ricultural Experiment Station
technic Institute and State University

Bulletin 87-2
ISSN 0096-6088

Demand for Disaggregate Fish and Shellfish Species in the United States

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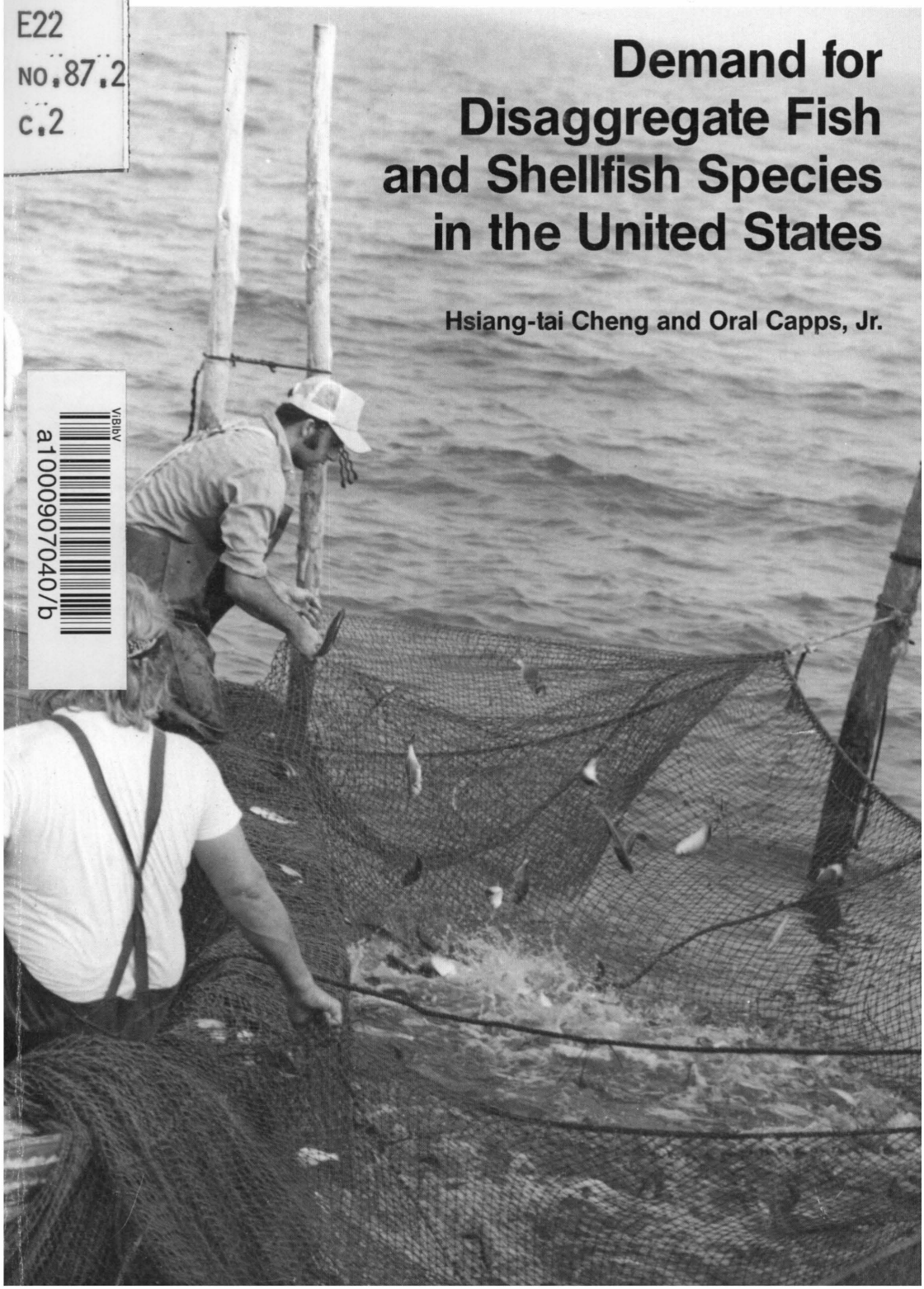

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The Virginia Agricultural and Mechanical College came into being in 1872 upon acceptance by the Commonwealth of the provisions of the Morrill Act of 1862 "to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life." Research and investigations were first authorized at Virginia's land-grant college when the Virginia Agricultural Experiment Station was established by the Virginia General Assembly in 1886.

The Virginia Agricultural Experiment Station received its first allotment upon passage of the Hatch Act by the United States Congress in 1887. Other related Acts followed, and all were consolidated in 1955 under the Amended Hatch Act which states "It shall be the object and duty of the State agricultural experiment stations . . . to conduct original and other researches, investigations and experiments bearing directly on and contributing to the establishment and maintenance of a permanent and effective agricultural industry of the United States, including the researches basic to the problems of agriculture and its broadest aspects and such investigations as have for their purpose the development and improvement of the rural home and rural life and the maximum contributions by agriculture to the welfare of the consumer . . . "

In 1962, Congress passed the McIntire-Stennis Cooperative Forestry Research Act to encourage and assist the states in carrying on a program of forestry research, including reforestation, land management, watershed management, rangeland management, wildlife habitat improvement, outdoor recreation, harvesting and marketing of forest products, and "such other studies as may be necessary to obtain the fullest and most effective use of forest resources."

In 1966, the Virginia General Assembly "established within the Virginia Polytechnic Institute a division to be known as the Research Division . . . which shall encompass the now existing Virginia Agricultural Experiment Station . . . "

DEMAND FOR DISAGGREGATE FISH AND SHELLFISH SPECIES IN THE UNITED STATES

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Virginia Agricultural Experiment Station
Bulletin 87-2

May 1987

ABSTRACT

As the popularity for seafood in the United States continues to grow, information about consumer patterns of fishery products will be available aid to various groups in the seafood industry. The primary objective of this research was to provide quantitative information, notably own-price, income, and household size elasticity measures, about consumer behavior relating to specific fish and shellfish products.

The objectives were threefold: (1) to organize and analyze at-home seafood consumption data for specific finfish and shellfish species by three product forms (canned, fresh and fresh-frozen, and other-prepared) from the 1981 Seafood Consumption Survey: (i) finfish -- cod, flounder (or sole), haddock, herring, mackerel, perch, pollock, salmon, sardines, snapper, tuna, whiting, total finfish, and (ii) shellfish -- clams, crabs, oysters, scallops, shrimp, and total shellfish; (2) to identify and assess the factors that affect household expenditure on these products for home consumption, and (3) to compare the results of this research to those from previously published works.

Price and coupon value are key factors in explaining the variation of household expenditure on seafood commodities for at-home consumption. All price elasticities were negative and in the inelastic range except for fresh and fresh-frozen oysters and canned tuna. These results suggest that for almost all shellfish and finfish species, unit percentage changes in product availability lead to greater than unit percentage changes in product prices. Coupon values, as expected, have significant positive impacts on household expenditures for seafood commodities for at-home consumption.

Except for scallops, all shellfish products were normal goods, while the nature of the income effects for finfish products was mixed. Generally, household size elasticities were not only positive but also less than unity.

Significant differences, by geographic region, urbanization, employment status and age of the household manager, race, and season, were found in household expenditures for fishery products. Finally, households spent significantly less on all categories of canned fishery products, but more on fresh and fresh-frozen shellfish, at the supermarket and/or the grocery store than at other seafood outlets. Occupation and education of the household head as well as religious affiliation are not generally statistically important factors in explaining the variation in household expenditure on fish and shellfish products.

ACKNOWLEDGMENTS

The authors express appreciation to several individuals for their assistance in this study. Funds for this research were provided by the National Oceanic and Atmospheric Administration, Office of Sea Grant, Grant/Project No. R/SE-4, from the Virginia Graduate Marine Science Consortium. Special recognition in this regard is due to Dr. William L. Richards, Director, Virginia Sea Grant Program. We also wish to thank Dr. David Smith, Assistant Director of the Virginia Sea Grant Program, who was instrumental in obtaining the data source of this research, the 1981 Seafood Consumption Survey, from the National Marine Fisheries Service. Further, the authors express appreciation to the Data Processing Laboratory in the Department of Agricultural Economics at Virginia Polytechnic Institute and State University, notably Jerry Spittle, Tom Finn, and Wendi Biggs, for their efforts in providing computational assistance. Additionally, the authors express appreciation to Mary Holliman for her thorough editorial review. Moreover, we wish to thank Dr. E.N. Boyd, Associate Director of the Virginia Agricultural Experiment Station, for his willingness to finance this publication. Finally, special recognition is due to Stacy Zemanek at Texas A&M University for her diligent efforts in typing the manuscript.

The authors wish to acknowledge the helpful comments of Dr. Charles W. Coale, Jr., Dr. George Flick, and Dr. Leonard A. Shabman on earlier drafts of this bulletin. The authors, however, are solely responsible for any remaining errors. This bulletin was written by the authors while affiliated with Virginia Polytechnic Institute and State University..

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Figure page

Chapter I

INTRODUCTION

1.1 BACKGROUND

The consumption of seafood in the United States has steadily expanded in recent decades. From 1960 to 1985, the annual per capita consumption of fish and shellfish has trended gradually upward from 10.3 pounds to 14.5 pounds of edible meat weight.[1] [U.S. Department of Agriculture, 1987]. In 1985, the annual per capita consumption of fishery products rose to 14.5 pounds of edible meat weight, exceeding the high of 13.7 pounds in 1984 (Table 1.1). The share of fish and shellfish expenditures relative to total red meat, poultry, and seafood has ranged from 4.9 percent (1969) to 9.1 percent (1985) over the past 26 years (Table 1.2). National Marine Fishery Service projections of current trends suggest that, by the end of the century, finfish and shellfish will account for almost 10 percent of meat, poultry and seafood consumption (Miller, 1985).

American consumers spend an estimated 15 billion dollars annually on seafood, which accounts for more than four percent of total food expenditure. The increases in U.S. consumption of fishery products is likely to continue. The Food and Agricultural Organization of the United Nations predicts fish and shellfish consumption in the United States will probably increase through 1990 at a growth rate in excess of that for beef, pork, vegetables, cereal, and milk [Office of Technology Assessment, 1977]. In developed countries, noticeable shifts in consumption patterns are evident away from red meats to leaner protein sources including seafood.

As the popularity of seafood in the United States continues to grow, information about consumer behavior and expenditure patterns of fishery products will be a valuable aid to policy decisions and to various groups in the seafood industry. Information on consumer behavior with regard to how prices, income, household size, and socio-demographic variates influence consumption of seafood, especially various disaggregate fish and shellfish commodities, is crucial to the success of any production or marketing program.

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[1] This consumption excludes recreational catches, estimated to be three to four pounds per capita annually [U.S. Department of Commerce]. Thus, annual per capita consumption of fish and shellfish products in the United States is currently in the neighborhood of 17 to 18 pounds of edible meat weight.

Table 1.1. Per Capita Consumption of Fishery Products

Year	Fresh and Frozen			Canned						Cured	Total
	Fish	Shellfish	Total	Salmon	Sardines (pilchards and herring)	Tuna	Shellfish	Other	Total		
	Pounds										
1960	3.8	1.9	5.7	0.7	0.4	2.0	0.4	0.5	4.0	0.6	10.3
1961	3.9	2.0	5.9	.8	.5	2.1	.4	.5	4.3	.5	10.7
1962	3.9	1.9	5.8	.9	.3	2.1	.4	.6	4.3	.5	10.6
1963	3.8	2.0	5.8	.9	.4	2.0	.5	.6	4.4	.5	10.7
1964	3.8	2.1	5.9	.7	.3	2.0	.5	.6	4.1	.5	10.5
1965	3.8	2.2	6.0	.9	.3	2.3	.5	.3	4.3	.5	10.8
1966	3.9	2.2	6.1	.8	.4	2.3	.4	.4	4.3	.5	10.9
1967	3.6	2.2	5.8	.7	.4	2.4	.5	.3	4.3	.5	10.6
1968	4.0	2.2	6.2	.7	.4	2.4	.5	.3	4.3	.5	11.0
1969	4.4	2.2	6.6	.7	.4	2.4	.5	.2	4.2	.4	11.2
1970	4.5	2.4	6.9	.7	.4	2.5	.5	.4	4.5	.4	11.8
1971	4.3	2.4	6.7	.7	.4	2.4	.5	.3	4.3	.5	11.5
1972	4.7	2.4	7.1	.7	.4	2.9	.5	.4	4.9	.5	12.5
1973	5.2	2.2	7.4	.4	.5	3.1	.5	.5	5.0	.4	12.8
1974	4.4	2.5	6.9	.3	.4	3.1	.5	.4	4.7	.5	12.1
1975	4.9	2.6	4.5	.3	.2	2.9	.5	.4	4.3	.4	12.2
1976	5.6	2.6	8.2	.3	.3	2.8	.4	.4	4.2	.5	12.9
1977	5.1	2.6	7.7	.5	.3	2.8	.6	.4	4.6	.4	12.7
1978	5.5	2.6	8.1	.6	.3	3.3	.5	.3	5.0	.3	13.4
1979	5.4	2.4	7.8	.5	.3	3.2	.5	.3	4.8	.4	13.0
1980	5.5	2.5	8.1	.5	.3	2.9	.5	.3	4.5	.3	12.8
1981	5.0	2.8	7.8	.5	.4	3.1	.5	.3	4.8	.3	12.9
1982	5.1	2.6	7.7	.5	.3	2.7	.4	.4	4.3	.3	12.3
1983	5.2	2.8	8.0	.5	.2	3.0	.5	.4	4.8	.3	13.1
1984	5.5	3.0	8.5	.6	.2	3.2	.4	.5	4.9	.3	13.7
1985	5.2	3.8	9.0	.6	.3	3.3	.5	.5	5.2	.3	14.5

Source: Food Consumption, Price, and Expenditures 1985, U.S. Department of Agriculture, Economic Research Service, Statistical Bulletin No. 749, January 1987.

Table 1.2. Price, Per Capita Consumption, and Share of Fish and Shellfish Expenditure Relative to Total Red Meat, Poultry, and Seafood Expenditure

Year	Per Capita Fish/Shellfish Consumption (Pounds)	Consumer Price Index for Fish/Shellfish (1967 = 100)	Per Capita Total Red Meat/Poultry/Seafood Consumption (Pounds)	Consumer Price Index for Total Red Meat/Poultry/Seafood (1967 = 100)	Fish/Shellfish Expenditure Share (%)
1960	10.3	85.0	188.8	89.1	5.2
1961	10.7	86.9	191.0	89.3	5.4
1962	10.6	90.5	192.4	91.5	5.4
1963	10.7	90.3	198.1	90.1	5.4
1964	10.5	88.2	202.2	88.7	5.1
1965	10.8	90.8	197.7	94.5	5.2
1966	10.9	96.7	203.7	102.0	5.0
1967	10.6	100.0	212.0	100.0	5.0
1968	11.0	101.6	215.6	102.2	5.0
1969	11.2	107.2	217.2	110.8	4.9
1970	11.8	118.0	222.9	116.5	5.3
1971	11.5	130.2	228.1	116.9	5.6
1972	12.5	141.9	227.2	128.0	6.0
1973	12.8	162.8	213.6	160.4	6.0
1974	12.1	187.7	223.0	163.9	6.2
1975	12.2	203.3	215.1	178.0	6.4
1976	12.9	227.3	228.8	179.4	7.1
1977	12.7	251.6	229.1	178.4	7.8
1978	13.4	275.4	226.1	208.3	7.8
1979	13.0	302.3	229.1	239.3	7.1
1980	12.8	330.2	231.0	248.2	7.3
1981	12.9	357.7	230.2	258.5	8.7
1982	12.3	370.6	224.4	268.9	7.5
1983	13.1	374.9	231.6	267.1	7.9
1984	13.7	386.8	234.2	271.5	8.3
1985	14.5	405.9	237.5	270.6	9.1

Source: Food Consumption, Prices, and Expenditures ,1985 U.S. Department of Agriculture, Economic Research Service, Statistical Bulletin No. 749, January 1987.

Generally, household consumption and expenditure patterns reflect prices, income, household size, and socio-demographic characteristics. The past several years have been characterized by marked changes in prices, incomes, and socio-demographic characteristics of the population. Such changes may alter household consumption and expenditure patterns for fish and shellfish products. For example, according to Miller (1985), real per capita disposable income has increased 40 percent since 1967, contributing to a 22 percent increase in consumption of seafood products. In addition, the rapid increase in single-person and dual-career households, the two fastest growing segments of the population, may influence the demand for prepared seafood and for seafood consumed away from home. Between 1970 and 1980, single-person households increased 78 percent, compared to 16 percent for family households. Similarly, 51 percent of the married women were in the civilian labor force in 1982, up from 31 percent in 1960. These noteworthy changes in household characteristics have contributed to the proliferation of convenience products and to the substantial growth in away-from-home eating. The development of convenience products, such as frozen seafood dinners, breaded shrimp, and prepared fish cakes has encouraged consumers to include seafood more often in the diet. Restaurants and fast-food establishments also offer seafood entrees in addition to meat and poultry entrees. Away-from-home outlets now account for roughly 60 percent of total U.S. seafood consumption (Miller, 1985). Further, population growth in urban areas, where markets are well-developed for convenience foods and eating out, is outpacing population growth in rural communities. Finally, health concerns have also played a role in the substitution of poultry and seafood for red meats. Consequently, economic forces, health concerns, changing lifestyles, and population growth in urban areas are potentially key factors responsible for the growing demand for seafood in America.

1.2 OBJECTIVES

Up to this point, the amount of information available about consumer behavior relating specifically to fishery products has been limited. Very few studies have focused on the factors affecting fish and shellfish consumption and expenditure patterns in the United States. Historically, product development and work to reduce production and processing costs have dominated research efforts. The consumer end of the market spectrum has often been ignored. Too few conscious attempts have been made to coordinate production activities with the work of consumers. Information about consumer behavior relating to fishery products will be a valuable aid to the various groups whose decisions will affect the production, processing, marketing, and consumption of these products.

Coupled with this specific need for information about consumer behavior and expenditure patterns of fishery products is a more fundamental need for basic fish and shellfish consumption information. In the past, information relating to demand parameters has been infrequently available for even broad aggregates of these products at the national and regional level. As fish and shellfish become a more prevalent part of the American diet, this information will be useful in providing more knowledge about consumption behavior toward finfish and shellfish. Comparisons with similar parameters of other consumer products is also worthwhile.

The objectives of this research are threefold: (1) to organize and to analyze at-home seafood consumption data; (2) to identify and assess the factors that affect household expenditures on disaggregate fish and shellfish species for home consumption; and (3) to provide quantitative information about consumer behavior relating to specific fish and shellfish products.

Specifically, this study attempts to evaluate household demand pattens for fish and shellfish. This study investigates nature and magnitude of the influence of own-price, household income, and socio-demographic variates on food finfish and shellfish consumption and expenditure. Economic theory and methods have been developed which can help analysts, private decision markers, and public officials better evaluate and understand the consumption and expenditure patterns for shellfish and finfish products. The research is important from the standpoint of answering the basic question of who buys various food finfish and shellfish products.

Knowledge of consumer behavior is of paramount importance to the success of the seafood industry. In the words of Miller and Nash, "It is difficult to overstate the importance of building our knowledge of consumer behavior. Consumers in a market economy are the inevitable arbiters of what and how much will be produced. Meticulous production schedules and faultless distribution mechanics can become expensive exercises in the face of consumer aloofness" (1971, p. 2). Price and quantity changes at the retail level of the seafood marketing chain provide signals to processors at the wholesale level and to commercial fishermen at the ex-vessel level.

Numerous persons and groups with interests in the seafood industry can anticipate a number of benefits from this research. For consumers, this research can provide information for various types of private and public programs which can insure a continuous flow of seafood products to market. For marketers and processors, this research can provide information which can be utilized in developing more effective marketing programs and promotional campaigns for food finfish and shellfish products. Consequently,

this research can serve as the basis for expanding domestic seafood industry markets.

This study can lead to the development of processing and storage activities and facilities to increase market outlets. This research can also contribute to public decisions which will insure a more uniform flow of raw products to the processing sector. Harvesters can benefit from this research by having a better understanding of household consumption and expenditure trends. Combined with information on the costs and returns of alternative investment and harvest practices, officials representing the harvest sector can more effectively argue for public programs to meet their income and non-income business objectives.

Public officials must make many decisions that directly and indirectly affect the economic value of U.S. fisheries. Examples include water-quality management decisions and fishery management regulation. Information gleaned from this research can be of assistance in this decision-making process. For marine advisory programs, the achievement of the economic potential of U.S. fisheries depends upon the timely extension of knowledge to private and public decision makers. This extension effort could effectively use information generated from this research.

1.3 SCOPE

The Seafood Consumption Survey (SCS) conducted by the Market Research Corporation of America in 1981 is the source of data for this research. This calendar year survey consists of a nationwide panel of 9,422 households. The Survey constitutes a comprehensive source of data on household consumption and expenditures for various species and product forms of seafood and income as well as a variety of household socio-demographic characteristics.

The number of seafood species that are currently marketed at retail markets in the United States is well in excess of 200 (Miller, 1985). To make the research manageable, on the basis of two criteria, relative importance in the seafood market and number of observations available in the survey data, the following species groups warrant attention in this study:

1. Shellfish -- clams, crabs, oysters, scallops, shrimp, total shellfish.
2. Finfish -- cod, flounder (or sole), haddock, herring, mackerel, perch, pollack, salmon, sardines, snapper, tuna, whiting, total finfish.

Other species such as lobsters, halibut, roe, and trout are not included in this study because of the small number of observations available in the survey data.

The aforementioned finfish and shellfish groups represent a useful aggregation to conduct analyses relevant to the seafood industry. Seafood in the United States is confined to a relatively small number of traditional species in stable or declining supply worldwide. A recent study by the National Marine Fisheries Service found that over a four-month sampling period, the typical seafood-user household consumed only four different species - tuna, shrimp, flounder (or sole), and cod. These four species represent, on average, 35 percent of the value of the U.S. catch (Miller, 1985). Further, fish and shellfish products are classified into three categories: (1) canned, (2) fresh and fresh frozen, and (3) other preparation. The purpose of this classification scheme is to distinguish among preferences for fishery products according to product form.

The soci-demographic factors hypothesized to influence household behavior relating to fish and shellfish products are the following: (1) household size, (2) geographic region, (3) urbanization, (4) occupation of household head, (5) education of household head, (6) employment status of household manager, (7) age of household manager, (8) ethnicity (race), (9) presence of children, (10) religion, (11) seasonality, (12) type of seafood outlet, and (13) coupon (or deal) value. (Figure 1.1). The household manager is the person primarily responsible for meal planning, food shopping, and food preparation. Generally, the household manager is the female household head.

Previous studies (see Chapter II) have established inferences that household size, place or residence (region), degree of urbanization (population density), race (or ethnicity), age-sex composition, education, occupation, and seasonality influence household expenditure on fish and shellfish [Purcell and Raunikar, 1968; Nash and Bell, 1969; Miller and Nash, 1971; Nash, 1970; Nash, 1971; Capps, 1982; Perry, 1981]. The various socio-demographic characteristics are likely to reflect, in part, shifts in consumption due to the life cycle, differences in accessibility of products, differences in climate, tastes and preferences, culture, and infrastructure of households.

In this study, econometric models based on demand theory incorporating relevant socio-demographic variates are developed and implemented to achieve the research objectives. Quantitative research in the form of demand analyses differs considerably from qualitative research in the form of focus group sessions. The focus group sessions involve actual panel discussions with groups of households (Miklos, 1981). Qualitative research is invaluable in generating insights and hypotheses as well as putting manufacturers and advertisers in close touch with consumers. However, by virtue of small sample size, focus group sessions are typically not projectable to the population at large. However, since the SCS deals with more than 9,400 households, this sample is

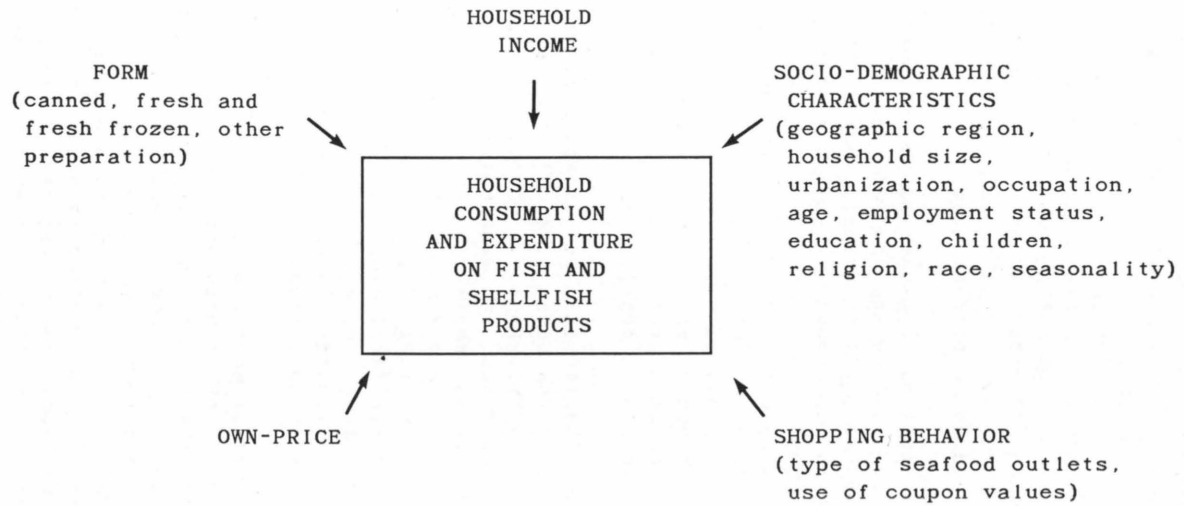


FIGURE 1.1. Schematic Diagram of Factors Hypthesized to Affect Household Consumption and Expenditure on Fish and Shellfish Products

representative of the entire population. In short, the demand analyses in this study constitute quantitative research projectable to the population at large.

