals c_6 and c_7. Again the relationship of these values to the adult male value is dependent on the commodity group in question. These properties are incorporated into four cubic equations in age, one each for males and females aged 0 to 20 and one each for males and females aged 55 to 75. The value of the scale is assumed to be constant for males and females aged 21 to 54. These equations are then solved for a series of seven variables which, when summed across all household members, characterize the household's age and sex composition (Appendix). These variables combine linearly to form the scale for the ith household and jth commodity

$$A_{ij} = P_i + c_2W_i + c_3R_i + c_4S_i + c_5T_i + c_6U_i + c_7V_i \qquad (23)$$

P, W, R, S, T, U, and V are weighted sums of the ages of household members which have been rescaled to avoid discontinuity of the scale function for ages 20 to 55.[1] These variables are based on the 7 properties the authors identify for the scale function and the ages of the household's members. The scale function, equation (23), is incorporated directly in the Engel curve model to be estimated, equation (10), which gives:

$$E_{ij} = E_{ij}(M_i, B_i, L_i, Z_i, c_1P_i + c_2W_i + c_3R_i + c_4S_i + c_5T_i + c_6U_i + c_7V_i) \qquad (24)$$

the coefficients; c_1, c_2, c_3, c_4, c_5, c_6, c_7; of the adult equivalent scale are determined at the same time as the other coefficients in the model. In this way both nutritional factors (through the equations generating the variables) and other market factors included in the model (through the estimation delivering the coefficients) are allowed to influence the determination of the scale's value for each household. This is to be preferred over previous scales which do not incorporate market factors. These effects (region, location of household, income, etc.) certainly have a bearing on the level of expenditures made for each household member. The use of this scale also provides a convenient method for determining the effect on expenditures of the addition or deletion

---

[1] To avoid the problem of discontinuity of the scale function between the ages 20 to 55 and over 75, ages were rescaled by the following schedule where the actual age is a and the rescaled age a*.

$a^* = a$ if $a \leq 20$
$a^* = 20$ if $20 \leq a \leq 55$
$a^* = a$ if $55 \leq a \leq 75$
$a^* + 75$ if $a \geq 75$

of household members of given ages and sexes through elasticities which can be calculated with the coefficients of the scale variables.

The coefficients c_1, c_2, c_3, c_4, c_5, c_6, and c_7 when summed together provide the number of adult equivalents in the household. The coefficient c_2 represents the scale value for an adult female (20-55 years) while c_3 provides the effect of a newborn infant. Coefficients c_6 and c_7 measure the increase in the number of adult equivalents due to the addition of an elderly male ($\geq$ 75 years) and elderly female, respectively. The coefficients c_4 and c_5 if not significantly different from zero indicate for males and females, respectively, that the scale function could have been appropriately specified as a monotonically increasing function of age throughout the growth and development years rather than as a cubic relation. Buse and Salathe [1978] also state that the parameters c_2, c_3, c_6, and c_7 can be interpreted as the change in expenditures for a given commodity resulting from addition of an infant, adult female, elderly male, or elderly female, respectively, in comparison to the change in expenditure resulting from addition of an adult male to a given household. This can be seen by taking the coefficients of the estimated expenditure equation for R, W, U and V and dividing by the coefficient obtained for P.

Expenditure of Food Away from Home

A variable representing amounts of expenditures on food away from home was included in the model. In many households which consume fishery products quite often this consumption takes place away from home in various eating out establishments. Because of this factor expenditures on these products at home may be depressed or increased. To quantify this effect the expenditure on food away from home variable was included.

Subdivision of the Data

All households included in the BLS diary survey were placed in one of four regional categories: the Northeast, North Central, South, and Western states.[1] Three income classes were used to divide the households: 1) Households with total annual income of $0.0-$10,000, 2) $10,001-$20,000, and 3) households with total annual income greater than $20,000. Stratifying the data by these factors yielded 12 data sets on which the income expenditure relation for fishery products was examined. The breakdown of observations by region and income class was as follows:

Table 2. Number of households in regional and income groups after BLS data was stratified by income and region

Income Class	Region				
	N. East	N. Central	South	West	Total
$0-$10,000	2054	2863	3808	1999	10,724
$10,001-$20,000	1553	2116	1864	1428	6,961
$20,000+	468	624	529	567	2,188
Total	4075	5603	6201	3994	19,873

---

[1] The states falling in the regions were the Northeast including: Connecticut, Maine, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; the North Central states: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin; the Southern states: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Mississippi, Maryland, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia; and the Western states: Alaska, Arizona, Colorado, California, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

The Empirical Model

The model actually specified for the analysis corresponded to the linear combination of independent variables outlined by Tobin [1958] presented in equation (12) above. The explanatory variables were included through this equation and the Tobin framework used to estimate the expenditure-income relationship for each of the data sets described in Table 2. Initially this appears as a linear specification of the functional form for the Engel curve. Leser [1943] and Aitchison and Brown [1955] discuss the dangers involved in a linear specification of the Engel relationship. Linear forms yield income elasticity behavior for necessities and moderate luxuries which increase toward unity rather than a declining elasticity which theory and empirical findings support. Because of these kinds of difficulties, curvilinear relationships are to be preferred as the elasticity behavior they imply is more nearly in accord with theoretical and empirical considerations.

As discussed, a functional form which is convex to the origin providing a positive intercept and capable of representing the middle ranges of the general Engel curve is to be preferred. A function with a form of this type is exactly what the expected value locus obtained through Tobin analysis provides. The locus, as calculated through equation (20) above, does not allow for the possibility of a negative intercept and is convex to the origin. Thus, in addition to allowing inclusion of the zero observations and avoiding the associated heteroskedastic problem associated with least squares, Tobin's model also incorporates enough curviture to avoid the inappropriate elasticity behavior implied by a strict linear specification of the model. Inferior goods are not precluded from the analysis as equation (12) may take a negative slope.

With this, the obtained expected value locus would be concave to the origin with second derivatives less than zero, corresponding to the upper portion of the sigmoid curve where the commodity in question has become inferior.

The Fully Specified General Model

With the above discussion, the general model of equation (10) was fully specified to include the actual variables included in the estimated relationships. Incorporating these changes, the general model for the ith household becomes:

$$E_{ij} = E_{ij}\ (M_i,\ E_i,\ Z_i,\ FA_i,\ O_i,\ ED_i,\ P_i,\ W_i,\ R_i,\ S_i,\ T_i,\ U_i,\ V_i) \quad (25)$$

where the included variables are as follows:

M_i	12-month total income of household i
E_i	0 -- 1 dummy variable for race
Z_i	0 -- 1 dummy variable for urbanization
FA_i	expenditures on food consumed away from home
O_i	0 -- 1 dummy variable for occupation of household head
ED_i	education level of household head
P_i, W_i, R_i, S_i, T_i, U_i, and V_i	variables of Buse and Salathe's [1978] adult equivalent scale.

Operationalizing this model for estimation with Tobin's [1958] procedures by putting the included variables in equation (12) and including a stochastic error term yields

$$E_{ij} = \beta_o + \beta_1 M_i + \beta_2 E_i + \beta_3 Z_i + \beta_4 FA_i + \beta_5 O_i + \beta_6 ED_i + c_1 P_i$$
$$+ c_2 W_i + c_3 R_i + c_4 S_i + c_5 T_i + c_6 U_i + c_7 V_i + u_{ij} \quad (26)$$

where u_{ij} is assumed to be distributed normally with zero mean and constant variance. Equation (26) was then used in the Rand Corporation's LIMDEP algorithm to solve for the coefficients maximizing the probability of the observed sample.

Food Stamps

To satisfy the stated objective of determining the impact of food stamps on fish and shellfish expenditures, a variable for the value of food stamps received by the household during the previous month was included in equation (26). This provided a model exactly like that used to examine the effects of the various socioeconomic and demographic factors on consumption with one additional variable included giving the impact of food stamps. This model was then estimated with the information available on those households receiving food stamps.

Some 587 households included in the BLS survey indicated that they received food stamps during the previous month. The food stamp variable was left on a monthly basis rather than reducing it to a weekly framework as this was the time frame on which the information was collected and stamps were issued to recipients monthly. With the variable on this time frame, as with income, the opportunity exists to explore more directly fluctuations in variable levels. In this way the effect of possible governmental changes in food stamp payment levels which would affect the recipients' monthly allotments of stamps can be easily identified.

Statistical Considerations

To maintain the statistical integrity of the investigation the model specified in equation (26) was estimated initially with the data from the

Northeastern region.[1] The model was estimated for the three income classes discussed above with 2,054, 1,553, and 468 observations, respectively. The total number of observations involved was 4,075 or 20.5 percent of the total sample. Respecification of the variables and other changes in the model were made as a result of indications from use with these three data sets. The variables and their specifications which resulted from this were then estimated intact with the data of the remaining regions.[2]

Omitted Observations

Some 3,313 observations or 14.34 percent of the total sample were omitted from the analysis. Among the omitted households were those reporting no expenditure information of any kind (812 households), and households refusing to report or providing incomplete income information (2,501 households). In his work with the data, Buse [1979] discovered many of the households that provided incomplete income information also provided poor or incomplete expenditure information in their daily expense records. The information provided is of such brevity that an accurate characterization of the consumer unit's expenditure behavior cannot be obtained. Likewise, those households reporting no expenditures

---

[1] To allow the tests of significance of the estimated coefficients to be meaningful, it is necessary that economic and statistical theory govern decisions regarding variables and their forms included in the estimated relationship. Running a model on the entire sample and then reformulating it based on the obtained results allows the data and not theory to determine the form of the relationship. With this any reported significance levels for the estimated coefficients are meaningless.

[2] The only alteration made as a result of the initial estimation was to broaden the widths of the income groups into which the data was stratified from $5,000 increments to $10,000 increments. Beyond this no additions, deletions, or respecifications of the included variables were made.

were deleted as this lack of information also prevents any understanding of their expenditure behavior.

CHAPTER V

EMPIRICAL RESULTS--REGIONAL MODELS

Introduction

A total of 85 equations were estimated using the BLS data. Twenty regional equations were estimated (examining expenditures by all households within each of the four regions) as well as sixty income-group equations (examining expenditures by households after separation into the three income categories). In each group of equations, household expenditures on all five fish and shellfish categories (total expenditures on fish and shellfish, expenditures on whole fish, filleted and steaked fish, canned fish, and shellfish) were examined as dependent variables.

Because the quantity of information generated by the analysis was great, an attempt to describe and discuss each estimated equation and coefficient was not made. While results from all equations are presented (both with respect to coefficient value and standard error), primary emphasis is placed on discussing the results obtained with the regional models. Additionally, discussion of the income-group equations will focus primarily on the findings obtained with those models having total expenditures on fish and shellfish products as the dependent variable. This expenditure category was chosen as it represents the summation of expenditures made on the other four product groups and therefore involved the greatest number of households and provided the greatest amount of information with respect to behavior and expenditures on fishery products in general. For ease of comparison and reference, the South was chosen as the base region to which the findings of the other regions were compared in discussion of both regional and income-group equations.

Results obtained with the regional models are presented in chapter V, findings with the income-group equations follow in chapter VI. In both chapters the South is discussed first and is followed by discussion of findings for the Northeast, West, and North Central states. The regional models allow examination of the variables included in equation (26) across all households within each region while the income-group equations allow examination, by region, of variable effects among households within each of the three income groups.

Chapter VII contains a tabular analysis of the average expenditure levels (on the five fish and shellfish categories) made by households included in the BLS survey when the sample was segregated into groups based on selected socioeconomic and demographic factors. Following this is a discussion of the results obtained with the five models estimated including the variable for value of food stamps received by the household during the previous month.

Southern Regional Model Results

Income (M_i). For the Southern regional models, the estimated income coefficient for all categories, except one, indicated a positive relationship between total household income and expenditures on fish and shellfish products.[1] The exception occurred in the whole fish expenditure equation

---

[1] For purposes of discussion in this disseration, a coefficient which was 1.645 times larger than its estimated standard error was considered significant. This corresponds to the 90 percent significance level for

where no significant relationship of any kind was indicated between income and expenditures (Table 3).

Table 3. Income variable coefficient's sign and significance

Region	Expenditures				
	Total	Shellfish	Fish		
			Canned	Whole	Filleted/ steaked
South	+	+	+	0	+
N. East	+	+	+	0	0
West	+	+	+	0	+
N. Central	+	+	+	0	+

For the total expenditure model an $1,000 increase in annual household income was predicted to prompt an $.01 per week increase in expenditures on fish and shellfish products[1] (Table 4). This translates into an annual increase of $.52. The largest effect on weekly household expenditures was found in the shellfish model where it was predicted that a similar $1,000 increase in income would illicit an increase in weekly shellfish expenditures of $.013. The smallest significant effect, $.004,

---

the two tailed test with greater than 30 degrees of freedom. It must be noted that, because of the estimation technique employed, the statistics reported here are not exact t statistics but are asymptotically normal variables.

[1] The expenditure changes discussed relate to the partial effects of the variables considered working in isolation of all other factors impinging on the expenditure decision. Because of this, the magnitudes of the changes examined may not, and most probably would not, be encountered in the market place where all factors together shape the expenditure decision.

Table 4. Southern regional model coefficients and standard errors[a]

Variable	Expenditures				
	Total	Shellfish	Fish		
			Canned	Whole	Filleted/ steaked
Income (M_i)	.00001171 (.000002903)[b]	.00001297 (.000005788)	.00000434 (.000001407)	.00000139 (.000006663)	.00000896 (.0000029411)
Food away (FA_i)	.0086 (.00336)	.0221 (.00757)	-.0010 (.00173)	.0136 (.00836)	.0029 (.00317)
Race (E_i)	.5682 (.08909)	.1609 (.23055)	-.1630 (.04712)	2.4352 (.19602)	.7552 (.09493)
Urbanization (Z_i)	-.0057 (.06881)	.0728 (.16735)	-.0001 (.03382)	-.1217 (.17737)	-.0211 (.07509)
Occupation (O_i)	-.0432 (.08415)	.1468 (.20599)	-.0523 (.04234)	-.1399 (.23682)	.0188 (.09458)
Education (ED_i)	.1245 (.02695)	.2892 (.06701)	.0664 (.01361)	.0314 (.07142)	.0111 (.030182)
Adult male (P_i)	.2673 (.05987)	.1948 (.14953)	.1636 (.03016)	.2331 (.14666)	.1958 (.06553)
Adult female (W_i)	.3881 (.05528)	.3386 (.13753)	.1892 (.02792)	.2806 (.13287)	.1948 (.06076)
Infant (R_i)	.1277 (.06892)	.1553 (.17187)	.0222 (.03494)	-.0522 (.17612)	.2178 (.07479)
Curvature (S_i)	-.0236 (.01927)	-.0717 (.04739)	.0158 (.00973)	-.0365 (.04698)	-.0277 (.02088)
Curvature (T_i)	-.0076 (.03079)	-.0564 (.07699)	.0088 (.01552)	.0355 (.07666)	-.0066 (.03310)
Elderly male (U_i)	.5286 (.13069)	.7179 (.32705)	.2177 (.06732)	1.0881 (.31788)	.4745 (.14333)
Elderly female (V_i)	.1996 (.11976)	.4847 (.30029)	.0683 (.06114)	.0917 (.31452)	.2637 (.13430)
EI_{ed}[c]	.069	.069	.062	.012	.082

[a] All coefficients relate to the change in weekly household expenditures, in dollars, resulting from an unit change in the value of the associated variable.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

occurred in the canned fish model while the filleted and steaked equation predicted an increase of just less than one cent per week.

Regarding the corresponding expenditure income elasticities of demand, the largest value, .082, was found for filleted and steaked expenditures while the smallest, .062, occurred in the canned fish equation (Table 4). The expenditure income elasticity of demand indicates the percentage change in expenditures on a given product category illicited by an one percent change in household income. Elasticity values in the 0.0 -- 1.0 interval are indicative of normal goods, expenditures on these products will change by a smaller percentage than did income. The total expenditure model and the shellfish equation both had the same expenditure income elasticity values, .069.

Expenditures on food away from home (FA_i). The effect of expenditures on food consumed away from home on household purchases of fishery products was positive in two of the five equations estimated (Table 5). For the total expenditure and shellfish models, increases in expenditures on food consumed away from home prompted increases in purchases of these products for home consumption.

Table 5. Away-from-home expenditure variable coefficient's sign and significance

Region	Expenditures				
	Total	Shellfish	Fish		
			Canned	Whole	Filleted/ steaked
South	+	+	0	0	0
N. East	0	+	0	0	0
West	0	0	0	0	0
N. Central	0	0	0	0	0

No significant relationship between expenditures on food away from home and the dependent variable was observed for canned fish, filleted and steaked fish, or whole fish.

In the total expenditure model, a $10 increase in weekly expenditures on food consumed outside the home was predicted to prompt an increase in spending of fishery products for home use of $.086 per week (Table 4). This translates into a $4.47 annual increase. The corresponding effect for shellfish expenditures was $.22 per week which translated into an annual expenditure increase of $11.44.

Race (E_i). The effect of race on fishery product expenditures made by Southern households was mixed. In three of the five categories; whole fish, filleted and steaked fish, and total expenditures; a positive relationship existed between the race variable and the dependent variable of the equation (Table 6). In the canned fish model, the relationship was negative while no significant relationship was found for shellfish.

Table 6. Race variable coefficient's sign and significance

Region	Expenditures				
			Fish		
	Total	Shellfish	Canned	Whole	Filleted/ steaked
South	+	0	-	+	+
N. East	0	0	0	+	0
West	0	0	-	+	0
N. Central	+	0	0	+	+

Black households were predicted to spend \$2.44 per week more on whole fish products than White households. Expenditure levels by Blacks on filleted and steaked fish were predicted to exceed those of Whites by \$.76 per week (Table 4). The total fishery product expenditure equation predicted Black households would spend \$.57 per week more than their White counterparts. For expenditures on canned fish products, the relationship was reversed with White households outspending the Blacks by \$.16 per week (Table 4).

Urbanization (Z_i). In the Southern region the estimated models indicated no significant difference in expenditure levels between urban and rural households (Table 7). In all five expenditure models, the coefficient of this variable was not found to differ significantly from zero.

Table 7. Urbanization variable coefficient's sign and significance

Region	Expenditures				
	Total	Shellfish	Fish		
			Canned	Whole	Filleted/ steaked
South	0	0	0	0	0
N. East	+	+	+	+	+
West	+	0	0	0	+
N. Central	0	0	0	0	0

Occupation (O_i). As with urbanization, the coefficients of the qualitative variable included in all five expenditure models to capture expenditure differences due to the occupation of the household head were not found to differ significantly from zero (Table 8).

Table 8. Occupation variable coefficient's sign and significance

Region	Expenditures				
	Total	Shellfish	Fish		
			Canned	Whole	Filleted/ steaked
South	0	0	0	0	0
N. East	0	0	0	0	0
West	0	0	0	0	0
N. Central	0	0	0	-	0

Thus, no significant expenditure differences between households headed by salaried individuals and those headed by non-salaried individuals in the South were predicted.

Education (ED_i). In three of the five models estimated, attainment of higher levels of education by the household head was predicted to have a positive impact on expenditures (Table 9).

Table 9. Education variable coefficient's sign and significance

Region	Expenditures				
	Total	Shellfish	Fish		
			Canned	Whole	Filleted/ steaked
South	+	+	+	0	0
N. East	0	0	+	0	0
West	0	0	+	-	0
N. Central	+	0	+	+	+

The coefficients of the total expenditure, canned fish, and shellfish models all indicated that movement of the household head into a higher educational category, as defined in the BLS data, would prompt increased household expenditures on the given product group. The largest effect, $.29 per week, was found for shellfish (Table 4). The smallest predicted increase, just under $.07, occurred for canned fish, while the total expenditure equation predicted weekly expenditures on fishery products as a whole would increase by $.12. As with the findings for income and food away from home, the largest impact from additional education occurred in the shellfish model and the smallest impact in the canned fish model (Table 4).

No significant impacts on expenditures from changes in the household head's education level were indicated for whole fish or filleted and steaked fish.

Adult male scale value (P_i). Addition of an adult male to the household was predicted to have a significant positive impact on expenditures in three of the five models estimated (Table 10).