Generally, demand analyses require the integration of the following five basic elements: (1) consumer behavior theory, (2) statistical methods, (3) data, (4) statistical results and economic analysis, and (5) findings of other relevant studies. Consumer behavior theory provides a theoretical framework on which to base the specification of econometric models. Statistics and econometrics offer techniques for parameter estimation and tests of hypotheses. Data availability not only affects the scope of analyses but also the type of demand parameters. Data quality affects the accuracy of parameter estimates and, hence, the reliability of economic analyses. The application of the results and findings of previous relevant studies aids in the determination of the usefulness, validity, and credibility of econometric models. Though much empirical work and theoretical work exists with respect to demand analyses in recent years, reliable estimates of demand parameters for disaggregate seafood commodities are few in number.

1.4 ORGANIZATION

In order to put this research into proper perspective, pervious works relating to seafood demand and consumption are reviewed in Chapter II. A theoretical base for the empirical analysis of household consumption behavior, the empirical model, and statistical procedures for this research are discussed in Chapter III. The data base is described in detail in Chapter IV. The empirical results and economic analysis of household expenditure behavior relating to shellfish and finfish species consumed at home are discussed in Chapters V and VI. The summary, conclusions, and implications of this research are presented in Chapter VII.

Chapter II

LITERATURE REVIEW

2.1 INTRODUCTION

Previous works on demand analysis for fishery products, using both time-series data and cross-section data, are presented in this chapter. In the use of time-series data, attention is generally focused on the estimation of the impacts of prices and income on demand, whereas in the use of cross-section data, attention is centered primarily on the impacts of socio-demographic factors on household expenditure.

The empirical analysis of demand relationships based on time-series data is discussed in Section 2.2. A number of studies have focused on analyzing demand relationships of individual fishery products. Nash and Bell (1969) compiled a set of demand equations for particular species of fish and shellfish. Johnston and Wood (1974) specified a two-equation recursive system to analyze the demand for canned Pacific Coast red (sockeye) salmon at the wholesale level. Results and findings based on cross-section analysis (including longitudinal data generated from household panels) concerning the income-consumption (Engel) relationships for aggregate and disaggregate species of fish and shellfish are discussed in Section 2.3.

Studies relating to consumption of fish and shellfish have been conducted, but not with great frequency. Purcell and Raunikar (1968) analyzed the demand for both aggregate and disaggregate species of fish and shellfish by households in Atlanta, Georgia, during the period from 1958 through 1962. Other research has examined factors affecting consumption of aggregate species of fish and shellfish at the national level [Perry, 1981; Capps, 1982]. The balance of previous work examining household consumption of disaggregate species of fish and shellfish has been descriptive in nature [Nash, 1970; Nash, 1971; Miller and Nash, 1971] and consequently lacks statistical support.

2.2 DEMAND RELATIONSHIPS -- TIME-SERIES STUDIES

The Division of Economic Research of the Bureau of Commercial Fisheries (now the National Marine Fisheries Service) held a conference on the demand for fishery products in November 1968. The purpose of the conference was to draw together on a species basis all the demand equations that had been estimated in previous

studies. A demand equation for each species was chosen as the most representative in the area. Nash and Bell (1969) compiled the set of demand equations in a working paper. Information in regard to the particular product, the geographic area, the observation unit, the market level, the mathematical form of the equation, the econometric approach used, and the researcher(s) was provided.

The functional forms used in this set of thirty-five demand equations for twenty-two species were either linear in actual variates or linear in logarithms. The former implies variable price and income elasticities, whereas the latter suggests that price and income elasticities are constant. Estimates of these elasticities of demand for individual species are summarized in Table 2.1.

Johnston and Wood (1974) analyzed the demand for canned Pacific Coast red (sockeye) salmon at the wholesale level using annual data for the period 1964 to 1971. The estimated price and income elasticities of demand were -3.79 and 0.531, respectively. On the basis of this information, the wholesale demand for canned red salmon is price elastic, and canned red salmon is a normal good.

2.3 CONSUMPTION-INCOME RELATIONSHIPS--CROSS-SECTION STUDIES

Cross-section data constitute samples from specific populations, usually household units, at a given period of time. In analyzing cross-section data, consumption-income (Engel) relations have been emphasized, and the data are typically collected over a short enough period of time that prices faced by consumers can be treated as constants. The diversity in the socio-demographic characteristics among households is primarily used for explanations of behavioral differences in demand for a given product. Consumption-income relationships may also be investigated by using panel data which involve observations obtained from a cross-section of households with the passage of time or by using household budget data.

2.3.1 CONSUMPTION STUDIES OF BROAD AGGREGATES OF FISH AND SHELLFISH

Purcell and Raunikar (1968) analyzed household demand for fish and shellfish using data from a consumer panel of 160 households in Atlanta, Georgia, during 1958 to 1962. Combining both cross-sectional (160 households) and time-series (4 quarters, 5 years) characteristics, the panel data provided 3,200 observations. The nature of the influence of household income, size, and race on demand for twenty-seven fish and shellfish categories was examined by cross tabulation. Statistical models used to estimate the magnitude of the effects of race, age composition, season, income, trend, gifts and price on quantities

Table 2.1. Estimates of Price and Income Elasticities for Fishery Products

Product	Geographic Area	Market Level	Observation Interval	Researcher	Form of Equation	Elasticities Price	Income
----FINFISH-----							
haddock	New England	ex-vessel	annual	Bell	double log	-2.609	1.136
haddock	Boston Fish Pier	ex-vessel	monthly	Haugh	double log	-3.220	-
scrod	Boston Fish Pier	ex-vessel	monthly	waugh	double log	-4.330	-
cod	Boston, New Bedford,Gloucester	ex-vessel	weekly	Bell	double log	-3.300	-1.997
cod	New York	wholesale	monthly	Haugh	double log	-2.900	-
yellowtail flounder	New Bedford	ex-vessel	monthly	Bell	double log	-2.283	1.760
flounder	Fulton Fish Market	wholesale	monthly	Haugh	double log	-10.280	-
whiting	Gloucester, Portland, Rockland	ex-vessel	monthly	Bell	double log	-22.727	27.795
bluefish	Fulton Fish Market	wholesale	monthly	Haugh	double log	-4.190	-
mackerel	Fulton Fish Market	wholesale	monthly	Haugh	double log	-16.000	-
yellow perch	Lake States	wholesale	annual	Nash	linear	-0.560	-
lake whitefish	Lake States	wholesale	annual	Nash	linear	-1.090	-1.550
lake trout	Lake States	wholesale	annual	Nash	linear	-4.292	-
canned Tuna	United States	ex-vessel	annual	Suttor	linear	-0.572	0.993
canned salmon	United States	ex-vessel	annual	Suttor	double log	-0.006	-1.628
---SHELLFISH----							
northern lobster	United States	ex-vessel	annual	Haugh	double log	-0.830	0.930
scallops	New England	ex-vessel	annual	Bell	double log	-1.602	2.069
scallops	New Bedford	ex-vessel	monthly	Bell	double log	-1.529	0.491
clams	Fulton Fish Market	wholesale	monthly	Haugh	double log	-5.100	-
fresh and frozen oysters	United States	ex-vessel	annual	Suttor	double log	-0.103	-1.208
shrimp	South Atlantic and Gulf	ex-vessel	monthly	Haugh	linear	-0.780	-
shrimp	United States	ex-vessel	annual	Suttor	linear	-0.290	1.329
shrimp	Chicago 26-30 count	wholesale	quarterly	Elkin	linear	-0.380	-
shrimp	United States	wholesale	quarterly	Doll	linear	-0.410	1.140
shrimp	United States	wholesale	annual	Elkin	linear	-0.460	1.240
shrimp	United States	retail	annual	Cleary	linear	-0.280	-
crabs	Fulton Fish Market	wholesale	monthly	Haugh	linear	-3.600	-

Source: Nash, D. A. and F. W. Bell, "An Inventory of Demand Equations for Fishery Products," Working Paper No.10, Bureau of Commercial Fisheries, July 1969.

purchased and expenditures by households of sixteen selected fish and shellfish categories were developed.

In the statistical analysis, four different models were developed to estimate the magnitudes of the effects of

socioeconomic variates on quantity and expenditure by households for selected categories of fish and shellfish. The models were, respectively, either linear in all variates or linear in all variates except income.

Income was a key determinant in influencing household expenditure on fish and shellfish. Race, age composition of the household, and seasonality were also found to be statistically important factors in explaining the variations of household expenditures on total fish and shellfish. However, the effect of the price of fish and shellfish on total expenditure for fishery products was not significantly different from zero.

Perry (1981) analyzed the impacts, both nationally and regionally, of socio-demographic characteristics on household expenditure for five fishery product groups in the United States. The five product groups were canned fish, shellfish, whole fish, filleted and steaked fish, and total fish and shellfish. The analysis examined Engel relationships for the five product groups based on household budget data from the 1972-74 Bureau of Labor Statistics (BLS) Consumer Expenditure Survey. Two-week diaries of various expenditures for 23,186 households were obtained from this survey.

A general model was developed which specified household expenditures on the five fishery product groups as a function of thirteen soico-demographic variates. The variables considered in the model were income, race, expenditures on food away-from-home, education, occupation, urbanization, and age-sex composition of the household. As Perry pointed out," In many households which consume fishery products quite often this consumption takes place away from home in various eating out establishments" (p. 55). Inclusion of the expenditure-on-food-away-from-home variable in the model analyzing fishery consumption was important to quantify this effect. Among the 19,873 households in the usable sample, only 10,294 reported income and fish and shellfish expenditure information. Therefore, expenditures for the five fishery product groups were considered to be limited dependent variables in the model, and consequently Tobit analysis was employed.

Among the socio-demographic factors considered in the study by Perry, income, race, and the adult equivalent scale were consistently found to be the most important factors affecting household expenditures on fish and shellfish. Urbanization and education were also important factors determining household expenditures in a particular region or expenditures on a particular product group. Household expenditure on food consumed away-from-home was not consistently found to have a statistically significant effect on household expenditures for fishery products. The effect of food stamps on household expenditures for fish and shellfish was also investigated.

Additional pieces of information about the effect of the various exogenous factors can be derived from using Tobit analysis: (1) effects on the probability of making fish and shellfish purchases, and (2) effects conditional on making expenditures for fish and shellfish. To illustrate, the income elasticity (for purchasing households as well as nonpurchasing households) may be decomposed into two components: (1) the elasticity of the expected value of expenditures (for purchasing households), and (2) the elasticity of the probability of making purchases. Such a decomposition gives insight as to whether a change in a particular factor of interest primarily affects either the potential number of purchasing households or the expenditures for fish and shellfish of the current number of purchasing households.

Capps (1982) investigated the impact of price, household income, and socio-demographic factors on aggregate seafood expenditure. The source of data was also the 1972-74 BLS Consumer Expenditure Diary Survey, from which were selected 9,066 households reporting income, seafood expenditure, and consistent socio-demographic information. Price information in the sample was obtained from the Consumer Price Index for fish and shellfish. In this analysis the following socio-demographic variates were hypothesized to affect seafood expenditure: (1) geographic region, (2) population density, (3) household size, (4) race of household head, (5) marital status of household head, (6) education of household head, (7) occupation of household head, (8) tenure class (homeownership) of household head, (9) seasonality, and (10) employment status of the female household head.

A quadratic expenditure function was specified in this analysis and was estimated by using ordinary least squares to measure the effects of price, household income, and socio-demographic characteristics on aggregate fish and shellfish expenditure. The findings indicated that geographic region, population density, race of household head, marital status of the household head, household income, household size, and price level of fish and shellfish had significant impacts on household expenditure on aggregate fish and shellfish. The effect of education of the household head, occupation of the household head, tenure class of the household head, seasonality, and employment status of the female household head were not found to be statistically significant. Household income, household size, and own-price elasticities evaluated at the sample means were 0.1651, 0.2296, and -0.4654, respectively. Accordingly, fish and shellfish was a normal good, and the demand for fish and shellfish was inelastic.

In summary, with regard to the studies by Purcell and Raunikar, Perry, and Capps, household size or age-sex composition of the household, race, geographic region, and urbanization were

generally found to be the most important factors affecting household expenditure on broad aggregates of fish and shellfish. In particular, black households and other non-white households in general had higher expenditures on fish and shellfish than white households. Other socio-demographic factors such as the education of household head, occupation of household head, and employment status of household manager were found to be relatively less important in explaining household expenditure on fish and shellfish.

2.3.2 CONSUMPTION STUDIES OF DISAGGREGATE FISH AND SHELLFISH

Previous analyses investigating household expenditure patterns for more specifically defined fish and shellfish products are covered in this section. The work done by Purcell and Raunikar (1968), covered previously, also dealt with household expenditures for particular categories of fish and shellfish using data obtained from a panel of 160 households in Atlanta, Georgia, during the period 1958 to 1962. The five-year average annual expenditures and quantities for twenty-seven fish and shellfish categories were summarized by household income, household size, and race in cross tabulations. The effects of race, age composition, season, income, trend, gifts, and price on household expenditure and quantity for sixteen categories of fish and shellfish were estimated by using four different linear models with the differences involving four forms of the income variable (linear, cube root, square root, and squared).

Income was consistently found to have a significant positive impact on expenditures for fish and shellfish products. However, significant price effects were noted only for household expenditures on salmon and shrimp. Price was found to be relatively unimportant in explaining household expenditure patterns on the other fish and shellfish categories considered in this analysis. Statistically significant differences in expenditures on all fish and shellfish categories with regard to race, age composition of the household, and seasonality were found.

Although this study provided a rather definitive analysis of the demand for more defined fish and shellfish products, information provided by this research was limited to a particular location (Atlanta, Georgia); different fish and shellfish demand patterns may be expected for households residing in different geographic regions.

A nationwide panel of 1,586 households in the United States representing nine geographic regions and eight socio-demographic characteristics was surveyed by the National Marine Fisheries Services from February 1969 to January 1970 to obtain a complete record of fish and shellfish product purchases. The purpose of

this survey was to investigate the patterns of fish and shellfish product purchases according to socio-demographic characteristics of households in the United States.

Nash (1971) presented a complete summary of the 1969 to 1970 statistical survey with respect to household purchases of fish and shellfish products. Purchase and consumption information of 1,586 households in the survey was summarized in cross tabulations by major fish and shellfish products, purchase, the socio-demographic characteristics of households, and month and quarter.

Four major categories of disaggregate fish and shellfish products were included in this work: (1) specialty items (tuna pie, clam chowder, oyster stew, TV dinners, smoked fish, other specialties), (2) fresh and frozen shellfish (shrimp, oysters, crabs, lobsters, lobster tails, clams, scallops, other shellfish), (3) fresh and frozen fish (haddock, flounder-sole, halibut, ocean perch, cod, salmon, red snapper, catfish, whiting, swordfish, pollock, other finfish), and (4) canned fish (pink salmon, red salmon, other salmon, white tuna, light tuna, other canned products). The household characteristics considered were: (1) household income, (2) household size, (3) geographic region, (4) age of household head, (5) education of household head, (6) occupation of household head, (7) age and sex of children, (8) race, and (9) religion.

Analysis based on tabulated results of the 1969 to 1970 survey of 1,586 households examining the nature of the influence of socio-demographic characteristics on demand for major species of fish and shellfish were conducted [Nash, 1970; Miller and Nash, 1971]. Nash (1970) analyzed the demand for fresh and frozen fish and shellfish products. Average annual per capita fish and shellfish purchased for home use and average price per pound were presented for each of the household characteristics by month. In addition, the effect of socio-demographic characteristics on the number of meals eaten away from home containing fish and shellfish were also examined by cross tabulation. All of the household characteristics contained in the survey except education of household head and age and sex of children were considered in the analysis.

Miller and Nash (1971) analyzed major shellfish consumption using data from the 1969 to 1970 survey of household purchases of fish and shellfish. The characteristics of shellfish consumption were examined on the basis of: (1) geographic concentration and distribution patterns, (2) seasonality, (3) comparisons between volumes consumed at home and away from home, and (4) income.

Both the Nash study and the Miller and Nash study provided a comprehensive and definitive summary of the effects of the socio-demographic factors on consumption of various species of fishery

product based on tabulated results of the 1969 to 1970 survey of fish and shellfish purchases conducted by the National Marine Fisheries Service. However, these studies, which are tabular in nature, did not provide causal relationships between purchases of fish and shellfish and the various socio-demographic factors; consequently these studies suffer from the lack of statistical support. The relationship between purchases of fishery products and household characteristics can be obtained through specification of econometric models utilizing statistical techniques such as analysis of covariance or regression analysis.

2.4 FOCUS OF THE PRESENT STUDY

A limited number of studies have investigated household expenditure patterns for more specific or disaggregate fish and shellfish products. Previous analyses of disaggregate species of fish and shellfish consumption were mostly either limited to a particular location or descriptive in nature (with lack of statistical support).

In this research, information is gleaned from the 1981 Seafood Consumption Survey on at-home consumption behavior for selected species of fish and shellfish as well as for various product forms. The statistical analysis undertaken is based on neoclassical consumption theory which provides a logical framework for model specification. The results and findings of previous studies examining effects of socio-demographic factors on household purchases of aggregate fish and shellfish product categories are useful in the specification of the empirical model in this study.

Chapter III

THEORETICAL FRAMEWORK AND EMPIRICAL CONSIDERATIONS

3.1 INTRODUCTION

The purposes of this chapter are as follows: (1) to provide a theoretical basis for the empirical work on consumption analysis of household budget data, and (2) to present the empirical model used and the statistical procedure employed to estimate the model in this research. The extension of the static theory of consumer behavior relating to a single consumer to the analysis of household consumption behavior is discussed in Section 3.2 The Engel function, generally the starting point for cross-section or household budget studies of consumer demand, is introduced in Section 3.3.

In analyzing household expenditure patterns, the form of the functional relationship between expenditure and income is of considerable interest. The functional form for estimating the household expenditure-income relationships is discussed in Section 3.4. In Section 3.5, the focus is on socio-demographic characteristics hypothesized to influence household expenditure for fish and shellfish products. A two-equation limited dependent variable model, presented in Section 3.6, takes into account the situation that many households report zero expenditure on the dissagregate seafood products included in this research. The statistical procedure (the Heckman sample selection procedure) used to estimate the demand parameters in this situation is discussed in Section 3.7.

THEORETICAL FRAMEWORK

3.2 HOUSEHOLD BEHAVIOR

The static theory of consumer behavior relates to a single consumer and attempts to explain how individuals make consumption decisions given prices, income, tastes, and preferences at a given point in time. However, this research focuses on household behavior toward seafood consumption. The purpose of this section is to extend the static theory of individual consumer behavior in order to make it applicable to the analysis of household consumption behavior.

Direct application of the static theory of consumer behavior for a single individual to the consumption behavior of a household, which generally contains more than one individual,

gives rise to a difficulty known as the aggregation (over consumers) problem. All household purchases are not usually made by the same person. If it is assumed that each individual in the household optimizes the choice of commodities consumed subject to the income available, the optimum choice of commodities for the household depends upon the preference ordering (or the utility function) of each individual as well as the distribution of the household income to the individual members of the household. Therefore, the static theory of consumer behavior cannot be applied directly to analyze household consumption unless individual members of the household have identical utility functions and the decision of allocating household income among individual members is known. Furthermore, the above approach of household behavior as an aggregation of individual behavior cannot be applied to the case when purchased commodities are intended for consumption by all members of the household.

The other approach of anlayzing household behavior is to consider a household as "the unit of decision" (Prais and Houthakker, 1971). The household as a whole makes consumption decisions the same way the individual consumer does. The household is assumed to have an aggregate utility function resulting from a decision-making process in which all members of the household participate. The household purchases the optimum bundle according to this aggregate utility function given household income. David (1962) explained the difficulties of the construction of the aggregate utility function for the household and the complexity of the decision-making process of a household. However, in the present study of household expenditure for seafood products, attention is focused on the result of the household decision-making process rather than on the process itself. Therefore, in this analysis the household is regarded as one decision unit, and consequently the household is the basic consumer unit of the static theory of consumer behavior.

3.3 ENGEL FUNCTIONS

A substantial portion of research studies focus attention on expenditure-income relationships (Engel or expenditure functions) [Aitchison and Brown, 1955; Allen and Bowley, 1935; Crockett, 1960; Houthakker, 1957; Leser, 1943; Prato, 1977; Tomek, 1977]. The purpose of this section is to examine Engel functions in the analysis of household expenditure on seafood products.

The Engel function for a single household h is specified as

$$E_{ih} = f_{ih}(I_h) \qquad (3\text{-}1)$$

expressing household expenditure on commodity i (E_{ih}) as a function (f_{ih}) of household income (I_h). In practice, budget data

from cross-section surveys used to estimate the coefficients of a given Engel function relate to many different households. "If all households in a survey had the same preferences, were faced by the same prices, and reacted to income and price changes instantaneously, then observations of expenditure at different levels of income would all lie on the Engel curve which is common to all these families" (Prais and Houthakker, 1971). Assume that households do react to income and price changes instantaneously. Then, in order to estimate Engel relationships from survey data, reflecting the behavior of one household facing different incomes, the following conditions have to be satisfied: (1) all households in a survey face the same prices, and (2) the preferences are the same for all households in a survey.

Obviously, these conditions are rarely fulfilled in practice. In empirical analysis of Engel relationships, there are two commonly adopted approaches to take account of these conditions. The first is to focus on the data itself (e.g., Prais and Houthakker, 1971; Brown and Deaton, 1972; and Phlips, 1983). In order to satisfy the condition of a given preference for all households, the data may be stratified into groups of homogeneous households by socio-demographic factors considered to have influences on perferences. As to the first condition that all households face the same prices, "the [household] budgets must be collected over the shortest practical period of time, and from a sufficiently small region for geographic differences in price to be negligible" (Brown and Deaton, 1972). Then, the Engel functions may be examined on each set of data relating to homogeneous categories.

The second approach, the approach adopted in this study, is to explicitly introduce prices and socio-demographic factors as additional variables in the Engel function. The socio-demographic factors commonly considered are those relating to the size and composition, location, social class, and ethnic background of the household. Inclusion of prices and socio-demographic factors in (3-1) yields a general Engel function specified as

$$E_{ih} = f_{ih}(I_h, P_i, S_h, L_h, R_h, O_h), \qquad (3\text{-}2)$$

where E_{ih} represents the expenditure of the hth household on the ith commodity, I_h the income of the household, P_i the price of commodity i, S_h household size, L_h household location (geographic region, urbanization, etc), C_h social class of the household, R_h the ethnic characteristics of the household, and O_h other remaining factors.

Household response to own-price, income, and household size changes is a problem of long standing concern to agricultural economists and to seafood industry analysts. As discussed in the literature review earlier, cross-price effects are generally ignored, and various socio-demographic characteristics influence household expenditure behavior relating to seafood. Furthermore, the socio-demographic variables, most of them zero-one (or binary) variables, generally enter the Engel function as intercept shifters. The econometric model in this study keeps in line with the literature with regard to the omission of cross-price effects and the use of intercept shifters.

The justification of prices in the Engel function rests on the fact that all households in a survey do not face the same prices. Socio-demographic variates are included in the model as variables representing the variety of tastes and preferences in households. Empirical estimation of (3-2) enables measurement of the impacts of income, prices, household size, and socio-demographic factors on household expenditures.

3.4 FUNCTIONAL FORMS

The form of the functional relationship between expenditure and income has received considerable attention. Various functions describing the relationship have been suggested [Prais and Houthakker, 1971; Goreux, 1960; Leser, 1963; and Salathe, 1976; 1978; 1979], with no single functional form having found general acceptance among researchers. The most widely used functional forms in measuring the relationship between expenditure and income include the linear, quadratic, double logarithmic, semi-logarithmic, inverse, and logarthimic-inverse functions, respectively. The mathematical form of these six Engel functions and the associated income elasticity measures are exhibited in Table 3.1.

The influence of income on expenditure is usually expressed in terms of income elasticity. This measure is by definition the percentage change in expenditure due to a one percent change in income. This coefficient is a real number independent of units of measurement and consequently is directly comparable to different commodities. From Table 3.1, the income elasticity measures differ with regard to functional form. For example, the income elasticity is constant for the double-logarithmic function, and the elasticity is inversely proportional to the level of expenditure for the semi-logarithmic function.

A priori one would expect the income elasticity of a normal commodity to vary when income rises from a very low level to a very high one. As Brown and Deaton (1972) noted, there is a good deal of empirical evidence indicating that, for a wide range of commodities, income elasticities decline as income increases.

Table 3.1. Alternative Engel Functions

Function	Functional Form	Income Elasticity
(1) Linear	$y = a + bx$	bx/y
(2) Quadratic	$y = a + bx + cx^2$	$(b+2cx)x/y$
(3) Double-log	$\log(y) = a + b \log(x)$	b
(4) Semi-log	$y = a + b \log(x)$	b/y
(5) Inverse	$y = a - (b/x)$	b/xy
(6) Log-Inverse	$\log (y) = a - (b/x)$	b/x

y is expenditure and x is income.

Engel curves with a sigmoid shape correspond rather well to this hypothesis of declining income elasticity.[2]

The sigmoid Engel curve corresponding to the log-log-inverse function ($\log(y)=a-(b/x)+c\log(x)$) is shown in Figure 3.1. The lower portion of the curve (segment AB) represents a luxury commodity with income elasticity, denoted by η_i, greater than unity. The middle region of the curve (segment BC) represents a necessary commodity with income elasticity greater than zero but less than unity. The upper portion of the curve (segment CD) represents an inferior good, with income elasticity less than zero. In practice, rarely is the case that the observed range of income is wide enough to capture all the phases of luxury, necessity, and inferiority of the commodity in question. Therefore, more tractable functional forms capable of approximating only portion(s) of the sigmoid Engel curve are employed to represent the expenditure changes within the observable range of income (Goreux, 1960; Prais and Houthakker, 1971).

This analysis assumes a double logarithmic function as the hypothesized form of the Engel function (Figure 3.2). The reasons for the choice of the double logarithmic function are as follows. First, the double-logarithmic form provides a fairly satisfactory

[2] Candidates for a mathematical function with a sigmoid shape are the logarithmic-logarithmic inverse function ($\log(y)=a-(b/x)+c\log(x)$, Goreux, (1960)), the lognormal distribution function, and the logistic distribution function (Brown and Deaton, 1972, p. 1175). The latter two functions, however, cannot represent inferior goods.

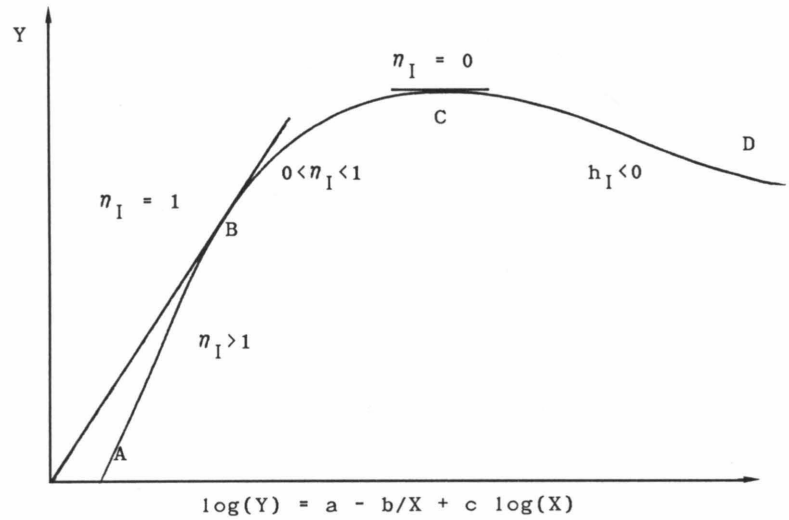
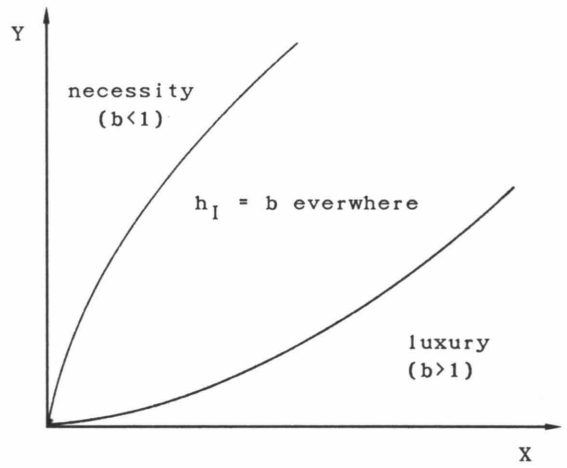


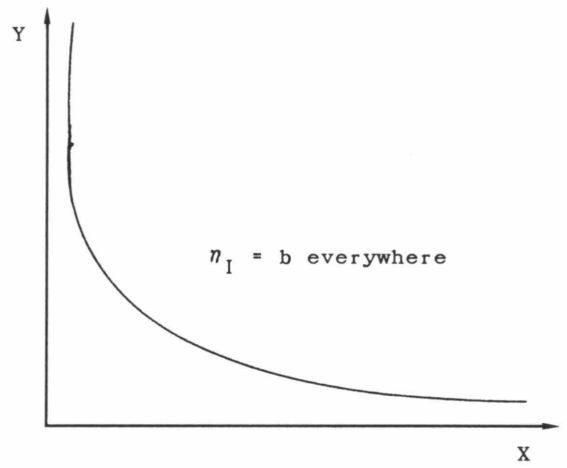
FIGURE 3.1. Log-Log-Inverse Engel Curve.

description of the curvature found in most commodities (Prais and Houthakker, 1971). Second, as Goreux (1960) noted, the double logarithmic function is often preferred to other functions when the income range is sufficiently narrow[3] and when consumption is expressed in terms of expenditure rather than in terms of quantity of the commodity in question. Third, the regression coefficient of income in the Engel function is equal to the income elasticity, albeit constant at any level of income; hence, this coefficient (elasticity) is directly comparable for different commodities in question.

Another alternative in selecting algebraic forms for the Engel function, although not used in this research, is to employ the Box-Cox (1964) transformation. This transformation has been used in econometric applications as a device for generalizing the functional form of the statistical model. For instance, the six most widely used functional forms of the Engel function presented in Table 3.1 can be shown as special cases of the Box-Cox transformation. Therefore, estimation of the Box-Cox transformation may be regarded as permitting the data to determine the most appropriate functional form.



(a) Normal goods



(b) Inferior goods

FIGURE 3.2 Double Logarithmic Engel Curves.

Source: Brown, A. and A. Deaton, "Surveys in Applied Economics: Models of Consumer Behavior" The Economic Journal, No. 328, December 1972, p. 1177.

3.5 SOCIO-DEMOGRAPHIC CHARACTERISTICS

The list of socio-demographic characteristics hypothesized to affect household expenditure for fish and shellfish products includes: (1) household size, (2) geographic religion, (3) urbanization, (4) occupation of household head, (5) education of household head, (6) employment status of household manager, (7) age of household manager, (8) presence or absence of children, (9) race, (10) religion, (11) seasonality, (12) coupon (or deal) value, and (13) seafood outlet.

The empirical evidence from the extant literature in consumption analysis indicates that household size and composition are the most important explanatory variables next to income in food expenditure-income (Engel) relationships. In this research the incorporation of household size into the expenditure function as a separate variable enables the examination of the impact of a change in the number of persons in the household on household expenditure for a particular seafood product in question. Presence or absence of children is included as a qualitative (or binary) variable, where households with no children forms the base group of the variable.[4]

The location of the household as to region of the United States and as to degree of urbanization is included in the study to take into account accessibility of the seafood product, climate, and culture. The nine geographic regions designated by the National Marine Fisheries Service (NMFS) are:

1. New England -- Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island.

2. Middle Atlantic -- New York, New Jersey, Washington, D.C., Maryland, Delaware, Virginia.

3. Southeast -- North Carolina, South Carolina, Georgia.

4. Gulf -- Texas, Louisiana, Mississippi, Alabama, Florida.

5. Great Lakes -- Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania.

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[3] In the 1981 Seafood Consumption Survey, the source of data for this study, 91 percent of the 9,422 households fall within the interval of $5,000 to $50,000.

[4] Information about the age and sex composition of the households is not available in the 1981 SCS. Because of the limitation of the data source, adult equivalent scales [Buse and Salathe, 1979; Tedford, Capps, Havlicek, 1986] are not included in this research.

6. East Central -- North Dakota, South Dakota, Nebraska, Kansas, Iowa, Missouri, Oklahoma, Arkansas, Kentucky, Tennessee, West Virginia.

7. West Central -- Nevada, Idaho, Montana, Wyoming, Utah, Colorado, Arizona, New Mexico.

8. Southwest/Pacific -- California, Hawaii.

9. Northwest -- Washington, Oregon, Alaska.

Eight 0-1 variables are specified for the first eight regions; and consequently the Northwest is taken as the base category of the geographic region variate. As to the degree of urbanization, households in the 1981 SCS data are characterized as residing within four areas: (1) farm area, (2) small city area with population under 50,000, (3) large city area with population 50,000 to 499,999, and (4) central city area with population 500,000 or more. The central city area is taken as the base category, and three 0-1 variables are specified for the remaining areas.

In addition to location and urbanization of the household, occupation and education of the household head may determine the social class in which the household belongs. Years of education of household head constitute the value for this variable in this study. For the occupation of household head, a great deal of detail with respect to this variate is available from the data base. The categories included in the 1981 SCS are as follows: (1) professional, technical, (2) farmer, farm manager, (3) manager, official, proprietor, (4) clerical and kindred, (5) sales worker, (6) craftsman, foreman, (7) operative and kindred, (8) service worker, private household worker, (9) farm laborer, foreman, (10) laborer (except farm and mine), and (11) retired or unemployed. These eleven occupational groups are divided into white collar workers (1, 3, 4, and 5 above), blue collar workers (2, 6, 7, 8, 9, and 10), while the remaining group (11) composed of retired and unemployed household heads forms the base group.

Household managers, by definition, are responsible for food purchases and preparation. The employment status of the household manager affects household income and the opportunity costs of the household manager's time, which in turn may have a direct influence on the household expenditure patterns for fishery products. Further, the age of household manager represents predominantly differences in lifestyles and values. As Miller and Nash (1971) pointed out, households headed by persons 45 years of age and older purchase substantially more shellfish products than households with younger household heads. To capture these effects, the employment status and age of the household manager are included in the analysis; these variates are represented by 0-

1 qualitative variables. The respective reference groups are households with unemployment managers at least 44 years of age.

The works by Purcell and Raunikar, 1968; Nash, 1970; Miller and Nash, 1971; Perry, 1981; and Capps, 1982 all indicated that in general, nonwhite households, black households in particular, had significantly higher levels of expenditures on fishery products than white households. To measure this impact on household expenditure for various fish and shellfish products, race of the household is included as a 0-1 variable with the reference category being white households. In addition, religious affiliation provides another measure of the ethnicity in household expenditure for fishery products. Different household expenditure patterns of fish and shellfish due to religion were noted by Nash (1970). To measure this impact, religious preference of the household is included as a binary variable. The reference category is no religious affiliation.

Seasonal differences in household expenditure for fishery products are likely to reflect the availability of the products. For example, Miller and Nash (1971) reported that the consumption of oysters closely followed the patterns of the months when most of the catch was landed. Also Miller and Nash found that the impact of seasonal factors on expenditure was very significant for those fishery products purchased chiefly in fresh form. In this study, the four seasons are defined as: (1) winter--from January to March, (2) spring--from April to June, (3) summer--from July to September, (4) fall--from October to December. Three binary variables are specified representing spring, summer, and fall; the winter quarter is taken as the base category for the seasonal variate.

The impacts of coupon (or deal) value and the kinds of stores where seafood purchases occur are also investigated in this study. Coupon value is taken as a continuous variable in the empirical model. A binary variable is specified for seafood outlet. The base category consists of health food store, drug store, variety store, department store, discount store, house to house sale, mail order, and other outlets. For a full description of the socio-demographic variables in this study, see Table 3.2. With the exclusion of the reference or base categories of the qualitative variables, the model consists of 28 exogeneous variables.

Table 3.2. List of Variable Names

Variate	Variable Name	Description
Expenditure	EXP	Household Expenditure on product i
Price	PRICE	Price of product i
Household Income	HHINC	Household income
Household Size	HHSIZE	Household size
Deal Value	DLV	Coupon value
Geographic Region	REG1	New England region
	REG2	Mid-Atlantic region
	REG3	Southeast region
	REG4	Gulf region
	REG5	Great Lakes region
	REG6	East Central region
	REG7	West Central region
	REG8	Southwest/Pacific region
		Northwest region (omitted category)
Population Density	URBN1	Farm
	URBN2	Less than 50,000 population
	URBN3	50,000 to 499,999 population
		Over 500,000 population (omitted category)
Occupation of Household Head	OC1	White collar
	OC2	Blue collar
		Retired and Unemployed (omitted category)
Education of Household Head	EDHH	Years of education of household head
Employment Status of Household Manager	EMPHM	Employed household manager
		Unemployed household manager(omitted category)
Age of Household Manager	AGEHM	Household manager less than 44 years of age
		Household manager at least 44 years of age (omitted category)
Children	CHILD	Presence of children
		Absence of children (omitted category)
Race	RACE	Black and other
		White (omitted category)
Religion	RELGN	With religious preference
		No religious preference (omitted category)
Season	DSP	Spring
	DSU	Summer
	DFA	Fall
		Winter (omitted category)
Seafood Outlet	OLT	Supermarket and grocery store
		Other stores (health food, drug, variety, department, discount, house to house, mail order and other outlets. (omitted category)

3.6 THE HECKMAN SAMPLE SELECTION PROCEDURE

In empirical analyses of household expenditure behavior using survey data, a commonly encountered problem is that many households report zero expenditures on some of the items. The more specifically or narrowly defined the commodity, the greater the proportion of households likely to report zero expenditures of the particular product. Therefore, potentially numerous observations of household expenditures for a particular commodity are concentrated around zero while other observations are above this value. Thus, household expenditure, specified as the dependent variable in the Engel function, can be regarded as part qualitative (buy or not buy) and part quantitative (amount spent). Models with such dependent variables limited in the range of possible values are termed censored response models.[5]

Tobin (1958) first discussed this problem in the regression context and analyzed this problem by formulating the regression model[6]

$$Y_i = \begin{cases} X_i'\beta + \epsilon_i & \text{if } Y_i > C \\ 0 & \text{otherwise,} \end{cases} \qquad (3\text{-}3)$$

where Y_i is expenditure on product i, X_i' is a 1 by k vector of explanatory variables, β is a kx1 vector of unknown parameters, and ϵ_i is the disturbance term. In (3-3), household expenditure on product i, Y_i, is determined by a set of explanatory variables, X_i, and Y_i is observable only if

$$Y_i > C, \qquad (3\text{-}4)$$

where C is a constant (generally zero). As Heckman (1976, 1979) noted, Y_i may be interpreted as an index of "intensity of desire" to purchase the product. According to the decision rule given in (3-3), if the intensity is sufficiently great ($Y_i > C$), Y_i is observed. Otherwise, a household will not purchase the product and Y_i equals zero. Although Tobit analysis takes into account

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[5] Two other kinds of models also have limited dependent variables: (1) truncated regression models, and (2) qualitative choice models (see Maddala, 1983).

[6] Because the statistical procedure proposed by Tobin to estimate (3-3) is related to probit analysis, this model was named the tobit model (Tobin's probit).

the behavior of those households reporting zero expenditures, it was not used in this study. For some categories of fishery products included in this research, over 96 percent of the households in the 1981 SCS reported zero expenditure on the particular product. In those cases, irreconcilable computational problems with the use of Tobit analysis occurred. Consequently, an alternative solution to circumvent the limited dependent variable problem was considered.

Among the nationwide panel of 9,422 households included in the 1981 SCS, generally households reported large proportions of zero expenditure levels (see Table 5.1). To illustrate, only 8.75 percent (824 households) reported expenditures on oysters. By product form, the percentage of households reporting expenditures on oysters was as follows: (1) canned oysters -- 4.16 percent (392 households), (2) fresh and fresh-frozen oysters -- 4.59 percent (432 households), and (3) other-prepared oysters -- 1.54 percent (145 households). When least squares estimation is employed using only the nonzero expenditure levels, sample selection bias may arise.

According to Heckman (1976, 1979), this sample selection is characterized as a specification error or omitted-variable problem. Heckman subsequently proposes a technique that amounts to estimating the omitted variable and using least squares, including the estimated omitted variable as a regressor. The description of the Heckman sample selection procedure is summarized in Table 3.3.[7]

For a random sample of N observations, a two-equation model is specified in (1a) and (1b) of Table 3.3. The assumptions about the disturbance terms specified in (2) and (3) of Table 3.3 are consistent with random sampling. The joint distribution of ϵ_{1i}, ϵ_{2i} is h (ϵ_{1i}, ϵ_{2i}). In addition, the regressor matrix is of full rank (absence of perfect multicollinearity) so that if all data were observable, the parameters of each equation (1a), (1b) could be estimated by least squares.

For the model considered in (1a) and (1b), let N_0 be the number of observations for which $Y_{1i} = 0$, and N_1 (equal to $N-N_0$) be the number of observations for which $Y_{1i} > 0$. Also, without any loss of generality, assume that the N_1 nonzero observations

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[7] Heckman (1979) noted that in practice sample selection bias may arise for the following reasons: (1) self selection by the individual or data unit, and (2) sample selection decisions by researchers.

Table 3.3. Description of the Heckman Sample Selection Procedure

(1a) $Y_{1i} = X_{1i}\beta_{1i} + \epsilon_{1i}$ $(i = 1, \ldots, N)$

(1b) $Y_{2i} = X_{2i}\beta_{2i} + \epsilon_{2i}$

where

(2) $E(\epsilon_{ji}) = 0$ for $j = 1, 2$

(3) $E(\epsilon_{ji}\epsilon_{j'i'}) = \begin{cases} \sigma_{j'i'} & \text{for } i = i',\ j, j' = 1, 2 \\ 0 & \text{for } i \neq i' \end{cases}$

(4a) $E(\epsilon_{1i} \mid Y_{2i} > 0) = E(\epsilon_{1i} \mid \epsilon_{2i} > -X_{2i}\beta_2)$

$= (\sigma_{12}/(\sigma_{22})^{1/2})\ \lambda_i$

(4b) $E(\epsilon_{2i} \mid Y_{2i} > 0) = E(\epsilon_{2i} \mid \epsilon_{2i} > -X_{2i}\beta_2)$

$= (\sigma_{22}/(\sigma_{22})^{1/2})\ \lambda_i$

where

(5) $\lambda_i = f(Z_i)/F(Z_i)$

$Z_i = X_{2i}\beta_2/(\sigma_{22})^{1/2}$

f and F respectively are the density and distribution function of the standard normal distribution.

(6) $Y_{1i} = X_{1i}\beta_1 + ((\sigma_{12})/(\sigma_{22})^{1/2})\ \lambda_i + V_{1i}$

where $E(V_{1i}) = 0$

(7) $E(V_{1i}^2) = \sigma_{11}((1+\rho^2(-Z_i\lambda_i - \lambda_i^2))$

where $\rho = \sigma_{12}/(\sigma_{11}\sigma_{12})^{1/2}$

Source: James J. Heckman, "The Common Structure of Statistical Models of Truncation. Sample Selection and Limited Dependent Variables and a Simple Estimator for Such Models," Annals of Economic and Social Measurement, 5(1976): pp. 475-492.

for Y_{1i} occur first. If only the first N_1 nonzero observations are used according to a given sample selection rule to estimate the behavior relationship specified in (1a), the regression function for the incomplete sample (or censored sample) may be written as

$$E(Y_{1i} | X_{1i}, \text{Sample Selection Rule}) = X_{1i}\beta_1 + E(\epsilon_{1i} | X_{1i}, \text{Sample Selection Rule}), \quad i = 1, \ldots, N_1.$$

If the conditional expectation of ϵ_{1i} given X_{1i} and the sample selection rule is zero, the above regression function is the same as the regression relationship in (1a) of Table 3.3. In this case, least squares estimators of the regression function for the selected subsample are still unbiased but less efficient than that of the regression function in (1a).

Equation (1a) is related to the aforementioned expenditure - income (Engel) function. Mathematically, the Engel function is given by

$$\begin{aligned}\log(EXP_{ih}) = {} & \beta_0 + \beta_1 \log(PRICE_{ih}) + \beta_2 \log(HHINC_h) + \beta_3 \log(HHSIZE_h) \\ & + \beta_5 DLV_{ih} + \beta_6 REG1_h + \beta_7 REG2_h + \beta_8 REG3_h + \beta_9 REG4_h \\ & + \beta_{10} REG5_h + \beta_{11} REG6_h + \beta_{12} REG7_h + \beta_{13} REG8_h + \beta_{14} URBN1_h \\ & + \beta_{15} URBN2_h + \beta_{16} URBN3_h + \beta_{17} OC1_h + \beta_{18} OC2_h + \beta_{19} EDHH_h \\ & + \beta_{20} EMPHM_h + \beta_{21} AGEHM_h + \beta_{22} CHILD_h + \beta_{24} RELGN_h \\ & + \beta_{25} DSP_{ih} + \beta_{26} DSU_{ih} + \beta_{27} DFA_{ih} + \beta_{28} OLT_{ih} + \epsilon_{ih} \quad (3\text{-}5)\end{aligned}$$

The variable names and notation are exhibited in Table 3.2. The parameters $\beta_0, \beta_1, \ldots, \beta_{28}$ are the coefficients that measure the change in expenditures for selected fishery products due to changes in price, household income, household size, and socio-demographic variables. Equation (1b) is related to the sample selection rule to determine the purchase or nonpurchase of a particular seafood product.

Data are available on $Y_{1i}(Y_{1i} > 0)$, if $Y_{2i} > 0$, while if $Y_{2i} \leq 0$, there are no observations on Y_{1i}. In essence, EXP_{ih} is observed when $Y_{2i} > 0$; and similarly $EXP_{ih} = 0$ when $Y_{2i} \leq 0$.

Although actual values of Y_{2i} are not observed, it is known whether or not $Y_{2i} > 0$ (bought or not bought) for all observations. Because individual households are price takers, with no perceptible influence on market prices, Y_{2i} may be interpreted as the index of intensity of desire to purchase the product. The index, Y_{2i} is hypothesized to be affected by household income, household size, geographic region, urbanization, occupation of household head, education of household head, employment status of household manager, age of household manager, presence of children, race, and religion.

According to this sample selection rule then, the conditional means of the disturbance terms of (1a) and (1b) are given by (4a) and (4b) of Table 3.3, respectively. If ϵ_{1i} is independent of ϵ_{2i}, the conditional mean of ϵ_{1i} in (4a) is zero, and the sample selection process into the incomplete sample is random -- no sample selection bias exists. In the general case, $E(\epsilon_{1i} | Y_{2i} > 0)$ is a function of X_{2i} as shown in (4a). If (1a) is estimated using the incomplete sample (or censored sample) in which only observed data on Y_{1i} are included, $(\sigma_{12}/\sigma_{22}^{1/2})\lambda_i$ is the omitted variable in (1a). Hence, the complete model for this analysis is specified as (6) in which λ_i is inserted as the additional variable to correct for sample selection bias.

In equation (5) of Table 3.3, Z_i is an index obtained from (1b) using probit analysis. That is, a binary random variable is defined with the properties

$$D_i = \begin{cases} 1 \text{ if } Y_{2i} > 0, \\ 0 \text{ otherwise.} \end{cases}$$

Using probit analysis Z_i is specified as a function of X_{2i}. The estimation of this relation is not of direct interest. This relation serves to aid in the identification of the sample selection problem. Then, $F(Z_i)$, the value of the standard normal distribution function of Z_i, gives the probability that $Y_{2i} > 0$

for the ith observation. λ is defined as the ratio of the value of the standard normal density function to the value of the standard normal distribution function. Since the denominator is the probability of the data availability of observation i for Y_{1i}, the lower this probability, the greater the value of λ for that observation. Equation (7) of Table 3.3 implies that the error structure of the fully specified model (6) is heteroscedastic, which in turn implies that a general least squares (GLS) procedure may improve the precision of the least square estimates of the complete model (6).

In brief, Heckman identifies the sample selection bias that arises from using nonrandomly selected samples to estimate behavioral relationships as a specification error or omitted variable problem. The omitted variable is estimated and used as a regressor so that it is possible to estimate the behavior functions of interest by traditional least squares methods. A two-stage estimation procedure developed by Heckman is described as follows:

Step 1: Equation (1b) in Table 3.3 is respecified as a qualitative choice model in which a new dependent variable D_i is defined such that it takes on the value 1 when $Y_{2i} > 0$ and takes on the value 0 otherwise. Then, probit analysis is employed to estimate the model by the method of maximum likelihood, determining the probability that Y_{2i}, and hence Y_{1i} by assumption, is positive. Therefore, Z_i, $f(Z_i)$, $F(Z_i)$, and consequently λ may be computed for each observation of the complete sample using (5) of Table 3.3.

Step 2: The estimate of λ is inserted in equation (6) and the coefficients in (6) are estimated using either ordinary least squares (OLS) or generalized least squares (GLS). For GLS, the weight for each observation is $(1 + \rho^2(-Z_i\lambda_i-\lambda_i^2))^{1/2}$, where Z_i and λ_i are estimated in step 1, and ρ^2 can be obtained by regressing each squared residual, V_{1i}^2, from the OLS estimation of (6) on $-Z_i\lambda_i-\lambda_i^2$. Then, according to (7) of Table 3.3, the estimated intercept of this relationship constitutes the estimate of σ_{11} while the estimated slope of this relationship constitutes the estimate of $\rho^2\sigma_{11}$. However, nothing in this procedure ensures that the estimate of σ_{11} is positive or that the estimate of ρ^2

lies in the unit interval. Consequently, this technique developed to correct for heteroscedasticity may break down. In the Heckman procedure, OLS produces consistent estimates, but GLS, when implementation is possible, improves the precision of the estimates.

As a final point, the Heckman sample selection procedure as described above allows the researcher to statistically test for sample selection bias. If the estimated coefficient associated with λ is significantly different from zero, sample selection bias exists. On the other hand, if the estimated coefficient associated with λ is not significantly different from zero, then there is no sample selection bias that arises from using nonrandomly selected samples to estimate behavioral relationships.

Of interest in this study is the estimation of equation (1a), or specifically of (3-5). Elasticities then can be computed from (3-5) to summarize the influence of own-price, household income, and household size on household expenditure for the particular fishery products in question. The own-price elasticities of demand measure the percentage change in consumption of a product due to a one-percent change in price of that product. The own-price elasticity of demand implied by (3-5) is given by β_1-1. If β_1 is greater than 0 and less than or equal to 1, then the demand for the particular product is inelastic. A negative value of β_1 indicates that the demand for the product is elastic. The larger the magnitude of the price elasticity, the more responsive expenditures on the products in question are to changes in price. Furthermore, if β_1 is greater than 1, then the product is a Giffen good.

The income elasticity measures the percentage change in consumption due to a one-percent change in household income. The income elasticity implied by (3-5) is given by β_2. A negative income elasticity indicates that consumption of the fishery product declines (rises) as income increases (decreases). A positive income elasticity indicates that consumption of the product increases (decreases) as income rises (declines). The larger the magnitude of the income elasticity, the more responsive the fishery products are to changes in household income.