Table 10. Adult male variable coefficient's sign and significance

Region	Expenditures				
	Total	Shellfish	Fish		
			Canned	Whole	Filleted/ steaked
South	+	0	+	0	+
N. East	+	+	+	+	+
West	+	+	+	+	+
N. Central	+	0	+	0	+

Those showing this relationship were canned fish, filleted and steaked fish, and total expenditures. The largest impact, $.27 per week, was associated with total expenditures (Table 4). The filleted and steaked model predicted increases of almost $.20 while canned fish showed the smallest impact with $.16 per week. No significant impact from an addition of this type was predicted by the shellfish or whole fish equations.

Adult female scale value (W_i). The impact on Southern household fishery product expenditures due to addition of an adult female was positive and significant in all five models estimated (Table 11).

Table 11. Adult female variable coefficient's sign and significance

Region	Expenditures				
	Total	Shellfish	Fish		
			Canned	Whole	Filleted/ steaked
South	+	+	+	+	+
N. East	+	0	+	0	+
West	+	+	+	0	+
N. Central	+	+	+	+	+

As with the adult male variable the largest impact, $.34, was observed for total expenditures and the smallest effect, $.19, for canned fish. The effect predicted by the filleted and steaked equation was $.19; that for whole fish, $.28; and that for shellfish, $.34 per week (Table 4). All the female coefficients, where comparisions were appropriate, were larger than the corresponding male effects estimated in the same models.

Infant scale value (R_i). With the exception of only the total expenditure and filleted and steaked models, addition of a newborn infant to a Southern household was predicted to have no significant impact on expenditures (Table 12). The predicted effect on total expenditures was an increase of $.13 per week while for fillets and steaks it was $.22 (Table 4). Included in the filleted and steaked group would be frozen breaded fish portions and boneless fillets which may be fed safely with little additional preparation to young children. This is in contrast to the products falling in the other expenditure categories which may contain bones or require involved preparation. These factors may have contributed to the relative size of this coefficient in the filleted and steaked model and its insignificance in others.

Table 12. Infant variable coefficient's sign and significance

Region	Expenditures				
	Total	Shellfish	Fish		
			Canned	Whole	Filleted/ steaked
South	+	0	0	0	+
N. East	0	0	+	0	0
West	0	0	0	0	0
N. Central	+	0	+	0	+

Elderly male scale value (U_i). A positive impact was predicted for all five expenditure categories as a result of addition of an elderly male to the household (Table 13).

Table 13. Elderly male variable coefficient's sign and significance

Region	Expenditures				
	Total	Shellfish	Fish		
			Canned	Whole	Filleted/ steaked
South	+	+	+	+	+
N. East	+	+	+	+	+
West	+	+	+	+	+
N. Central	+	0	+	+	+

The largest impact, $1.09 per week, occurred in the whole fish model while the smallest effect, $.22, was found in the canned fish equation (Table 4). The filleted and steaked model predicted increases of $.47 per week, the shellfish model increases of $.72, while the total expenditure equation predicted spending increases of $.53. The impact of an additional elderly male was larger in all cases than the increases predicted for adult males. This is in line with the findings reported by Nash [1970] who found households headed by individuals aged 45 years or older tended to have higher consumption levels than those with heads aged less than 45 years.

Elderly female scale value (V_i).[1] The effect on household expenditures from addition of an elderly female was not significant in three of the five equaitons estimated (Table 14).

---

[1] Because their significance and magnitude were not integral to the economic interpretation of the findings of this research, the coefficients estimated for the two curvature variables, S_i and T_i of equation (26),

Table 14. Elderly female variable coefficient's sign and significance

Region	Expenditures				
			Fish		
	Total	Shellfish	Canned	Whole	Filleted/ steaked
South	+	0	0	0	+
N. East	+	0	+	0	+
West	+	0	0	0	+
N. Central	0	0	0	+	0

For fillets and steaks and total expenditures, the predicted impact was positive. The largest effect was found in the filleted and steaked model, \$.26 per week, while the household's expenditures on fishery products in general were predicted to increase almost \$.20 per week (Table 4).

Northeastern Regional Model Results

Income (M_i). For the shellfish, canned fish and total expenditure models, as was the case in the South, the relationship between income and expenditure levels was found to be positive (Table 3). Unlike the South, the Northeastern filleted and steaked model showed no significant relationship between income and expenditures. For both regions, no relationship between income and expenditures was found for whole fish.

An \$1,000 increase in annual household income was predicted to increase total household expenditures on fishery products by almost \$.04

---

were not discussed in the text of this dissertation. All coefficients estimated for these variables in the regional, income group, and food stamp models are presented with their estimated standard errors.

per week (Table 16). On an annual basis, this translated into an increase of $2.08. These values are larger than the comparable partial effects predicted for the South where the effects were $.01 and $.52, respectively.[1] Shellfish expenditures showed the largest response to an $1,000 income increase in the Northeast, as was the case in the South. The estimated impact was $.06 per week. The smallest significant effect occurred in the canned fish model, again similar to the South, where the effect was $.01 per week. All significant Northeastern impacts were larger than the corresponding values estimated in the South (Tables 16 and 4).

The largest expenditure income elasticity of demand found in the Northeast occurred in the shellfish model. This differed from the South where it was the second largest. The Northeastern value was .344 against .069 in the South. Overall, the Northeast's expenditure income elasticities were larger than those encountered in the South. The canned fish elasticity in the Northeast was .175, with the Southern value being .062. The Northeast's total expenditure elasticity was .204; those for whole fish and filleted and steaked fish, .145 and .085, respectively (Table 15).

---

[1] The reader is reminded when examining expenditure levels and expenditure income elasticities of demand between regions that direct comparisons are of little meaning as there is no assurance that the commodities included in the expenditures by households in the different regions were the same. With this in mind, comparisons between coefficient effects and expenditure income elasticities should be interpreted as the manner in which a household would respond with expenditures on a broad category of commodities and not one particular good.

Table 15. Regional expenditure income elasticity of demand values

Region	Expenditure income elasticity value				
	Total	Shellfish	Fish		
			Canned	Whole	Filleted/ steaked
South	.069	.069	.062	.012[a]	.082
N. East	.204	.344	.175	.145[a]	.085[a]
West	.136	.235	.111	.045[a]	.100
N. Central	.163	.263	.113	.146[a]	.134
Food stamps	.084[a]	.299[a]	.217	-.296[a]	-.126[a]

[a] Denotes models with coefficients which were not significantly different from zero.

Expenditures on food away from home (FA_i). In the Northeast, the findings of all models except one indicated that no significant relationship existed between expenditures on fishery products purchased for home consumption and food eaten outside the home (Table 5). The only significant effect was observed for shellfish. Increasing away-from-home food expenditures $10 per week prompted increases in expenditures on shellfish products for home consumption of $.16 per week (Table 16). This translates into an annual increase of $8.32. In the South, the shellfish equation was one of two models where significance of the food away from home variable was encountered. The effect predicted for a comparable $10 spending increase by the Southern shellfish model was $.22 per week.

Race (E_i). Unlike the South, significantly different expenditure levels between races were predicted only in the Northeast's whole fish equation. For all other models, no significant difference in expenditure

Table 16. Northeastern regional model coefficients and standard errors[a]

Variable	Expenditures				
	Total	Shellfish	Fish		
			Canned	Whole	Filleted/ steaked
Income	.00003606	.00006118	.00001282	.00001279	.00000985
(M_i)	(.000006137)[b]	(.000013251)	(.0000030671)	(.000011503)	(.000006598)
Food away	.0046	.0162	.0009	-.0014	-.0015
(FA_i)	(.00334)	(.00680)	(.00162)	(.00703)	(.00361)
Race	.2247	-.5020	-.0136	1.0230	.1886
(E_i)	(.15596)	(.40587)	(.08066)	(.25866)	(.16147)
Urbanization	.5267	.5289	.0727	.4393	.6843
(Z_i)	(.08630)	(.20731)	(.04383)	(.17501)	(.09164)
Occupation	.0888	.2602	-.0125	-.3491	.0404
(O_i)	(.10910)	(.25724)	(.05514)	(.23564)	(.11724)
Education	.0593	.0858	.0354	.0324	.0171
(ED_i)	(.03677)	(.08910)	(.01867)	(.07436)	(.03907)
Adult male	.4313	.4087	.1698	.2760	.3597
(P_i)	(.07646)	(.18250)	(.03850)	(.14853)	(.08048)
Adult female	.3569	.2579	.1704	.0592	.1830
(W_i)	(.06778)	(.16084)	(.03404)	(.13822)	(.07200)
Infant	.1280	-.2364	.1215	.1653	-.0591
(R_i)	(.00867)	(.22044)	(.0434)	(.17199)	(.09013)
Curvature	.0243	.0333	-.0062	.0979	.0490
(S_i)	(.02377)	(.05707)	(.01193)	(.04966)	(.02514)
Curvature	-.0611	-.0983	-.0154	-.1090	.0201
(T_i)	(.04009)	(.10265)	(.02001)	(.08380)	(.04333)
Elderly male	.6937	1.1289	.1746	.4809	.6564
(U_i)	(.16072)	(.38646)	(.08353)	(.30543)	(.16663)
Elderly	.5940	-.2029	.2176	.3241	.5577
female (V_i)	(.15062)	(.38457)	(.07737)	(.29427)	(.15744)
EI_{ed}[c]	.204	.344	.175	.145	.085

---

[a] All coefficients relate to the change in weekly household expenditures, in dollars, that would result from a unit change in the value of the associated variable.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

levels were noted (Table 6). For whole fish, Black households were predicted to spend \$1.02 per week more than Whites. The comparable effect in the South was \$2.44 per week.

Urbanization (Z_i). Households living in urban settings were predicted to have larger expenditures on all fishery product categories than households in rural settings in the Northeast (Table 7). This differs from the South where no significant different in expenditures was found between these two groups.

The largest difference was encountered in the filleted and steaked model where urban households were predicted to spend \$.68 per week more on these products than rural households (Table 16). The smallest effect, \$.07 per week, was found for canned fish. The total expenditure and shellfish models both showed urban expenditure levels above those of rural households by \$.53 per week. The whole fish model predicted expenditures between the two groups would differ by \$.44 per week.

For the Northeastern region, with its abundance of large metropolitan centers, locational factors were consistently significant in explaining expenditures on fishery products while in the South household location was not of significant importance.

Occupation (O_i). No significant relationship between the occupation of the household head and expenditures on any of the fishery product categories were found (Table 8). This was similar to the findings observed for the Southern region.

Education (ED_i). The only model for which the education level of the household head had a significant impact on expenditures was in the canned fish equation (Table 9). In all other expenditure classes no significant effect was noted for this variable.

For canned fish expenditures, movement of the household head into a higher education category was predicted to increase spending by $.04 per week (Table 16). In the South, the comparable effect was $.07 per week (Table 4).

Adult male scale value (P_i). In the Northeast, addition of an adult male to the household was predicted to have a positive impact on all five expenditure categories (Table 10). This differs from the South where no significant impacts were predicted for shellfish or whole fish expenditures. The largest impact in the Northeast occurred for total expenditures where the partial effect from an addition of this type was an increase of $.43 per week (Table 16). This translates into an annual increase of $22.36. The smallest impact was found in the canned fish equation where an increase of $.17 per week was estimated. The total expenditure and canned fish models also held the largest and smallest impacts, respectively, in the South.

The impact predicted for shellfish in the Northeast was an increase of $.41, that for whole fish, $.28, and that for filleted and steaked fish, $.36 per week.

Adult female scale value (W_i). In the Northeast, addition of an adult female to the household was predicted to increase expenditures on three of the five product groups and have no impact on two (Table 11). For canned fish, filleted and steaked fish, and the total expenditures, the predicted impacts were $.17, $.18, and $.36 per week, respectively (Table 16). For shellfish and whole fish no significant impacts from an addition of this type were observed.

These findings differ from those of the South where significant positive impacts were encountered in all five estimated equations. Also the impacts predicted for adult females in the Northeast tended to be smaller than corresponding adult male values. The opposite relationship was observed in the South.

Infant scale value (R_i). In the Northeast only for canned fish was a significant relationship between addition of an infant to the household and expenditure level encountered (Table 12). The model predicted spending on canned fishery products would increase by $.12 per week (Table 16). This translates into an annual expenditure increase of $6.24.

This finding differs from that encountered in the South where the canned fish model showed no significant effect from an addition of this type while the filleted and steaked and total expenditure models did show an effect.

Elderly male scale value (U_i). As was the case with their younger counterparts, a significant positive impact was observed for all expenditure categories due to addition of an elderly male to the household (Table 13). The largest impact, $1.13 per week, was found for shellfish. This was followed by whole fish, $.48 per week; fillets and steaks, $.66 per week; and total expenditures on fish and shellfish, $.69 per week (Table 16).

As with the South, the predicted impacts in the Northeast from adding an elderly male to the household were larger, in absolute terms, in all cases than the impacts from addition of an adult male (Tables 4 and 16).

Elderly female scale value (V_i). No significant impacts from addition of an elderly female to the household were predicted by the Northeast's whole fish or shellfish models (Table 14). Positive impacts were found for fillets and steaks, total expenditures, and canned fish. The largest predicted impact, \$.59 per week, was found for total expenditures. The smallest impact, \$.22, was found in the canned fish model with the filleted and steaked equation predicting expenditures would increase by \$.56 per week.

Compared to the South where significant impacts were found only for total expenditures and fillets and steaks, the effects predicted by the Northeast's equations were larger (Tables 4 and 16). Expenditures on all fishery products in the Northeast would increase by \$.59, against \$.20 in the South, while in the filleted and steaked equation expenditures would increase by \$.56, against \$.26 in the South.

Western Regional Model Results

Income (M_i). The significance and sign of the income variable in the Western regional models followed the pattern found in the South (Table 3). For all categories, except whole fish, a significant positive relationship was found between income and the dependent variable. In the whole fish model no significance was observed.

As with the South, the largest predicted effect for an \$1,000 increase in annual household income occurred in the shellfish model. In the West, shellfish expenditures were predicted to increase by \$.04 per week (Table 17). This was larger than the Southern value predicted by the same model. The smallest effect observed in the West was found for canned fish where expenditures were predicted to increase by \$.008 per

Table 17. Western regional model coefficients and standard errors[a]

Variable	Expenditures				
	Total	Shellfish	Fish		
			Canned	Whole	Filleted/ steaked
Income (M_i)	.00002170 (.000005083)[b]	.00003541 (.000009233)	.00000827 (.000002743)	.00000363 (.000009235)	.00001057 (.000005403)
Food away (FA_i)	-.0022 (.00376)	-.0027 (.0070)	-.0025 (.00213)	.0025 (.00734)	.0020 (.00403)
Race (E_i)	-.0481 (.22213)	.5794 (.44516)	-.3874 (.13076)	.6979 (.38859)	.3070 (.23377)
Urbanization (Z_i)	.2465 (.09284)	.2640 (.19788)	.0755 (.05182)	.2688 (.19086)	.1978 (.10323)
Occupation (O_i)	.0230 (.11177)	.1001 (.23546)	-.0581 (.06204)	.3755 (.22864)	.0857 (.12480)
Education (ED_i)	.0106 (.03959)	.0849 (.08465)	.0416 (.02218)	-.1907 (.07959)	-.0528 (.04379)
Adult male (P_i)	.5862 (.08740)	.4408 (.18220)	.3246 (.04832)	.5679 (.16506)	.3502 (.09445)
Adult female (W_i)	.4867 (.08023)	.2766 (.09504)	.2254 (.04456)	.1890 (.15925)	.4586 (.08705)
Infant (R_i)	.1080 (.09572)	.2514 (.20382)	.0158 (.05324)	-.2003 (.20871)	.1110 (.10102)
Curvature (S_i)	.0689 (.27068)	-.0062 (.05563)	.0386 (01501)	.0734 (.05240)	.0712 (.02976)
Curvature (T_i)	-.0414 (.04473)	-.1841 (.09762)	.0074 (.02483)	-.0468 (.09761)	-.0567 (.04889)
Elderly male (U_i)	.9021 (.19185)	.7775 (.40673)	.3330 (.10940)	1.1982 (.34513)	.9039 (.20535)
Elderly female (V_i)	.3518 (.19116)	.4490 (.40402)	.0308 (.11016)	.1802 (.37599)	.4365 (.20928)
EI_{ed}[c]	.136	.235	.111	.045	.100

---

[a] All coefficinets relate to the change in weekly household expenditures, in dollars, that would result from a unit change in the value of the associated variable.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

week for an income increase of this type. In the South, the smallest effect, \$.004 per week, was also associated with canned fish. This boost in annual income was predicted to increase expenditures on filleted and steaked fishery products by \$.01 per week while the total expenditure model predicted increases of \$.02 per week.

In general, the Western coefficients were larger than those in corresponding Southern equations, indicating Western households would respond to a given income increase with larger expenditures on the broad categories of goods considered than Southern households. When compared against the Northeast, however (with the exception of fillets and steaks), the Western coefficients were all smaller.

The expenditure income elasticities of demand in the Western models, with the exception of the filleted and steaked equation, were all smaller than those obtained in the Northeast. The largest Western elasticity was observed for shellfish, .235, while the smallest, .100, occurred in the filleted and steaked equation (Table 15). The largest and smallest elasticities in the Northeast were found in these same categories. In the South, the largest elasticity occurred in the filleted and steaked equation and the smallest in the whole fish model. The Western elasticity values in the total expenditure and canned fish models were .136 and .111 respectively. Both elasticities obtained in these latter two Western models were larger than the corresponding Southern values but smaller than those encountered in the Northeast.

The higher cost of living in the Northeast and West can be identified as a major factor contributing to the larger income coefficients and elasticity values associated with these regions. Proximity to major production areas and year-round availability of many products may also contribute to a stronger preference for fishery products in these regions than in the South.

Expenditures on food away from home (FA_i). No significant relationship between expenditures on food outside the home and purchases of fishery products for home use were found in the West. This pattern is similar to that found in the South and Northeast where a significant relationship was identified in only three of the ten equations estimated.

Race (E_i). Only for the canned and whole fish models were any significant expenditure differences between races encountered among Western households. The effects were mixed with that for canned fish negative and that for whole fish positive.

The coefficient in the canned fish model indicated that expenditures by White households on canned products would be, on average, $.39 per week greater than those of Black households (Table 17). The whole fish model indicated Black households spending on these products would exceed that of Whites by almost $.70 per week, all other factors held constant. Comparable effects were also noted in the South and Northeast where Black households were also predicted to spend more on these products than White households. The largest difference in whole fish expenditures between races, more than $2.00 per week, occurred in the South (Table 4). The predicted difference in the Northeast, $1.02, was also larger than that found in the West. Like the West, the South also showed Blacks spending less on canned fish than Whites. The difference predicted by the Southern model was smaller than that of the West, $.16 against $.39, respectively. In the Northeast's canned fish model, no significant difference in expenditure levels between Black and White households was noted.

Urbanization (Z_i). In the West, households in urban central city areas were predicted to have higher expenditure levels on filleted and steaked products and fishery products in general than their rural counterparts (Table 7). No significant difference in expenditure levels were found for canned fish, whole fish, or shellfish. The total expenditure model predicted households in urban settings would spend almost $.25 per week more on these products than those in rural areas (Table 17). For filleted and steaked fishery products the difference was almost $.20.

These findings differ from the South where no significant difference between urban and rural household expenditure levels were found in any models and the Northeast where significant differences were found in all models.

Occupation (O_i). As was the case in the South and Northeast for all five fishery product groups, no significant difference was found in expenditure levels between households headed by salaried individuals and those headed by non-salaried individuals (Table 8).

Education (ED_i). The education level of the household head had a significant impact on expenditure levels only in the canned fish and whole fish models (Table 9). In the canned fish equation, the observed effect was positive. Attainment of higher levels of formal education by the household head was predicted to increase expenditures on canned fish products. This was the same relationship observed in the South and Northeast. The opposite effect was found in the whole fish model. Here, higher levels of education attained by the household head tended to lower expenditure levels on whole fish products. This result differed from findings in the South and Northeast where no significant effect was observed.

Adult male scale value (P_i). For all five expenditure categories, addition of an adult male to the household was predicted to have a positive impact on expenditures (Table 10). This differed from the South where no significant impact was encountered for whole fish and shellfish. The Western pattern of significance and sign was the same as that encountered in the Northeast.

The largest impact found in the West occurred for total expenditures where spending was predicted to increase by $.59 per week from an addition to the household of this kind (Table 17). The smallest impact occurred in the canned fish equation where weekly expenditures were predicted to increase by $.32. Filleted and steaked expenditures were predicted to increase by $.35, shellfish expenditures by $.44, and whole fish expenditures by $.57 per week.