The household-size elasticity is defined as the percentage change in consumption of a fishery product due to a one-percent change in household size. The household-size elasticity implied by (3-5) is given by β_3. A positive (negative) household-size

elasticity indicates that expenditure on commodity i rises (declines) as household size increases.

In (3-5), the parameter for variable DLV, β_5, can be interpreted as the rate of change in expenditure for product i due to a one-cent increase in coupon value ceteris paribus. Similarly, the parameter for variable EDHH, β_{19}, gives the rate of change in expenditure due to one additional year of education received by the household head.

The independent variables REG1 - REG8, URBN1 - URBN3, OC1, OC2, EMPHM, AGEHM, CHILD, RACE, RELGN, DSP, DSU, DFA, and OLT are binary or zero-one variables, which take on the value of unity with the occurrence of a particular attribute and take on the value of zero otherwise. The use of zero-one variables achieves a greater degree of generalization in model formulation. These zero-one (or binary) variables are intercept shifters of the expenditure function. The impacts of geographic region, population density, occupation of household head, employment status of household manager, age of household manager, presence of children, race, religion, season, and seafood outlet are reflected by the coefficients of the binary variables.

When zero-one variables are used, each of the socio-demographic variates is classified into mutually exclusive and exhaustive groups according to their attributes. For each household, the sum of all zero-one variables of a particular socio-demographic variate is one, a perfect linear association with the intercept of the statistical model. To handle this singularity problem, one of the zero-one variables of each set of classifications is arbitrarily deleted. The reference category consists of non-white households with household head retired or unemployed, household manager over 44 years of age and unemployed, the absence of children, no religious affiliation, and living in a central city area of the Northwest. Further, the reference household expenditure with regard to season for the product in question is the winter quarter, and the reference seafood outlet is for stores other than the supermarket or grocery store. For households with socio-demographic characteristics different from those of the reference categories, the percentage change in expenditures relative to the expenditure of the base groups may be expressed as $(\exp(\beta_i)-1)X100\%$ (for details, see Cheng, 1985).

Chapter IV

THE DATA BASE

4.1 THE DATA BASE

The National Seafood Consumption Survey (SCS) of 1981, conducted by the Market Research Corporation of America (MRCA) under contract with the National Marine Fisheries Service (NMFS), provides a comprehensive source of consumption, expenditure, attitudinal, and income information related to socio-demographic characteristics of households in the United States. The length of the survey generating the data is short enough to insure stable consumer preferences, yet long enough to accommodate the diversity of consumer choice and to allow a fairly reliable record of expenditures.

The principal motivation behind the SCS was to collect data in order to assess the impacts of fishery and other Federal regulations on the seafood industry, to evaluate the nutritional contribution of seafood, and to help with promotional activities. The SCS was conducted in calendar year 1981 using a nationwide panel of 9,422 households. The households completed diaries that provided data on the amount of seafood purchased for home use and on the amount of seafood purchased at restaurants, cafeterias, and other away-from-home establishments. Two questionnaires were also collected together with the diary data. A seafood consumption questionnaire was designed to gather information on consumer attitudes toward seafood. The second questionnaire was used to collect information on the household socio-demographic characteristics.

The weekly diary is divided by daily shopping record and daily expenses on seafood classified by species and type of products (fresh and fresh-frozen, canned, prepared dishes, etc.) to aid the respondent when recording purchases and to facilitate the coding of individual purchases. Within the daily shopping record, as shown in Figure 4.1, information is available on total expenses on seafood for each trip to the store as well as to the kind of store where purchases were made. For the daily expense record, information is available on the species of fish and shellfish, net weight per unit, price paid per unit, and total expenditure on each product. The contents of the daily expense record are presented in Figures 4.2 and 4.3, respectively.

The 1981 SCS data tape used in this research work consists of three files. Data on household purchases of seafood commodities

Y[illegible] Panel Number _____

Your Name _____

Address _____

City _____

State _____ Zip Code _____

IF YOUR ADDRESS LABEL IS NOT ENTIRELY RIGHT, PLEASE CORRECT YOUR NAME AND ADDRESS

ALWAYS RETURN THIS PAGE

Dear Doris

I can assure you that ALL purchases of items included in this diary, which were made by me or any other member of my household during this week, have been entered in this diary.

Please sign here for extra 10 points

FOR PRODUCT INDEX SEE NEXT PAGE

Please record all trips to store
- which sell products listed in this diary
- when purchases were made by you or any member of your household

Also include
- mail and phone orders
- purchases from door-to-door salesmen

DAILY SHOPPING RECORD

STORE TRIP NO	TRIP DATE MONTH	TRIP DATE DAY	NAME of STORE or DELIVERY COMPANY	DOES THIS STORE Use Electronic SCANNERS At Check-Out? Yes	DOES THIS STORE Use Electronic SCANNERS At Check-Out? No	DOES THIS STORE Regularly Mark Price On Each Package? Yes	DOES THIS STORE Regularly Mark Price On Each Package? No	Check KIND of STORE: Supermarket 1	Health Food Store 2	Other Grocery Store 3	Drug Store 4	Variety Store 5	Department Store 6	Discount Store 7	House to House 8	Mail Order 9	Other 0	TOTAL* Number of DOLLARS SPENT at STORE
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

☐ Check here IF NO PURCHASES were made by any household member this week (If Special Reason, please explain above)

*If you pay the milkman weekly or monthly, you may enter the full amount when billed

CIRCLE WEEK REPORTED IN THIS DIARY

1982			APRIL			1982
SUN	MON	TUE	WED	THU	FRI	SAT
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	[1]

1982			MAY			1982
SUN	MON	TUE	WED	THU	FRI	SAT
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29

1982			JUNE			1982
SUN	MON	TUE	WED	THU	FRI	SAT
[30]	[31]	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	[1]	[2]	[3]

MAIL ON SUNDAY OR MONDAY EACH WEEK

USE THESE STORE TRIP NUMBERS WHEN ENTERING PURCHASES

Figure 4.1. National Consumer Panel, Weekly Diary - Daily Shopping Record

ALL FISH, SHELLFISH AND SEAFOOD PRODUCTS (PAGES 8 AND 9)

• ON THIS PAGE ENTER - FISH & FISH PRODUCTS

Page 8 • ON FACING PAGE 9 ENTER - SHELLFISH & OTHER SEAFOOD PRODUCTS; and SEAFOOD SOUPS, CHOWDERS & JUICES

FRESH AND FRESH FROZEN FISH (Not Prepared) Also Include Fish Used At Home Which Was RECREATIONALLY "CAUGHT" By Your Family, or Given to You.

LIVE, ICED, REFRIGERATED, AND FROZEN

refers back to P.1

If no brand, write in store name. If "caught," write in date obtained.

STORE TRIP NO. 45

(Brand)	KIND (Ocean Perch, Catfish, Flounder, Haddock, Fresh Water Trout, Sea Trout, etc.)	DESCRIBE IN DETAIL — FORM OF FISH: If You Bought the entire Fish, Did you have it Cleaned? Check as many as apply (✓ ✓): Whole, Scaled, Gutted, Headed, Fillets, Pieces, Steaks	If You Did Not Buy the entire Fish (✓): Fillets, Pieces, Steaks; Other Write In	CHECK ONE (✓): Live, Iced/Refrigerated, Frozen	WHERE BOUGHT? (✓): Seafood or Fish Market, Fish Dock, Open Market, Supermarket, Other Store	IF IT WAS "CAUGHT" BY YOUR FAMILY, OR GIVEN TO YOU BY OTHER "SPORT" FISHERMAN: Was it "Caught" in Fresh or Salt Water? (✓): Fresh, Salt; Where Was it "Caught"? WRITE IN name of lake, river, stream, bay, estuary, sound, gulf, ocean, etc. and name of STATE (Lake Michigan, Ill., San Francisco Bay, Calif., Atlantic Ocean, Maine, etc.)	If Imported, write in Country of origin	IF EXACT WEIGHT AS BOUGHT OR "CAUGHT" IS NOT KNOWN, PLEASE ESTIMATE IN POUNDS AND OUNCES: TOTAL WEIGHT LBS, OZS	TOTAL PRICE PAID	IF SPATIAL DIFFERENTIATION CODE AND VALUE OF DEAL CODE	VALUE

PREPARED FISH AND FISH DISHES (Not-Cooked, and Pre-Cooked)

INCLUDE: TAKEOUT, CARRY-IN, ETC.

46

(Brand)	KIND (Ocean Perch, Cod, Haddock, Flounder, Catfish, Trout etc. Include Combinations, Flounder & Crab, etc.)	DESCRIBE IN DETAIL — FORM Check as many as apply (✓ ✓): Whole, Fillets, Slices, Steaks, Portions, Sticks, Bars/Cakes, Croquette, Minced/Chopped, Pieces/Chunks, Other	HOW PREPARED OR NAME OF DISH: Coated (✓): Breading, Batter; OTHER Write In Preparation or Name of Dish (Almondine, Au Gratin, Stew Pot Pie, Casserole, Crepe, Salad, Stuffed Flounder, Gefilte, Etc.)	DISH or DINNER? Check One (✓): Dish/Entree, Dinner-Carry-In-Tv, Multi-Course Meal	Pre-Cooked? (✓): Yes, No	Check one (✓): Frozen, Iced/Refrigerated, Other	If Imported, write in Country of origin	IF ON PACKAGE WRITE IN UNIVERSAL PRODUCT CODE	QUANTITY Number of Packages	WEIGHT of Each Package (Size)	PRICE PAID: Each Package, TOTAL	CODE	VALUE

DEAL CODES

1 Newspaper Coupon
2 Magazine Coupon
3 Mail Coupon
4 Coupon From Prior Purchase of Same Item
5 Coupon From Other Purchase
6 Free Product
Bonus Size Package
7 ¢ Off on Label
8 Store Special
9 Other Special Offer

Figure 4.2. Weekly Finfish Purchase Record

CANNED TUNA, BONITA, BONITO

44	KIND (✓) Tuna / Bonita, Bonito	FORM – As Shown on Label (✓) One: Solid or Fancy / Chunk or Bite Size / Grated Flakes / Other	Check ONE (✓) White, Albacore / Light	Packed in What? Per Label (✓) WATER (Brine, Broth, Spring, Etc.) / OIL (Corn, Soybean, Vegetable, Safflower, Etc.)	Are Cans Packaged Together? If Yes How Many Per Pack? / No (✓)	Is a Recipe Printed on the Label (✓) Yes / No	Does Label say Diet? (✓) Yes / No	Is this a pull-top can? (✓) Yes / No	If Imported, write in Country of Origin	IF ON PACKAGE WRITE IN UNIVERSAL PRODUCT CODE	QUANTITY Number of Packages	WEIGHT of Each Package (Size)	PRICE PAID Each Package / TOTAL	STORE USE ONLY CODE / VALUE
(Brand)														

OTHER CANNED FISH

Space Dot No. 47	DESCRIBE IN DETAIL: KIND (Salmon, Sardines, Mackerel, Herring, Anchovies, etc.) / FORM (Whole, Chunks, Flakes, Bite Size, Meat, etc.) / HOW PREPARED? (Plain, Natural, etc.)	Must it be Kept Cold Before Opening? (✓) Yes / No	PACKED IN WHAT? (✓) Water / Oil / Tomato Sauce / Mustard Sauce / Other write in Kind or Flavor	Does Label Say Diet? (✓) Yes / No	If Imported, write in Country of origin	IF ON PACKAGE WRITE IN UNIVERSAL PRODUCT CODE	QUANTITY Number of Packages	WEIGHT of Each Package (Size)	PRICE PAID Each Package / TOTAL	STORE USE ONLY CODE / VALUE
(Brand)										

OTHER PREPARED FISH AND FISH PRODUCTS (Smoked, Pickled, Paste, Marinated, Roe, Etc.)

48	DESCRIBE IN DETAIL: KIND (Herring, Salmon, Lox, Chubs, etc.) / FORM (Whole, Chunks, Patties, Sticks, Slices, Stew, Bite Size, Spread, etc.) / HOW PREPARED? (Smoked, Salted, Dried, Cured, Kippered, Plain, etc.)	HOW PACKAGED? (✓) Paper / Envelope / Other	Must it be Kept Cold Before Opening? (✓) Yes / No	IF IN LIQUID OR SAUCE Write in Kind or Flavor (Sour Cream, Wine Sauce, Brine, Oil, etc.)	If Imported, write in Country of origin	IF ON PACKAGE WRITE IN UNIVERSAL PRODUCT CODE	QUANTITY Number of Packages	WEIGHT of Each Package (Size)	PRICE PAID Each Package / TOTAL	STORE USE ONLY CODE / VALUE
Brand										

FIGURE 4.2 (Continued).

ALL FISH, SHELLFISH AND SEAFOOD PRODUCTS (PAGES 8 AND 9)

THIS PAGE ENTER SHELLFISH & OTHER SEAFOOD PRODUCTS, SEAFOOD SOUPS, CHOWDERS & JUICES
• ON FACING PAGE 8 ENTER FISH & FISH PRODUCTS

FRESH and FRESH FROZEN SHELLFISH (Not Prepared) (Shrimp, Lobster, Crab, Oysters, Clams, Scallops, Abalone; Frog Legs, Squid, Etc.)

Also Include Shellfish Used At Home Which Was RECREATIONALLY "CAUGHT" By Your Family, or Given to You.

LIVE, ICED, REFRIGERATED, AND FROZEN

If no brand, write in store name If "caught" write in date obtained.

55 (Brand)	DESCRIBE IN DETAIL: KIND (Shrimp, King Crab, Spiny Lobster, Scallops, Frog Legs, Clams, Oysters, etc.)	DESCRIBE IN DETAIL: FORM OF SHELLFISH (Check as many as apply ✓✓): Whole, Headless, In Shell, Peeled/Shucked, Deveined, Steaks, Pieces, Tails, Legs/Claws, Other Write in	CHECK ONE (✓): Live, Iced/Refrigerated, Frozen	WHERE BOUGHT? (✓): Seafood or Fish Market, Fish or Open Market, Supermarket, Other Store	IF IT WAS "CAUGHT" BY YOUR FAMILY, OR GIVEN TO YOU BY OTHER "Sport" FISHERMAN: Was it "Caught" in Fresh or Salt Water? (✓): Fresh, Salt; Where was it "Caught"? WRITE IN name of lake, river, stream, bay, estuary, sound, gulf, ocean, etc. and name of STATE (Lake Michigan, Ill., San Francisco Bay, Calif., Atlantic Ocean, Maine, etc.)	If Imported, write in Country of origin	IF EXACT WEIGHT AS BOUGHT OR CAUGHT IS NOT KNOWN, PLEASE ESTIMATE IN POUNDS AND OUNCES: TOTAL WEIGHT LBS, OZS	TOTAL PRICE PAID	If Special Offer Entered, Code and Value of Deal: CODE, VALUE

PREPARED SHELLFISH and SHELLFISH DISHES (Not-Cooked, and Pre-Cooked)

INCLUDE: TAKE-OUT, CARRY-IN, ETC.

56 (Brand)	DESCRIBE IN DETAIL: KIND (Shrimp, King Crab, Spiny Lobster, Scallops, Frog Legs, Clams, Oysters, etc.)	DESCRIBE IN DETAIL: FORM (Check as many as apply ✓✓): Whole, Headless, In Shell, Peeled/Shucked, Deveined, Pieces, Slices, Balls/Cakes, Tails, Legs/Claws, Meat, Minced/Chopped, Other	HOW PREPARED OR NAME OF DISH: Coated (✓): Breading, Batter; OTHER Write In Preparation or Name of Dish (Creole, Spiced Shrimp, Deviled, Cocktail, Stew, Egg Rolls, Salad, Chop Suey, etc.)	DISH or DINNER? Check One (✓): Dish/Entree, Dinner, Carry-In, TV Multi-Course Meal	Pre cooked? (✓): Yes, Inc	Check one (✓): Frozen, Iced/Refrigerated, Other	If Imported, write in Country of origin	IF ON PACKAGE WRITE IN UNIVERSAL PRODUCT CODE	QUANTITY Number of Packages	WEIGHT of Each Package (Size)	PRICE PAID: Each Package, TOTAL	If Special Offer Entered, Code and Value of Deal: CODE, VALUE

DEAL CODES

1 Newspaper Coupon
2 Magazine Coupon
3 Mail Coupon
4 Coupon From Prior Purchase of Same Item
5 Coupon From Other Purchase
6 Free Product/Bonus Size Package
7 ¢ Off on Label
8 Store Special
9 Other Special Offer

Figure 4.3. Weekly Shellfish Purchase Record

CANNED SHELLFISH (Crab, Lobster, Shrimp, Oysters, Clams, Squid, Etc.)

STORE TRIP NO	58	DESCRIBE IN DETAIL: KIND (Snowcrab, Lobster, Shrimp, Clams, Oysters, etc.)	FORM (Whole, Meat, Pieces, Minced, Slices, etc.)	HOW PREPARED? (Plain, Natural, etc.)	Must it be Kept Cold Before Opening? (✓) Yes	No	PACKED IN WHAT? (✓) Oil	Water	Brine	Other: Write in Kind or Flavor	Does label say Diet? (✓) Yes	No	If imported, write in Country of origin	IF ON PACKAGE WRITE IN UNIVERSAL PRODUCT CODE	QUANTITY Number of Packages	WEIGHT of Each Package (Size)	PRICE PAID Each Package	TOTAL	If SPLIT CASE, WRITE CODE AND VALUE OF EACH ITEM: CODE	VALUE
	(Brand)																			

OTHER PREPARED SHELLFISH and SHELLFISH PRODUCTS

STORE TRIP NO	58	DESCRIBE IN DETAIL: KIND (Kelp, Sea Cucumbers, Dried Shrimp, etc.)	FORM (Whole, Meat, Pieces, Minced, Slices, Spread, Bite size, etc.)	HOW PREPARED? (Smoked, Dried, Salted, Cured, Pickled, Marinate, Plain, Natural, etc.)	HOW PACKAGED? (✓) Can	Jar	Carton	Pouch	Envelope	Other	Must it be Kept Cold Before Opening? (✓) Yes	No	PACKED IN WHAT? (✓) Oil	Water	Brine	Other: Write in Kind or Flavor	If imported, write in Country of origin	IF ON PACKAGE WRITE IN UNIVERSAL PRODUCT CODE	QUANTITY Number of Packages	WEIGHT of Each Package (Size)	PRICE PAID Each Package	TOTAL	If SPLIT CASE, WRITE CODE AND VALUE OF EACH ITEM: CODE	VALUE
	(Brand)																					

SEAFOOD SOUP, CHOWDER, CLAM JUICE (Fish, Shellfish and Other Seafood)

	63	DESCRIBE IN DETAIL KIND(S) of Fish or Shellfish from which product was made (Clam, Oyster, Lobster, Crab etc. Include Combinations)	FORM (✓) Dry Mix	Condensed	Ready to Serve	Other	Product Check One (✓) Chowder	Soup	Juice	STYLE Copy from Label (Manhattan, New England, Bisque, Gumbo, Bouillabaisse, etc.)	HOW PACKAGED? (✓) Can	Jar	Carton	Pouch	Envelope	Other	Must it be Kept Cold Before Opening? (✓) Yes	No	If imported, write in Country of Origin	IF ON PACKAGE WRITE IN UNIVERSAL PRODUCT CODE	QUANTITY Number of Packages	WEIGHT of Each Package (Size)	PRICE PAID Each Package	TOTAL	If SPLIT CASE, WRITE CODE AND VALUE OF EACH ITEM: CODE	VALUE
	(Brand)																							

FIGURE 4.3 (Continued).

for home consumption during the survey year are contained in the first file. Data on household income, household size, and other socio-demographic characteristics are contained in the second file. Qualitative information on household attitudes toward seafood is contained in the third file.

4.2 DATA ORGANIZATION AND SAMPLE SELECTION

The first file in the 1981 SCS data tape contains data on household purchases of various kind of seafood in different product forms (canned, fresh and fresh-frozen, other-prepared, etc.) during the survey year. More than 700 codes were developed by MRCA to differentiate among kinds of fish and shellfish. Due to such a lengthy list, it was worthwhile to group disaggregate fish and shellfish species with common characteristics into particular aggregates. This aggregation process greatly reduced the number of species to to be analyzed. The aggregation and selection of species are discussed later in this section.

Ten separate codes differentiated finfish and shellfish by product forms. Aggregating over some product forms was done so that attention could be focused on three major product forms for both finfish and shellfish species: canned, fresh and fresh-frozen, and other-prepared. For a detailed description of these three aggregate product forms, see Cheng (1985, Appendix A). Aggregating over product forms as well as species of fish and shellfish is necessary not only to allow the focus on household expenditure patterns on major species and product forms of seafood but also to increase the number of observations and, hence, to reduce the degrees-of-freedom problem in the estimation of demand parameters.

For each household, quantity purchased and expenditure for seafood consumed at home during the survey year were summed separately by species and by the three product forms of each species. This sample was then divided into subsamples by species and by product forms; the respective data on household socio-demographic characteristics were integrated with household purchase and expenditure data in the subsamples. Normally, with large data bases, the nonreporting of household income is a common and pervasive problem.[8] However, in the case with the 1981 SCS data, all of the 9,422 participating households in the Survey do provide continuous income information. The respective distributions of households by income group and by particular socioeconomic and demographic characteristics are presented in Table 4.3 in the next section.

[8] For example, in the 1977-78 USDA Nationwide Household Food Consumption Survey approximately 30 percent of all households included did not report income figures (see Capps and Cheng, 1986).

In short, each subsample includes only those households in the 1981 SCS that report purchases of a particular seafood species or a seafood species in particular product form. Such subsamples are usually termed censored samples because part of the observations from the complete sample is missing in those subsamples. This study includes 46 censored samples, consisting of at least 300 observations. Nineteen are related to shellfish products, and the remaining 27 are related to finfish products.

The categories of fish and shellfish products included in this study are the following:

1. Shellfish -- 19 categories

    * Clams
        - Canned Clams
        - Other Prepared Clams
        - Total Clams

    * Crabs
        - Canned Crabs
        - Fresh and Fresh Frozen Crabs
        - Other Prepared Crabs
        - Total Crabs

    * Oysters
        - Canned Oysters
        - Fresh and Fresh Frozen Oysters
        - Total Oysters

    * Scallops
        - Total Scallops

    * Shrimp
        - Canned Shrimp
        - Fresh and Fresh Frozen Shrimp
        - Other Prepared Shrimp
        - Total Shrimp

    * Shellfish
        - Canned Shellfish
        - Fresh and Fresh Frozen Shellfish
        - Other Prepared Shellfish
        - Total Shellfish

2. Finfish -- 27 Categories

    * Cod
        - Fresh and Fresh Frozen Cod
        - Other Prepared Cod
        - Total Cod

* Flounder/Sole
    - Fresh and Fresh Frozen Flounder/Sole
    - Other Prepared Flounder/Sole
    - Total Flounder/Sole

* Haddock
    - Fresh and Fresh Frozen Haddock
    - Other Prepared Haddock
    - Total Haddock

* Herring
    - Other Prepared Herring
    - Total Herring

* Mackerel
    - Total Mackerel

* Perch
    - Fresh and Fresh Frozen Perch
    - Other Prepared Perch
    - Total Perch

* Pollock
    - Total Pollock

* Salmon
    - Canned Salmon
    - Total Salmon

* Sardines
    - Canned Sardines

* Snapper
    - Fresh and Fresh Frozen Snapper

* Tuna
    - Canned Tuna

* Whiting
    - Other Prepared Whiting
    - Total Whiting

* Finfish
    - Canned Finfish
    - Fresh and Fresh Frozen Finfish
    - Other Prepared Finfish
    - Total Finfish

Five shellfish species and 12 finfish species were included in this study. The categories relating to total shellfish and to total finfish are the aggregation over the respective species. A list of codes and kinds of seafood aggregated separately into the

respective 5 shellfish and 12 finfish species are available (see Cheng, 1985, Appendix B).

Finally, implicit prices are derived, where possible, from expenditure and quantity data compiled from the 46 censored samples. Each censored sample does not include those households reporting zero expenditure on particular products. Deletion of those households not reporting purchases of the item from empirical analysis may lead to statistical problems due to sample selection bias. To avoid imputation of the missing values of the price variables, above, the aforementioned Heckman sample selection procedure (Chapter III) was used in this study.

4.3 DATA DESCRIPTION

In order to gain insight into the large data base, several tables that summarize pertinent information are constructed. The number and percentage of households reporting nonzero expenditures for selected categories of fishery products are exhibited in Table 4.1. Over 68 percent of the households reported nonzero expenditures on canned tuna consumed at home. On the basis of the evidence in Table 4.1, canned tuna was the most popular fishery product for home consumption. The percentage of households reporting nonzero expenditures on shrimp, salmon, cod, pollock, and clams ranged from 15.71 percent to 22.57 percent. In the aggregate, 36.41 percent of the households reported nonzero expenditure values on shellfish products, while 77.17 percent of the households reported nonzero expenditure values on finfish products.

The average annual household expenditure[9] on the selected categories of shellfish and finfish products is presented in Table 4.2. Average annual household expenditure for total shellfish was $5.32, and for total finfish the average annual expenditure was $15.92. The largest average annual household expenditures were for canned tuna ($8.49), total shrimp ($2.82), fresh and fresh-frozen shrimp ($1.86), total salmon ($1.75).

The distribution of households according to socio-demographic characteristics is presented in Table 4.3. All of the 9,422 households included in the 1981 SCS report completed information on household income, household size, and socio-demographic characteristics. Roughly, 90 percent of the households fell within the $5,000-$49,999 income boundaries. Households with 1 to 5 persons accounted for 94.13 percent of the total number of households. The distribution of households by geographic region is closely related to the distribution of the U.S. population. Over 52 percent of the households were located in central cities,

[9] Mean expenditures of the sample based on 9,422 participating households in the 1981 SCS.