The impacts predicted by the Western total expenditure, canned fish, and filleted and steaked models were larger than the corresponding effects in the Southern equations. With the exception of fillets and steaks, all Western impacts from addition of an adult male were larger than those predicted for the Northeast.

Adult female scale value (W_i). In the Western models, significant impacts from addition of an adult female to the household were encountered for canned fish, filleted and steaked fish, shellfish, and total expenditures (Table 11). The effect in each category was positive. The largest predicted impact, as with their male counterparts, was found in the total expenditure model. Expenditures on all fishery products were predicted to increase by $.99 per week (Table 17). The smallest impact, again similar to adult males, occurred for canned fish where expenditures were predicted to increase by $.22 per week. The expenditure increases in the filleted and steaked and canned fish models were predicted to be \$.46 and \$.23 per week, respectively.

The Western results differed somewhat from those encountered in the South for this variable where all five models showed significant positive impacts from household additions of this type. In the Northeast no significant impact was encountered in the whole fish and shellfish models with all others being positive.

Infant scale value (R_i). No significant impact on household expenditures were encountered in any of the estimated models from addition of a newborn infant (Table 12). This differed from the South where positive impacts were predicted for total expenditures and filleted and steaked fish and the Northeast where a significant impact was found for canned fish.

Elderly male scale value (U_i). The predicted impact on expenditures in all five categories from addition of an elderly male to the household was positive (Table 13). This was the same finding with the adult male variable in all expenditure categories for this region. The largest effect, \$1.20 per week, occurred in the whole fish model while the smallest, \$.33, occurred in the canned fish equation (Table 17). Expenditure increases in the filleted and steaked and total expenditure models were predicted to be \$.90 per week while the shellfish model predicted increases of \$.78. These increases were all larger than those predicted for adult males.

Elderly female scale value (V_i). Only for total expenditures and fillet and steaked fish were significant impacts from addition of an elderly female to the household found (Table 14). Both were positive with the largest, \$.44 per week, found in the filleted and steaked model. The total expenditure model predicted increases of \$.35. A similar situation was encountered in the South where these were the only two models showing significant impacts from household additions of this kind. As with the elderly male values, predicted impacts in the West were larger than those encountered in the Southern models.

North Central Regional Model Results

Income (M_i). The effect of income in the North Central region followed exactly the pattern of sign and significance found in the West and South (Table 3). Significant positive relationships were found between income and expenditures on canned fish, filleted and steaked fish, shellfish, and total fishery product expenditures. No significant relation was found between income and purchases of whole fish.

The largest effect encountered for an \$1,000 increase in annual household income occurred; as with the South, Northeast and West; for shellfish (Table 18). For North Central households, the shellfish equation predicted expenditures would increase \$.03 per week for an income increase of this type (Table 18). The comparable expenditure increase predicted for Southern households was \$.01 per week (Table 4). The largest impact of all regions encountered with this model, \$.06, occurred in the Northeast (Table 16).

The smallest effect encountered in the North Central region, \$.007 per week, was found for canned fish expenditures. The canned fish equation also gave the smallest predicted change in the South. In the other North Central categories where significant effects were observed, the

Table 18. North Central regional model coefficients and standard errors[a]

Variable	Expenditures				
	Total	Shellfish	Fish		
			Canned	Whole	Filleted/ steaked
Income	.00001850	.00003021	.00000659	.00001262	.00001263
(M_i)	(.000003748)[b]	(.000009200)	(.000002338)	(.000012309)	(.000005322)
Food away	.0008	.0086	-.0015	.0061	-.0036
(FA_i)	(.00221)	(.00537)	(.00135)	(.00624)	(.00345)
Race	.5321	.1507	-.0569	1.0827	.7873
(E_i)	(.09999)	(.27819)	(.06514)	(.03157)	(.13509)
Urbanization	-.0046	.0220	-.0367	.0903	.0908
(Z_i)	(.05509)	(.15178)	(.03422)	(.19390)	(.07979)
Occupation	-.0258	.2228	.0363	-.6086	-.1288
(O_i)	(.06570)	(.17659)	(.04053)	(.24732)	(.09645)
Education	.0590	.0047	.0257	.1394	.0683
(ED_i)	(.02357)	(.06530)	(.01470)	(.08133)	(.03427)
Adult male	.2028	.0719	.1204	.1520	.1988
(P_i)	(.04885)	(.13192)	(.03010)	(.16617)	(.06917)
Adult female	.3909	.2901	.2493	.3696	.2859
(W_i)	(.04496)	(.11692)	(.02764)	(.14635)	(.06349)
Infant	.1726	.1068	.0659	.2708	.1548
(R_i)	(.05431)	(.14812)	(.03362)	(.18903)	(.07683)
Curvature	.0017	.0141	.0020	-.0072	.0157
(S_i)	(.01532)	(.04120)	(.00937)	(.52155)	(.02199)
Curvature	-.0318	-.0006	-.0081	-.1308	-.0336
(T_i)	(.02487)	(.06679)	(.01528)	(.08749)	(.03530)
Elderly male	.4642	.3907	.2413	1.1186	.4464
(U_i)	(.10834)	(.30834)	(.06479)	(.33706)	(.15553)
Elderly	.1413	.2533	.0308	.6657	.2199
female (V_i)	(.10649)	(.31219)	(.67739)	(.34484)	(.15432)
EI_{ed}[c]	.163	.263	.113	.146	.134

[a] All coefficients relate to the change in weekly household expenditures, in dollars, that would result from a unit change in the value of the associated variable.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

filleted and steaked model predicted weekly expenditures would increase by $.01 and the total expenditure model predicted an increase of $.02.

Like the South, the North Central region's largest expenditure income elasticity of demand was associated with shellfish. The elasticity value was .263. This was larger than that found in the South, but smaller than the Northeast's (Table 15). The smallest elasticity, .113, occurred in the North Central canned fish model. This was the same situation observed in the South where the smallest elasticity was also found in this model. The expenditure income elasticities of the North Central filleted and steaked and total expenditure models were .134 and .163 respectively.

Examination of Table 15 indicates that the largest elasticities were generally associated with the Northeast while the smallest were found in the South. The elasticities of the North Central and Western states tended to be similar in several models and generally fell between those of the Northeast and South. The cost of living in various parts of the country can be identified as the primary factor behind the observed relationship among elasticities, costs being highest in the Northeast and lowest in the South.

Expenditures on food away from home (FA_i). As was the case with the West, no significant relationship between household expenditures on food away from home and any of the five fishery product categories were found (Table 5). This differed from the South where positive effects were found for shellfish and total expenditures and the Northeast where a positive effect was found in the shellfish equation.

Race (E_i). In the estimated North Central equations, significant relationships between race and expenditures were found only in the total expenditure, whole fish, and filleted and steaked models (Table 6). All effects were positive. Households headed by Blacks were predicted to spend $1.08 per week more on whole fish, $.79 more on filleted and steaked products, and $.53 more on fishery products in general than White households (Table 18).

In the South, Northeast, and West the largest expenditure difference between races were also observed for whole fish. The respective effects for these regions were $2.44, $1.02, and $.70 per week. The consistent significance and magnitude of the race coefficient in the whole and filleted and steaked equations, across all regions indicates a strong preference of Blacks, relative to Whites, for these products. Contributing to this Black households tended to have lower average annual income than White households. Many, but not all, fresh fish products are available at lower per unit costs than prepared fish, shellfish, or other meats. Thus because of economic factors as well as a taste preference, Blacks may consumer more fresh fish than Whites.

Urbanization (Z_i). As with the South, no significant differences in expenditure levels on any of the five product categories considered were found between urban and rural households (Table 7). This differed from the Northeast where different spending levels were found in all models and the West where significant differences were found in the filleted and steaked and total expenditure equations.

Occupation (O_i). The only significant difference in expenditures between households headed by salaried or non-salaried individuals among all regional equations estimated occurred in the North Central region (Table 8). For whole fish, households headed by individuals falling in the non-salaried category were predicted to spend \$.61 per week more on these products than households headed by salaried individuals (Table 18). In the other expenditure categories, as was the case in the other three regions, no significant differences in expenditures between households falling in these two groups were noted. Because of its consistant insignificance in all regions, occupation of household head cannot be identified as an important determinant in the expenditure decision. The multitude of fishery products available in a variety of qualities, at different costs, and requiring different levels of expertise in preparation may contribute to this.

Education (ED_i). In the North Central region, for all models except shellfish, a positive relationship between the education level of the household head and expenditures was noted (Table 9). The largest impact, \$.14 per week, was observed for whole fish, the smallest, \$.03, occurred in the canned fish equation (Table 18). The total expenditure model predicted weekly increases of \$.06, while the filleted and steaked model predicted increases of \$.07. All regions showed significant positive impacts for education on canned fish expenditures. Beyond this, there was no similarity among the various regions regarding the significance of this variable.

Adult male scale value (P_i). The impact on fishery product expenditures in the North Central region from addition of an adult male to the household was similar to that encountered in the South. Significant positive impacts were predicted by all models except whole fish and shellfish

(Table 10). These findings differ from those in the Northeast and West where significant positive impacts were found in all five expenditure equations.

In the North Central models, the largest impact occurred for total expenditures where an addition of this kind was predicted to boost spending by $.20 per week (Table 18). The smallest impact, $.12 per week, occurred for canned fish with the filleted and steaked equation predicting increases of just under $.20. In the Southern region, the largest impact was also found for total expenditures; however the effect was larger than that observed in the North Central states.

Adult female scale value (W_i). As with their adult male counterparts, the impact on expenditures from addition of an adult female to the household followed the pattern found for this variable in the South (Table 11). Significant positive impacts were found for all five models. The largest impact, almost $.40 per week, occurred in the total expenditure equation, similar to the finding with adult males for this region (Table 18). The smallest impact, $.25 per week, was associated with canned fish. This was also the case with adult males. The predicted impact on whole fish expenditures was almost $.37 per week while those on shellfish and filleted and steaked fish were both $.29.

The impacts from addition of an adult female in the total expenditure, canned fish, and whole fish models were larger than those observed with the adult male variable. The predicted expenditure increases in the North Central models, with the exception of filleted and steaked fish, were all larger than those found in the South.

Infant scale value (R_i). Three of the five estimated models predicted a positive impact on expenditures from addition of an infant to the household. Significant positive relationships were observed for total expenditures, canned fish, and filleted and steaked fish (Table 12). No effect was found for either whole fish or shellfish.

The largest impact, similar to male and female adults, was for total expenditures. Here expenditures were predicted to increase $.17 per week (Table 18). The smallest impact, again similar to the adults, occurred in the canned fish model where the impact was predicted as $.07 per week. The filleted and steaked model predicted expenditures would increase by $.15 per week. Compared with the South, the North Central total expenditure model predicted a larger impact and the filleted and steaked equation a smaller impact on expenditures from an addition of this type.

Elderly male scale value (V_i). For all categories, with the exception of shellfish, a significant positive impact on expenditures was estimated from addition of an elderly male to the household (Table 13). The largest impact of $1.12 per week was found in the whole fish model while the smallest, $.24, occurred for canned fish (Table 18). The filleted and steaked model predicted spending would increase by $.44 per week while the total expenditure model predicted it would increase by $.45. The total expenditure model predicted smaller increases than those found with this model in the South.

Elderly female scale value (V_i). Only for whole fish was a significant relationship between addition of an elderly female to the household and any of the expenditure categories encountered (Table 14). In the whole fish model, expenditures were estimated to increase by $.67 per week from an addition of this type (Table 18). No significant effect for this variable was observed in any of the other estimated models.

CHAPTER VI

EMPIRICAL RESULTS--INCOME-GROUP MODELS

Introduction

In this chapter data from the 1972-1974 BLS, CEDS is examined after households included in the survey were segregated into three income groups. The groups considered were households with total annual income of $10,000 or less, those with income of $10,001 to $20,000, and those with income greater than $20,000. The model estimated, equation (26), was of the same form as that discussed in Chapter V with the regional results. As in the previous chapter, the South is discussed first and serves as the base region for comparisons.

Southern Income-Group Model Results

Income (M_i). Of the three total expenditure on fish and shellfish equations estimated, income was observed to have a significant impact on expenditures only for the low income group[1] (Table 19). An $1,000 increase in annual household income was predicted to increase expenditures

---

[1] For brevity, households with annual income of $0-$10,000 are referred to as the low income group, those with income of $10,001-$20,000 as the middle income group, and those with income greater than $20,000 as the high income group.

Table 19. Southern income group coefficients--sign and significance

Variable	Expenditures														
	Total			Shellfish			Fish								
							Canned			Whole			Filleted/ steaked		
Income Group[a]	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H
Income (M_i)	+[b]	0	0	+	0	0	+	0	0	0	0	0	+	0	0
Food away (FA_i)	0	0	+	+	0	0	0	0	0	0	0	0	0	0	0
Race (E_i)	+	0	0	0	0	0	0	-	0	+	+	+	+	+	+
Urbanization (Z_i)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Occupation (O_i)	0	0	0	0	0	0	-	0	0	0	0	0	0	0	0
Education (ED_i)	+	0	0	+	0	0	+	0	+	0	0	0	0	0	0
Adult male (P_i)	+	0	+	0	-	0	+	0	+	0	0	0	+	0	0
Adult female (W_i)	+	+	0	0	0	0	+	+	0	+	0	0	+	+	0
Infant (R_i)	0	+	0	0	0	0	0	0	0	0	0	0	0	+	0
Curvature (S_i)	0	-	0	0	-	0	+	0	0	0	0	0	0	0	0
Curvature (T_i)	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0
Elderly male (U_i)	+	0	0	+	0	0	+	0	0	+	0	0	+	+	+
Elderly female (V_i)	+	0	0	+	0	0	+	0	0	0	0	0	+	0	0
EI_{ed}[c]	.239	-.021	.018	.284	.566	-.034	.285	-.088	.063	-113	.174	-.077	.288	.244	.133

---

[a] L refers to the low income group (annual household income of \$0-\$10,000), M to the middle income group (annual household income of \$10,001-\$20,000), and H to the high income group (annual household income greater than \$20,000).

[b] + indicates estimated coefficient was positive and at least 1.645 times larger than its standard error, - that coefficient was negative and its absolute value at least 1.645 times larger than its standard error, and 0 that the coefficient was not significant by having absolute value less than 1.645 times its standard error.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

on fish and shellfish products by $.07 per week (Table 20). The corresponding expenditure income elasticity of demand for the group was .239. This elasticity value was larger than that of the South's regional total expenditure model, .069, indicating that low income households in the South would devote a larger proportion of a given income increase to fishery products than Southern households in general.

For all other models, with the exception of only the three whole fish equations, the only significant impact of income observed was in the low income group (Table 19). For all of the remaining product categories, including expenditures by all three groups on whole fish, income was not a significant factor in explaining expenditures.

In the regional models, significant positive impacts were observed for income in all equations with the exception of whole fish expenditures where no significance was found (Table 3).

Expenditures on food away from home (FA_i). Only for the high income group was a significant relationship found between total fish and shellfish expenditures and expenditures on food consumed away from home (Table 19). A $10 increase in weekly expenditures for food outside the household was predicted to increase purchases of fish and shellfish for home use by $.24 per week (Table 20). The only other significant impact noted, occurred in the low income group shellfish model. Here expenditures were predicted to increase by $.02 per week for a similar $10 increase in away-from-home expenditures (Table 21). No significant relationship between expenditures on food away-from-home and the dependent variable were noted in any of the other income-group equations estimated.

In the Southern regional models, significance of this variable, again positive, was found only for total expenditures and shellfish (Table 5).

Table 20. Southern total expenditure income group coefficients and standard errors[a]

Variable	Income Group		
	Low ($0-$10,000)	Middle ($10,001-$20,000)	High ($20,000+)
Income (M_i)	.00006697 (.000015882)[b]	-.00000276 (.000002302)	.00000143 (.000004999)
Food away (FA_i)	.0046 (.00475)	-.0009 (.00581)	.0238 (.00969)
Race (E_i)	.6756 (.09136)	.2308 (.20876)	.8587 (.61947)
Urbanization (Z_i)	.0688 (.07618)	-.1372 (.12652)	.2841 (.29209)
Occupation (O_i)	-.1527 (.11278)	-.0530 (.13957)	-.0240 (.32232)
Education (ED_i)	.0807 (.03239)	.0612 (.05406)	.1266 (.12290)
Adult male (P_i)	.2919 (.06871)	-.0804 (.12141)	.5925 (.25704)
Adult female (W_i)	.4232 (.06766)	.4020 (.10243)	-.1188 (.22367)
Infant (R_i)	-.0127 (.08250)	.3146 (.12276)	.1497 (.29734)
Curvature (S_i)	.0289 (.02436)	-.0693 (.03556)	-.0798 (.06693)
Curvature (T_i)	-.0103 (.03758)	-.0662 (.05277)	.2873 (.10177)
Elderly male (U_i)	.5142 (.12701)	.1517 (.38220)	1.0795 (.85197)
Elderly female (V_i)	.3362 (.12135)	.1056 (.33401)	.0619 (.76548)
EI_{ed}[c]	.239	-.021	.018

[a] All coefficients relate to the change in weekly household expenditures, in dollars, that would result from an unit change in the value, of the associated variable.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

Table 21. Southern shellfish expenditure income group coefficients and standard errors[a]

Variable	Income Group		
	Low ($0-$10,000)	Middle ($10,001-$20,000)	High ($20,000+)
Income (M_i)	.00007459 (.000035271)[b]	.00009674 (.000066249)	-.00000253 (.000008694)
Food away (FA_i)	.0183 (.00917)	.0074 (.01597)	.0258 (.01614)
Race (E_i)	.3279 (.20395)	-.2176 (.62742)	.0516 (1.0912)
Urbanization (Z_i)	.0798 (.16886)	-.0517 (.36520)	.8169 (.50625)
Occupation (O_i)	-.1303 (.24780)	.0495 (.40210)	-.0971 (.57167)
Education (ED_i)	.1489 (.07072)	.2395 (.15787)	.1276 (.21703)
Adult male (P_i)	.2331 (.15190)	-.7481 (.36360)	.6466 (.44608)
Adult female (W_i)	.1357 (.15036)	.3853 (.29977)	.1399 (.36493)
Infant (R_i)	-.0447 (.18270)	-.5412 (.35483)	-.1774 (.53171)
Curvature (S_i)	.0239 (.05349)	-.2370 (.10489)	-.0622 (.11531)
Curvature (T_i)	.0447 (.08242)	-.2540 (.15632)	.2106 (.22909)
Elderly male (U_i)	.5979 (.27329)	-.3132 (1.0932)	1.1220 (1.5131)
Elderly female (V_i)	.5784 (.26300)	.2189 (.93922)	.0541 (1.3444)
EI_{ed}[c]	.284	.566	-.034

[a] All coefficients relate to the change in weekly household expenditures, in dollars, that would result from an unit change in the value, of the associated variable.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

Race (E_i). Race had a pronounced effect on expenditures made by the three income classes on fresh fish products (Table 19). In the total expenditure models, the only significant effect, showing Black households outspending Whites by $.68 per week, was found for low income families (Table 20). In the whole fish and filleted and steaked categories, Blacks were predicted to outspend Whites in all three income groups (Table 19). For the filleted and steaked models, Blacks were predicted to outspend Whites by $.80, $.55, and $1.29 per week in the low, middle, and high income groups, respectively (Table 22). In the whole fish models for these same income groupings, Blacks were predicted to outspend Whites by $2.51, $2.09 and $2.12 per week (Table 23). All other estimated income-group equations showed no significant differences in expenditure levels between races with the exception of middle income households canned fish purchases (Table 24). It was estimated that middle income Whites would outspend Blacks by $.31 per week on these products.

Among the Southern regional models a similar pattern was found. Black households were predicted to outspend Whites on filleted and steaked and whole fish while for canned fish and total expenditures, Whites were predicted to outspend Blacks (Table 6).

Urbanization (Z_i). No significant difference in expenditures was found between urban and rural households in any of the three total expenditure income-group equations estimated (Table 19). This was also observed in the income-group equations of the other four expenditure categories. A similar situation was found with the regional models where no significant difference in spending between these two groups was noted in any of the equations estimated (Table 7).

Table 22. Southern filleted and steaked expenditure income group coefficients and standard errors[a]

Variable	Income Group		
	Low ($0-$10,000)	Middle ($10,001-$20,000)	High ($20,000+)
Income (M_i)	.00005807 (.000019347)[b]	.00001212 (.000020747)	.00000732 (.00000628)
Food away (FA_i)	-.0030 (.00588)	-.0080 (.00546)	.0134 (.01287)
Race (E_i)	.7997 (.10692)	.5486 (.17416)	1.2859 (.74775)
Urbanization (Z_i)	.0371 (.09271)	-.1119 (.11452)	.0706 (.39517)
Occupation (O_i)	.1455 (.13490)	.0155 (.12619)	-.6015 (.42840)
Education (ED_i)	.0072 (.03974)	-.0597 (.04859)	.1694 (.16530)
Adult male (P_i)	.1679 (.08118)	.1573 (.10546)	.3885 (.33961)
Adult female (W_i)	.2686 (.08006)	.1516 (.09022)	-.3165 (.28943)
Infant (R_i)	.1492 (.09632)	.2710 (.10763)	.3340 (.38528)
Curvature (S_i)	-.0137 (.02853)	-.0196 (.03112)	-.1022 (.08695)
Curvature (T_i)	-.0149 (.04346)	-.0324 (.04562)	.2325 (.16850)
Elderly male (U_i)	.3631 (.15497)	.6890 (.33150)	2.2999 (.11283)
Elderly female (V_i)	.3721 (.14727)	.2246 (.30113)	-.9641 (1.20583)
EI_{ed}[c]	.288	.244	.133

[a] All coefficients relate to the change in weekly household expenditures, in dollars, that would result from an unit change in the value of the associated variable.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

Table 23. Southern whole fish expenditure income group coefficients and standard errors[a]

Variable	Income Group		
	Low ($0-$10,000)	Middle ($10,001-$20,000)	High ($20,000+)
Income (M_i)	-.00002888 (.000051767)[b]	.00001138 (.000050718)	-.00000205 (.000006741)
Food away (FA_i)	.0202 (.01325)	-.0005 (.01381)	.0150 (.01193)
Race (E_i)	2.5063 (.26004)	2.0919 (.33252)	2.1218 (.60901)
Urbanization (Z_i)	-.1465 (.24608)	-.0258 (.28161)	-.2207 (.40164)
Occupation (O_i)	-.1252 (.39560)	-.1644 (.32481)	-.1290 (.42586)
Education (ED_i)	.0328 (.10769)	.0522 (.11666)	.0253 (.16074)
Adult male (P_i)	.3262 (.20508)	.0896 (.24765)	.0701 (.30919)
Adult female (W_i)	.4423 (.19548)	.1983 (.24056)	-.0763 (.26766)
Infant (R_i)	-.0049 (.25038)	-.2487 (.28800)	-.2800 (.40238)
Curvature (S_i)	.0323 (.07203)	-.1072 (.07264)	-.0926 (.08142)
Curvature (T_i)	-.0292 (.11140)	.0923 (.10004)	.2351 (.16503)
Elderly male (U_i)	1.1896 (.38429)	.7665 (.76453)	.7610 (1.2999)
Elderly female (V_i)	.1552 (.38714)	.3576 (.69673)	-4.0679 (.04449)
EI_{ed}[c]	-.113	.174	-.077

[a] All coefficients relate to the change in weekly household expenditures, in dollars, that would result from an unit change in the value of the associated variable.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

Table 24. Southern canned fish expenditure income group coefficients and standard errors[a]

Variable	Income Group		
	Low ($0-$10,000)	Middle ($10,001-$20,000)	High ($20,000+)
Income (M_i)	.00003543 (.00000880)[b]	-.00000456 (.000010564)	.00000192 (.000002263)
Food away (FA_i)	-.0024 (.00271)	-.0026 (.00275)	-.0013 (.00454)
Race (E_i)	-.0726 (.05247)	-.3065 (.10114)	-.3612 (.30948)
Urbanization (Z_i)	.0235 (.04242)	-.0271 (.05808)	.1124 (.13569)
Occupation (O_i)	-.1130 (.06257)	-.0518 (.06397)	-.0320 (.15145)
Education (ED_i)	.0460 (.01801)	.0236 (.02477)	.0995 (.05777)
Adult male (P_i)	.1490 (.03800)	.0305 (.05602)	.3795 (.11850)
Adult female (W_i)	.2308 (.03769)	.1644 (.04697)	.0488 (.09817)
Infant (R_i)	-.0382 (.04635)	.0565 (.05615)	.2112 (.13689)
Curvature (S_i)	.0325 (.01360)	.0019 (.01636)	.0107 (.03096)
Curvature (T_i)	-.0031 (.02097)	.0124 (.02410)	.0623 (.05900)
Elderly male (U_i)	.2541 (.07132)	-.0708 (.07958)	.1677 (.40642)
Elderly female (V_i)	-.1271 (.06802)	.0699 (.15250)	.2389 (.35120)
EI_{ed}[c]	.285	-.088	.063

[a] All coefficients relate to the change in weekly household expenditures, in dollars, that would result from an unit change in the value of the associated variable.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

Occupation (O_i). In all three of the total expenditure models, no significant difference in expenditures between households headed by salaried individuals and those headed by non-salaried individuals were noted (Table 19). This was the case with the income-group equations of the other expenditure categories with the exception of the low income-group's canned fish model. Here non-salaried households were predicted to spend \$.11 more per week than salaried households. Among the regional equations estimated, no significant differences in expenditures between these two groups were observed (Table 8).

Education (ED_i). In the three total fish and shellfish equations estimated, a significant impact on expenditures from the household head moving into a higher education category was found only among low income households (Table 19). For this group, expenditures on fishery products were predicted to increase by \$.08 per week (Table 20). Education was observed to have no significant effect on the total expenditures, filleted and steaked, or whole fish purchases of households in the higher income groups. In the shellfish model, a positive impact, \$.15 per week, was identified for low income households. Positive effects of \$.05 and \$.10 per week were found in the low and high canned fish equations, respectively (Table 24). Beyond these, all income groups showed no significant relationship between education and expenditure levels.

In the Southern regional models, significant impacts (all positive) were found only in the total, shellfish, and canned fish equations (Table 9).

Adult male scale value (P_i). Among the total fish and shellfish models, significant positive impacts on expenditures, from addition of an adult male to the household, were noted for the region's low and high income groups (Table 19). The effects were \$.29 and \$.59 per week, respectively, with no significant impact noted among middle income households (Table 20). No whole fish models showed significant impacts. Among the shellfish models, the only significant impact occurred with the middle income group. Here expenditures were predicted to fall \$.75 per week (Table 21). Significant effects were also found for low, \$.15 per week, and high, \$.38 per week, income group canned fish expenditures.

In the Southern regional models, significant positive impacts were found for all models except whole fish and shellfish (Table 10).

Adult female scale value (W_i). Addition of an adult female to the household was predicted to have a significant impact on total expenditures only in the low and middle income-group groups (Table 19). The effects were \$.42 and \$.40 per week, respectively (Table 20). Significant positive impacts were predicted for low and middle income household expenditures on filleted and steaked and canned fish products, while no impact was predicted for any group's shellfish expenditures (Table 19). A positive impact in the low income-group was the only significant effect noted for whole fish expenditures. Among the regional models, significant positive impacts were found for all five expenditure categories (Table 11).

Infant scale value (R_i). Addition of an infant to the household was predicted to have a significant impact on total fishery product expenditures only among middle income households (Table 19). Weekly expenditures were predicted to increase by \$.31 (Table 20). The only other significant impact observed, \$.27 per week, occurred for middle income-group filleted and steaked expenditures (Table 22). At the regional level, significant impacts (all positive) were found only for the total expenditure and filleted and steaked models (Table 12).

Elderly male scale value (U_i). Of the three Southern total expenditure models, addition of an elderly male was predicted to have a significant impact on expenditures only among low income households (Table 19). Expenditures were predicted to increase by $.51 per week (Table 20). In the shellfish, whole fish, and canned fish models, significant positive impacts were also observed only for the low income-group. For filleted and steaked expenditures, significant positive impacts were found for all three income groups. For the low, middle, and high categories, the predicted impacts were $.36, $.69, and $2.30 per week, respectively (Table 22). Among the regional models, significant positive impacts were found in all categories except whole fish (Table 13).

Elderly female scale value (V_i). The only significant impact observed on total fishery product expenditures, from an addition of this type, occurred among low income households (Table 19). Here expenditures were predicted to increase by $.34 per week (Table 20). In the shellfish, filleted and steaked, and canned fish models, significant effects from addition of an elderly female were also found only among low income households (Table 19). The respective effects for these three categories were $.58, $.37, and $.13 per week. Among the three whole fish income-group equations no significant impacts were observed. At the regional level significant effects, all positive, were found for total expenditures and filleted and steaked products (Table 14).

Northeastern Income-Group Model Results

Income (M_i). In the Northeast total expenditure models, income did not have a significant impact on expenditures for any income group (Table 25). This differed from the South where a significant positive relationship between expenditures and income was found among low income households (Table 19). Significant positive relationships between income and canned fish expenditures were observed for the Northeast low income group. A significant negative relationship was noted between whole fish expenditures and income among middle income households. A significant relationship was also found in the middle income group shellfish model (Table 25).

Among the Northeastern regional models, significant positive impacts were noted in each case with the exception of the whole fish and filleted and steaked groups where no relationship was found (Table 3).

Expenditures on food away from home (FA_i). A significant positive relationship between expenditures on food away from home and total purchases of fish and shellfish products for home use was found with the regions high income group (Table 25). This was also the only significant impact encountered with the South's total fish and shellfish expenditures (Table 19). The only other significant relationship observed occurred in the low income-group shellfish model. The Northeast's regional shellfish model showed a positive relationship between these two variables with all others showing no significance (Table 5).

Race (E_i). Significant differences in total fish and shellfish expenditures between White and Black households were found only in the Northeast's low income group (Table 25). Blacks were predicted to spend

Table 25. Northeastern income group coefficients--sign and significance

Variable	Expenditures														
	Total			Shellfish			Fish								
							Canned			Whole			Filleted/ steaked		
Income Group[a]	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H
Income (M_i)	0[b]	0	0	0	+	0	+	0	0	0	-	0	0	0	0
Food away (FA_i)	0	0	+	+	0	0	0	0	0	0	0	0	0	0	0
Race (E_i)	+	0	0	0	0	0	0	0	0	+	0	0	0	0	0
Urbanization (Z_i)	+	+	0	+	0	0	0	0	0	+	+	0	+	+	0
Occupation (O_i)	0	0	0	-	0	0	0	0	0	0	0	0	0	0	0
Education (ED_i)	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0
Adult male (P_i)	+	+	0	+	0	0	+	+	0	0	+	0	+	+	0
Adult female (W_i)	+	0	+	0	0	+	+	+	+	0	0	0	+	0	0
Infant (R_i)	0	0	+	0	0	0	+	0	+	0	0	0	0	-	0
Curvature (S_i)	0	+	-	0	0	0	0	0	-	0	+	0	0	+	0
Curvature (T_i)	0	0	-	0	0	0	0	0	-	0	0	0	0	0	0
Elderly male (U_i)	+	0	0	+	0	0	0	0	0	+	0	0	+	0	0
Elderly female (V_i)	+	+	0	0	0	0	0	0	+	0	0	0	+	+	0
EI_{ed}[c]	.098	.245	.138	.260	.774	.089	.206	.074	.221	.322	-1.349	.885	.004	.048	-.040

[a] L refers to the low income group (annual household income of \$0-\$10,000), M to the middle income group (annual household income of \$10,001-\$20,000), and \$ to the higher income group (annual household income greater than \$20,000).

[b] + indicates estimated coefficient was positive and at least 1.645 times larger than its standard error, - that coefficient was negative and its absolute value at least 1.645 times larger than its standard error, and 0 that the coefficient was not significant by having absolute value less than 1.645 times its standard error.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

$.29 per week more on fishery products than Whites (Table 26). This was also the only model showing signficantly different levels for this expenditure category in the South (Table 19). The only other Northeastern model showing significant differences between races was the low income-group whole fish equation. Blacks were predicted to spend $1.19 per week more on whole fish products than Whites (Table 27). The Northeast's regional whole fish model showed Blacks with significantly higher expenditures than Whites (Table 6). For the remaining four regional models, no significant differences in expenditures between the races were observed.

Urbanization (Z_i). Urban households in the low and middle income groups were predicted to have larger weekly expenditures on all fish and shellfish products than rural households (Table 25). No significant difference in expenditure levels were noted between these groups among the Northeast's high income households. For both low and middle income groups, urban households were predicted to outspend their rural counterparts by $.52 per week (Table 26). This differed from the South where no difference in expenditures between urban and rural households were found for any income division (Table 19). In the Northeast, all expenditure categories (with the exception of canned fish) showed at least one income group in which expenditures between urban and rural households differed (Table 25).

Among the Northeast regional models, all five expenditure categories showed a significant positive difference in expenditures between urban and rural groups (Table 7). In the Southern models, no significant differences were observed in any category.

Table 26. Northeastern total expenditure income group coefficients and standard errors[a]

Variable	Income Group Low ($0-$10,000)	 Middle ($10,001-$20,000)	 High ($20,000+)
Income (M_i)	.00003093 (.000022592)[b]	.00003333 (.00002270)	.000015564 (.000016987)
Food away (FA_i)	.0055 (.00483)	-.0005 (.00478)	.0166 (.00937)
Race (E_i)	.2880 (.17419)	-.0370 (.27039)	-.2144 (.88523)
Urbanization (Z_i)	.5233 (.11052)	.5191 (.12670)	.3503 (.36731)
Occupation (O_i)	-.2584 (.17858)	.1144 (.14263)	.2529 (.39053)
Education (ED_i)	.0261 (.04636)	.0882 (.05586)	.0689 (.15339)
Adult male (P_i)	.5169 (.11140)	.4710 (.10879)	.0561 (.28106)
Adult female (W_i)	.4707 (.09953)	.1558 (.09765)	.5752 (.22448)
Infant (R_i)	.1109 (.12117)	-.0739 (.11734)	.8087 (.39467)
Curvature (S_i)	.0407 (.03899)	.0651 (.03187)	-.1296 (.07443)
Curvature (T_i)	-.0424 (.05655)	.0161 (.05460)	-.3631 (.16046)
Elderly male (U_i)	.8722 (.17292)	-.1086 (.32377)	1.3693 (.91835)
Elderly female (V_i)	.5528 (.17187)	.9256 (.28700)	1.1194 (.93866)
EI_{ed}[c]	.098	.245	.138

[a] All coefficients relate to the change in weekly household expenditures, in dollars, that would result from an unit change in the value of the associated variable.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes the expenditure income elasticty of demand.

Table 27. Northeastern whole fish expenditure income group coefficients and standard errors[a]

Variable	Income Group		
	Low ($0-$10,000)	Middle ($10,001-$20,000)	High ($20,000+)
Income	.00005669	-.00009199	.00003579
(M_i)	(.000047197)[b]	(.000055340)	(.000002197)
Food away	.0058	-.0080	-.0013
(FA_i)	(.00932)	(.01261)	(.01546)
Race	1.1855	.6267	.4787
(E_i)	(.29980)	(.52998)	(1.5462)
Urbanization	.4133	.5079	.0187
(Z_i)	(.23049)	(.29365)	(.63916)
Occupation	-.2906	-.4493	-.1417
(O_i)	(.39854)	(.35666)	(.67689)
Education	.0350	.0949	-.0146
(ED_i)	(.09644)	(.13348)	(.26777)
Adult male	.2840	.5464	-.3193
(P_i)	(.22521)	(.23694)	(.51875)
Adult female	.1699	.0019	.0825
(W_i)	(.20344)	(.23665)	(.38545)
Infant	.1909	-.0511	.1619
(R_i)	(.24465)	(.27074)	(.71560)
Curvature	.1060	.1554	-.0426
(S_i)	(.08005)	(.07665)	(.13665)
Curvature	-.0893	-.0678	-.3164
(T_i)	(.11626)	(.13314)	(.33211)
Elderly male	.7967	-1.2536	.5049
(U_i)	(.33315)	(.94957)	(1.6407)
Elderly female	.5518	.7313	-.24495
(V_i)	(.34849)	(.62002)	(2.5257)
EI_{ed}[c]	.322	-1.349	.885

[a] All coefficients relate to the change in weekly houshold expenditures, in dollars, that would result from an unit change in the value of the associated variable.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes the expenditure income elasticty of demand.

Occupation (O_i). No significant difference in total expenditures on fish and shellfish products were noted between households headed by salaried professionals and those headed by non-salaried professionals in any of the Northeast's three income groups (Table 25). Among all 15 income-group equations estimated, the only significant difference in expenditures observed occurred in the low income-group shellfish equation. Here households headed by non-salaried individuals were predicted to spend $.77 per week more on shellfish products than those headed by salaried individuals (Table 28). In the Northeastern regional models, no significant differences in expenditures between these two groups were noted in any expenditure category (Table 8).

Education (ED_i). Among the Northeast income-group models, movement of the household head to a higher education level was predicted to have no significant impact on total fishery product expenditures (Table 25). Of the 15 income-group equations estimated from this region, only for middle income-group canned fish expenditures was a significant relationship observed. Here movement into a higher educational category was predicted to increase expenditures by $.08 per week (Table 29). Among the regional equations, the only significant impact observed for this variable was also found for canned fish (Table 9).

Adult male scale value (P_i). Addition of an adult male to a Northeastern household was predicted to have a significant positive impact on total fishery product expenditures made by low and middle income households. No significant effect was observed in the high income group (Table 25). Similar patterns were also observed in the filleted and steaked and canned fish equations. A positive impact was observed for

Table 28. Northeastern shellfish expenditure income group coefficients and standard errors[a]

Variable	Income Group		
	Low ($0-$10,000)	Middle ($10,001-$20,000)	High ($20,000+)
Income	.00006664	.0001305	.00001005
(M_i)	(.000046260)[b]	(.000059834)	(.000034175)
Food away	.0161	.0048	.0287
(FA_i)	(.00783)	(.01235)	(.01859)
Race	-.2008	-1.0715	-2.0605
(E_i)	(.36697)	(.80795)	(2.0986)
Urbanization	.6280	.0967	.9760
(Z_i)	(.22612)	(.33607)	(.74168)
Occupation	-.7709	.4878	.2825
(O_i)	(.33913)	(.37446)	(.81950)
Education	.0225	.0151	.4913
(ED_i)	(.09446)	(.14941)	(.33208)
Adult male	.4026	.4623	.0328
(P_i)	(.22685)	(.28836)	(.59661)
Adult female	.2084	-.0949	.9913
(W_i)	(.20114)	(.26420)	(.46673)
Infant	-.1833	-.5096	.7058
(R_i)	(.25966)	(.32971)	(.88111)
Curvature	.0027	.1308	-.1167
(S_i)	(.08041)	(.08746)	(.15591)
Curvature	-.0255	.0165	-.5848
(T_i)	(.12348)	(.15346)	(.35615)
Elderly male	1.2516	-.5810	2.6627
(U_i)	(.33864)	(.87210)	(1.9404)
Elderly female	-.0823	-.0569	-2.0227
(V_i)	(.35796)	(.78708)	(2.2724)
EI_{ed}[c]	.260	.774	.089

[a] All coefficients relate to the change in weekly household expenditures, in dollars, that would result from a unit change in the value of the associated variables.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

Table 29. Northeastern canned fish expenditures income group coefficients and standard errors[a]

Variable	Income Group Low ($0-$10,000)	 Middle ($10,001-$20,000)	 High ($20,000+)
Income (M_i)	.00002988 (.000001334)[b]	.0000042 (.00001130)	.00000861 (.000006856)
Food away (FA_i)	.0026 (.00272)	.0001 (.00236)	.0016 (.00388)
Race (E_i)	-.0679 (.10458)	-.0520 (.13733)	.4142 (.35197)
Urbanization (Z_i)	.0814 (.06486)	.0678 (.06325)	.0070 (.15004)
Occupation (O_i)	-.0681 (.10409)	.0326 (.07117)	-.1110 (.15890)
Education (ED_i)	.0198 (.03796)	.0757 (.02802)	-.0765 (.06191)
Adult male (P_i)	.1253 (.06495)	.2143 (.05411)	.0202 (.11414)
Adult female (W_i)	.1269 (.05778)	.1726 (.04828)	.1665 (.09130)
Infant (R_i)	.1342 (.06980)	.0443 (.05804)	.3798 (.16042)
Curvature (S_i)	.0032 (.02269)	.0053 (.01579)	-.0533 (.03024)
Curvature (T_i)	.0126 (.03250)	-.0034 (.02697)	-.1143 (.06458)
Elderly male (U_i)	.1164 (.10344)	.2337 (.16296)	.2155 (.37822)
Elderly female (V_i)	.1642 (.10142)	.1988 (.14531)	.7411 (.38511)
EI_{ed}[c]	.206	.074	.221

[a] All coefficients relate to the change in weekly household expenditures, in dollars, that would result from an unit change in the value of the associated variable.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

middle income whole fish and low income shellfish expenditures. Among the Northeast's regional equations, significant positive impacts were found in all five expenditure categories (Table 10).