Table 4.1. The Number and Percentage of Households Reporting Nonzero Expenditure Values on Shellfish and Finfish Products

Item	Number of Households	Percent
Canned Clams	531	5.64
Other Prepared Clams	1088	11.55
Total Clams	1480	15.71
Canned Crabs	337	3.58
Fresh and Fresh Frozen Crabs	348	3.69
Other Prepared Crabs	307	3.26
Total Crabs	852	9.04
Canned Oysters	392	4.16
Fresh and Fresh Frozen Oysters	432	4.59
Total Oysters	824	8.75
Total Scallops	360	3.82
Canned Shrimp	536	5.69
Fresh and Fresh Frozen Shrimp	1103	11.71
Other Prepared Shrimp	1052	11.17
Total Shrimp	2127	22.57
Canned Shellfish	1370	14.54
Fresh and Fresh Frozen Shellfish	1646	17.47
Other Prepared Shellfish	2062	21.88
Total Shellfish	3431	36.41
Fresh and Fresh Frozen Cod	734	7.79
Other Prepared Cod	1054	11.19
Total Cod	1633	17.33
Fresh and Fresh Frozen Flounder/Sole	973	10.33
Other Prepared Flounder/Sole	397	4.21
Total Flounder/Sole	1223	12.98
Fresh and Fresh Frozen Haddock	593	6.29
Other Prepared Haddock	373	3.96
Total Haddock	863	9.16
Other Prepared Herring	426	4.52
Total Herring	561	5.95
Total Mackerel	397	4.21
Fresh and Fresh Frozen Perch	873	9.27
Other Prepared Perch	382	4.05
Total Perch	1140	12.10
Total Pollock	1567	16.63
Canned Salmon	1889	20.05
Total Salmon	2093	22.21
Canned Sardines	1172	13.05
Fresh and Fresh Frozen Snapper	326	3.46
Canned Tuna	6444	68.39
Other Prepared Whiting	591	6.27
Total Whiting	767	8.14
Canned Finfish	6849	72.69
Fresh and Fresh Frozen Finfish	2601	27.61
Other Prepared Finfish	3058	32.46
Total Finfish	7271	77.17

Table 4.2. Average Annual Household Expenditure on Shellfish and Finfish Products

Category	Mean	Standard Deviation	Max
Canned Clams	0.1961	1.4846	87.34
Other Prepared Clams	0.3549	1.6098	37.72
Total Clams	0.6602	2.8298	96.66
Canned Crabs	0.1739	1.2531	37.56
Fresh and Fresh Frozen Crabs	0.5175	3.9671	150.60
Other Prepared Crabs	0.2255	2.3692	150.60
Total Crabs	0.9168	5.1917	164.04
Canned Oysters	0.1886	1.6108	75.50
Fresh and Fresh Frozen Oysters	0.3580	2.9602	167.00
Total Oysters	0.5926	3.6363	167.00
Total Scallops	0.3338	2.3503	59.89
Canned Shrimp	0.2749	1.8027	70.32
Fresh and Fresh Frozen Shrimp	1.8619	10.0796	566.50
Other Prepared Shrimp	0.6811	3.2883	78.32
Total Shrimp	2.8178	11.1450	566.50
Canned Shellfish	0.8335	3.3752	87.34
Fresh and Fresh Frozen Shellfish	3.1353	13.8272	733.50
Other Prepared Shellfish	1.3525	4.9673	144.59
Total Shellfish	5.3213	16.6007	733.50
Fresh and Fresh Frozen Cod	0.4920	2.8230	91.21
Other Prepared Cod	0.5945	2.8287	102.14
Total Cod	1.0898	4.1395	112.20
Fresh and Fresh Frozen Flounder/Sole	0.9380	4.9021	116.50
Other Prepared Flounder/Sole	0.1800	1.7066	117.33
Total Flounder/Sole	1.1180	5.3878	133.28
Fresh and Fresh Frozen Haddock	0.5119	3.4336	163.17
Other Prepared Haddock	0.1898	1.6143	69.72
Total Haddock	0.7024	3.9042	165.45
Other Prepared Herring	0.1905	1.3977	41.90
Total Herring	0.8237	3.4118	110.20
Total Mackerel	0.1118	0.9418	51.18
Fresh and Fresh Frozen Perch	0.4873	2.3560	78.15
Other Prepared Perch	0.1294	0.8119	20.96
Total Perch	0.6167	2.6071	78.15
Total Pollock	0.8237	3.4118	110.20
Canned Salmon	1.3940	4.7768	145.68
Total Salmon	1.7451	5.7329	162.79
Canned Sardines	0.3744	1.8273	67.45
Fresh and Fresh Frozen Snapper	0.1801	1.4107	38.36

Table 4.2. Average Annual Household Expenditure on Shellfish and Finfish Products, continued

Category	Mean	Standard Deviation	Max
Canned Tuna	8.4862	15.0955	251.80
Other Prepared Whiting	0.2385	1.3734	45.91
Total Whiting	0.3417	1.8309	57.83
Canned Finfish	10.3811	16.9580	282.58
Fresh and Fresh Frozen Finfish	3.0910	9.1779	163.17
Other Prepared Finfish	2.4423	6.8103	172.46
Total Finfish	15.9156	23.9308	367.95

Table 4.3. Distribution of Households According to Socio-demographic Characteristics

Variates	Number of Households	Cumulative Frequency	Percent	Cumulative Percentage
INCOME				
>0 and <5,000	469	469	4.978	4.978
$5,000-$9,999	1167	1636	12.386	17.364
$10,000-$14,999	1387	3023	14.721	32.084
$15,000-$19,999	1463	4486	15.527	47.612
$20,000-$24,999	1494	5980	15.857	63.468
$25,000-$29,999	1139	7119	12.089	75.557
$30,000-$34,999	817	7936	8.671	84.228
$35,000-$49,999	1115	9051	11.834	96.062
>$50,000	371	9422	3.938	100.000
HOUSEHOLD SIZE				
1	1443	1443	15.315	15.315
2	2878	4321	30.546	45.861
3	1727	6048	18.329	64.190
4	1867	7915	19.815	84.006
5	954	8869	10.125	94.131
6	368	9237	3.906	98.037
7	112	9349	1.189	99.225
8	50	9399	0.531	99.756
9	15	9414	0.159	99.915
10	6	9420	0.064	99.979
12	2	9422	0.021	100.000
GEOGRAPHIC REGION				
New England	516	516	5.477	5.477
Middle Atlantic	1487	2003	15.782	21.259
Southeast	526	2529	5.583	26.841
Gulf	1212	3741	12.864	39.705
Great Lakes	2727	6468	28.943	68.648
East Central	1260	7728	13.373	82.021
West Central	460	8188	4.882	86.903
Southwest/Pacific	893	9081	9.478	96.381
Northwest	341	9422	3.619	100.000
URBANIZATION				
Farm	480	480	5.094	5.094
Small City	2057	2537	21.832	26.926
Large City	1912	4449	20.293	47.219
Central City	4973	9422	52.781	100.000

Table 4.3. Distribution of Households According to Socio-demographic Characteristics, continued

Variates	Number of Households	Cumulative Frequency	Percent	Cumulative Percentage
OCCUPATION OF HOUSEHOLD HEAD				
White Collar	3798	3798	40.310	40.310
Blue Collar	3352	7150	35.576	75.886
Retired and Unemp.	2272	9422	24.114	100.000
EDUCATION OF HOUSEHOLD HEAD				
Less than 7 Years	167	167	1.772	1.772
7-12 Years	4962	5129	52.664	54.436
13-16 Years	3163	8292	33.570	88.007
Greater than 16 years	1130	9422	11.993	100.000
EMPLOYMENT STATUS OF HOUSEHOLD MANAGER				
Unemployed	5053	5053	53.630	53.630
Employed	4369	9422	46.370	100.000
AGE OF HOUSEHOLD MANAGER				
At Least 44 Years of Age	4638	4638	49.225	49.225
Less Than 44 Years of Age	4784	9422	50.775	100.000
CHILDREN				
Absence of Children	5020	5020	53.280	53.280
Presence of Children	4402	9422	46.720	100.000
RACE				
White	8707	8707	92.411	92.411
Nonwhite	715	9422	7.589	100.000
RELIGION				
No Religious Affiliation	189	189	2.006	2.006
Religious Affiliation	9233	9422	97.994	100.000

about 40 percent in small and large city areas, and only 5 percent in farm areas.

Household expenditure patterns on fish and shellfish (by species and product form) by income, household size, and other socio-demographic classifications are available (see Cheng, 1985, Appendix C). The cross-tabulations of household expenditure by income, household size, and socio-demographic factors enables the examination of the gross effects of these forces on household expenditure for fishery products. In the following two chapters, attention is focused on the partial effects of socio-demographic factors on household expenditures for fish and shellfish products consumed at home.

Chapter V

STATISTICAL RESULTS AND ECONOMIC ANALYSIS -- SHELLFISH

5.1 INTRODUCTION

This chapter deals with the statistical results and economic analyses of household expenditure patterns for selected shellfish products. Those for selected finfish products follow in Chapter VI. The purposes of these two chapters are: (1) to analyze the impacts of household income, household size, price, and socio-demographic factors on household expenditure for disaggregate seafood commodities, and (2) to compare the results to other relevant studies.

A two-stage estimation procedure proposed by Heckman (1976, 1979), presented and discussed in Chapter III, is employed in this research to estimate the parameters in equation (3-10) for each of the selected categories of fishery products. The first stage of the Heckman procedure involves the use of probit analysis. The statistical results of the probit analyses, although available upon request, are not reported here. The procedure for circumventing heteroscedasticity in the Heckman procedure breaks down for 8 of the 46 categories of fishery products. A total of 46 equations are estimated using ordinary least squares (OLS); consequently, 38 of these equations are further estimated by using weighted least squares (WLS) to correct for heteroscedasticity in the Heckman procedure. Parameter estimates, associated standard errors, coefficients of determination, and other relevant statistics for the each of the equations estimated are available (see Cheng, 1985, Appendix D). In the Heckman procedure, the OLS estimates are consistent, but the WLS estimates, when implementation is possible, are statistically more efficient. In general, the OLS and WLS procedures produce similar results in terms of the direction and significance of the parameter estimates in this research. The discussion of the statistical results and economic analyses is based, where possible, on the WLS parameter estimates. Otherwise the discussion is based on the OLS parameter estimates. The effects of the explanatory variables included in this study are considered to be statistically significantly different from zero if their coefficient estimates, in absolute value, are equal to or greater than their associated standard errors.

5.2 HOUSEHOLD INCOME, HOUSEHOLD SIZE, AND PRICE

The household income, household size, and price elasticities for shellfish products are exhibited in Table 5.1. The price elasticity of demand provides a measure of how sensitive consumption is to a one-percent change in price of the product in question, holding all other factors constant. All price elasticities are negative and range from -0.1603 (other-prepared shrimp) to -1.1243 (fresh and fresh-frozen oysters). Consequently, the demand for most of the disaggregate shellfish products is inelastic. Contrary to the work of Purcell and Raunikar (1968), empirical evidence in this study indicates that price plays a statistically significant role in household expenditure on shellfish products. Furthermore, in comparing the significance and magnitude of the price elasticities with the income and household size elasticities, price is the dominant factor in explaining household expenditure on shellfish products.

In general, household income is a statistically significant factor of at-home consumption of shellfish products. As expected, a positive sign for the household income elasticity is obtained for all categories of shellfish except scallops, canned shrimp, and canned shellfish. The impacts of household income on the consumption of canned shrimp and canned shellfish are, however, not statistically significant. The results imply that, in general, quantity purchased and expenditure for shellfish products increase as household income increases. Moreover, on the basis of the magnitudes of the respective income elasticities, shellfish are normal goods. A statistically significant negative income elasticity is noted for scallops. Consequently, evidence exists to indicate that scallops consumed at home are inferior goods. However, the characteristics, consumer perceptions, and retail prices of the three scallop species -- bay, calico, and sea scallops -- are very different. Most of the households in the 1981 SCS reporting nonzero expenditures on scallops consumed at home did not provide detailed information as to which scallop species they had bought during the survey period; hence, no empirical evidence can be derived in order to indicate specifically which of the three scallop species is (are) inferior good(s). However, since sea scallops are distributed primarily through eating out establishments (ie. restaurants), the empirical evidence may suggest that for at home consumption, bay and calico scallops are inferior goods.

Household size is a key factor in explaining the variation in household consumption of shellfish products at home. Significant positive household size effects are noted for canned clams, other-prepared clams, total clams, fresh and fresh-frozen oysters, total oysters, total scallops, other-prepared shrimp, total shrimp, fresh and fresh-frozen shellfish, other-prepared shellfish, and total shellfish. The effect of household size on these products

Table 5.1. Household Income, Household Size, and Price Elasticities for Shellfish

Category	Household Income		Household Size		Price	
	OLS	WLS	OLS	WLS	OLS	WLS
Canned Clams	0.2818*	0.2856*	0.1753*	0.1823*	-0.7677*	-0.7593
Other Prepared Clams	0.0192	0.0195	0.1055*	0.1051*	-0.5301*	-0.5301*
Total Clams	0.1158*	0.1172*	0.0751*	0.0746*	-0.6084*	-0.6091*
Canned Crabs	0.1692*	0.1696*	0.0488	0.0467	-0.2282*	-0.2266*
Fresh and Fresh-Frozen Crabs	0.4628*	NA	-0.0859	NA	-0.7566*	NA
Other Prepared Crabs	0.8605*	NA	-0.3276*	NA	-0.5221*	NA
Total Crabs	0.5043*	0.5127*	-0.1533*	-0.1612*	-0.6123*	-0.6113
Canned Oysters	0.1377	0.1340	-0.0446	-0.0281	-0.8239*	-0.8315*
Fresh and Fresh-Frozen Oysters	0.0966	0.0884	0.1780*	0.1669*	-1.1194*	-1.1243*
Total Oysters	0.1975*	0.1941*	0.1488*	0.1531*	-0.8272*	-0.8252*
Total Scallops	-0.2539*	-0.2846*	0.2572*	0.2591*	-0.8109*	-0.8180*
Canned Shrimp	-0.0628	-0.0529	-0.0691	-0.0699	-0.2047*	-0.1967*
Fresh and Fresh-Frozen Shrimp	0.0536	0.0701	0.0927	0.0903	-0.6910*	-0.6897*
Other Prepared Shrimp	0.1307*	0.1276*	0.1231*	0.1238*	-0.1615*	-0.1603*
Total Shrimp	0.1285*	0.0899*	0.0820*	0.0828*	-0.6831*	-0.6828*
Canned Shellfish	-0.0099	-0.0080	-0.0865*	-0.0876*	-0.5808*	-0.5793*
Fresh and Fresh-Frozen Shellfish	0.1150*	0.1240*	0.0808*	0.0774*	-0.9045*	-0.9053*
Other Prepared Shellfish	0.0825	0.0806	0.0860*	0.0864*	-0.3506*	-0.3501*
Total Shellfish	0.1036*	0.1026*	0.0617*	0.0614*	-0.6308*	-0.6309*

* The coefficient estimate is considered to be statistically significant if in absolute value, this estimate is equal to or greater than the associated standard error (see Cheng, 1985, Appendix D).
NA: Not available

is inelastic. For other-prepared crabs, total crabs, and canned shellfish, significant negative household size elasticities are obtained ranging from -0.0865 to -0.3276.

5.3 GEOGRAPHIC REGION

Differences in expenditure for shellfish products due to geographic region relative to the Northwest are statistically significant for all categories of shellfish except canned shrimp, other-prepared shrimp, and fresh and fresh-frozen oysters. The percentage deviation of shellfish expenditure by households located in regions other than the Northwest from shellfish expenditure by households located in the Northwest is presented in Table 5.2. For example, households located in New England spend 14.15 percent less on canned clams than households located in the Northwest.

As clam markets are highly concentrated in New England, Middle Atlantic, and Pacific regions (Miller and Nash, 1971), no statistically significant differences exist in expenditure for total clams among households located in these regions and households located in the Northwest. On the other hand, households located in other regions spend 17.16 percent to 37.24 percent less on total clams than households located in the Northwest.

Households located in the Northwest spend more on total crabs than households located in other regions of the United States except the New England and Middle Atlantic regions. However, no statistically significant differences exist in expenditure on total crabs among households located in New England, the Middle Atlantic, or the Northwest.

Households located in New England spend 44.78 percent less on total oysters than households located in the Northwest, while households located in the Southeast spend 27.94 percent more on total oysters than households located in the Northwest. For all other regions, expenditures on total oysters relative to the Northwest are statistically the same. On the other hand, expenditures on total scallops by households located in New England and the Middle Atlantic are roughly 50 percent lower relative to expenditures by households located in the Northwest. Households located in the Great Lakes and East Central regions spend substantially more on total scallops than do households located in the Northwest.

In agreement with Miller and Nash (1971) and Nash (1971), shrimp products have a fairly even distribution among the regions of the United States. For canned shrimp and other-prepared shrimp, no statistically significant differences in expenditures due to region relative to the Northwest are found. In general,

Table 5.2. Percentage Change in Expenditure for Shellfish by Geographic Region (Reference Category: the Northwest)

Category	New England	Mid Atlantic	South-east	Gulf	Great Lakes	East Central	West Central	S.West/ Pacific
Canned Clams	-15.13* (-14.15)	-19.20 (-19.22)	-60.16* (-60.46*)	-62.00* (-62.27*)	-54.42* (-54.83*)	-58.49* (-58.28*)	-15.62 (-15.37)	- 6.15 (- 6.06)
Other Prepared Clams	- 8.14 (- 8.36)	-14.25* (-14.30*)	-28.74* (-28.68*)	-30.32* (-30.12*)	-25.14 (-25.01)	-28.26 (-27.99)	-14.83 (-14.79)	-13.47 (-13.54)
Total Clams	8.17 (8.40)	- 2.81 (- 2.62)	-34.03* (-33.95*)	-36.51* (-36.28*)	-30.63* (-30.46*)	-37.35* (-37.24*)	-17.20* (-17.16*)	- 3.88 (- 3.94)
Canned Crabs	7.24 (7.74)	- 9.87 (-10.01)	-13.56 (-14.38)	-20.45 (-20.36)	-28.55* (-28.64*)	-24.15 (-24.08)	-20.54 (-20.53)	-24.44* (-24.21*)
Fresh and Fresh-Frozen Crabs	-48.71* (NA)	25.18 (NA)	6.41 (NA)	-11.08 (NA)	-20.17 (NA)	-38.94 (NA)	3.66 (NA)	- 4.33 (NA)
Other Prepared Crabs	26.46 (NA)	191.75* (NA)	78.59* (NA)	23.32 (NA)	14.04 (NA)	-54.90* (NA)	-35.17 (NA)	-13.80 (NA)
Total Crabs	- 0.31 (0.62)	15.62 (15.71)	-23.31* (-24.45*)	-22.04* (-22.53*)	-27.11* (-27.60*)	-37.34* (-38.24*)	-26.83* (-26.91*)	-23.69* (-23.62*)
Canned Oysters	-14.38 (-14.36)	- 5.16 (- 2.06)	65.14* (66.19*)	-12.53 (-10.44)	3.98 (5.70)	23.68 (24.77)	29.91 (29.63)	20.85 (23.26)
Fresh and Fresh-Frozen Oysters	-35.77 (-32.50)	20.70 (25.10)	17.91 (18.03)	11.55 (13.84)	- 7.66 (- 4.48)	30.28 (36.36)	-23.76 (-21.31)	-27.43 (-24.05)
Total Oysters	-45.14* (-44.78*)	- 6.84 (- 5.88)	27.82* (27.94*)	-15.87 (-15.67)	-23.88 (-23.23)	-17.94 (-17.21)	-19.24 (-19.24)	-29.29 (28.46)
Total Scallops	-56.14* (-59.59*)	-44.52* (-47.07*)	-14.93 (-11.55)	5.48 (11.37)	35.12 (42.98*)	152.81* (179.93*)	0.69 (7.25)	5.61 (9.49)
Canned Shrimp	5.59 (4.78)	67.01 (61.50)	132.84 (124.79)	111.10 (102.80)	64.01 (59.18)	75.57 (67.94)	34.90 (32.17)	34.84 (31.47)
Fresh and Fresh-Frozen Shrimp	30.50* (30.86*)	47.60* (48.91*)	55.44* (55.61*)	82.29* (82.69*)	39.69* (39.11*)	108.78* (105.73*)	27.58* (28.08*)	- 1.57 (- 1.66)
Other Prepared Shrimp	-13.07 (-13.72)	3.90 (3.55)	- 5.82 (- 6.02)	6.60 (6.07)	8.35 (7.95)	-12.15 (-12.35)	- 3.87 (- 4.82)	- 9.14 (- 9.50)
Total Shrimp	6.30 (6.04)	30.04* (29.47*)	39.00* (37.43*)	45.45* (43.72*)	30.52* (29.21*)	27.67* (25.52*)	13.61 (12.43)	11.22 (10.35)
Canned Shellfish	6.62 (7.11)	26.48 (26.77)	50.38* (50.74*)	24.46 (24.98)	26.96 (27.25)	37.51 (38.01)	1.44 (1.54)	23.50* (23.26*)
Fresh and Fresh-Frozen Shellfish	-15.66* (-15.31*)	13.41 (13.89)	10.87 (10.49)	24.88* (24.41*)	1.96 (1.72)	45.86* (44.79*)	4.26 (4.07)	-10.53 (-10.81)
Other Prepared Shellfish	- 3.47 (- 3.76)	- 6.75 (- 6.97)	-18.24* (-18.26*)	-18.49* (-18.44*)	-16.49* (-16.45*)	-31.49* (-31.45*)	-11.93 (-12.00)	-17.68* (-17.65*)
Total Shellfish	- 8.36 (- 7.78)	13.94* (14.45*)	9.66 (10.31)	12.37 (12.90)	- 0.98 (- 0.08)	- 2.81 (- 1.96)	- 1.33 (- 1.23)	- 3.20 (- 2.45)

Calculated value based on associated OLS estimates. Values based on GLS estimates are in parentheses.

* The coefficient estimate is considered to be statistically significant if in absolute value, this value is equal to or greater than the associated standard error (see Cheng, 1985).

households located outside the Pacific coast area spend more on fresh and fresh-frozen shrimp and total shrimp than households located in the Northwest; no significant differences in expenditures are noted for these two shrimp products among households located either in the Southwest/Pacific region or in the Northwest.

In general, the regional expenditure patterns for aggregate shellfish are not the same as the regional expenditure patterns for disaggregate shellfish products. Households located in the Middle Atlantic states spend 14.45 percent more on total shellfish than do households located in the Northwest, while households located in other regions spend roughly the same amounts as those households located in the reference region. For fresh and fresh-frozen shellfish, households located in the Gulf and East Central Regions spend substantially more than households located in the Northwest. Households located in New England spend about 15 percent less on fresh and fresh-frozen shellfish for at-home consumption than households located in the Northwest.

5.4 URBANIZATION (OR POPULATION DENSITY)

The percentage deviation of expenditures for shellfish by households located either in farm areas, small city areas (with less than 50,000 population), or large city areas (with 50,000 to 499,999 population) from expenditures for shellfish by households located in central city areas (with 500,000 and over population) is shown in Table 5.3. Clams, oysters, total crabs, fresh and fresh-frozen shellfish, and total shellfish are the shellfish categories for which no statistically significant differences in expenditures exist due to population density relative to central city areas.

Households located in farm areas spend 106.65 percent more on total scallops and 36.39 percent more on other-prepared shrimp, but 22.15 percent less on canned shrimp than households located in central city areas. For households located in small city areas, expenditures on canned crab,fresh and fresh-frozen shrimp, and canned shellfish are about 13 percent to 18 percent higher than those by households located in central city areas. Expenditures on other-prepared crabs by households located in small city areas are 32.3 percent lower than those households located in central city areas. In addition, households located in large cities spend more for total scallops and canned shrimp but spend less for fresh and fresh-frozen and other-prepared crabs, other-prepared shrimp, and other-prepared shellfish than households located in central cities. Ceteris paribus, differences in population density help explain the differences in expenditure patterns on certain shellfish products.