<u>Adult female scale value (W_i).</u> Addition of an adult female to the household was predicted to have a significant positive impact on total fishery product expenditures of low and high income households (Table 25). Significant positive impacts were estimated for the canned fish expenditures of all three income groups, the low group's filleted and steaked expenditures, and the high group's shellfish expenditures. In all other models. no significant impacts on expenditures were noted. Among the regional models, significant positive impacts were observed for all expenditure categories except whole fish and shellfish (Table 11).

<u>Infant scale value (R_i).</u> Addition of an infant to the household was predicted to increase fishery product expenditures only among high income households (Table 25). No significant impact was observed for the expenditures of low or middle income families. Introduction of an infant was predicted to have no impact on the whole fish or shellfish expenditures made by households in any income group. In the middle income group filleted and steaked model, expenditures were predicted to decrease by $.24 per week (Table 30). In the low and high groups canned fish equations, a significant positive impact on expenditures was predicted. In the Northeast regional models, the only significant impact (positive) was observed in the canned fish equation (Table 12).

<u>Elderly male scale value (U_i).</u> In the Northeast, addition of an elderly male was predicted to have a significant impact on total fishery product expenditures only among low income households (Table 25). For

Table 30. Northeast filleted and steaked expenditure income group coefficients and standard errors[a]

Variable	Income Group		
	Low ($0-$10,000)	Middle ($10,001-$20,000)	High ($20,000+)
Income (M_i)	.000000932 (.000026372)[b]	.00000404 (.000024271)	-.00000236 (.000017375)
Food away (FA_i)	.0001 (.00605)	-.0030 (.00528)	.0010 (.00939)
Race (E_i)	.3016 (.14842)	.0043 (.27592)	-1.1713 (.97824)
Urbanization (Z_i)	.7272 (.13061)	.7306 (.13252)	.2244 (.36365)
Occupation (O_i)	-.2028 (.21441)	-.0206 (.15176)	.3224 (.38688)
Education (ED_i)	-.0071 (.05470)	.0348 (.05943)	.0284 (.15079)
Adult male (P_i)	.5637 (.12961)	.3735 (.11436)	-.1892 (.26862)
Adult female (W_i)	.4412 (.11551)	-.0563 (.10454)	.2868 (.21927)
Infant (R_i)	-.0748 (.14500)	-.2367 (.12807)	.5676 (.37474)
Curvature (S_i)	.0505 (.04507)	.0726 (.03366)	-.0546 (.07238)
Curvature (T_i)	-.0142 (.06501)	.0929 (.05911)	-.1714 (.15655)
Elderly male (U_i)	.9466 (.19732)	-.1792 (.34573)	.9588 (.88564)
Elderly female (V_i)	.7414 (.19974)	.7556 (.29425)	.7309 (.90106)
EI_{ed}[c]	.004	.048	-.040

[a] All coefficients relate to the change in weekly household expenditures, in dollars, that would result from an unit change in the value of the associated variable.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

this group, expenditures were predicted to increase by $.87 per week (Table 26). A similar pattern, with respect to sign and significance, was observed for shellfish, whole fish, and filleted and steaked expenditures (Table 25). No impacts were observed for any income groups canned fish purchases. In the regional models, significant positive impacts from an addition of this type were observed in all five expenditure equations (Table 13).

Elderly female scale value (V_i). Addition of an elderly female was predicted to increase total expenditures made by households in the low and middle income groups and have no impact on high income households (Table 25). For the low and middle groups the predicted impacts were $.55 and $.93 per week, respectively (Table 26). Significant positive impacts were found for low and middle group filleted and steaked expenditures. A significant positive impact was observed for high income household's canned fish purchases. No significant impacts were observed for any whole fish or shellfish equations. Among the regional models, significant positive impacts were observed for all expenditure groups except whole fish and shellfish (Table 14). A similar pattern was observed for the adult female variable for households in this region (Table 11).

Western Income-Group Model Results

Income (M_i). Only for the total expenditures of low income households was a significant relationship between income and the dependent variable found among Western households (Table 31). For this income group, an increase in annual household income of $1,000 was predicted to prompt a $.04 per week expenditure increase in fishery products in general (Table 32). The corresponding expenditure income elasticity of

Table 31. Western income group coefficients--sign and significance

Variable	Expenditures														
	Total			Shellfish			Fish								
							Canned			Whole			Filleted/ steaked		
Income Group[a]	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H
Income (M_i)	+[b]	0	0	0	0	0	0	0	0	0	0	0	+	0	0
Food away (FA_i)	+	0	0	0	0	0	+	-	-	0	0	0	0	0	0
Race (E_i)	0	-	0	+	0	0	-	-	0	0	+	0	+	0	+
Urbanization (Z_i)	+	0	+	0	0	0	+	0	0	0	0	+	0	0	+
Occupation (O_i)	-	0	0	-	0	0	0	0	0	0	0	0	-	0	0
Education (ED_i)	0	0	0	+	0	0	0	+	0	-	-	0	0	0	0
Adult male (P_i)	+	+	0	0	+	0	+	+	+	+	0	0	+	+	0
Adult female (W_i)	+	+	0	0	0	0	+	+	0	0	0	0	+	+	+
Infant (R_i)	0	0	0	+	0	0	0	0	0	0	0	0	0	0	+
Curvature (S_i)	+	0	0	0	0	0	+	0	+	0	+	0	0	0	0
Curvature (T_i)	0	0	0	0	0	+	0	0	0	0	0	-	0	0	0
Elderly male (U_i)	+	0	0	+	0	0	+	0	0	+	0	0	+	0	0
Elderly female (V_i)	+	0	0	0	0	0	0	0	0	0	0	0	0	0	+
EI_{ed}[c]	.140	.049	.056	-.013	.096	.120	.125	.290	.205	.461	1.243	-.121	.249	-.392	-.264

[a] L refers to the low income group (annual household income of \$0-\$10,000), M to the middle income group (annual household income of \$10,001-\$20,000), and \$ to the high income group (annual household income greater than \$20,000).

[b] + indicates estimated coefficient was positive and at least 1.645 times larger than its standard error, and 0 that the coefficient was not significant by having absolute value less than 1.645 times its standard errors.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

Table 32. Western total expenditure income group coefficients and standard errors[a]

Variable	Income Group		
	Low ($0-$10,000)	Middle ($10,001-$20,000)	High ($20,000+)
Income (M_i)	.00003923 (.000023044)[b]	.00000656 (.000025629)	.00000543 (.000010925)
Food away (FA_i)	.0120 (.00553)	-.0094 (.00600)	-.0152 (.00968)
Race (E_i)	.3740 (.22917)	-.9661 (.39613)	.7936 (1.1617)
Urbanization (Z_i)	.2985 (.11247)	-.0372 (.14146)	.7905 (.33859)
Occupation (O_i)	-.3154 (.16248)	.0867 (.15542)	.1380 (.37823)
Education (ED_i)	-.0065 (.04686)	-.0326 (.06305)	.0753 (.16040)
Adult male (P_i)	.5963 (.10789)	.4409 (.14215)	.4567 (.30190)
Adult female (W_i)	.5250 (.10781)	.4127 (.11702)	.2654 (.28203)
Infant (R_i)	.0424 (.12111)	.1289 (.13839)	.2095 (.36895)
Curvature (S_i)	.0684 (.04024)	.0566 (.03953)	.0207 (.08060)
Curvature (T_i)	-.0481 (.06044)	-.0316 (.06204)	-.0923 (.16295)
Elderly male (U_i)	1.1289 (.19184)	.3655 (.40316)	-.3390 (1.1045)
Elderly female (V_i)	.3698 (.19226)	.2600 (.42692)	1.5988 (.98276)
EI_{ed}[c]	.140	.049	.056

---

[a] All coefficients relate to the change in weekly household expenditures, in dollars, that would result from an unit change in the value of the associated variable.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

demand for this group was .140. The pattern of sign and significance observed for the West's total expenditure models was similar to that found in the South where low income households were also the only group observed to have a significant response to an income increase of this type (Table 19). The only other significant effect noted for income occurred among low income household's filleted and steaked expenditures. Here the relationship was also positive with weekly expenditures predicted to increase by $.05 for each $1,000 increase in annual household income (Table 33). Among the West's regional models, significant positive relationships between income and expenditures were observed for all estimted equations with the exception of whole fish (Table 3).

Expenditures on food away-from-home (FA_i). As with the income variable, the only significant relationship observed between away-from-home food expenditures and total expenditures occurred among low income households (Table 31). The relationship was positive and differed somewhat from the Southern results where a significant positive impact was found in the high income-group's equation. The only other models showing significant relationships between the dependent variable and expenditures on food consumed away from home were canned fish. Among low income households, a positive relationship was found while in the middle and high groups a negative relationship was observed (Table 31). Among the West's regional models, no significant relationship between expenditures on food consumed away from home and any of the expenditure categories were noted (Table 5).

Race (E_i). The middle income group's total expenditure on fish and shellfish model showed White households outspending Blacks by $.97 per week (Tables 31 and 32). No significant differences in expenditures

Table 33. Western filleted and steaked expenditure coefficients and standard errors[a]

	Income Group		
Variable	Low ($0-$10,000)	Middle ($10,001-$20,000)	High ($20,000+)
Income (M_i)	.00004956 (.000027604)[b]	-.00003908 (.00003394)	-.00001205 (.000009751)
Food away (FA_i)	.0004 (.00690)	-.0013 (.00764)	.0022 (.00696)
Race (E_i)	.5651 (.25712)	-.7905 (.53786)	1.8232 (.74804)
Urbanization (Z_i)	.1340 (.13505)	.0928 (.18616)	.6903 (.25144)
Occupation (O_i)	-.3854 (.20100)	.2227 (.20520)	.1565 (.28551)
Education (ED_i)	-.0421 (.05561)	-.1161 (.08275)	-.1113 (.11824)
Adult male (P_i)	.4577 (.12527)	.3090 (.18271)	-.1871 (.22562)
Adult female (W_i)	.5134 (.12546)	.4030 (.15017)	.3535 (.21102)
Infant (R_i)	-.0244 (.14421)	.1210 (.18052)	.4800 (.27072)
Curvature (S_i)	.0650 (.04740)	.0582 (.05122)	.0252 (.06211)
Curvature (T_i)	-.1131 (.07235)	-.0013 (.07990)	-.1427 (.12012)
Elderly male (U_i)	1.0566 (.21984)	.5305 (.50579)	.1084 (.78575)
Elderly female (V_i)	.3102 (.22806)	.6090 (.54526)	2.1361 (.66500)
EI_{ed}[c]	.249	-.392	-.264

[a] All coefficients relate to the change in weekly household expenditures, in dollars, that would result from an unit change in the value of the associated variable.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

between races were observed among households in the low or high groups for this expenditure category. White low and middle income households were predicted to outspend Black low and middle income households on canned fish products by \$.31 and \$.58 per week, respectively (Table 34). Low income Black households were predicted to have shellfish expenditures \$1.12 per week larger than White households (Table 35). Black households in the middle income group were predicted to outspend Whites by \$1.39 per week on whole fish products (Table 36). Black households in the low and high income groups were predicted to outspend their White counterparts on filleted and steaked products by \$.57 and \$1.82 per week, respectively (Table 33). No significant difference in expenditures between races were found in any of the remaining models.

Among the regional models, Whites were predicted to outspend Blacks on canned fish and Blacks were predicted to outspend Whites on whole fish. No significant differences in expenditures were observed in the remaining equations (Table 6).

Urbanization (Z_i). Urban households falling in the low and high income categories were estimated to have larger weekly total fishery product expenditures than households in rural areas (Table 31). Beyond these, the only significant differences in expenditures between these two groups, all showing urban households outspending rural households, occurred for high income group whole fish and filleted and steaked expenditures and low income group canned fish expenditures. Regarding the regional models, the only significant differences in purchases were found in the total expenditure and filleted and steaked models (Table 7). For both, urban households were predicted to have larger weekly expenditures than rural households.

Table 34. Western canned fish expenditure income group coefficients and standard errors[a]

Variable	Income Group		
	Low ($0-$10,000)	Middle ($10,001-$20,000)	High ($20,000+)
Income	.00002038	.00001815	.00000656
(M_i)	(.00001677)[b]	(.000013968)	(.000004183)
Food away	.0076	-.0069	-.0089
(FA_i)	(.00400)	(.00331)	(.00394)
Race	-.3058	-.5676	-.2024
(E_i)	(.17775)	(.21783)	(.46910)
Urbanization	.2223	-.1016	.1535
(Z_i)	(.08198)	(.07725)	(.13086)
Occupation	.0473	-.1278	-.2274
(O_i)	(.11543)	(.08469)	(.14615)
Education	-.0056	.0636	.0996
(ED_i)	(.03434)	(.03447)	(.06267)
Adult male	.3530	.1511	.4762
(P_i)	(.07740)	(.07688)	(.11651)
Adult female	.2777	.2261	.0321
(W_i)	(.07877)	(.06351)	(.10832)
Infant	-.0331	.1058	-.1336
(R_i)	(.08786)	(.07514)	(.14369)
Curvature	.0663	.0056	.0548
(S_i)	(.02917)	(.02145)	(.03119)
Curvature	.0125	-.0305	.0796
(T_i)	(04350)	(.03381)	(.06302)
Elderly male	.4466	.2252	-.4569
(U_i)	(.14120)	(.22144)	(.45240)
Elderly female	.0723	.0117	.3755
(V_i)	(.14447)	(.23358)	(.38695)
EI_{ed}[c]	.125	.290	.205

[a] All coefficients relate to the change in weekly household expenditures, in dollars, that would result from an unit change in the value of the associated variable.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

Table 35. Western shellfish expenditure income group coefficients and standard errors[a]

Variable	Income Group Low ($0-$10,000)	Middle ($10,001-$20,000)	High ($20,000+)
Income (M_i)	-.00000301 (.00004548)[b]	.00000971 (.000044785)	.00001207 (.000020456)
Food away (FA_i)	.0096 (.01043)	-.0102 (.01058)	-.0221 (.02020)
Race (E_i)	1.1183 (.39639)	-.8769 (.75295)	-.0336 (2.5245)
Urbanization (Z_i)	.2941 (.22495)	-.0963 (.24890)	1.0495 (.70465)
Occupation (O_i)	-.6089 (.34352)	.3501 (.27148)	-.3126 (.78972)
Education (ED_i)	.1518 (.09183)	-.0828 (.11082)	.3673 (.35023)
Adult male (P_i)	.2079 (.21039)	.4969 (.24714)	.2628 (.64101)
Adult female (W_i)	.2020 (.21981)	.1765 (.20415)	-.2453 (.60884)
Infant (R_i)	.5739 (.23171)	-.2530 (.25460)	.5476 (.76719)
Curvature (S_i)	-.0968 (.07716)	.1004 (.07019)	-.1562 (.16677)
Curvature (T_i)	-.1370 (.11752)	-.0336 (.11410)	-.6093 (.36132)
Elderly male (U_i)	1.1827 (.36193)	-.1028 (.70569)	-.9994 (2.3568)
Elderly female (V_i)	.5225 (.36835)	.0737 (.74473)	-.0938 (2.0039)
EI_{ed}[c]	-.013	.096	.120

[a] All coefficients relate to the change in weekly household expenditures, in dollars, that would result from an unit change in the value of the associated variable.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

Table 36. Western whole fish expenditure income group coefficients and standard errors[a]

Variable	Income Group		
	Low ($0-$10,000)	Middle ($10,001-$20,000)	High ($20,000+)
Income (M_i)	.00008393 (.000062027)[b]	.00008495 (.000005305)	-.00000307 (.00013411)
Food away (FA_i)	-.0052 (.01617)	.0057 (.11562)	-.0011 (.01205)
Race (E_i)	.6323 (.54020)	1.3888 (.62048)	-8.9212 (2947.2)
Urbanization (Z_i)	.4457 (.29532)	-.1144 (.31083)	.7076 (.41543)
Occupation (O_i)	-.0070 (.42474)	.5419 (.33487)	.4883 (.48583)
Education (ED_i)	-.2102 (.12383)	-.2710 (.13246)	-.1226 (.18881)
Adult male (P_i)	.7289 (.25849)	.4499 (.28407)	-.0447 (.37844)
Adult female (W_i)	-.0656 (.28083)	.2218 (.24462)	.3759 (.33649)
Infant (R_i)	-.4530 (.36105)	-.0039 (.29834)	.1182 (.49981)
Curvature (S_i)	-.0299 (.09756)	.1918 (.08548)	-.0454 (.0960)
Curvature (T_i)	.0806 (.16746)	-.0422 (.13684)	-.6131 (.32138)
Elderly male (U_i)	1.3168 (.44043)	1.0575 (.76713)	.0669 (1.2300)
Elderly female (V_i)	.0492 (.48260)	.3957 (.86950)	.9398 (.95585)
EI_{ed}[c]	.461	1.243	-.121

---

[a] All coefficients relate to the change in weekly household expenditures, in dollars, that would result from an unit change in the value of the associated variable.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

Occupation (O_i). Households in the low income group headed by non-salaried individuals were predicted to have larger total expenditures on fish and shellfish products than comparable households headed by salaried individuals (Table 31). The same relationship was observed in the low income group shellfish and filleted and steaked equations. For all other income groups, no significant difference in expenditure levels between occupations were observed. In the West's regional models, no significant difference in expenditure levels between these groups were noted in any of the five equations estimated (Table 8).

Education (ED_i). Education level was observed to have no significant impact on total fish and shellfish expenditures made by households falling in any income group (Table 31). Significant positive impacts were observed for low income group shellfish and middle income group canned fish expenditures. Negative relationships were observed for low and middle income whole fish expenditures. This implies additional education tends to depress whole fish expenditures made by households falling in these income categories. Beyond these models, no other significant impacts were observed.

Among the West's regional models, a significant positive relationship was noted in the canned fish equation while a negative relationship was noted for whole fish. The remaining three models showed no significant effect for education (Table 9).

Adult male scale value (P_i). Significant positive impacts from addition of an adult male were observed for low and middle income households total expenditures (Table 31). No significant impact was noted in the high income group. These findings differ from those found in the Southern models where positive impacts were observed among low and high income groups. Positive impacts from an addition of this kind were found in all three canned fish equations, the low and middle groups filleted and steaked equation, the low group whole fish equation, and the middle group shellfish equation. In the West's regional models, significant positive impacts were observed for all five expenditure categories (Table 10).

Adult female scale value (W_i). Addition of an adult female to a Western household was predicted to have a similar impact on total fishery product expenditures to that observed for adult males. Significant positive impacts occurred in the low and middle income group models (Table 31). No significant impacts on the whole fish or shellfish expenditures made by households in any income category were predicted. Positive effects were predicted for low and middle income households' canned fish and filleted and steaked expenditures. The only significant impact for high income households was observed for filleted and steaked expenditures. The West's regional models showed significant positive impacts on expenditures from addition of an adult female to the household in all categories except whole fish (Table 11).

Infant scale value (R_i). Addition of an infant to the household was predicted to have a significant impact on expenditures in only two of the 15 income-group equations estimated (Table 31). From an addition of this type, low income households shellfish and high income households filleted and steaked expenditures were predicted to increase. No significant impacts on spending levels from addition of an infant were noted in any of the West's regional models (Table 12).

Elderly male scale value (U_i). Significant impacts from addition of an elderly male to the household were noted in all five low income group equations (Table 31). None of the equations estimated for the middle or high income groups showed any significant effect on household expenditures from an addition of this kind. Among the West's regional models, significant positive impacts were observed in all five equations (Table 13).

Elderly female scale value (V_i). Addition of an elderly female was predicted to effect low income households total fishery product expenditures and high income households filleted and steaked expenditures (Table 31). In both cases, the estimated effect was positive. In the remaining 13 income-group equations, addition of an elderly female was predicted to have no measurable impact on household expenditures. Among the West's regional models, significant positive impacts were observed in the total expenditure and filleted and steaked models (Table 14). No significant impacts were predicted by the remaining three equations.

North Central Income-Group Model Results

Income (M_i). As with the South and West, a significant positive relationship was found between income and total fish and shellfish expenditures for low income households (Table 37). No significant relationship was found for income in the other income-group models estimated. A $1,000 increase in annual household income was predicted to increase expenditures by low income households on fish and shellfish products $.03 per week (Table 38). The associated expendiure income elasticity of demand was .185. This compares with a value of .239 for the South

Table 37. North Central income group coefficients--sign and significance

Variable	Expenditures														
	Total			Shellfish			Fish								
							Canned			Whole			Filleted/ Steaked		
Income Group[a]	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H
Income (M_i)	+[b]	0	0	+	0	0	+	0	0	0	0	0	0	0	0
Food away (FA_i)	0	0	0	0	0	+	0	0	0	0	+	0	0	0	0
Race (E_i)	+	+	+	0	0	0	0	0	0	+	+	0	+	+	+
Urbanization (Z_i)	0	0	0	0	+	0	0	-	0	+	0	-	0	0	0
Occupation (O_i)	0	0	0	0	0	0	0	0	+	0	0	0	-	0	0
Education (ED_i)	+	0	+	0	0	0	+	0	0	0	0	0	0	0	+
Adult male (P_i)	+	0	+	0	0	0	+	0	+	0	0	0	0	0	+
Adult female (W_i)	+	+	+	+	0	0	+	+	+	+	0	0	+	+	0
Infant (R_i)	0	+	0	0	0	+	0	+	0	0	0	0	0	+	-
Curvature (S_i)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+
Curvature (T_i)	0	-	0	0	0	0	0	0	+	0	0	0	0	-	0
Elderly male (U_i)	+	0	0	+	0	0	+	0	0	+	+	+	+	0	0
Elderly female (V_i)	+	0	0	0	0	0	+	0	0	+	0	0	+	0	0
EI_{ed}[c]	.185	.085	-.033	.477	.454	-.103	.223	.111	-.149	-.001	-.511	.579	.077	-.201	.128

[a] L refers to the low income group (annual household income of \$0-\$10,000), M to the middle income group (annual household income of \$10,001-\$20,000), and \$ to the high income group (annual household income greater than \$20,000).

[b] + indicates estimated coefficient was positive and at least 1.645 times larger than its standard error, and 0 that the coefficient was not significant by having absolute value less than 1.645 times its standard errors.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

Table 38. North Central total expenditure income group coefficients and standard errors[a]

Variable	Income Group		
	Low ($0-$10,000)	Middle ($10,001-$20,000)	High ($20,000+)
Income	.00003456	.00000812	-.00000219
(M_i)	(.000013164)[b]	(.000016223)	(.0000091082)
Food away	-.0043	.0021	.0007
(FA_i)	(.00430)	(.00294)	(.00611)
Race	.2997	.8584	1.2488
(E_i)	(.10520)	(.18501)	(.49518)
Urbanization	.0614	-.0812	.0673
(Z_i)	(.06564)	(.08993)	(.19808)
Occupation	-.1148	.0365	.0308
(O_i)	(.08916)	(.10060)	(.21379)
Education	.0653	.0002	.1916
(ED_i)	(.02750)	(.04037)	(.08548)
Adult male	.1723	.0935	.3700
(P_i)	(.06207)	(.08100)	(.15812)
Adult female	.4167	.3416	.3977
(W_i)	(.06084)	(.07026)	(.13508)
Infant	.0776	.2379	.1358
(R_i)	(.07186)	(.08101)	(.19648)
Curvature	-.0035	-.0281	.0721
(S_i)	(.02263)	(.02349)	(.04319)
Curvature	.0375	-.0689	-.0707
(T_i)	(.03443)	(.03637)	(.08473)
Elderly male	.5179	.1594	.8986
(U_i)	(.10357)	(.27104)	(.56443)
Elderly female	.3344	-.2117	-.8763
(V_i)	(.10879)	(.26801)	(.54579)
EI_{ed}[c]	.185	.085	-.033

[a] All coefficients relate to the change in weekly household expenditures, in dollars, that would result from an unit change in the value of the associated variable.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

and .140 for the West. Positive relationships were also noted between income and total expenditures in the low income groups shellfish and canned fish models. Beyond these, no significant effects were observed. Among the North Central regional models, significant positive effects on expenditures from added income were noted in all expenditure groups except whole fish (Table 3).

Expenditures on food away from home (FA_i). No significant relationship between purchases of food for consumption away from home and total fishery product expenditures were observed (Table 37). The only significant relationship noted, all positive, occurred for middle income group whole fish and the high income group shellfish purchases. The North Central regional models showed no significant relationship between any of the five expenditure categories and the expenditures on food consumed outside the household (Table 5).

Race (E_i). For all three income groups in the North Central region, Black households were predicted to have significantly higher weekly total fish and shellfish expenditures than Whites (Table 37). These expenditure differentials for the low, middle and high income groups, respectively, were \$.30, \$.86, \$1.25 (Table 38). Low and middle income Black households were also predicted to outspend Whites on whole fish. The expenditure differentials here were predicted to be \$.76 and \$1.25, respectively (Table 39). Black households in all three income groups were predicted to have significantly higher weekly expenditures on filleted and steaked fish products. For the low, middle and high income groups, respectively, the differences were \$.39, \$1.31, and \$1.80 per week (Table 40). Among the regional equations, significant impacts all positive were found only

Table 39. North Central whole fish expenditure income group coefficients and standard errors[a]

Variable	Income Group Low ($0-$10,000)	 Middle ($10,001-$20,000)	 High ($20,000+)
Income (M_i)	-.00002269 (.000060699)[b]	-.00002942 (.00004848)	.00002170 (.000024976)
Food away (FA_i)	-.0168 (.02445)	.0120 (.00541)	-.0204 (.02113)
Race (E_i)	.7560 (.40161)	1.2454 (.43586)	1.3607 (1.1099)
Urbanization (Z_i)	.5711 (.30418)	-.3313 (.27305)	-.1268 (.59784)
Occupation (O_i)	-.6315 (.46048)	-.1160 (.29886)	-2.0234 (.68794)
Education (ED_i)	.1946 (.12140)	.0472 (.07749)	.3642 (.26304)
Adult male (P_i)	.1759 (.27564)	.3073 (.23663)	.4274 (.44441)
Adult female (W_i)	.7689 (.24164)	.1314 (.20673)	-.1440 (.40113)
Infant (R_i)	.4922 (.30832)	.1370 (.23825)	-.0015 (.61169)
Curvature (S_i)	-.0535 (.09422)	-.0018 (.07035)	.0009 (.12301)
Curvature (T_i)	-.1703 (.14523)	-.1268 (.11440)	.0386 (.26229)
Elderly male (U_i)	1.1945 (.42751)	1.1126 (.63491)	2.8980 (1.3140)
Elderly female (V_i)	1.2827 (.47022)	.0584 (.66139)	-.3752 (1.5055)
EI_{ed}[c]	-.001	-.511	.579

[a] All coefficients relate to the change in weekly household expenditures, in dollars, that would result from an unit change in the value of the associated variable.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

Table 40. North Central filleted and steaked expenditure income group coefficients and standard errors[a]

Variable	Income Group Low ($0-$10,000)	Income Group Middle ($10,001-$20,000)	Income Group High ($20,000+)
Income (M_i)	.00001212 (.000019033)[b]	-.00001654 (.000025036)	.00000589 (.000001169)
Food away (FA_i)	-.0115 (.00724)	.0012 (.00456)	-.0107 (.00854)
Race (E_i)	.3931 (.14404)	1.3056 (.25901)	1.7997 (.53756)
Urbanization (Z_i)	.1102 (.09474)	-.0195 (.13898)	.3566 (.26297)
Occupation (O_i)	-.2527 (.13362)	-.0033 (.15641)	-.1169 (.29143)
Education (ED_i)	.0624 (.03988)	-.0024 (.06205)	.3367 (.12021)
Adult male (P_i)	.1272 (.08837)	.0923 (.12121)	.6548 (.20933)
Adult female (W_i)	.2963 (.08430)	.3509 (.10579)	.0524 (.18439)
Infant (R_i)	.1148 (.10174)	.3035 (.12185)	-.4501 (.25746)
Curvature (S_i)	.0114 (.03225)	-.0192 (.03575)	.1615 (.05896)
Curvature (T_i)	.0174 (.04784)	-.1284 (.05589)	.1679 (.11174)
Elderly male (U_i)	.4562 (.14673)	.2580 (.41476)	.6003 (.77085)
Elderly female (V_i)	.2988 (.15648)	-.2455 (.42536)	-.1145 (.71733)
EI_{ed}[c]	.077	-.201	.128

[a] All coefficients relate to the change in weekly household expenditures, in dollars, that would result from an unit change in the value of the associated variable.

[b] Figures in parentheses are standard errors of the coefficient.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

in the total expenditure, filleted and steaked, and whole fish models (Table 6).

Urbanization (Z_i). No significant difference in expenditure levels between urban and rural households were predicted for the total expenditures of any income group (Table 37). Urban households were predicted to outspend their rural counterparts in the low income-group whole fish and the high income-group shellfish models. The opposite relationship was observed for middle income canned fish and the high income whole fish expenditures. Among the five regional models, no significant difference in expenditures between urban and rural households were noted (Table 7).

Occupation (O_i). The occupation of the household head was predicted to have no significant impact on the total expenditure, whole fish, or shellfish purchases of any income group (Table 37). The only models showing significant relationships were the high income group canned fish equation, salaried professional households were predicted to have higher expenditures, and the low income group filleted and steaked equation, non-salaried professionals were predicted to have higher expenditures. In the regional models, no significant difference in expenditures between these two groups were noted with the exception of whole fish. Here households headed by non-salaried individuals were predicted to have larger weekly expenditures than those headed by salaried individuals (Table 8).

Education (ED_i). Increased levels of formal education attained by the household head were predicted to have significant positive impacts on total fishery product expenditures made by low and high income households (Table 37). No significant impact was predicted for middle income households. Significant positive impacts were also observed in the low income group canned fish and the high income group filleted and steaked equations. In all remaining categories, no significant relationship was found. Significant positive coefficients were obtained for this variable in all regional equations except in the shellfish model where no significance was observed (Table 9).

Adult male scale value (P_i). For low and high income groups total expenditures, addition of an adult male to the household was predicted to have a significant positive impact on spending (Table 37). Significant positive impacts were also noted for low and high income households canned fish expenditures (Table 41). High income households filleted and steaked expenditures were also predicted to increase. In the remaining models, no significant impacts from an addition of this type were noted. Among the regional equations, significant positive effects were noted in all models with the exception of whole fish and shellfish where no relationship was observed (Table 10).

Adult female scale value (W_i). For both canned fish and total expenditures, addition of an adult female to the household was predicted to increase the purchases of all income groups (Table 37). Significant positive impacts were also noted among low income household filleted and steaked, whole fish and shellfish expenditures and middle income household filleted and steaked expenditures. Beyond these, no significant impacts were observed. In the regional equations estimated, an addition of this type was predicted to significantly increase weekly expenditures in all five fishery product categories (Table 11).

Table 41. North Central canned fish expenditure income group coefficients and standard errors[a]

Variable	Income Group		
	Low (\$0-\$10,000)	Middle (\$10,001-\$20,000)	High (\$20,000+)
Income	.00002581	.00005319	-.00000399
(M_i)	(.000010283)[b]	(.00000952)	(.000004745)
Food away	-.0004	-.0017	-.0030
(FA_i)	(.00318)	(.00171)	(.00304)
Race	-.0907	.0638	-.1612
(E_i)	(.08561)	(.11322)	(.25645)
Urbanization	.0262	-.1026	.0167
(Z_i)	(.05101)	(.05301)	(.97208)
Occupation	.0017	.0151	.2381
(O_i)	(.06843)	(.05911)	(.10420)
Education	.0502	-.0035	-.0059
(ED_i)	(.02143)	(.02395)	(.04141)
Adult male	.1143	.0397	.2321
(P_i)	(.04759)	(.04761)	(.07638)
Adult female	.2892	.2084	.2448
(W_i)	(.04699)	(.04094)	(.06507)
Infant	.0719	.0802	-.0229
(R_i)	(.05538)	(.04771)	(.09592)
Curvature	.0032	-.0169	.0395
(S_i)	(.01727)	(.01372)	(.02078)
Curvature	-.0021	-.0123	.0020
(T_i)	(.02665)	(.02112)	(.04097)
Elderly male	.3550	-.1096	.4587
(U_i)	(.08099)	(.16622)	(.27934)
Elderly female	.1951	-.0498	-.5650
(V_i)	(.08574)	(.16232)	(.28220)
EI_{ed}[c]	.223	.111	-.149

[a] All coefficients relate to the change in weekly household expenditures, in dollars, that would result from an unit change in the value of the associated variable.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

Infant scale value (R_i). Addition of an infant was predicted to have a significant positive impact on the total, canned fish, and filleted and steaked expenditures of middle income households (Table 37). Additional significant effects were noted in the shellfish; positive impact; and filleted and steaked models; negative impact; of the high income group (Tables 42 and 40). In the remaining income-group models estimated, an addition of this type was predicted to have no significant impact on weekly expenditures. With the exception of whole fish and shellfish all regional models showed significant positive effects on spending from addition of an infant to the household (Table 12).

Elderly male scale value (U_i). Addition of an elderly male to a low income household was predicted to significantly increase spending on all five expenditure categories in the North Central region (Table 37). An addition of this type was predicted to significantly effect spending by middle and high income households only on whole fish products. In the remaining income-group models, no significant impacts were observed. On a regional basis, significant positive impacts were found in all equations except the shellfish model (Table 13).

Elderly female scale value (V_i). The only significant impacts observed from addition of an elderly female to the household occurred among expenditures made by low income households. Significant positive impacts were noted in all models except shellfish where no relationship was found (Table 37). Among the North Central regional models, a significant positive impact was noted for whole fish expenditures with all others showing no effect from an addition of this type (Table 14).

Table 42. North Central shellfish expenditure income group coefficients and standard errors[a]

Variable	Income Group		
	Low ($0-$10,000)	Middle ($10,001-$20,000)	High ($20,000+)
Income (M_i)	.00007765 (.000031935)[b]	.00004322 (.000044509)	-.00000730 (.000023896)
Food away (FA_i)	-.0080 (.01111)	.0047 (.00789)	.0319 (.01576)
Race (E_i)	.1789 (.24827)	.0361 (.52990)	-.3601 (1.4455)
Urbanization (Z_i)	.1042 (.16121)	.0447 (.24883)	-.2156 (.55005)
Occupation (O_i)	-.0028 (.21722)	.4536 (.27388)	-.5176 (.58942)
Education (ED_i)	-.0776 (.15033)	.0164 (.11184)	.2023 (.24363)
Adult male (P_i)	.0804 (.14848)	.1451 (.22715)	-.5864 (.43825)
Adult female (W_i)	.2763 (.13924)	.1461 (.18735)	.4739 (.37379)
Infant (R_i)	-.1805 (.18233)	.0451 (.22413)	1.1233 (.51999)
Curvature (S_i)	-.0014 (.05476)	.0522 (.06477)	-.1068 (.12262)
Curvature (T_i)	.1156 (.08228)	.0081 (.10015)	-.3501 (.22784)
Elderly male (U_i)	.4414 (.25137)	-.5857 (.83412)	.1198 (1.6517)
Elderly female (V_i)	-.0887 (.27535)	-.4985 (.80834)	-.2031 (1.5338)
EI_{ed}[c]	.477	.454	-.103

[a] All coefficients relate to the change in weekly household expenditures, in dollars, that would result from an unit change in the value of the associated variable.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes the expenditure income elasticity of demand.

CHAPTER VII

EMPIRICAL RESULTS--
AVERAGE WEEKLY EXPENDITURES AND FOOD STAMP MODELS

Introduction

In this chapter actual average weekly fish and shellfish expenditures are examined when the households included in the BLS survey were stratified into groups by major socioeconomic and demographic factors. The factors examined were region, urbanization, race, income class, occupation, and education. Following this, examination of the effect of food stamps on fishery product expenditures is presented.

Tabular Analysis of Weekly Expenditures

Weekly expenditures by region. Households in the Northeast showed the largest weekly total fish and shellfish expenditures with $.98 (Table 43). Western households had the second largest outlay with $.73, followed by the South with $.64 and North Central households with $.51. The regional order of total expenditures was not reflected in the households' average annual income. The largest average income, $12,109.06, occurred in the West which had the second largest total expenditure value. The Northeast had the second largest average income, $11,374.39, followed by North Central, $11,120.69, and Southern, $9,935.29, households. With the exception of only whole fish, the Northeast had the largest average weekly expenditures on the four component categories

Table 43. Average weekly expenditures and income by region

Expenditure (dollars)	Northeast	North Central	South	West
Total	.98	.51	.64	.73
Shellfish	.24	.22	.17	.16
Canned	.34	.09	.23	.29
Whole	.05	.03	.06	.04
Filleted/steaked	.35	.17	.19	.25
Income	11,374.39	11,120.69	9,935.29	12,109.06
Households[a]	4,075	5,604	6,201	3,994

[a] Number of households.

making up total expenditures. The South's whole fish expenditure of $.06 per week was the largest observed. Smallest expenditure levels tended to be associated with North Central households. This region's canned fish expenditure level was $.14 per week smaller than the South's, $.20 smaller than that of Western households, and $.25 smaller than that found in the Northeast. North Central households also had the smallest whole fish and filleted and steaked ependitures. North Central households had the second largest shellfish expenditure, $.22, exceeded by the Northeast by only $.02 per week.

<u>Weekly expenditures by region and urbanization</u>. The relative expenditure levels identified above for the different regions were maintained when the BLS sample was examined on the basis of region and urbanization. In all regions, except the North Central, urban households had larger total fish and shellfish expenditures than rural households. The largest average expenditures were associated with urban households in the Northeast, $1.10 per week (Table 44). Rural households in this region had total expenditures averaging $.88 per week. The Northeast was followed

Table 44. Average weekly expenditures and income by region and urbanization

Expenditures (dollars)	Northeast		North Central	
	Urban	Rural	Urban	Rural
Total	1.10	.88	.49	.52
Shellfish	.24	.23	.07	.09
Canned	.33	.35	.20	.24
Whole	.07	.04	.03	.02
Filleted/steaked	.46	.27	.19	.16
Income	9,897.74	12,512.84	9,966.17	12,133.27
Households[a]	1774	2301	2618	2985

Expenditures (dollars)	South		West	
	Urban	Rural	Urban	Rural
Total	.65	.63	.76	.71
Shellfish	.17	.17	.17	.15
Canned	.22	.23	.29	.29
Whole	.06	.05	.04	.03
Filleted/steaked	.20	.18	.26	.23
Income	9,603.11	10,215.25	11,666.10	12,498.65
Households[a]		3365	1869	2125

[a] Number of households.

by the West where the urban-rural expenditure averages were $.76 and $.71 per week, respectively. Urban households in the South had expenditures averaging $.65 per week, while rural households' total fish and shellfish expenditures averaged $.63. In the North Central region, rural households had larger average weekly expenditures, $.52, than their urban counterparts, $.49.

As with the total region, expenditures by urban and rural households in the Northeast, on each of the four component fishery product categories, tended to be larger than corresponding expenditures made by households in the other regions. The lone exception occurred in canned fish purchases where rural Southern household expenditures averaged $.01 per week more than expenditures of Northeastern households. Urban and rural households in the North Central region consistently had the smallest expenditures on the four fishery product categories.

Weekly expenditures by race. Of the 19,873 households from the survey data studied, 17,837 or 89.8 percent were White, while 2,036 or 10.2 percent were Black. On average, Black households spent $.21 per week more on fish and shellfish products than White households. The average weekly total expenditure by Black households was $.88, while that of Whites' was $.67 (Table 45). White households outspent Blacks on shellfish and canned fish products, while Black households outspent Whites on whole fish and filleted and steaked products. White households spent an average $.16 per week on shellfish, against $.12 for Blacks, and $.27 on canned fish, against $.22 for Blacks. Black households' weekly expenditures on whole fish averaged $.16, against $.03 for Whites, and their expenditures on filleted and steaked products averaged $.39, against $.21 for Whites.

Table 45. Average weekly expenditures and income by race

Expenditures (dollars)	Black	White
Total	.88	.67
Shellfish	.12	.16
Canned	.22	.27
Whole	.16	.03
Filleted/steaked	.39	.21
Income	7,453.33	11,406.47
Households[a]	2,036	17,837

[a] Number of households.