Table 5.3. Percentage Change in Expenditure for Shellfish by Urbanization (Reference Category: Central City Areas[1])

Category	Farm OLS	Farm WLS	Small City[2] OLS	Small City[2] WLS	Large City[3] OLS	Large City[3] WLS
	---------- Percent ----------					
Canned Clams	-23.92	-24.63	+ 9.12	+ 8.93	- 8.49	- 8.42
Other-Prepared Clams	-21.58	-21.41	+ 0.91	+ 1.00	+ 0.52	+ 0.69
Total Clams	-11.08	-11.00	+ 0.22	- 0.04	- 1.81	- 1.73
Canned Crabs	- 3.84	- 3.48	+16.33*	+16.26*	+10.53	+10.67
Fresh and Fresh-Frozen Crabs	+ 6.09	NA	+14.68	NA	-14.91*	NA
Other-Prepared Crabs	-26.98	NA	-32.30*	NA	-23.78*	NA
Total Crabs	+ 2.07	+ 2.34	+ 4.55	+ 4.93	- 2.26	- 1.95
Canned Oysters	+ 3.42	+ 1.80	+ 5.36	+ 5.19	- 3.15	- 4.42
Fresh and Fresh-Frozen Oysters	- 7.15	- 6.33	-14.29	-15.22	- 1.18	- 2.84
Total Oysters	+ 9.70	+ 8.91	+12.34	+11.62	+12.63*	+11.83
Total Scallops	+69.97	+106.65*	+ 2.14	+ 2.89	+27.82*	+28.65*
Canned Shrimp	-22.76*	-22.15*	+ 0.67	+ 0.76	+13.04*	+12.26*
Fresh and Fresh-Frozen Shrimp	- 5.07	- 6.58	+15.62*	+14.57*	+ 3.45	+ 2.64
Other-Prepared Shrimp	+35.29*	+36.39*	+ 0.05	+ 0.48	- 9.14*	- 9.03*
Total Shrimp	- 1.65	- 1.42	+13.00*	+12.58*	+ 0.34	- 0.23
Canned Shellfish	- 6.10	- 6.18	+18.57*	+18.43*	+ 2.51	- 2.30
Fresh and Fresh-Frozen Shellfish	-13.35	-12.63	+ 3.56	+ 3.29	- 5.89	- 5.93
Other-Prepared Shellfish	+13.55	+13.96	+ 0.65	+ 0.75	- 5.50*	- 5.46*
Total Shellfish	- 4.48	- 4.06	+ 4.33	+ 4.61	- 2.88	- 2.75

[1] with 500,000 and over population.
[2] with less than 50,000 population.
[3] with 50,000 to 499,999 population.
* The coefficient estimate is considered to be statistically significant if in absolute value, this estimate is equal to or greater than the associated standard error (see Cheng, 1985, Appendix D).
NA: Not available

5.5 OCCUPATION AND EDUCATION OF HOUSEHOLD HEAD

The percentage deviation in expenditures for shellfish by households with a household head who is either a blue collar worker or a white collar worker from expenditures for shellfish by households with either a retired or unemployed household head is presented in Table 5.4. Differences in expenditures, due to

Table 5.4. Percentage Change in Expenditure for Shellfish by Occupation of Household Head (Reference Category: Retired and Unemployed)

Category	White Collar OLS	White Collar WLS	Blue Collar OLS	Blue Collar WLS
	---------- Percent ----------			
Canned Clams	-15.49*	-15.37*	-21.75*	-22.33*
Other Prepared Clams	- 2.06	- 1.93	+ 8.04	+ 8.20
Total Clams	- 4.87	- 4.73	- 1.12	- 0.84
Canned Crabs	+ 8.59	+ 8.99	+23.63*	+23.86*
Fresh and Fresh-Frozen Crabs	+ 6.55	NA	+25.68*	NA
Other-Prepared Crabs	-30.87*	NA	38.61*	NA
Total Crabs	- 8.23	- 8.22	- 5.56	- 5.98
Canned Oysters	- 1.48	- 1.05	+4.95	+ 5.53
Fresh and Fresh-Frozen Oysters	- 2.30	- 1.76	-20.58*	-19.78*
Total Oysters	- 2.02	- 2.39	-13.96*	-13.61*
Total Scallops	+16.89*	+19.28*	+31.43*	+35.22*
Canned Shrimp	-11.57*	-11.72*	+ 0.97	+ 0.04
Fresh and Fresh-Frozen Shrimp	- 7.41	- 7.53	- 5.38	- 5.67
Other-Prepared Shrimp	+ 5.08	+ 5.25	+ 0.76	+ 0.77
Total Shrimp	- 2.47	- 2.22	- 4.24	- 3.93
Canned Shellfish	+ 5.88	+ 5.81	+13.48*	+13.46*
Fresh and Fresh-Frozen Shellfish	- 1.07	- 1.33	- 6.38	- 6.50
Other-Prepared Shellfish	- 2.26	- 2.01	+ 4.29	+ 4.31
Total Shellfish	+ 2.66	+ 2.40	- 0.77	- 0.97

* The coefficient estimate is considered to be statistically significant if in absolute value, this estimate is equal to or greater than associated standard error (see Cheng, 1985, Appendix D).
NA: Not available

occupation of the household head relative to retired or unemployed household heads, for other-prepared and total clams, total crabs, canned oysters, all categories of shrimp except canned shrimp, and all categories of total shellfish except canned shellfish are nonexistent.

Households headed by retired or unemployed individuals spend more on canned clams and other-prepared crabs than households headed by either white collar workers or blue collar workers. Households headed by blue collar workers spend more on canned crabs, fresh and fresh-frozen crabs, total scallops, and canned shellfish than households with retired or unemployed household heads; moreover, expenditures on fresh and fresh-frozen oysters and total oysters by households headed by blue collar workers are lower than for households headed by retired or unemployed individuals. Further, households headed by white collar workers spend more on total scallops and less on canned shrimp than households with retired or unemployed individuals. Previous works (Perry, 1981; Capps, 1982) on broad aggregates of fish and shellfish indicate that occupation of household head was not a statistically important factor in the explanation of household expenditure patterns. However, the results of this study indicate that this factor influences household expenditure for some, although not all, specific categories of shellfish products.

The percentage change in expenditure for shellfish due to unit changes in the education level of the household head is depicted in Table 5.5. Education of household head has positive impacts on household expenditures for all categories of clams and crabs, but negative impacts on household expenditures for all categories of oysters, scallops, shrimp, and shellfish. The education of the household head statistically influences expenditures for canned clams, all categories of crabs, total scallops, canned oysters, other-prepared shrimp, and total shrimp.

5.6 EMPLOYMENT STATUS AND AGE OF HOUSEHOLD MANAGER

The percentage deviation of expenditures on shellfish by households with employed household managers from expenditure on shellfish by households with unemployed household managers is given in Table 5.6. In general, with three exceptions, households wherein the household manager is employed spend less on shellfish products consumed at home. The greatest difference occurs in expenditure for other-prepared crabs; households with employed household managers spend 23.35 percent less than households with unemployed household managers. These results suggest that households with working household managers, who presumably have less time for meal preparation, spend more on shellfish products in restaurants or other eating-out establishments. On the other hand, canned clams, fresh and fresh-frozen oysters, and total scallops are the only categories of shellfish for which households

Table 5.5. Percentage Change in Expenditure for Shellfish by One-Year Increases in Education of Household Head

Category	OLS	WLS
	------- Percent ------	
Canned Clams	+ 2.55*	+ 2.57*
Other-Prepared Clams	+ 0.87	+ 0.86
Total Clams	+ 1.44	+ 1.44
Canned Crabs	+ 2.70*	+ 2.71*
Fresh and Fresh-Frozen Crabs	+ 2.05*	NA
Other-Prepared Crabs	+ 8.26*	NA
Total Crabs	+ 4.16*	+ 4.20*
Canned Oysters	- 2.10*	- 2.16*
Fresh and Fresh-Frozen Oysters	- 0.29	- 0.46
Total Oysters	- 1.08	- 1.05
Total Scallops	- 6.89*	- 7.65*
Canned Shrimp	- 1.47	- 1.58
Fresh and Fresh-Frozen Shrimp	- 1.41	- 1.27
Other-Prepared Shrimp	- 2.04*	- 2.06*
Total Shrimp	- 2.00*	- 1.96*
Canned Shellfish	- 0.85	- 0.86
Fresh and Fresh-Frozen Shellfish	- 0.51	- 0.43
Other-Prepared Shellfish	- 0.30	- 0.32
Total Shellfish	- 0.37	- 0.40

* The coefficient estimate is considered to be statistically significant if in absolute value, this estimate is equal to or greater than the associated standard error (see Cheng, 1985, Appendix D).
NA: Not available

with employed household managers have lower expenditures than households with unemployed household managers.

The percentage deviation of expenditures on shellfish by households wherein the household manager is less than 44 years of age from expenditures on shellfish by households with the household manager at least 44 years of age is presented in Table 5.6. When statistically significant differences in expenditure on shellfish occur, households with younger household managers have lower expenditure than households with older household managers.

Table 5.6. Percentage Change in Expenditure for Shellfish by Employment Status and Age of Household Manager (Reference Category: Unemployed and At least 44 years of Age)

Category	Employed		Less Than 44 Years of Age	
	OLS	WLS	OLS	WLS
	---------- Percent ----------			
Canned Clams	+ 1.42	+ 1.45	-22.34*	-22.39*
Other-Prepared Clams	- 3.23	- 3.38	-18.31*	-18.20*
Total Clams	- 1.91	- 2.01	-16.43*	-16.19*
Canned Crabs	-15.47*	-15.43*	- 3.33	- 3.56
Fresh and Fresh-Frozen Crabs	- 2.63	NA	-10.78	NA
Other-Prepared Crabs	-23.35*	NA	-56.06*	NA
Total Crabs	- 9.72*	- 9.57*	-28.59*	-28.58*
Canned Oysters	-12.20	-11.96	-28.57	-28.28
Fresh and Fresh-Frozen Oysters	+ 4.92	+ 4.47	+ 7.51	+10.95
Total Oysters	- 7.95*	- 7.96*	-25.66	-25.57
Total Scallops	+ 9.65	+10.92*	+ 6.97	+ 8.97
Canned Shrimp	- 1.76	- 2.66	+11.90	+11.01
Fresh and Fresh-Frozen Shrimp	- 6.25	- 6.02	- 5.20	- 5.95
Other-Prepared Shrimp	- 6.41*	- 6.43*	- 8.29	- 8.34
Total Shrimp	-11.59*	-11.47*	- 4.27	- 4.80
Canned Shellfish	- 6.10*	- 6.31*	- 2.34	- 2.39
Fresh and Fresh-Frozen Shellfish	- 2.28	- 1.98	+ 3.89	+ 3.74
Other-Prepared Shellfish	- 4.83*	- 4.86*	-16.85*	-16.72*
Total Shellfish	- 6.12*	- 5.98*	- 9.19*	- 8.83*

* The coefficient estimate is considered to be statistically significant if in absolute value, this estimate is equal to or greater than the associated standard error (see Cheng, 1985, Appendix D).
NA: Not available.

The largest impact of the age of household manager occurs for expenditure for other-prepared crabs; households with the household managers less than 44 years of age spend 56.06 percent less than households with older household managers.

In general, households wherein the household manager is employed and less than 44 years of age spend less on shellfish

products than households wherein the household manager is unemployed and at least 44 years of age. The opportunity cost of the working household manager's time and the development of seafood consumption habits, due to differences in values and lifestyles, may directly influence household expenditure patterns for at-home consumption of shellfish products.

5.7 PRESENCE OR ABSENCE OF CHILDREN

The percentage deviation of expenditures on shellfish by households with at least one child from expenditures on shellfish by households with no children is shown in Table 5.7. The presence of children, ceteris paribus, leads to significant positive effects on expenditures for other-prepared clams, total clams, other-prepared crabs, total crabs, and other-prepared shellfish. Of these effects, the most notable is on expenditures for other-prepared crabs; households with children spend 61.28 percent more than households with no children. However, the presence of children, ceteris paribus, leads to significant negative effects on expenditures for canned crabs, fresh and fresh-frozen oysters, total oysters, and fresh and fresh-frozen shrimp. No statistically significant differences in household expenditures due to presence of children exist for the remaining shellfish products.

5.8 RELIGION

The percentage change in expenditures on shellfish due to religious status is shown in Table 5.8. Other-prepared shrimp is the only category of shellfish for which households with religious affiliation expend more than households with no religious affiliation. Households with religious affiliation spend less on canned clams, other-prepared clams, total clams, total oysters, and canned shellfish than households with no religious affiliation. The most notable difference in this case is for canned clams; households with religious affiliation spend about 40 percent less than households with no religious affiliation. For the remaining categories of shellfish products, no statistically significant differences exist due to religious status.

Table 5.7. Percentage Change in Expenditure for Shellfish by Presence or Absence of Children (Reference Category: Absence of Children)

Category	Presence of Children	
	OLS	WLS
	------- Percent ------	
Canned Clams	- 7.42	- 7.60
Other-Prepared Clams	+13.38*	+13.06*
Total Clams	+10.00*	+ 9.54*
Canned Crabs	-13.32*	-13.31*
Fresh and Fresh-Frozen Crabs	- 3.65	NA
Other-Prepared Crabs	+61.28*	NA
Total Crabs	+18.77*	+18.79*
Canned Oysters	- 9.44	-10.14
Fresh and Fresh-Frozen Oysters	-23.77*	-22.99*
Total Oysters	-25.88*	-25.72*
Total Scallops	-11.88	-10.55
Canned Shrimp	+ 0.76	+ 2.53
Fresh and Fresh-Frozen Shrimp	-11.42*	-11.89*
Other-Prepared Shrimp	+ 0.31	+ 0.34
Total Shrimp	- 3.42	- 3.53
Canned Shellfish	+ 7.30	+ 7.63
Fresh and Fresh-Frozen Shellfish	- 6.78	- 7.70
Other-Prepared Shellfish	+13.16*	+12.97*
Total Shellfish	+ 0.56	+ 0.46

* The coefficient estimate is considered to be statistically significant if in absolute value, this estimate is equal to or greater than the associated standard error (see Cheng, 1985, Appendix D).
NA: Not available.

Table 5.8. Percentage Change in Expenditure for Shellfish by Religious Status[1] (Reference Category: No Religious Affiliation)

Category	With Religious Affiliation	
	OLS	WLS
	------ Percent -------	
Canned Clams	-41.64*	-40.76*
Other-Prepared Clams	-22.06*	-22.48*
Total Clams	-19.91*	-20.22*
Canned Crabs	-13.05	-13.21
Fresh and Fresh-Frozen Crabs	- 2.22	NA
Other-Prepared Crabs	+17.65	NA
Total Crabs	-18.01	-18.34
Canned Oysters	-14.06	-13.38
Fresh and Fresh-Frozen Oysters	-11.25	-10.65
Total Oysters	-21.67*	-21.20*
Total Scallops	+16.90	+15.57
Canned Shrimp	- 9.50	- 8.87
Fresh and Fresh-Frozen Shrimp	+12.74	+12.38
Other-Prepared Shrimp	+28.79*	+28.92*
Total Shrimp	+12.16	+12.14
Canned Shellfish	-21.57*	-20.50*
Fresh and Fresh-Frozen Shellfish	+ 2.57	+ 2.99
Other-Prepared Shellfish	+ 7.78	+ 7.29
Total Shellfish	- 2.52	- 1.88

[1] Protestant, Catholic, Jewish, and other.

* The coefficient estimate is considered to be statistically significant if in absolute value, this estimate is equal to or greater than the associated standard error (see Cheng, 1985, Appendix D).

NA: Not available.

5.9 RACE

The percentage deviation of expenditures on shellfish by nonwhite households from expenditures for shellfish by white households is exhibited in Table 5.9. In general, nonwhite households spend more on shellfish products than do white households. In particular, nonwhite households expend 80 to 180 percent more on fresh and fresh-frozen crabs, on other-prepared crabs, and on total crabs than white households. Canned clams is

Table 5.9. Percentage Change in Expenditure for Shellfish by Race (Reference Category: White Household)

Category	Nonwhite Household OLS	WLS
	------- Percent -------	
Canned Clams	- 21.74*	- 22.90*
Other-Prepared Clams	+ 3.82	+ 4.05
Total Clams	- 4.55	- 4.86
Canned Crabs	+ 40.00*	+ 40.35*
Fresh and Fresh-Frozen Crabs	+ 82.66*	NA
Other-Prepared Crabs	+186.18*	NA
Total Crabs	+100.24*	+ 99.41*
Canned Oysters	+ 44.73*	+ 43.80*
Fresh and Fresh-Frozen Oysters	+ 21.18	+ 18.76
Total Oysters	+ 58.66*	+ 57.75*
Total Scallops	+ 26.97	+ 33.12*
Canned Shrimp	+ 2.14	+ 1.22
Fresh and Fresh-Frozen Shrimp	+ 12.15	+ 13.32*
Other-Prepared Shrimp	- 3.64	- 3.54
Total Shrimp	+ 8.88*	+ 8.93*
Canned Shellfish	+ 13.33*	+ 13.36*
Fresh and Fresh-Frozen Shellfish	+ 24.09*	+ 24.16*
Other-Prepared Shellfish	+ 18.93*	+ 18.57*
Total Shellfish	+ 29.01*	+ 28.31*

* The coefficient estimate is considered to be statistically significant if in absolute value, this estimate is equal to or greater than the associated standard error (see Cheng, 1985, Appendix D).
NA: Not available.

the only category for which nonwhite households spend less (22.90 percent) than white households. Previous works confirm the result that nonwhite households expend more on fishery products than white households [Purcell and Raunikar, 1968; Nash, 1971; Perry, 1981; and Capps, 1982].

5.10 SEASON

The percentage deviation of expenditures by season from winter quarter expenditures on selected shellfish categories is shown in Table 5.10. The respective percentage deviations shown in this table may be inflated due to the specification of the qualitative variables for the seasonal factor in this study. When a household reported expenditures on a shellfish product in more than one season, seasonal preference was designated as the season in which the household spent the most on the product in question.

Expenditures on shellfish in the winter quarter are generally lower than in the other seasons, with two exceptions. Expenditures on fresh and fresh-frozen oysters in the summer quarter and on total scallops in the fall quarter are lower than in the winter quarter. Those categories for which households expenditure differs the most from the winter quarter are total shellfish (spring and summer), other-prepared crabs (summer), total crabs (spring and summer), and total oysters (summer). No statistically significant differences due to season relative to the winter quarter exist for expenditure on canned clams, other-prepared clams, or fresh and fresh-frozen crabs.

5.11 COUPON VALUE AND SEAFOOD OUTLET

Coupon values have significant positive effects on household expenditure for all categories of shellfish except fresh and fresh-frozen oysters. The percentage change in expenditures for shellfish due to a one-cent change in coupon value is presented in Table 5.11. The largest impacts of coupon value on shellfish expenditures are for clams, crabs, and shrimp.

With regard to seafood outlet, the effects on expenditure of the kind of stores where seafood purchases are made are mixed. The percentage deviation of expenditures for shellfish made at the supermarket and the grocery store from expenditures for shellfish made at other store locations is presented in Table 5.12. For at-home consumption, households spend less on canned clams, total clams, canned oysters, total oysters, canned shellfish, and total shellfish at the supermarket and the grocery store than at other stores. On the other hand, households expend more on other-prepared crabs, fresh and fresh-frozen shrimp, other-prepared shrimp, and fresh and fresh-frozen shellfish at the supermarket and the grocery store than at other stores. For other-prepared clams, canned crabs, fresh and fresh-frozen crabs, total crabs,

Table 5.10. Percentage Change in Expenditure for Shellfish by Season (Reference Category: Winter Quarter)

Category	Spring		Summer		Fall	
	OLS	WLS	OLS	WLS	OLS	WLS
	Percent					
Canned Clams	- 0.90	- 0.68	+ 2.35	+ 2.96	+ 1.36	+ 1.28
Other-Prepared Clams	- 1.29	- 0.94	+ 7.85	+ 7.88	+ 4.26	+ 4.29
Total Clams	+ 7.80*	+ 8.17*	+10.81*	+10.83*	+ 3.77	+ 3.75
Canned Crabs	+13.02*	+13.28*	+26.43*	+26.64*	+11.14*	+11.04*
Fresh and Fresh-Frozen Crabs	+ 6.79	NA	- 6.51	NA	- 7.68	NA
Other-Prepared Crabs	+26.33*	NA	+30.70*	NA	+24.72*	NA
Total Crabs	+27.01*	+26.92*	+29.36*	+29.40*	+18.59*	+18.51*
Canned Oysters	+19.66*	+20.50*	+23.75*	+25.73*	+14.85*	+17.21*
Fresh and Fresh-Frozen Oysters	+13.23	+13.50	-23.09*	-23.27*	+18.59*	+19.37*
Total Oysters	+ 2.38	+ 3.09	+31.54*	+33.98*	+22.72*	+23.40*
Total Scallops	- 7.04	- 8.53	- 7.11	- 7.33	-19.92*	-20.49*
Canned Shrimp	+12.03*	+14.04*	- 6.41	- 6.09	- 0.35	+ 0.61
Fresh and Fresh-Frozen Shrimp	- 2.04	- 0.55	+12.01*	+11.83*	+ 9.51*	+ 9.77*
Other-Prepared Shrimp	+11.08*	+10.87*	+11.38*	+11.25*	+ 6.31	+ 6.19
Total Shrimp	+13.16*	+13.30*	+15.99*	+15.85*	+14.56*	+14.59*
Canned Shellfish	+ 6.73	+ 7.02	+ 5.62	+ 5.97	+ 6.64*	+ 6.69*
Fresh and Fresh-Frozen Shellfish	+23.80*	+23.74*	+24.44*	+24.76*	+ 9.23*	+ 9.41*
Other-Prepared Shellfish	+12.26*	+12.24*	+17.68*	+17.40*	+ 5.06	+ 5.03
Total Shellfish	+30.28*	+30.28*	+31.47*	+31.47*	+18.06*	+17.93*

* The coefficient estimate is considered to be statistically significant if in absolute value, this estimate is equal to or greater than the associated standard error (see Cheng, 1985, Appendix D).
NA: Not available

Table 5.11. Percentage Change in Expenditure for Shellfish Due to One-Cent Increases in Coupon Value

Category	OLS	WLS
	------- Percent --------	
Canned Clams	+ 0.724*	+ 0.728*
Other-Prepared Clams	+ 0.753*	+ 0.754*
Total Clams	+ 0.771*	+ 0.773*
Canned Crabs	+ 0.457*	+ 0.452*
Fresh and Fresh-Frozen Crabs	+ 0.558*	NA
Other-Prepared Crabs	+ 0.499*	NA
Total Crabs	+ 0.464*	+ 0.465*
Canned Oysters	+ 0.387*	+ 0.379*
Fresh and Fresh-Frozen Oysters	+ 0.028	+ 0.002
Total Oysters	+ 0.423*	+ 0.435*
Total Scallops	+ 0.225*	+ 0.229*
Canned Shrimp	+ 0.443*	+ 0.435*
Fresh and Fresh-Frozen Shrimp	+ 0.475*	+ 0.464*
Other-Prepared Shrimp	+ 0.574*	+ 0.572*
Total Shrimp	+ 0.511*	+ 0.507*
Canned Shellfish	+ 0.533*	+ 0.534*
Fresh and Fresh-Frozen Shellfish	+ 0.416*	+ 0.415*
Other-Prepared Shellfish	+ 0.629*	+ 0.631*
Total Shellfish	+ 0.516*	+ 0.519*

* The coefficient estimate is considered to be statistically significant if in absolute value, this estimate is equal to or greater than the associated standard error (see Cheng, 1985, Appendix D)
NA: Not available.

fresh and fresh-frozen oysters, total scallops, canned shrimp, total shrimp, and other-prepared shellfish, no differences in expenditures for at-home consumption exist due to seafood outlets.

Table 5.12. Percentage Change in Expenditure for Shellfish by Seafood Outlet (Reference category: Variety Stores[1])

Category	Supermarket and Grocery Store	
	OLS	WLS
	------- Percent -------	
Canned Clams	-25.04*	-24.32*
Other-Prepared Clams	- 5.79	- 5.59
Total Clams	-24.93*	-24.46*
Canned Crabs	- 8.46	- 8.60
Fresh and Fresh-Frozen Crabs	+ 6.47	NA
Other-Prepared Crabs	+80.25*	NA
Total Crabs	- 4.79	- 3.78
Canned Oysters	-41.64*	-41.73*
Fresh and Fresh-Frozen Oysters	- 0.44	- 0.23
Total Oysters	-12.27*	-12.45*
Total Scallops	- 2.43	- 1.58
Canned Shrimp	- 4.89	- 4.21
Fresh and Fresh-Frozen Shrimp	+50.63*	+51.30*
Other-Prepared Shrimp	+11.45*	+11.62*
Total Shrimp	+ 5.73	+ 5.72
Canned Shellfish	-28.28*	-28.04*
Fresh and Fresh-Frozen Shellfish	+28.91*	+29.42*
Other-Prepared Shellfish	- 5.96	- 5.72
Total Shellfish	-29.27*	-28.96*

[1] Health food store, drug store, department store, discount store, house to house, mail order, and other.

* The coefficient estimate is considered to be statistically significant if in absolute value, this estimate is equal to or greater than the associated standard error (see Cheng, 1985, Appendix D).

NA: Not available.

5.12 SAMPLE SELECTION BIAS

The estimated coefficients associated with the parameter λ derived from the probit model specification in this research are presented in Table 5.13. For 11 of the 19 categories of shellfish products, the estimates of the parameter λ are statistically different from zero. This result indicates the existence of sample selection bias in these cases. Consequently, deleting zero expenditure observations from the analysis of the 11 categories of shellfish products (canned clams, fresh and fresh-frozen crabs, other-prepared crabs, total crabs, total scallops, canned shrimp, fresh and fresh-frozen shrimp, total shrimp, canned shellfish, fresh and fresh-frozen shellfish, and total shellfish) is inappropriate from a statistical point of view. The use of the Heckman sample selection procedure in these cases is essential to eliminate the sample selection bias problem.

Table 5.13. Evidence of Sample Selection Bias: Estimates of the Coefficients Associated with the Parameter λ

Category	OLS	WLS
Canned Clams	0.8620*	0.8851*
Other-Prepared Clams	0.0115	0.0048
Total Clams	0.1808	0.1803
Canned Crabs	0.3934	0.3956
Fresh and Fresh-Frozen Crabs	0.7878*	NA
Other-Prepared Crabs	2.7160*	NA
Total Crabs	0.8275*	0.8538*
Canned Oysters	0.4894	0.4516
Fresh and Fresh-Frozen Oysters	-0.1406	-0.2089
Total Oysters	0.6978	0.6760
Total Scallops	-1.4287*	-1.6084*
Canned Shrimp	-0.9941*	-0.9539*
Fresh and Fresh-Frozen Shrimp	-0.6842*	-0.6195*
Other-Prepared Shrimp	0.3228	0.3001
Total Shrimp	-0.4663*	-0.4269*
Canned Shellfish	-0.6638*	-0.6648*
Fresh and Fresh-Frozen Shellfish	-0.6862*	-0.6633*
Other-Prepared Shellfish	0.0215	0.0129
Total Shellfish	-0.5800*	-0.5881*

*The coefficient estimate is considered to be statistically significant if in absolute value, this estimate is equal to or greater than the associated standard error (see Cheng, 1985, Appendix D).
NA: Not available

Chapter VI

STATISTICAL RESULTS AND ECONOMIC ANALYSIS -- FINFISH

6.1 HOUSEHOLD INCOME, HOUSEHOLD SIZE, AND PRICE

Household income, household size, and price elasticities of demand for finfish products are presented in Table 6.1. As for shellfish products, price is the dominant factor influencing household expenditures for finfish products. All price elasticities, except for canned tuna, are negative, and household responses to changes in price are inelastic.