Black households had larger average expenditures on those categories which contained the majority of products consumed in the fresh form, while White households' expenditures were largest on those categories which contained more highly processed fishery products. With respect to total expenditures, the proportion of income spent on fishery products by Black households was exactly twice that of White households. Differences in taste and overall preferences for fishery products can be seen as the factors motivating these expenditure differences.

Weekly expenditures by region and race. As found above with expenditures at a national level, in each of the four regions Black households had larger average total weekly expenditures on fishery products than White households. For both races the largest total expenditures were observed in the Northeast. Here Black household total expenditures of $1.10 per week were $.13 greater than those of White households (Table 46). Smallest weekly total expenditures for both races occurred in the North Central region. Here Black household total expenditures averaged $.79 and White household expenditures $.48. In the South, Black household

Table 46. Average weekly expenditures and income by region and race

Expenditures (dollars)	South		North Central	
	White	Black	White	Black
Total	.59	.87	.48	.79
Shellfish	.17	.13	.09	.06
Canned	.23	.19	.22	.21
Whole	.03	.19	.02	.09
Filleted/steaked	.16	.36	.15	.42
Income	10,661.84	6,520.93	11,354.41	8,385.00
Households[a]	5,113	1,088	5,162	441

Expenditures (dollars)	Northeast		West	
	White	Black	White	Black
Total	.97	1.10	.73	.81
Shellfish	.25	.15	.16	.21
Canned	.34	.33	.29	.19
Whole	.04	.15	.04	.10
Filleted/steaked	.34	.47	.24	.31
Income	11,624.30	8,490.65	12,261.46	8,916.95
Households[a]	3,750	325	3,812	182

[a] Number of households.

expenditures were almost $.30 per week larger than those of Whites, $.87 against $.59. Among Western households, the expenditure difference was only $.08 with Black households averaging $.81 per week and White households $.73.

As was the case at the national level, in all four regions expenditures by Blacks on whole and filleted and steaked products were larger than those of Whites. Among whole fish expenditures, the largest difference in weekly spending levels occurred in the South where Black expenditures were $.16 per week larger than those of Whites. The smallest difference for this category, $.06, was found in the West. In the filleted and steaked category, the largest expenditure difference, $.27, occurred in the North Central region. The smallest difference, $.07, occurred in the West.

White households had larger average weekly canned fish expenditures than Blacks, although for two regions the difference was only $.01. The largest difference, $.10, occurred in the West, while in the South, Whites outspent Blacks by $.04. In the Northeast and North Central regions, the difference was only $.01.

Among shellfish expenditures, White households had larger average weekly expenditures than Blacks in the South, Northeast and North Central regions. The largest difference, $.10, occurred in the West with the smallest, $.03, observed in the North Central states. In the South, Whites outspent Blacks by $.04. In the West, Black households outspent Whites by $.05 per week, $.21 against $.16.

Regarding income, Whites had larger average annual income than Blacks in all four regions. The average difference was $3,404.77, with the smallest difference, $3,000.00, occurring in the North Central region and the largest difference, $4,140.90, in the South.

Weekly expenditures by income group. At the national level, the largest weekly total expenditures, $1.21, were made by high income households (Table 47). Middle income households averaged $.44 per week below this at $.77, with low income households averaging $.53.

Table 47. Average weekly expenditures and income by income groups

Expenditure (dollars)	Income Group Low $0-$10,000	 Middle $10,001-$20,000	 High $20,000+
Total	.53	.77	1.21
Shellfish	.09	.18	.40
Canned	.20	.31	.42
Whole	.05	.04	.05
Filleted/steaked	.20	.25	.34
Income	4,247.29	14,119.39	29,284.82
Households[a]	10,724	6,961	2,188

[a] Number of households.

With the exception of whole fish, the high income group had larger average expenditures on the four fishery product categories than the middle group. Middle income households had larger expenditures than low income households. For whole fish, average expenditures by the three groups were almost the same. Low and high income households both averaged $.05, while the middle group averaged $.04. The largest expenditures of all three groups were for canned products.

Average incomes for the low, middle and high income categories were $4,247.29, $14,119.39, and $29,284.82, respectively. With these income levels, the relationship between income and food expenditures identified by Engel were exhibited. In moving from the low to high income group, the proportion of income devoted to fishery product expenditures declines.

Using total expenditures as an example, the percentage of income spent on fish by low, middle, and high income households were .0125, .0055, and .0042, respectively.

Weekly expenditures by region and income group. When the sample was stratified by region and income group, the largest average weekly total expenditures were observed for high income households in the Northeast. Here expenditures averaged $1.70 (Table 48). This was followed by high income household in the West, $1.20; South, $1.16; and North Central regions, $.88. Average total expenditures made by middle income households followed this same pattern, with spending levels by the respective regions being $1.02, $.82, $.74, and $.58. Average total expenditures made by low income households followed this same relationship.

The smallest average expenditures of all regions and income classes were for whole fish products. Here the range in expenditures was from $.02 to $.06. For low and middle income households, the largest expenditure levels were associated with canned fish products. Among high income households, the largest expenditures for all regions tended to be on shellfish. The exception of this occurred among North Central high income households, where the largest outlays were for canned fish products.

Weekly expenditures by occupation and household head. When the BLS data was divided into groups made up of households headed by salaried professionals and those headed by non-salaried professionals, differences in average weekly fishery product expenditures were noted. Salaried professional households had larger total fish and shellfish expenditures, $.84, than those headed by non-salaried professionals, $.66 (Table 49). This relationship was maintained for canned fish and shellfish expenditures

Table 48. Average weekly expenditure and income by region and income group

Expenditure (dollars)	Northeast			North Central		
	Low	Middle	High	Low	Middle	High
Total	.78	1.02	1.70	.37	.58	.88
Shellfish	.13	.26	.62	.05	.09	.23
Canned	.26	.38	.56	.17	.26	.35
Whole	.05	.04	.05	.03	.02	.04
Filleted/ steaked	.34	.34	.46	.13	.20	.25
Income	5,445.07	14,234.32	27,907.17	5,272.62	14,137.67	27,721.85
Households[a]	2054	1553	468	2863	2116	624

Expenditure (dollars)	South			West		
	Low	Middle	High	Low	Middle	High
Total	.52	.74	1.16	.54	.82	1.20
Shellfish	.10	.23	.44	.11	.15	.38
Canned	.18	.28	.39	.21	.35	.41
Whole	.06	.04	.06	.04	.04	.04
Filleted/ steaked	.18	.20	.28	.18	.28	.38
Income	5,037.12	13,940.40	31,082.21	5,408.16	14,200.98	30,465.11
Households[a]	3808	1864	529	1999	1428	567

[a] Number of households.

Table 49. Average weekly expenditures and income by occupation of household head

Expenditures (dollars)	Salaried	Non-Salaried
Total	.84	.66
Shellfish	.25	.13
Canned	.32	.25
Whole	.04	.05
Filleted/steaked	.25	.24
Income	16,421.97	9,188.16
Households[a]	5,301	14,572

[a] Number of households.

where spending by salaried households averaged $.32 and $.25 per week, respectively, against $.25 and $.13 per week for non-salaried households.

Expenditures by the two groups on the two fresh fish categories, whole fish and filleted and steaked products, differed by only $.01 in each case. Whole fish expenditures by salaried and non-salaried households amounted to $.04 and $.05, respectively. Filleted and steaked expenditures for the same two groups were $.25 and $.24.

Weekly expenditures by region and occupational status of household head. When the sample was stratified by region and occupational status of the household head, the tendency addressed above of salaried households to have larger expenditures on canned fish and shellfish and expenditures by the two groups on whole fish and filleted and steaked products to be about the same, was maintained (Table 50).

Weekly expenditures by education level of household head. Similar to the findings with income, average total fish and shellfish expenditures tended to increase with the education level of the household head.

Table 50. Average weekly expenditures and income by region and occupation of household head

Expenditure (dollars)	Northeast		North Central	
	Salaried	Not Salaried	Salaried	Not Salaried
Total	1.19	.90	.59	.47
Shellfish	.40	.18	.13	.07
Canned	.40	.32	.27	.20
Whole	.04	.05	.02	.03
Filleted/steaked	.35	.35	.17	.17
Income	16,630.17	9,589.64	15,379.88	9,523.63
Households[a]	1,033	3,042	1,528	4,075

Expenditure (dollars)	South		West	
	Salaried	Not Salaried	Salaried	Not Salaried
Total	.75	.60	.85	.68
Shellfish	.25	.14	.22	.14
Canned	.27	.21	.33	.27
Whole	.04	.06	.04	.04
Filleted/steaked	.20	.19	.27	.24
Income	16,048.67	7,938.05	17,629.16	9,701.33
Households[a]	1,527	4,674	1,213	2,781

[a] Number of households.

Households headed by individuals with no reported formal education spent, on average, \$.55 per week on fishery products (Table 51). Those headed by college graduates had average expenditures of \$.89 per week. Increased levels of formal education also coincided with increasing average weekly shellfish and canned fish expenditures. For both shellfish and canned fish the difference in spending between the lowest and highest educational category was \$.17.

Average weekly whole fish expenditures followed the opposite pattern with households headed by individuals with no formal education having average weekly expenditures of \$.07, while those headed by college graduates had averaged expenditures of \$.04. Filleted and steaked expenditures exhibited no pattern with respect to education level of the household head.

Effect of Food Stamps on Household Expenditures

The model estimated was identical to the regional and income-group models, equation (26), with an additional independent variable representing the dollar value of food stamps received by the household during the previous month included. With this, the estimated equation became

$$E_{ij} = \beta_0 + \beta_1 M_1 + \beta_2 E_i + \beta_3 Z_i + \beta_4 FA_i + \beta_5 O_i + \beta_6 ED_i + \beta_7 VFS_i +$$

$$c_1 P_i + c_2 W_i + c_3 R_i + c_4 S_i + c_5 T_i + c_6 U_i + c_7 V_i + u_{ij} \qquad (27)$$

where all variables are as specified in equation (26) and VFS_i represents the dollar value of food stamps received by the household during the previous month. Because this information was collected during the second year only, the 587 households indicating they received food stamps were

Table 51. Average weekly expenditures and income by education level of household head

Expenditure (dollars)	Education Level					
	None	Some grade school	Some high school	High school graduate	Some college	College graduate
Total	.55	.64	.69	.72	.72	.89
Shellfish	.09	.11	.13	.18	.18	.26
Canned	.16	.23	.27	.27	.29	.33
Whole	.07	.05	.05	.04	.04	.04
Filleted/steaked	.23	.27	.25	.23	.21	.26
Income	5,637.75	6,921.40	9,512.64	11,413.94	12,497.86	17,358.65
Households[a]	280	4,444	3,273	6,021	2,815	3,040

[a] Number of households.

contacted during the 1973-1974 portion on the survey. No food stamp information of any kind was collected during the first year of the survey.

Income. The estimated coefficients and standard errors obtained with the food stamp model are presented in Table 52. The models performance, when compared to the findings obtained with the regional and income-group specifications, was poor. Only for canned fish expenditures was income predicted to have a significant impact on purchases. Here an $1,000 increase in annual household income was predicted to prompt a $.05 increase in weekly canned fish expenditures. The corresponding expenditure income elasticity of demand was .217. This was larger than the canned fish elasticities obtained with the regional models, but not unlike those obtained for low income groups when the sample was separated into income classes.

Value of Food Stamps. Similar to income, the only food stamp coefficient which was significant occurred in the canned fish model. A $10 decrease in the households monthly food stamp allotment was predicted to translate into a $.03 per week decline in expenditures on canned fish products. On an annual basis, this translates into an expenditure drop of $1.56.

The obtained food stamp expenditure elasticity of demand was .339. The food stamp elasticity was larger than the corresponding income elasticity. This indicates that a larger proportion of an increase in food stamp allotment would be translated into food expenditures than would an increase in income. This finding is to be expected in view of the restriction that food stamps may be used only in the purchase of food products, while income earned by household members may be funneled

Table 52. Food stamp model coefficients standard errors and elasticities[a]

Variable	Expenditures				
	Total	Shellfish	Fish		
			Canned	Whole	Filleted/ steaked
Income (M_i)	.000033891 (.000031494)[b]	.00006810794 (.000045824)	.0000467627 (.000022335)	-.0000790451 (.00010503)	-.000043985 (.000051276)
Food stamps (VFS_i)	.0026 (.00217)	.0020 (.00335)	.0031 (.00158)	.0024 (.00597)	-.0035 (.00318)
Food away (FA_i)	-.0198 (.01874)	-.0282 (.03272)	-.0042 (.01313)	-.0850 (.06558)	-.0056 (.02621)
Race (E_i)	.3318 (.17873)	.0574 (.26665)	-.3531 (.13304)	1.9608 (.46351)	.5958 (.26690)
Urbanization (Z_i)	.2061 (.18282)	.5466 (.28217)	.0910 (.13288)	.5498 (.49394)	.1615 (.27653)
Occupation (O_i)	-.2123 (.47544)	.8904 (.57392)	-.9313 (.40365)	-.0951 (1.3214)	-.3223 (.75864)
Education (ED_i)	-.0051 (.08348)	.0079 (.12301)	-.0232 (.06045)	.0039 (.22855)	-.0694 (.12921)
Adult male (P_i)	.2038 (.12267)	.1260 (.19013)	.1588 (.08845)	-.0851 (.31834)	.0723 (.17861)
Adult female (W_i)	.3355 (.14253)	-.0451 (.21499)	.0770 (.10196)	1.1883 (.33926)	.4338 (.21054)
Infant (R_i)	-.1720 (.15883)	-.4188 (.26495)	-.1081 (.11373)	-.2476 (.41401)	.2318 (.23522)
Curvature (S_i)	.0667 (.04875)	.0559 (.04376)	.0402 (.03469)	.0797 (.13162)	.0370 (.07179)
Curvature (T_i)	.0632 (.06793)	.1193 (.10936)	.0653 (.04954)	-.1986 (.17651)	.0648 (.098695)
Elderly male (U_i)	.4308 (.33254)	.1716 (.46043)	.4211 (.23081)	-.1587 (.88031)	.7919 (.48751)
Elderly female (V_i)	-.1411 (0.29684)	.2692 (.41743)	-.1049 (.21860)	1.3567 (.68393)	-.9334 (.49791)
EI_{ed}[c]	.084	.299	.217	-.296	-.126
FSE_{ed}[d]	.154	.209	.339	.210	-.239

[a] All coefficients relate to the change in weekly household expenditures, in dollars, that would result from an unit change in the value of the associated variable.

[b] Figures in parentheses are standard errors of the coefficients.

[c] EI_{ed} denotes expenditure income elasticity of demand.

[d] FSE_{ed} denotes food stamp expenditure elasticity of demand.

into purchases of any products. As with income the small number of households in the sample receiving food stamps may have contributed to the lack of significance of this and other variables included in the estimated food stamp equation.

Expenditures on food away from home (FA_i). No significant relationship between expenditures on food outside the home and purchases of fishery products for home use were observed in any of the estimated models (Table 54). This was similar to the majority of the regional and income-group equations.

Table 53. Food stamp model coefficient--sign and significance

	Expenditures				
	Total	Shellfish	Fish		
			Canned	Whole	Filleted/ steaked
Income	0	0	+	0	0
Food stamps	0	0	+	0	0
Food away	0	0	0	0	0
Race	+	0	-	+	+
Urbanization	0	+	0	0	0
Occupation	0	0	-	0	0
Education	0	0	0	0	0
Adult male	+	0	+	0	0
Adult female	+	0	0	+	+
Infant	0	0	0	0	0
Curvature	0	0	0	0	0
Curvature	0	0	0	0	0
Elderly male	0	0	+	0	0
Elderly female	0	0	0	+	-

Race. The coefficients of the variable included to capture the effect of race on expenditures followed a pattern across expenditure categories similar to that observed in the regional and income-group equations. Four of the five estimated race coefficients were significantly different from zero. The largest racial effect, $1.96 per week, was estimated for whole fish expenditures (Table 52). Black households were also predicted to spend almost $.60 per week more on filleted and steaked products than White households. Black households estimated total expenditures on fish and shellfish were $.33 per week larger than those of Whites. Shellfish expenditures of White and Black households were not found to differ significantly. The food stamp model predicted that Black households would spend $.35 per week less on canned fish products than Whites.

Urbanization (Z_i). Significant differences in expenditure levels between urban and rural households which received food stamps were observed only for shellfish expenditures (Table 54). Urban households were predicted to spend $.55 per week more on these products than rural households (Table 52).

Occupation (O_i). Weekly expenditures by households headed by salaried professionals and non-salaried professionals were not predicted to differ significantly in four of the five food stamp equations estimated (Table 53). For canned fish expenditures, non-salaried households were predicted to spend $.93 per week more than salaried households (Table 52).

Education (ED_i). Education level of the household head was not predicted to have a significant impact on expenditures in any of the five equations estimated (Table 53).

Adult male scale value (P_i). Addition of an adult male to the household was predicted to increase total expenditures by $.20 per week and canned fish expenditures by $.16 per week (Table 52). No significant effect from an addition of this type was noted in the other three expenditure categories (Table 53).

Adult female scale value (W_i). Addition of an adult female to a household receiving food stamps was predicted to increase expenditures in three of the five models estimated (Table 53). Total expenditures were estimated to increase by $.34, whole fish expenditures by $1.19, and filleted and steaked expenditures by $.43 per week (Table 52). No significant impact was noted in the remaining two equations.

Infant scale value (R_i). Addition of an infant was predicted to have no significant impact on expenditures on any of the five fishery product categories considered (Table 53).

Elderly male scale value (U_i). Addition of an elderly male was predicted to have a significant impact only on canned fish expenditures (Table 53). Expenditures were estimated to increase by $.42 per week (Table 52).

Elderly female scale value (V_i). Addition of an elderly female to a household receiving food stamps was predicted to increase spending by $1.36 on whole fish products and decrease spending by $.93 on filleted and steaked products (Table 52). No significant impact was indicated for the other three categories (Table 53).

Average Weekly Expenditures Of Households Receiving Food Stamps By Race

Average total expenditures on fishery products by Black households receiving food stamps were $.95 per week against $.63 for Whites (Table 54). Average weekly shellfish expenditures between races differed by only $.02, with Blacks spending $.10 against $.08 for Whites. Black filleted and steaked product expenditures averaged $.43, while those of Whites averaged $.22. Whole fish expenditures of Black households were 600 percent larger than those of Whites, $.18 against $.03. Average weekly expenditures on canned fish by White households were $.31, while that of Blacks was $.24.

Table 54. Average weekly expenditures and income of food stamp recipients by race

Expenditure (dollars)	White	Black
Total	.63	.95
Shellfish	.08	.10
Canned	.31	.24
Whole	.03	.18
Filleted/steaked	.22	.43
Income	3,957.34	3,419.92
Households[a]	354	233

[a] Number of households.

CHAPTER VIII

SUMMARY AND IMPLICATIONS FOR FURTHER RESEARCH

Summary

A series of socioeconomic and demographic factors has been shown to explain observed variation in household expenditures on fishery products in the United States. Generally the findings indicate that income, race, and the adult equivalent scale for household size and composition were consistently the most important factors in explaining household expenditures on fish and shellfish. Other factors, urbanization and education in particular, were important in explaining the expenditures in a particular region or expenditures by households in all regions on a particular group of products.

Income was consistently found to have a significant positive impact on expenditures. At the regional level it was significant in 16 of 20 estimated models. In the canned fish, shellfish, and total expenditure models of all four regions the estimated income coefficient was significant. Income was also significant in explaining filleted and steaked fish expenditures in all regions except for those in the Northeast. Income had no significant impact on whole fish expenditures by households in any region.

With the exception of filleted and steaked products, Northeastern households relative to households in all other regions consistently displayed the largest expenditure response to a change in household income. Western and North Central households had the largest expenditures for filleted and steaked products. These conclusions parallel the findings of Nash [1970] and Miller and Nash [1971] who identified the New England and the Middle Atlantic states as areas of high per capita consumption of many fish and shellfish products. In the BLS data the strong preference of the Northeast for fishery products, relative to that of the other areas, was also emphasized by the level of actual household expenditures during the period of the survey. In all categories, except filleted and steaked products where the difference was one cent, spending levels of Northeastern households were larger than those in the other three regions. This occurred even though households in the Northeast did not have the largest observed average annual income indicating the relative strength of the preference in this region for fish and shellfish.

The smallest expenditure responses and elasticities were found in the South where households had the smallest observed average annual income. For this region, however, actual average expenditure levels were not the smallest encountered. The lowest expenditures were made by North Central households on most product categories. The distance between this area and coastal centers of major production may have limited availability, relative to the other areas, and contributed to its low expenditures.