The effect of household income on household expenditure for finfish products is mixed. Significant positive impacts are found for fresh and fresh-frozen flounder/sole, fresh and fresh-frozen haddock, other-prepared herring, total herring, canned tuna, canned finfish, and total finfish. The income elasticities of demand indicate that these products are normal goods. Significant negative income elasticities are found for other-prepared flounder/sole, other-prepared haddock, other-prepared perch, and other-prepared finfish, suggesting that these products are inferior goods.

Household size is consistently found to have significant positive effects on household expenditures on finfish products. Where statistical significance occurs, household size elasticities range from 0.1747 to 0.5005. Finfish expenditures are generally more sensitive to changes in household size than to changes in income.

6.2 GEOGRAPHIC REGION

The percentage deviation of expenditures for finfish by households located in regions outside of the Northwest from expenditures for finfish by households located in the Northwest is presented in Table 6.2. Distinct regional differences in household expenditures for finfish products relative to the Northwest occur in this study. Exceptions to this finding include prepared haddock, total haddock, and fresh and fresh-frozen snapper.

Households located in New England spend more on total cod than do households located in other regions of the United States. However, for fresh and fresh-frozen cod and other-prepared cod products, households located in New England, along with households located in some other regions outside of the Northwest, spend

Table 6.1. Household Income, Household Size, and Price Elasticities for Finfish

Category	Household Income		Household Size		Price	
	OLS	WLS	OLS	WLS	OLS	WLS
Fresh and Fresh-Frozen Cod	-0.0326	-0.0287	0.2261*	0.2264*	-0.5065*	-0.5117*
Other-Prepared Cod	-0.0480	-0.0476	0.3717*	0.3717*	-0.4091*	-0.4103*
Total Cod	0.0199	0.0206	0.4383*	0.4383*	-0.4385*	-0.4379*
Fresh and Fresh-Frozen Flounder /Sole	0.0702	0.0735*	0.3125*	0.3099*	-0.4469*	-0.4559*
Other-Prepared Flounder/Sole	-0.2928*	NA	0.0473	NA	-0.1246*	NA
Total Flounder/ Sole	-0.0055	0.0103	0.3311*	0.3240*	-0.4436*	-0.4640*
Fresh and Fresh-Frozen Haddock	0.2199*	0.2157*	0.0956	0.0844	-0.4921*	-0.4836*
Other-Prepared Haddock	-0.2174*	NA	0.2960*	NA	-0.5613*	NA
Total Haddock	-0.0446	-0.0459	0.2773*	0.2634*	-0.5409*	-0.5459*
Other-Prepared Herring	0.1950*	NA	0.1177	NA	-0.9557	NA
Total Herring	0.2341*	NA	-0.0101	NA	-0.7194*	NA
Total Mackerel	0.0301	0.0298	0.0112	0.0101	-0.7140*	-0.7109*
Fresh and Fresh-Frozen Perch	0.0535	NA	0.2236*	NA	-0.7033*	NA
Other-Prepared Perch	-0.1542*	-0.1604*	0.3834*	0.3939*	-0.5275*	-0.5285*
Total Perch	0.0137	0.0090	0.2144*	0.2139*	-0.7364*	-0.7343*
Total Pollock	-0.0422	NA	0.0075	NA	-0.5384*	NA
Canned Salmon	0.0077	-0.0002	0.2146*	0.2109*	-0.6266*	-0.6263*
Total Salmon	-0.0195	-0.0268	0.2268*	0.2302*	-0.5552*	-0.5627*
Canned Sardine	0.0263	0.0266	0.1016	0.1018	-0.6620*	-0.6618*
Fresh and Fresh-Frozen Snapper	-0.0974	-0.1113	0.4672*	0.4784*	-0.9494	-0.9154
Canned Tuna	0.1323*	0.1320*	0.5032*	0.5005*	0.4300*	0.4265*
Other-Prepared Whiting	-0.0389	NA	-0.0984	NA	-0.3521*	NA
Total Whiting	0.0407	0.0412	0.0548	0.0538	-0.7742*	-0.7734*
Canned Finfish	0.0618*	0.0609*	0.4547*	0.4522*	-0.0423*	-0.0476*
Fresh and Fresh-Frozen Finfish	0.0625	0.0629	0.3324*	0.3350*	-0.6447*	-0.6438*
Other-Prepared Finfish	-0.1219*	-0.1181*	0.1714*	0.1747*	-0.3868*	-0.3886*
Total Finfish	0.0558*	0.0555*	0.4673*	0.4660*	-0.5150*	-0.5184*

* The coefficient estimate is considered to be statistically significant if its value is equal to or greater than associate standard error in absolute value (see Cheng, 1985, Appendix D).
NA: Not available

Table 6.2. Percentage Change in Expenditure for Finfish by Geographic Region (Reference Category: the Northwest)

Category	New England	Mid Atlantic	South-east	Gulf	Great Lakes	East Central	West Central	S.West/ Pacific
Fresh and Fresh-Frozen Cod	33.38 (36.22)	32.04* (31.64*)	63.41 (55.29)	26.03 (23.43)	10.74 (10.53)	7.19 (5.78)	0.45 (- 0.67)	5.74 (4.74)
Other-Prepared Cod	16.89 (-17.06)	-24.69* (-24.81*)	-26.59 (-26.83)	-12.32 (-12.59)	- 9.04 (- 9.16)	4.37 (4.25)	9.35 (8.94)	-15.46 (-15.56)
Total Cod	16.32* (16.36*)	-11.08 (-11.33)	-45.83* (-46.25*)	-33.34* (-33.79*)	-12.65* (-12.96*)	-12.34 (-12.66)	-20.95 (-21.24)	-27.86* (-28.08*)
Fresh and Fresh-Frozen Flounder /Sole	26.12* (26.23*)	49.29* (50.28*)	54.19* (55.97*)	44.94* (44.93*)	15.09 (15.85)	3.30 (4.39)	3.33 (4.66)	4.04 (4.07)
Other-Prepared Flounder/Sole	-88.89* (NA)	-93.12* (NA)	-90.76* (NA)	-83.03* (NA)	-74.01* (NA)	-57.39* (NA)	-64.85* (NA)	-72.50* (NA)
Total Flounder/ Sole	10.56 (12.47)	17.85 (22.62)	23.37 (28.44)	37.13* (36.71*)	23.26* (23.46*)	10.64 (10.44)	5.14 (5.93)	8.42 (8.76)
Fresh and Fresh-Frozen Haddock	1293.54* (1195.72*)	360.52* (341.33*)	-24.16 (-24.64)	14.39 (13.64)	335.40* (318.34*)	77.14 (74.73)	43.90 (40.60)	13.09 (13.35)
Other-Prepared Haddock	-67.11 (NA)	-41.76 (NA)	2.17 (NA)	19.59 (NA)	-31.56 (NA)	28.34 (NA)	4.20 (NA)	-14.61 (NA)
Total Haddock	-40.59 (-45.80)	-25.94 (-29.49)	-19.41 (-18.03)	6.84 (7.64)	-19.31 (-22.68)	7.91 (7.33)	-10.31 (-11.69)	-0.40 (- 0.14)
Other-Prepared Herring	80.34* (NA)	148.61* (NA)	37.91 (NA)	35.62 (NA)	146.98* (NA)	37.91 (NA)	17.35 (NA)	83.80* (NA)
Total Herring	49.27 (NA)	90.88* (NA)	8.32 (NA)	22.38 (NA)	69.49* (NA)	13.99 (NA)	5.70 (NA)	54.54* (NA)
Total Mackerel	-74.68* (-74.69*)	-69.02* (-69.00*)	-66.34* (-66.42*)	-59.53* (-59.52*)	-18.60 (-18.57)	-72.12* (-72.10*)	-56.48* (-56.45*)	131.41* (131.45*)
Fresh and Fresh-Frozen Perch	44.11 (NA)	65.43* (NA)	71.18* (NA)	75.24* (NA)	92.56* (NA)	100.75* (NA)	45.38* (NA)	16.28 (NA)
Other-Prepared Perch	318.07* (329.78*)	648.37* (679.16*)	1246.36 (1327.56)	1084.46* (1145.28*)	3483.21 (3754.65)	2159.39 (2310.96)	667.95* (694.26*)	693.58 (728.34*)
Total Perch	53.00* (56.32*)	65.79* (64.88*)	63.56* (59.57*)	64.73* (64.12*)	74.37 (65.98)	73.99* (68.39*)	64.05* (61.64*)	32.79* (33.59*)
Total Pollock	-35.62* (NA)	-30.89* (NA)	-19.63* (NA)	4.49 (NA)	-27.93* (NA)	- 8.76 (NA)	27.37* (NA)	-13.03* (NA)
Canned Salmon	- 4.93 (- 6.11)	-21.11* (-22.80*)	-45.01* (-49.15*)	-30.27* (-32.95*)	-29.13* (-31.44*)	-30.36* (-32.99*)	- 2.04 (- 3.44)	-14.16* (-14.23*)
Total Salmon	21.93* (22.35*)	-13.10* (-12.47*)	-41.67* (-42.43*)	-21.36* (-21.20*)	-16.54* (-15.94*)	-19.99* (-19.42*)	9.12 (10.06)	- 0.16 (0.89)
Canned Sardines	20.20 (20.18)	57.26* (57.34*)	29.35* (29.40*)	26.82* (26.89*)	34.04 (34.12)	4.89 (4.94)	20.19 (20.25)	20.20* (20.28*)
Fresh and Fresh-Frozen Snapper	-11.35 (- 4.69)	- 9.80 (- 4.19)	33.71 (41.57)	48.78 (59.19)	-12.73 (- 5.78)	6.85 (15.18)	- 9.68 (- 5.23)	-10.98 (- 9.44)
Canned Tuna	- 4.52 (- 4.70)	- 1.37 (- 1.38)	-33.43* (-33.23*)	-26.84* (-26.82*)	-27.33* (-27.27*)	-29.01* (-28.81*)	- 5.86 (- 5.60)	-10.70* (-10.70*)
Other-Prepared Whiting	-51.60* (NA)	-60.83* (NA)	-49.75* (NA)	-43.41* (NA)	-55.02* (NA)	-56.56* (NA)	-43.31* (NA)	-65.10* (NA)
Total Whiting	-43.32* (-43.35*)	-52.25* (-52.40*)	-30.80* (-30.98*)	-31.35* (-31.41*)	-40.61* (-40.74*)	-48.84* (-48.95*)	-15.47 (-15.73)	-44.76* (-44.86*)

Table 6.2. Percentage Change in Expenditure for Finfish by Geographic Region (Reference Category: the Northwest), continued

Category	New England	Mid Atlantic	South-east	Gulf	Great Lakes	East Central	West Central	S.West/ Pacific
Canned Finfish	- 8.31 (- 8.56)	- 4.26 (- 4.46)	-16.25* (-16.15*)	-20.58* (-20.68*)	-22.55* (-22.57*)	-21.08* (-20.99*)	- 6.53 (- 6.33)	-11.55* (-11.57*)
Fresh and Fresh-Frozen Finfish	35.59* (37.45*)	19.39* (20.30*)	- 1.76 (- 1.49)	- 0.05 (- 1.12)	- 0.21 (0.41)	- 3.52 (- 4.63)	-10.81 (-10.56)	- 3.59 (- 3.06)
Other-Prepared Finfish	-11.50 (-10.63)	-22.05* (-21.33*)	20.69* (19.76*)	44.04* (42.94*)	-16.40* (-15.90*)	19.34* (18.93*)	26.88* (25.83*)	0.96 (1.15)
Total Finfish	- 0.51 (- 0.41)	- 2.17 (- 2.06)	-24.90* (-24.61*)	-28.10* (-28.01*)	-21.21* (-20.99*)	-26.98* (-26.66*)	-13.44* (-13.15*)	-10.52* (-10.37*)

Calculated value based on associated OLS estimates. Values based on GLS estimates are in parentheses.

* The coefficient estimate is considered to be statistically significant if in absolute value, this value is equal to or greater than the associated standard error (see Cheng, 1985).

statistically the same amount on the given products as households located in the Northwest. Households located in the Middle Atlantic spend significantly more on fresh and fresh-frozen cod than households located in the Northwest. But for other-prepared cod products, the reverse is true.

Fresh and fresh-frozen flounder and sole are heavily consumed by households located on the East Coast and in the Gulf. Households located in New England, the Middle Atlantic, the Southeast, and the Gulf regions spend 26 percent to 54 percent more on fresh and fresh-frozen flounder/sole than do households located in the Northwest. No significant differences in expenditures on this product exist for households located in the Northwest and in the remaining regions of the Nation. By far, households located in the Northwest expend more on other-prepared flounder and sole than do households located in any other region.

Households located in New England, the Middle Atlantic, and Great Lakes spend over three times more for fresh and fresh-frozen haddock than do households located in the Northwest. Households located in New England, the Middle Atlantic, Great Lakes, and the Southwest Pacific generally expend more on both other-prepared herring and total herring than households located in the Northwest. Households located in the Pacific coast area spend more on total mackerel than households located in other regions.

In general, households located in areas outside of the Northwest spend significantly more on all categories of perch and canned sardines than do households located in the Northwest. However, for total pollock, canned salmon, total salmon, canned

tuna, other-prepared and total whiting, canned finfish, and total finfish products, the reverse is generally true.

6.3 URBANIZATION (OR POPULATION DENSITY)

The percentage deviation of expenditures for finfish by households located either in farm areas, small city areas (with less than 50,000 population), or large city areas (with 50,000 to 499,999 population) from household expenditures for finfish by households located in central city areas (with 500,000 and over population) is presented in Table 6.3. Urbanizational differences relative to central city areas exist in household expenditures on most of the finfish products. The exceptions occur for fresh and fresh-frozen cod, other-prepared cod, fresh and fresh-frozen flounder/sole, total flounder/sole, other-prepared perch, canned and total salmon, and fresh and fresh-frozen finfish.

Households located in central cities generally expend more on total cod, other-prepared and total herring, canned sardine, fresh and fresh-frozen snapper, canned tuna, canned finfish, and total finfish than households located in other areas. In fact, households located in central city areas spend about 6 percent to 12 percent more on total finfish than do households located in farm, small city, and large city areas. On the other hand, households located in areas outside central city areas spend more on other-prepared flounder and sole, fresh and fresh-frozen haddock, total haddock, and other-prepared whiting than households located in the central city areas. Availability may play a key role in determining household expenditures on the aforementioned finfish products.

6.4 OCCUPATION AND EDUCATION OF HOUSEHOLD HEAD

The occupation of household head is a statistically important factor in explaining the variation in household expenditures on some finfish products. The percentage deviation of expenditures on finfish by households headed by white collar workers or blue collar workers from expenditures on finfish by households headed by retired or unemployed individuals is presented in Table 6.4.

When statistically significant differences occur, households headed by white collar workers generally expend more on finfish products than do households headed by retired or unemployed individuals. The exceptions are total cod and other-prepared perch. Households headed by blue collar workers spend more than the reference households on other-prepared flounder and total flounder, other-prepared haddock, total mackerel, other-prepared whiting, and other-prepared finfish.

Table 6.3. Percentage Change in Expenditure for Finfish by Urbanization (Reference Category: Central City Areas[1])

Category	Farm OLS	Farm WLS	Small City[2] OLS	Small City[2] WLS	Large City[3] OLS	Large City[3] WLS
	Percent					
Fresh and Fresh-Frozen Cod	- 2.59	- 3.25	- 6.70	- 7.91	- 3.28	- 4.01
Other-Prepared Cod	+ 6.47	+ 5.99	+ 0.76	+ 0.69	- 5.46	- 5.66
Total Cod	-15.34	-15.74	-13.94*	-14.03*	-11.20*	-11.33*
Fresh and Fresh-Frozen Flounder /Sole	+ 5.11	+ 5.65	-11.25	-11.30	- 4.65	- 5.03
Other-Prepared Flounder/Sole	+454.19*	NA	+95.33*	NA	+37.26*	NA
Total Flounder/ Sole	+16.97	+14.43	+ 6.57	+ 4.13	- 1.29	- 2.45
Fresh and Fresh-Frozen Haddock	+32.26*	+32.28*	+40.67*	+40.69*	+66.42*	+65.47*
Other-Prepared Haddock	+67.72*	NA	- 7.97	NA	-19.67	NA
Total Haddock	+59.85*	+59.49*	+14.77*	+15.21*	- 4.35	- 5.10
Other-Prepared Herring	-23.54	NA	-36.42*	NA	-26.78*	NA
Total Herring	-10.14	NA	-21.19*	NA	-20.49*	NA
Total Mackerel	-71.49*	-71.54*	-29.10*	-29.19*	+48.07*	+48.12*
Fresh and Fresh-Frozen Perch	+14.97*	NA	- 5.33	NA	+ 0.52	NA
Other-Prepared Perch	-12.54	-13.25	+ 8.90	+ 8.89	-29.64	-30.07
Total Perch	+26.92*	+27.60*	- 0.34	+ 0.16	+ 7.82	+ 9.03
Total Pollock	+52.70*	NA	- 7.86*	NA	-13.00*	NA
Canned Salmon	- 3.91	- 4.48	- 0.34	- 0.45	- 1.95	- 2.22
Total Salmon	- 0.40	- 0.77	- 1.34	- 1.25	+ 0.11	- 0.41
Canned Sardines	+ 0.35	+ 0.34	-13.59*	-13.60*	- 9.49	- 9.50
Fresh and Fresh-Frozen Snapper	-43.87*	-44.47*	+ 9.32	+11.66	- 3.76	- 1.49
Canned Tuna	-23.86*	-23.71*	-16.47*	-16.46*	- 9.57*	- 9.50*
Other-Prepared Whiting	+62.03*	NA	+37.77*	NA	+32.60*	NA
Total Whiting	+18.30	+18.38	+18.03	+18.12	+ 8.16	+ 8.21
Canned Finfish	- 9.08*	- 9.02*	-11.89*	-11.86*	- 7.14*	- 7.06*
Fresh and Fresh-Frozen Finfish	+ 6.04	+ 5.76	- 4.64	- 4.92	+ 1.94	+ 1.80
Other-Prepared Finfish	+86.70*	+84.36*	+19.14*	+18.72*	+ 6.11	+ 5.91
Total Finfish	-11.82*	-11.85*	-11.84*	-11.85*	- 6.57*	- 6.54*

[1] with 500,000 and over population.
[2] with less than 50,000 population.
[3] with 50,000 to 499,999 population.
* The coefficient estimate is considered to be statistically significant if in absolute value, this estimate is equal to or greater than the associated standard error (see Cheng, 1985, Appendix D).
NA: Not available

Table 6.4. Percentage Change in Expenditure for Finfish by Occupation of Household Head (Reference Category: Retired and Unemployed)

Category	White Collar OLS	White Collar WLS	Blue Collar OLS	Blue Collar WLS
	---------- Percent ----------			
Fresh and Fresh-Frozen Cod	- 3.17	- 3.75	- 1.80	- 1.31
Other-Prepared Cod	- 4.60	- 4.56	- 2.37	- 2.37
Total Cod	-12.36*	-12.36*	- 5.87	- 5.65
Fresh and Fresh-Frozen Flounder/Sole	+ 5.95	+ 5.15	+ 9.09	+ 8.27
Other-Prepared Flounder/Sole	+68.10*	NA	+77.15*	NA
Total Flounder/Sole	+ 8.85*	+ 7.32	+13.97*	+11.87*
Fresh and Fresh-Frozen Haddock	- 4.15	- 3.91	- 9.22	- 9.50
Other-Prepared Haddock	+32.84	NA	+34.71*	NA
Total Haddock	+23.74*	+24.68*	+13.71	+12.64
Other-Prepared Herring	+ 8.29	NA	-21.71*	NA
Total Herring	+ 1.53	NA	-11.72	NA
Total Mackerel	+152.06*	+152.17*	+59.89*	+60.01*
Fresh and Fresh-Frozen Perch	- 3.93	NA	+ 8.43	NA
Other-Prepared Perch	-36.40*	-36.73*	-17.06*	-17.03*
Total Perch	- 4.69	- 4.99	- 2.12	- 2.65
Total Pollock	+13.30*	NA	- 2.14	NA
Canned Salmon	- 4.69	- 4.09	- 4.90	- 4.66
Total Salmon	- 1.82	- 1.31	- 4.05	- 3.77
Canned Sardines	- 8.88	- 8.89	- 3.39	- 3.41
Fresh and Fresh-Frozen Snapper	- 5.18	- 5.77	- 3.68	- 4.46
Canned Tuna	+ 9.28*	+ 9.09*	+ 1.54	+ 1.37
Other Prepared Whiting	+33.63*	NA	+43.66*	NA
Total Whiting	+ 3.47	+ 3.54	+ 3.62	+ 3.73
Canned Finfish	+ 5.06*	+ 5.01*	+ 0.01	- 0.07
Fresh and Fresh-Frozen Finfish	+ 2.19	+ 2.18	+ 4.26	+ 4.04
Other-Prepared Finfish	+29.34*	+28.54*	+ 7.16*	+ 6.70*
Total Finfish	+ 5.15	+ 5.08	+ 0.14	+ 0.12

* The coefficient estimate is considered to be statistically significant if in absolute value, this estimate is equal to or greater than the associated standard error (see Cheng, 1985, Appendix D).
NA: Not available

Other-prepared perch is the only category for which households headed by either white collar workers or blue collar workers expend less than do households headed by retired or unemployed individuals. In addition, households headed by white

collar workers spend 12.36 percent less on total cod, and households headed by blue collar workers spend 21.71 percent less on other-prepared herring than households headed by retired or unemployed individuals.

The percentage change in household expenditure for finfish due to the education of the household head is presented in Table 6.5. The effect of education of the household head on expenditure for finfish products is mixed. One additional year of education received by the household head leads to increases in household expenditure for total cod (3.79 percent), total mackerel (9.22 percent), and total finfish (1.47 percent). Negative associations between education of the household head and household expenditure occur for total haddock, total pollock, canned salmon, total salmon, total whiting, and other-prepared finfish.

6.5 EMPLOYMENT STATUS AND AGE OF HOUSEHOLD MANAGER

The employment status of the household manager gives rise to predominantly negative effects on expenditure for several finfish products for at-home consumption. But in most of the cases, no statistically significant differences exist in expenditure between the households with working household managers and households with unemployed household managers. The percentage deviation of expenditures by households with employed household managers from expenditures for finfish by households with unemployed household managers is presented in Table 6.6. The household with a working household manager expends significantly less on other-prepared flounder/sole, fresh and fresh-frozen haddock, other-prepared herring, total herring, fresh and fresh-frozen perch, and total fresh and fresh-frozen finfish than the household with an unemployed household manager. The greatest difference in expenditure due to the employment status of the household manager occurs for other-prepared flounder/sole; households with working household managers spend 22.69 percent less than households with unemployed household managers.