With respect to the relative magnitudes of the income coefficients and elasticities between expenditure categories, the largest values were normally associated with shellfish expenditures and the smallest with purchases of filleted and steaked products. This indicates, for most households, that the largest portion of a given income increase devoted to fishery products would be spent on shellfish and the smallest amount on fillets and steaks.

The effect of income on expenditures predicted by the income-group models generally followed the pattern identified by the regional equations. Significance was usually found for total expenditures, shellfish, canned fish, and filleted and steaked purchases. Because the number of households in each category declined from the low to high income groups, significance of income was normally, though not exclusively, found among low income households. This pattern was also present for the estimated coefficients of other variables included in equation (26).

Household expenditures on food consumed away-from-home did not have a consistent impact on purchases of fishery products for home use. At the regional level, only three of the 20 models estimated indicated a significant relationship between purchases of fishery products and eating out. All significant effects were positive. No significant relationship between expenditures on food away-from-home and the canned fish, whole fish, or filleted and steaked expenditures of households in any region was found. Likewise, no relationship between this variable and expenditures by North Central or Western households on any of the five product categories were noted. Only for shellfish expenditures of Northeastern households and total expenditures and shellfish expenditures of Southern households was significance found. Sign and significance of the income-group models tended to follow the pattern of the regional equations although significant impacts were found for other regions and other expenditure categories not noted at the regional level.

By far race was the largest single factor effecting the size of household expenditures. In all regional whole fish models a strong positive relationship between race and expenditures was found. Significant positive relationships were also noted for Southern and North Central households total and filleted and steaked expenditures. Negative relationships were obtained for the effect of race on Southern and Western canned fish expenditures. In all other regional models, including all shellfish equations, race was not predicted to have a significant effect.

Where significance was found, Black households were estimated to have higher weekly expenditures than Whites on all fishery products except canned fish. The predicted differences ranged from a few cents to more than two dollars per week. The largest impacts due to the partial effect of race were estimated for fresh fish products (whole fish and filleted and steaked fish). Frequently, the weekly effect was from $1.00 to $2.00 indicating the strong preference of Blacks for fresh fish commodities. Much smaller differences were estimated for total expenditures. White households displayed a preference for canned fish products by outspending Blacks on this category. These findings are supported directly by those of Nash [1970], who found race to have a strong impact on expenditures, and Purcell and Rauniker [1968] who found Blacks tended to outspend Whites on all products except tuna.

The income-group models closely followed the pattern established by the regional equations with significant positive impacts often found for whole fish and filleted and steaked fish for all three income groups. Significant negative coefficients were frequently associated with the canned fish expenditures of one or more income groups.

At the regional level urbanization was estimated to have a significant impact on expenditures only for households in the Northeast and West. This variable was of no significance in explaining expenditures made by Southern or North Central households. In the Northeast, households in urban settings were predicted to have significantly larger weekly expenditures on all five expenditure categories than households in rural areas. In the West urban households total and filleted and steaked expenditures were found to be significantly larger. The predominance of large urban centers in these two regions and the associated higher costs in these areas undoubtedly contributes to the positive significance of this variable for these regions. Likewise, the relative lack of large urbanized areas in the Southern and North Central areas of the country contributed to the insignificance of this variable in these regions.

With the exception of North Central households expenditures on whole fish, occupation was found to have no significant impact on fishery product expenditures of any kind in all four regions. This was generally the case with the income-group models, although scattered positive and negative impacts were found. This indicates that occupation is of little importance in expendiutre decisions involving fish and shellfish products.

At the regional level additional education of the household head was found to have a significant positive impact on the canned fish expenditures of households in all four regions. Positive impacts were also estimated for North Central purchases of whole, filleted and steaked and total fish products and Southern expenditures on shellfish and total fish products. A negative impact was observed for Western households expenditures on whole fish. Thus additional education had a consistant positive impact of the canned fish purchases of households in all regions and a positive impact on most expenditure categories for North Central households.

Addition of an adult male to the household was shown to increase expenditures in 16 of the 20 regional models estimated. Expenditure increases on all categories were predicted for households in the Northeast and West. Among North Central and Southern households, expenditures were predicted to increase for all categories except whole fish and shellfish. This pattern was reflected in the income-group equations with the exception of Western whole fish expenditures.

Addition of an adult female was estimated to have a significant positive impact on the total, canned fish, and filleted and steaked expenditures of households in all four regions. Positive impacts were also noted for the shellfish expenditures of households in all regions except the Northeast, and the whole fish expenditures of households in all regions except the Northeast and West. The sign and pattern of the significant impacts noted for addition of an adult female in the total expenditure, canned, and filleted and steaked models were identical to those found for adult males. In the Northeastern and Western regional models the impact on expenditures of an adult male tended to be larger than that of an adult female. In the South and North Central states the opposite relationship was found with the impact from addition of a female estimated to be larger.

Similar to the findings for adults, the only significant impact on expenditures caused by addition of an infant to the household at the regional level were for canned fish, filleted and steaked fish, and total expenditures. No impact was estimated for the shellfish or whole fish expenditures of households in any region. Significant impacts, all positive, were noted in the South total and filleted and steaked models, the Northeast canned fish model, and the total expenditure, canned fish, and filleted and steaked models of North Central households. Addition of an infant was found to have no impact on Western households expenditures on any fishery products. The magnitude of the estimated impacts was generally smaller than that found for adult males and females. In the income-group models the pattern of sign and significance identified at the regional level was maintained although there were instances of significance in expenditure categories which were not found in the regional equations.

Similar to the findings with adult males, addition of an elderly male to the household was observed to have a positive impact on expenditures at the regional level. Significant positive coefficients were found in 19 of the 20 models estimated. An addition of this type was predicted to increase the canned fish, filleted and steaked, whole fish and total expenditures of households in all four regions. Only for the shellfish expenditures of North Central households was no effect predicted. The estimated impacts for elderly males were consistently larger than those of either adult males or adult females. The largest impacts, greater than $1.00 in three of the four equations, were found in the whole fish models while the smallest impacts were found for canned fish expenditures.

Addition of an elderly female was predicted to have no significant impact on expenditures in 12 of the 20 equations estimated. Significant effects, all positive, were found in the total expenditure and filleted and steaked models of the South, Northeast, and West; the canned fish equation of the Northeast; and the whole fish equation of North Central states. In all instances except one the estimated impacts for addition of an elderly female were smaller than those of elderly males.

The findings with the adult equivalent scale indicated that adult males and females, and elderly males consistantly had a greater impact on purchases of fish and shellfish products than infants or elderly females. Tastes, dietary preferences, and nutritional requirements are probably the primary factors behind the different impacts indicated for individuals in these different groups.

Food stamps were predicted to have a significant impact only on canned fish expenditures. Among the five food stamp models estimated this was also the only product for which additional income was predicted to have a significant impact on expenditures. Similar to the other models, expenditures on food away-from-home was found to have no impact on purchases of fish for home use. Black households were predicted to have larger expenditures on filleted and steaked, whole and total fish products, while Whites were predicted to have larger expenditures on canned products. Urbanization, occupation, and education were found to have no consistent impact. Likewise, no consistent pattern was identified among the variables of the adult equivalent scale. The small sample size contributed to the insignificance of many of the variables included in this model. The significance of both income and the value of food stamps variable in the canned fish equation is note worthy. Canned fish tended to be the category of highest expenditure for all income groups both on a national and regional basis. Because of this it is plausible that additional purchasing power, either as income or food stamps, would be used to purchase these types of products first, before purchases of other goods.

Implications for Further Research

The most straightforward and useful extension of this research would be additional studies examining effects of the same, or similar, variables on household purchases of specific or disaggregated fishery products as additional data becomes available. Cross sectional surveys, which are representative of the entire country similar to the BLS survey used in this research, are now being completed approximately every five years. With the information contained in these samples the opportunity to monitor any changes in tastes, preferences, or consumption similar to that postulated by the Food and Agricultural Organization of the United Nations exists. If consumers in the United States are moving toward including larger proportions of lean meats and fish in the protein they consume, household expenditure patterns will reflect the shift. By periodically reestimating the models examined in this research the opportunity to quantify and examine this shift as it occurs, exists. Likewise, obtaining new estimates of the expenditure income elasticities of demand and other coefficients with current data, will provide political leaders and policy makers with information on the possible impacts on consumer expenditures and the fishing industry of alternative programs and policies.

The information, approach, and methods developed and used in this work could easily serve as a basis for ongoing research addressing the same questions examined in this dissertation. As additional data becomes available periodic reestimation of similar models could be made providing current values of parameter and elasticity magnitudes. Extensions examining the impacts of the same, or similar, variables on household purchases of more specifically defined fish and shellfish categories should also be made. Because of the characteristics of the data used, the expenditure categories examined in this research were broad. With groupings of this type the opportunity to gain a great deal of understanding about expenditure behavior for a wide range of goods exists.

However, a great deal of specificity, with respect to individual product groups, is lost. Examination of relationships explaining expenditures on more narrowly defined product categories would avoid this. Additionally different estimation techniques and approaches to the same questions examined in this dissertation should be made. This allows examination of any impact the alternative approach may have on the estimated parameters. To the degree that the findings are similar, generalities about parameters characterizing consumers of these products can be made. Where significant differences are found the need for additional research is identified.

Due to computational limitations a national model estimated with all observations included in the BLS sample was not made. Estimation of such a model in future work would be useful as it allows coefficients obtained with different regions and different income-groups to be compared with those obtained at the national level. The ability to test and identify any differences or similarities which may exist between parameters obtained at different levels of aggregation is a useful extension of the present research allowing further characterization of expenditure patterns.

The information provided by this research, as well as that generated by those areas outlined above for further works, will provide information useful to all sectors (academic, public, and private) making decisions in which economic intelligence is useful. Whether it is academic efforts to identify changes in parameters or elasticities over time, government programs designed to monitor or change expenditure patterns of given segments of the population, or efforts by the private sector to anticipate shifts in consumer purchases, the information provided by this research will allow greater insight into consumer behavior. With a better understanding of the forces motivating this behavior decisions can be made from a more intelligent base.

APPENDIX

The generation of the scale function presented by Buse and Salathe is as follows. For the ages 0 to 20 and 55 to 75 a cubic function of age was selected to represent the scale as it allows incorporation of the seven properties the authors state an adult equivalent scale should possess. For males aged 0 to 20 the scale function would be

$$S(a_i, 1) = J_{01}, + J_{11}a_i + J_{21}a_i^2 + J_{31}a_i^3 \tag{1}$$

In this age range properties I, II, and IV apply to the function for males. I sets J_{01} equal to c_3, the scale value for males and females at birth while II imposes continuity. Incorporating these properties gives

$$0 = J_{11} + 40J_{21} + 1200J_{31} \tag{2}$$

Property IV constrains the scale to equal 1 for 20 year old males. This gives

$$1 = c_3 + 20J_{11} + 400J_{21} + 8000J_{31} \tag{3}$$

Equations (2) and (3) can be solved simultaneously for J_{21} and J_{31}

$$J_{21} = -.1000J_{11} - .00750(c_3-1) \tag{4}$$

$$J_{31} = .0025J_{11} + .00025(c_3-1) \tag{5}$$

Equations (4) and (5) which incorporate the appropriate three properties for males 0 to 20 years old can then be substituted into (1) to give the fully specified scale function for household members of this sex and age group

$$S(a_i, 1) = c_3 + c_4a_i - (.1c_4 + .0075(c_3 - 1))a^2 + (.0025c_4 + .00025(c_3 - 1))a_i^3 \qquad (6)$$

The equivalently derived scale equation for females of 0 to 20 years is

$$S(a_i, 2) = c_3 + c_5a_i - (.1c_5 + .0075(c_3 - c_2))a_i^2 + (.0025c_5 + .00025(c_3 - c_2))a_i^3 \qquad (7)$$

For males and females 55 to 75 years old the scale function is again assumed to be a monotonic function of age taking on the constant value of c_6 for males and c_7 for females for ages 75 and older. This condition sets J_{11} equal to zero and provides the following for males and females, respectively

$$S(a_i, 1) = 1 - .0075(a_i - 55)^2(1 - c_6) + .0025\ (a_i - 55)^3 (1 - c_6) \qquad (8)$$

$$S(a_i, 2) = c_2 - .0075(a_i - 55)^2(c_2 - c_7) + .00025\ (a_i - 55)^3 (c_2 - c_7)^1 \qquad (9)$$

When these four equations; (6), (7), (8), and (9); are summed across all household members and like terms combined, the equation for the total number of adult equivalents in household i is yielded as

$$A_i = P_i + c_2W_i + c_3R_i + c_4S_i + c_5T_i + c_6U_i\ c_7V_i \qquad (10)$$

The variables P_i, W_i, R_i, S_i, T_i, U_i, V_i are weighted sums of rescaled ages, computed according to the schedule

$a_i = a_i$ if $a_i \leq 20$

$a_i = 20$ if $20 \leq a_i \leq 55$

$a_i = a_i$ if $55 \leq a_i \leq 75$

$a_i = 75$ if $a_i \geq 75$,

which are calculated and are unique for each household.

REFERENCES

Aitchison, J., and J.A.C. Brown. "A Synthesis of Engle Curve Theory." Review of Economic Studies 21-22 (1955):35-46.

Allen, R.G.D., and A.L. Bowley. Family Expenditure. London: Staples Press, 1935.

Allen, R.G.D., A.L. Bowley and P.S. King. Family Expenditure, A Study of its Variation. London: Orchard House, 1935.

Benas, J., J. Kmenta and H. Shapiro. "The Dynamics of Household Budget Allocation to Food Expenditures." The Review of Economics and Statistics 58 (1976):129-138.

Brown, J.A.C. "The Consumption of Food in Relation to Household Composition and Size." Econometrica 22 (1954):444-460.

Brown, J.A.C., and A.S. Deaton. "Surveys of Applied Economics: Models of Consumer Behavior." The Economic Journal 82 (1972):1145-1236.

Buse, R.C. Data Problems in the BLS/CES PU-2 Diary Tape: The Wisconsin 1972-1973 CES Diary Tape. University of Wisconsin, Agricultural Economics Staff Paper No. 164, July 1979.

Buse, R.C., and L.E. Salathe. "Adult Equivalent Scales: An Alternative Approach." American Journal of Agricultural Economics 60 (1978): 460-468.

Chang, H. "Functional Forms and the Demand for Meat in the United States." The Review of Economics and Statistics 59 (1977):355-359.

Comptroller General of the U.S. The U.S. Fishing Industry: Present Conditions and Future of Marine Fisheries. Report to Congress. Vol. 1, Pubn. CED-76-130. 1976.

Cornfield, J., and N. Mantel. "Some New Aspects of the Application of Maximum Likelihood to the Calculation of the Dosage Response Curve." Journal of the American Statistical Association 45 (1950):181-210.

Cramer, J.S. Empirical Econometrics. New York: North Holland Publishing Co., 1971.

Fisk, P.R. "Maximum Likelihood Estimation of Törnqvist Demand Equations." Review of Economic Studies 26 (1959):35-50.

Houthakker, H.S. "An International Comparison of Household Expenditure Patterns Commemorating the Centenary of Engel's Law." Econometrica 25 (1957):532-551.

Houthakker, H.S. "Additive Preferences." Econometrica 28 (1960):244-257.

Johnston, R.S., and R.W. Wood. Demand Analysis for Canned Red Salmon at Wholesale. Oregon State University, Agricultural Experiment Station Research Publication #ORSU-T-74-001. May 1974.

Lancaster, K.J. "A New Approach to Consumer Theory." Journal of Political Economy 73 (1966):132-157.

Leftwich, R.H. The Price System and Resource Allocation. Hinsdale, Illinois: Drydon Press, 1976.

Leser, C.E.V. "Family Budget Data and Price Elasticities of Demand." The Review of Economic Studies 9-10 (1943):40-52.

Leser, C.E.V. "Forms of Engel Functions." Econometrica 4 (1963):294-703.

Maddala, G.S. Econometrics. New York: McGraw-Hill Book Co., 1977.

Miller, M.M., and D.A. Nash. Regional and Other Related Aspects of Shellfish Consumption--Some Preliminary Findings from the 1969 Consumer Panel Survey. National Marine Fisheries Service. Circular 361, June 1971.

Nash, D.A. Preliminary Analysis of a Survey of Buying Patterns for Fresh and Frozen Fish and Shellfish by Household Characteristics. Bureau of Commercial Fisheries. Working Paper 46, August 1970.

Nash, D.A., and F.W. Bell. An Inventory of Demand Equations for Fishery Products. Bureau of Commercial Fisheries. Working Paper 10, July 1969.

Nicholson, J.L. "Variations in Working Class Family Expenditures." Journal of the Royal Statistical Society." Journal of the Royal Statistical Society. 122 Series A (1949).

Office of Technology Assessment, U.S. Congress. Establishing a 200-Mile Fisheries Zone. Washington, D.C., June 1977.

Phelps, C.E. "LIMDEP--A Regression Program for Limited Dependent Variables." Internal Publication, The Rand Corporation, 1972.

Phlips, L. Applied Consumption Analysis. New York: American Elsevier Publishing Company, Inc., 1974.

Pindyk, R.S., and D.L. Rubinfield. Econometric Methods and Economic Forecasts. New York: McGraw-Hill Book Co., 1976.

Pippen, K., and W.R. Morrison. Retail Market Potential for Farm-Cultured Catfish. University of Arkansas. Agricultural Experiment Station Research Bulletin 799, May 1975.

Prais, S.J. "Non-Linear Estimates of the Engel Curves." Review of Economic Studies 19-20 (1953):87-104.

Prais, S.J., and H.J. Houthakker. The Analysis of Family Budgets. Cambridge: The University Press, 1971.

Price, D.W. "Unit Equivalent Scales for Specific Food Commodities." American Journal of Agricultural Economics 52 (1970):224-233.

Public Law 94-265. Ninety-Fourth Congress of the United States. H.R. 200. April 1976.

Purcell, S.C., and R. Rauniker. Analysis of Demand for Fish and Shellfish. Bureau of Commercial Fisheries. Bulletin 51. December 1968.

Salathe, L.E. "An Empirical Comparison of Functional Forms for Engel Relationships." Agricultural Economics Research. USDA 58(1976): 129-138.

Salathe, L.E. Household Expenditure Patterns in the United States. USDA ESCS Technical Bulletin 1603. April 1979.

Smith, F.J. Seafood Product Development and Marketing. Issue Paper #3, n.d.

Stigler, G.J. "The Early History of Empirical Studies of Consumer Behavior." The Journal of Political Economy 62 (1954):95-113.

Sydenstricker, E., and W.I. King. "The Measurement of the Relative Status of Families." Quarterly Publication of the American Statistical Association 18 (1921):842-857.

Tobin, J. "Estimating of Relationship for Limited Dependent Variables." Econometrica 26 (1958):24-36.

U.S. Department of Commerce, NOAA, NMFS. Fisheries of the United States. No. 7800. April 1979.

U.S. Department of Commerce, NOAA, NMFS. Fisheries of the United States. No. 8000. April 1980.

U.S. Department of Labor. Bureau of Labor Statistics. Consumer Expenditure Survey: Diary Survey July 1972--June 1974. Bulletin No. 159. 1974.

BIOGRAPHICAL SKETCH

The author was born May 1, 1954, in Gainesville, Florida. He graduated from P.K. Yonge High School in 1972. In May of 1976 he received the Bachelor of Science degree in biology from Davidson College.

In June of 1976 the author entered the University of Florida to pursue a Ph.D. in the food and resource economics department. He served as a graduate research assistant in this department from June of 1976 to September 1980. In September 1980 he accepted a position with Connell Commodities Inc. of Westfield, New Jersey, as a Research Economist/Commodity Analyst.

The author was married to the former Virginia Lee Henderson of Gainesville in October 1980.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Fred J. Prochaska

Fred J. Prochaska, Chairman
Professor of Food and Resource
Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

James C. Cato

James C. Cato
Associate Professor of Food and
Resource Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

John A. Koburger

John A. Koburger
Professor of Food Science and
Human Nutrition

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

W.W. McPherson
W.W. McPherson
Professor of Food and Resource
Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Daniel S. Tilley
Daniel S. Tilley
Associate Professor of Food and
Resource Economics

This dissertation was submitted to the Graduate Faculty of the College of Agriculture and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

August, 1981

Jack L. Fry
Dean, College of Agriculture

Dean for Graduate Studies and
Research