The age of the household manager gives rise to mixed effects on household expenditures for finfish products. The percentage deviation of expenditures on finfish by household with household managers less than 44 years of age from expenditures by households with household managers at least 44 years of age is given in Table 6.6. Those categories of finfish for which households with younger household managers spend more than households with household managers at least 44 years of age are other-prepared flounder/sole, other-prepared haddock, total mackerel, total pollock, total salmon, other-prepared whiting and total whiting, and other-prepared finfish. The greatest difference in expenditure occurs for total mackerel and other-prepared flounder/sole. On the other hand, younger household managers expend less than older household managers on fresh and fresh-frozen flounder/sole, fresh and fresh-frozen haddock, other-

Table 6.5. Percentage Change in Expenditure for Finfish by One-Year Increases in Education of Household Head

Category	OLS	WLS
	------- Percent ------	
Fresh and Fresh-Frozen Cod	+ 0.12	+ 0.37
Other-Prepared Cod	+ 1.62	+ 1.64
Total Cod	+ 3.75*	+ 3.79*
Fresh and Fresh-Frozen Flounder/Sole	- 0.12	- 0.07
Other-Prepared Flounder/Sole	- 1.88	NA
Total Flounder/Sole	+ 0.29	+ 0.52
Fresh and Fresh-Frozen Haddock	+ 0.29	+ 0.18
Other-Prepared Haddock	- 2.16	NA
Total Haddock	- 3.74*	- 3.92*
Other-Prepared Herring	+ 0.48	NA
Total Herring	+ 1.33	NA
Total Mackerel	+ 9.22*	+ 9.22*
Fresh and Fresh-Frozen Perch	+ 0.02	NA
Other-Prepared Perch	+ 4.01	+ 4.19
Total Perch	- 0.74	- 0.86
Total Pollock	- 4.97*	NA
Canned Salmon	- 1.41*	- 1.48*
Total Salmon	- 1.27*	- 1.33*
Canned Sardines	- 0.21	- 0.21
Fresh and Fresh-Frozen Snapper	- 2.14	- 2.51
Canned Tuna	+ 0.53	+ 0.54
Other-Prepared Whiting	- 4.25	NA
Total Whiting	- 3.46*	- 3.46*
Canned Finfish	+ 0.12	+ 0.12
Fresh and Fresh-Frozen Finfish	+ 1.03	+ 1.12
Other-Prepared Finfish	- 2.86*	- 2.68*
Total Finfish	+ 1.45*	+ 1.47*

* The coefficient estimate is considered to be statistically significant if in absolute value, this estimate is equal to or greater than the associated standard error (see Cheng, 1985, Appendix D).
NA: Not available

prepared herring, total herring, other-prepared perch, canned tuna, and all categories of aggregate finfish products except for other-prepared finfish. For aggregate finfish products, households with household managers less than 44 years of age spend about 16 to 19 percent less on canned finfish, fresh and fresh-frozen finfish, and total finfish than households with older

Table 6.6. Percentage Change in Expenditure for Finfish by Employment Status and Age of Household Manager (Reference Category: Unemployed and At Least 44 years of Age)

Category	Employed		<44 Years of Age	
	OLS	WLS	OLS	WLS
	Percent			
Fresh and Fresh-Frozen Cod	- 7.16	- 7.12	+ 0.90	- 0.62
Other-Prepared Cod	- 1.86	- 1.82	+11.74	+11.66
Total Cod	+ 5.66	+ 5.67	-13.16	-13.35
Fresh and Fresh-Frozen Flounder/Sole	- 1.83	- 1.94	-15.24*	-15.25
Other-Prepared Flounder/Sole	-22.69*	NA	+125.57*	NA
Total Flounder/Sole	- 3.02	- 3.43	- 3.11	- 4.77
Fresh and Fresh-Frozen Haddock	-14.21*	-13.31*	-32.07*	-31.24*
Other-Prepared Haddock	+ 8.29	NA	+34.43*	NA
Total Haddock	- 4.11	- 3.60	+ 7.99	+10.17
Other-Prepared Herring	-15.16*	NA	-42.58*	NA
Total Herring	-15.15*	NA	-34.79*	NA
Total Mackerel	+ 5.82	+ 5.88	+147.06*	+147.34*
Fresh and Fresh-Frozen Perch	- 8.51*	NA	- 8.57	NA
Other-Prepared Perch	+ 2.45	+ 2.10	-58.49*	-59.24*
Total Perch	- 3.56	- 4.09	- 6.67	- 4.93
Total Pollock	- 0.33	NA	+10.30*	NA
Canned Salmon	- 4.52	- 4.08	+45.34	+53.42*
Total Salmon	+ 1.86	+ 2.28	+52.63*	+55.31*
Canned Sardines	- 7.41	- 7.41	-19.10	-19.11
Fresh and Fresh-Frozen Snapper	+ 2.08	+ 2.67	+31.34	+37.96
Canned Tuna	+ 2.18	+ 2.16	-24.10*	-23.80*
Other-Prepared Whiting	- 3.42	NA	+38.65*	NA
Total Whiting	- 2.07	- 2.07	+36.17*	+36.32*
Canned Finfish	+ 1.16	+ 1.19	-19.41*	-19.01*
Fresh and Fresh-Frozen Finfish	- 8.20*	- 8.23*	-15.53*	-16.04*
Other-Prepared Finfish	- 0.60	- 0.61	+15.01*	+13.93*
Total Finfish	+ 0.60	+ 0.56	-18.07*	-17.94*

* The coefficient estimate is considered to be statistically significant if in absolute value, this estimate is equal to or greater than the associated standard error (see Cheng, 1985, Appendix D).
NA: Not available.

household managers; however, the reverse is true for other-prepared finfish products.

6.6 PRESENCE OR ABSENCE OF CHILDREN

The percentage deviation of expenditures on finfish by households with children from expenditure on finfish by households with no children is shown in Table 6.7. In general, the presence of children produces negative effects on household expenditure for finfish products for at-home consumption. However, exceptions occur for other-prepared perch and canned tuna; households with children spend 102.83 percent more on other-prepared perch and about 6 percent more on canned tuna than do households with no children.

6.7 RELIGION

With regard to the impact of religion on household expenditure on finfish, significant differences in expenditure exist for only 10 of the 27 selected finfish categories. The percentage deviation of expenditures by households with religious affiliation from expenditure on finfish by households with no religious affiliation is given in Table 6.8. Other-prepared flounder or sole and total salmon are the only two finfish categories for which households with religious affiliation spend more than households with no religious affiliation. Those finfish categories for which households with religious affiliation expend less are other-prepared cod, total cod, other-prepared herring, total herring, fresh and fresh-frozen perch, total pollock, total salmon, fresh and fresh-frozen finfish, and total finfish.

6.8 RACE

The percentage deviation of expenditures on finfish by nonwhite households from expenditures on finfish by white households is presented in Table 6.9. Race is a statistically significant factor in explaining the variation in household expenditures on most of the finfish categories. The exceptions occur for fresh and fresh-frozen cod, other-prepared cod, other-prepared haddock, total haddock, other-prepared perch, and canned finfish. When statistically significant differences exist in expenditure between white households and nonwhite households, nonwhite households, in general, spend more on finfish products than white households. The most notable difference occurs for other-prepared flounder or sole where nonwhite households spend almost 2.5 times more than white households. In addition, nonwhite households spend 155.89 percent and 107.94 percent more on other-prepared whiting and total pollock, respectively, than white households. Those finfish categories for which white households expend more than nonwhite households are total cod, fresh and fresh-frozen haddock, other-prepared herring, total herring, total mackerel, and canned tuna.

Table 6.7. Percentage Change in Expenditure for Finfish by Presence of Children (Reference Category: Absence of Children)

Category	Presence of Children OLS	WLS
	------- Percent -----	
Fresh and Fresh-Frozen Cod	-17.26*	-17.16*
Other-Prepared Cod	-15.84*	-15.76*
Total Cod	-16.37*	-16.28*
Fresh and Fresh-Frozen Flounder/Sole	- 8.71	- 8.77
Other-Prepared Flounder/Sole	-11.89	NA
Total Flounder/Sole	-11.95*	-11.87*
Fresh and Fresh-Frozen Haddock	+ 7.68	+ 8.28
Other-Prepared Haddock	-27.42	NA
Total Haddock	-18.29*	-17.95*
Other-Prepared Herring	-30.86*	NA
Total Herring	-24.23*	NA
Total Mackerel	-47.50*	-47.51*
Fresh and Fresh-Frozen Perch	- 4.96	NA
Other-Prepared Perch	+100.91*	+102.83*
Total Perch	- 1.25	- 1.81
Total Pollock	-35.04*	NA
Canned Salmon	-17.36*	-16.66*
Total Salmon	-14.67*	-14.48*
Canned Sardines	-17.66*	-17.67*
Fresh and Fresh-Frozen Snapper	-19.00*	-20.59*
Canned Tuna	+ 6.11*	+ 5.93*
Other-Prepared Whiting	-46.61*	NA
Total Whiting	-29.11*	-29.23*
Canned Finfish	- 3.64	- 3.77
Fresh and Fresh-Frozen Finfish	-17.50*	-17.32*
Other-Prepared Finfish	-18.70*	-18.06*
Total Finfish	- 7.10*	- 7.08*

[1] Protestant, Catholic, Jewish, and other

* The coefficient estimate is considered to be statistically significant if in absolute value, this estimate is equal to or greater than the associated standard error (see Cheng, 1985, Appendix D).

NA: Not available.

Table 6.8. Percentage Changes in Expenditure for Finfish by Religious Status (Reference category: No Religious Affiliation)

Category	With Religious Affiliation OLS	WLS
	------- Percent ------	
Fresh and Fresh-Frozen Cod	-17.22	-17.07
Other-Prepared Cod	-40.12*	-40.15*
Total Cod	-33.89*	-33.90*
Fresh and Fresh-Frozen Flounder/Sole	-12.60	-13.72
Other-Prepared Flounder/Sole	+47.15*	NA
Total Flounder/Sole	- 4.94	- 8.57
Fresh and Fresh-Frozen Haddock	- 8.97	- 9.49
Other-Prepared Haddock	+30.76	NA
Total Haddock	+29.96	+31.04
Other-Prepared Herring	-40.23*	NA
Total Herring	-39.90*	NA
Total Mackerel	+16.96	+17.19
Fresh and Fresh-Frozen Perch	-20.51*	NA
Other-Prepared Perch	+145.89	+152.73
Total Perch	-15.19	-13.81
Total Pollock	-22.54*	NA
Canned Salmon	+15.02	+13.18
Total Salmon	+15.32*	+13.04
Canned Sardines	- 5.18	- 5.15
Fresh and Fresh-Frozen Snapper	- 0.07	+ 1.17
Canned Tuna	- 6.06	- 6.04
Other-Prepared Whiting	+14.07	NA
Total Whiting	+ 0.55	+ 0.96
Canned Finfish	- 3.59	- 3.65
Fresh and Fresh-Frozen Finfish	-29.33*	-30.03*
Other-Prepared Finfish	+ 8.41	+ 7.59
Total Finfish	- 8.20*	- 8.38*

[1] Protestant, Catholic, Jewish, and other.
* The coefficient estimate is considered to be statistically significant if in absolute value, this estimate is equal to or greater than the associated standard error (see Cheng, 1985, Appendix D).
NA: Not available.

Table 6.9. Percentage Change in Expenditure for Finfish by Race (Reference Category: White Household)

Category	Nonwhite Household OLS	Nonwhite Household WLS
	------- Percent ------	
Fresh and Fresh-Frozen Cod	+ 5.11	+ 3.23
Other-Prepared Cod	- 13.52	- 13.30
Total Cod	- 29.52*	- 29.61*
Fresh and Fresh-Frozen Flounder/Sole	+ 14.73*	+ 15.99*
Other-Prepared Flounder/Sole	+248.46*	NA
Total Flounder/Sole	+ 31.33*	+ 31.69*
Fresh and Fresh-Frozen Haddock	- 31.17*	- 30.19*
Other-Prepared Haddock	+ 81.18	NA
Total Haddock	+ 33.21	+ 37.42
Other-Prepared Herring	- 46.02*	NA
Total Herring	- 27.74*	NA
Total Mackerel	- 85.95*	- 85.97*
Fresh and Fresh-Frozen Perch	+ 44.03*	NA
Other-Prepared Perch	- 4.94	- 4.95
Total Perch	+ 36.23*	+ 32.96*
Total Pollock	+107.94*	NA
Canned Salmon	+ 30.90*	+ 28.11*
Total Salmon	+ 20.91*	+ 19.16*
Canned Sardines	+ 45.26*	+ 45.25*
Fresh and Fresh-Frozen Snapper	+ 37.13*	+ 40.86*
Canned Tuna	- 19.90*	- 19.76*
Other-Prepared Whiting	+155.89*	NA
Total Whiting	+ 76.31*	+ 76.01*
Canned Finfish	+ 3.30	+ 3.37
Fresh and Fresh-Frozen Finfish	+ 36.04*	+ 36.36*
Other-Prepared Finfish	+ 94.39*	+ 90.88*
Total Finfish	+ 7.89*	+ 7.86*

* The coefficient estimate is considered to be statistically significant if in absolute value, this estimate is equal to or greater than the associated standard error (see Cheng, 1985, Appendix D).
NA: Not available.

6.9 SEASON

The percentage deviation by season from the winter quarter expenditure for finfish products is shown in Table 6.10. Significant seasonal differences in household expenditures exist for 21 of the 27 selected categories of finfish products. Generally, households spend more on finfish products for at-home consumption in spring, summer, and fall than in winter.

Household seasonal expenditure patterns relating to fresh and fresh-frozen cod, total flounder and sole, all categories of perch, and canned tuna generally follow the patterns of the landings of the respective seafood products. For example, total landings of fresh and fresh-frozen cod in the spring quarter of 1981 reached 74.5 million pounds (National Marine Fisheries Services, 1982), the highest record in that year. Household expenditure for fresh and fresh-frozen cod is about 14 percent more in the spring quarter than in the winter quarter. The expenditure for the product in the summer and the fall is statistically the same as in the winter quarter.

No significant seasonal differences relative to the winter quarter exist in household expenditure on other-prepared cod, fresh and fresh-frozen flounder and sole, fresh and fresh-frozen haddock, other-prepared herring and total herring, and fresh and fresh-frozen snapper.

6.10 COUPON VALUE AND SEAFOOD OUTLET

Coupon value gives rise to positive effects on household expenditure for all finfish categories except for other-prepared perch. The percentage change in expenditure for finfish due to a one-cent change in coupon value is presented in Table 6.11. The greatest impact of coupon value occurs for total mackerel where a ten-cent increase in coupon value leads to a 8.52 percent change in household expenditure.

The percentage deviation in expenditures on finfish by households at supermarkets and grocery stores from expenditures by households at other seafood outlets is presented in Table 6.12. Household expenditure patterns on finfish products for at-home consumption due to seafood outlets are mixed. Households spend more at the supermarket and the grocery store than at other stores for other-prepared cod, other-prepared flounder/sole, all categories of haddock, other-prepared perch, and total whiting. On the other hand, households spend less at the supermarket and the grocery store than at other stores for all categories of herring, all categories of salmon, canned sardines, canned tuna, canned finfish, fresh and fresh-frozen finfish, and total finfish. Households spend more on all categories of canned finfish products--canned salmon, canned sardines, canned tuna, and total

Table 6.10. Percentage Change in Expenditure for Finfish by Season (Reference Category: Winter Quarter)

Category	Spring		Summer		Fall	
	OLS	WLS	OLS	WLS	OLS	WLS
	Percent					
Fresh and Fresh-Frozen Cod	+13.36*	+13.91*	+ 0.99	- 1.78	+ 7.18	+ 5.99
Other-Prepared Cod	+ 5.53	+ 5.50	+ 0.24	+ 0.23	+ 3.64	+ 3.75
Total Cod	+ 9.68*	+ 9.71*	+ 0.25	+ 0.07	+ 2.97	+ 2.84
Fresh and Fresh-Frozen Flounder /Sole	+ 7.49	+ 7.14	+ 2.61	+ 2.18	+ 3.86	+ 3.95
Other-Prepared Flounder/Sole	+17.37*	NA	+ 6.88	NA	+ 4.49	NA
Total Flounder/ Sole	+ 9.45*	+ 9.67*	+ 1.30	+ 1.64	+ 5.50	+ 5.40
Fresh and Fresh-Frozen Haddock	- 1.82	- 1.09	- 5.24	- 4.73	- 1.44	- 0.65
Other-Prepared Haddock	- 9.46	NA	+32.67*	NA	+22.49*	NA
Total Haddock	- 5.53	- 4.97	+ 9.66*	+10.05*	+ 8.83*	+10.03*
Other-Prepared Herring	+ 9.99	NA	+10.84	NA	+ 2.35	NA
Total Herring	- 3.00	NA	+ 1.76	NA	+ 7.31	NA
Total Mackerel	+ 7.02	+ 6.85	+14.36*	+14.16*	+28.47*	+28.37*
Fresh and Fresh-Frozen Perch	- 3.52	NA	+10.90*	NA	- 0.13	NA
Other-Prepared Perch	- 1.91	- 2.24	+11.14*	+11.47*	-11.31*	-11.43*
Total Perch	+ 5.28	- 5.08	+16.99*	+16.48*	- 1.06	- 1.15
Total Pollock	+ 8.21*	NA	+ 4.52	NA	+17.18*	NA
Canned Salmon	+ 1.68	+ 1.00	+23.64*	+22.82*	+13.41*	+12.25*
Total Salmon	+ 0.03	- 0.68	+30.43*	+29.48*	+13.41*	+12.22*
Canned Sardines	+12.76*	+12.74*	+ 5.54	+ 5.53	- 7.27*	- 7.28*
Fresh and Fresh-Frozen Snapper	+ 0.71	- 1.53	+ 0.73	- 1.05	+ 3.96	+ 2.65
Canned Tuna	+ 7.95*	+ 7.81*	+13.92*	+13.80*	- 2.6top	- 2.74
Other-Prepared Whiting	- 6.72*	NA	+ 8.90*	NA	- 2.08	NA
Total Whiting	- 0.15	- 0.18	+11.99*	+12.08*	+ 0.09	+ 0.07
Canned Finfish	+ 6.80*	+ 6.71*	+16.42*	+16.40*	- 0.69	- 0.74
Fresh and Fresh-Frozen Finfish	+15.38*	+15.22*	+19.34*	+18.73*	+10.61*	+10.29*
Other-Prepared Finfish	+ 6.00*	+ 5.84*	+10.53*	+10.50*	+ 3.70	+ 3.91
Total Finfish	+14.49*	+14.34*	+16.18*	+16.18*	- 5.32*	- 5.36*

* The coefficient estimate is considered to be statistically significant if in absolute value, this estimate is equal to or greater than the associated standard error (see Cheng, 1985, Appendix D).
NA: Not available

Table 6.11. Percentage Change in Expenditure for Finfish Due to One-Cent Increases in Coupon Value

Category	OLS	WLS
	------- Percent --------	
Fresh and Fresh-Frozen Cod	+ 0.500*	+ 0.193*
Other-Prepared Cod	+ 0.516*	+ 0.514*
Total Cod	+ 0.482*	+ 0.480*
Fresh and Fresh-Frozen Flounder/Sole	+ 0.367*	+ 0.381*
Other-Prepared Flounder/Sole	+ 0.349*	NA
Total Flounder/Sole	+ 0.393*	+ 0.414*
Fresh and Fresh-Frozen Haddock	+ 0.383*	+ 0.383*
Other-Prepared Haddock	+ 0.401*	NA
Total Haddock	+ 0.409*	+ 0.108*
Other-Prepared Herring	+ 0.544*	NA
Total Herring	+ 0.679*	NA
Total Mackerel	+ 0.851*	+ 0.852*
Fresh and Fresh-Frozen Perch	+ 0.230*	NA
Other-Prepared Perch	+ 0.039	+ 0.039
Total Perch	+ 0.208*	NA
Total Pollock	+ 0.604*	NA
Canned Salmon	+ 0.479*	+ 0.480*
Total Salmon	+ 0.487*	+ 0.488*
Canned Sardines	+ 1.052*	+ 1.052*
Fresh and Fresh-Frozen Snapper	+ 0.723*	+ 0.764*
Canned Tuna	+ 0.310*	+ 0.312*
Other-Prepared Whiting	+ 0.474*	NA
Total Whiting	+ 0.381*	+ 0.381*
Canned Finfish	+ 0.287*	+ 0.289*
Fresh and Fresh-Frozen Finfish	+ 0.323*	+ 0.329*
Other-Prepared Finfish	+ 0.544*	+ 0.545*
Total Finfish	+ 0.258*	+ 0.260*

* The coefficient estimate is considered to be statistically significant if in absolute value, this estimate is equal to or greater than the associated standard error (see Cheng, 1985, Appendix D).
NA: Not available.

Table 6.12. Percentage Change in Expenditure for Finfish by Seafood Outlet (Reference Category: Other Stores[1])

Category	Supermarket and Grocery Store OLS	Supermarket and Grocery Store WLS
	-------- Percent ------	
Fresh and Fresh-Frozen Cod	- 8.18	- 7.39
Other-Prepared Cod	+33.85*	+34.43*
Total Cod	+ 3.35	+ 3.69
Fresh and Fresh-Frozen Flounder/Sole	+ 1.48	+ 1.90
Other-Prepared Flounder/Sole	+34.37*	NA
Total Flounder/Sole	+ 2.59	+ 2.64
Fresh and Fresh-Frozen Haddock	+16.77*	+18.05*
Other-Prepared Haddock	+47.40*	NA
Total Haddock	+20.17*	+20.81*
Other-Prepared Herring	-25.24*	NA
Total Herring	-37.04*	NA
Total Mackerel	+ 3.07	+ 3.05
Fresh and Fresh-Frozen Perch	- 3.04	NA
Other-Prepared Perch	+29.82*	+30.20*
Total Perch	- 5.79	- 5.19
Total Pollock	+ 1.73	NA
Canned Salmon	-29.95*	-30.02*
Total Salmon	-30.44*	-30.43*
Canned Sardines	-32.05*	-32.07*
Fresh and Fresh-Frozen Snapper	+14.40	+16.30
Canned Tuna	-52.74*	-52.64*
Other-Prepared Whiting	+ 6.71	NA
Total Whiting	+31.09*	+30.91*
Canned Finfish	-53.88*	-53.81*
Fresh and Fresh-Frozen Finfish	- 8.51*	- 8.12*
Other-Prepared Finfish	- 5.64	- 5.68
Total Finfish	-62.33*	-62.30*

[1] Health food store, drug store, variety store, department store, discount store, house to house, mail order, and other.

* The coefficient estimate is considered to be statistically significant if in absolute value, this estimate is equal to or greater than the associated standard error (see Cheng, 1985, Appendix D).

NA: Not available.

canned finfish-- at other stores rather than at the supermarket and the grocery store.

6.11 SAMPLE SELECTION BIAS

The estimated coefficients associated with the parameter λ, derived from the probit model specification in this research, are presented in Table 6.13. For 12 of the 27 categories of finfish products, the estimate of the parameter λ is statistically significantly different from zero. This result suggests the existence of sample selection bias in these cases. Consequently, deleting zero expenditure observations from the analysis of the 12 categories of finfish products (other-prepared flounder, fresh and fresh-frozen haddock, other-prepared haddock, other-prepared herring, total mackerel, total pollock, canned salmon, total salmon, canned tuna, other-prepared whiting, total whiting, and other-prepared finfish) is inappropriate from a statistical point of view. The use of the Heckman sample selection procedure in these cases is essential to eliminate the sample selection bias problem. On the other hand, for the remaining finfish products, no sample selection bias is noted.

Table 6.13. Evidence of Sample Selection Bias: Estimates of the Coefficients Associated with the Parameter λ

Category	OLS		WLS	
Fresh and Fresh-Frozen Cod	-0.1235		-0.0712	
Other-Prepared Cod	-0.0286		-0.0170	
Total Cod	0.9268		0.9351	
Fresh and Fresh-Frozen Flounder/Sole	-0.0960		-0.0887	
Other-Prepared Flounder/Sole	-3.5121	*	NA	
Total Flounder/Sole	-0.4985		-0.4173	
Fresh and Fresh-Frozen Haddock	1.5550	*	1.4986	*
Other-Prepared Haddock	-1.7245	*	NA	
Total Haddock	-0.9734		-1.0587	
Other-Prepared Herring	1.5471	*	NA	
Total Herring	1.2275		NA	
Total Mackerel	-5.2430	*	-5.2449	*
Fresh and Fresh-Frozen Perch	0.1222		NA	
Other-Prepared Perch	3.5462		3.6217	
Total Perch	-0.1972		-0.3300	
Total Pollock	-2.4829	*	NA	
Canned Salmon	-0.8883	*	-1.0238	*
Total Salmon	-1.2452	*	-1.3008	*
Canned Sardines	0.4061		0.4063	
Fresh and Fresh-Frozen Snapper	-0.3979		-0.4628	
Canned Tuna	0.4499	*	0.4384	*
Other-Prepared Whiting	-3.0480	*	NA	
Total Whiting	-1.6519	*	-1.6603	*
Canned Finfish	-0.1415		-0.1597	
Fresh and Fresh-Frozen Finfish	-0.1075		-0.0721	
Other-Prepared Finfish	-2.2125	*	-2.1461	*
Total Finfish	-0.3836		-0.3906	

* The coefficient estimate is considered to be statistically significant if in absolute value, this estimate is equal to or greater than the associated standard error (see Cheng, 1985, Appendix D).
NA: Not available

Chapter VII

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

7.1 SUMMARY AND CONCLUSIONS

The amount of information available about consumer behavior on disaggregate seafood commodities is extremely limited. To enhance the understanding of household expenditure behavior relating to fishery products in the United States, we investigated the nature and magnitude of the impacts of price, household income, household size, and particular socio-demographic factors on expenditures for at-home consumption of disaggregate fish and shellfish commodities. Consequently, the focus of the research was on the specification and estimation of Engel functions. The list of socio-demographic factors for this research included: (1) geographic region, (2) population density (or urbanization), (3) household size, (4) occupation of household head, (5) education of household head, (6) employment status of household manager, (7) age of household manager, (8) presence or absence of children, (9) race, (10) religion, (11) seasonality, (12) coupon (or deal) value, and (13) seafood outlets.

The source of data was the 1981 Seafood Consumption Survey (SCS) conducted by the Market Research Corporation of America (MRCA) for the National Marine Fisheries Service (NMFS). The 1981 SCS, which consisted of a nationwide panel of 9422 households, provided a comprehensive source of information in regard to seafood consumption, attitudes, income, and socio-demographic characteristics of households in the United States.

In empirical analyses of household expenditure behavior using data from cross-section surveys, a commonly encountered problem is that households report zero expenditure on some of the items included in the survey. The Heckman sample selection procedure was used in the estimation of the Engel functions to circumvent potential econometric problems.

The seafood commodities were categorized by species and by three types of product form (canned, fresh and fresh-frozen, and other-prepared). Nineteen categories of shellfish products and 27 categories of finfish products were selected in this research, including total shellfish and total finfish.

The findings of this research indicated that price, coupon (or deal) value, household income, household size, geographic region, race, and seasonality were the key factors in explaining

the variation of household expenditures on seafood commodities for at-home consumption. The partial effects of all factors included in this research are summarized below.

For shellfish and finfish products for at-home consumption, all price elasticities were negative and in the inelastic range except for fresh and fresh-frozen oysters (-1.12) and canned tuna (.4265). These results suggest that for almost all shellfish and finfish species, unit percentage changes in product availability lead to greater than unit percentage changes in product prices.

Coupon value (or deal value) was consistently found to have significant positive impacts on household expenditure for seafood commodities for at-home consumption. The findings suggest that offering coupons to households for purchasing seafood products may be effective in promoting sales. Those categories of seafood products for which coupon values had the greatest positive effects on household expenditure were all categories of clams, total mackerel, and fresh and fresh-frozen snapper.

Household income was found to have significant impacts on household purchases of fish and shellfish for home consumption; however, the income effects were mixed. Shellfish purchased for home consumption were normal goods except for total scallops. Those categories of finfish for which significant positive income effects were found included fresh and fresh-frozen haddock, other-prepared and total herring, canned tuna, canned finfish, and total finfish. On the other hand, all finfish products in other-prepared form, except cod and herring, consistently exhibited negative income responses.

Household size was consistently found to have significant positive effects on household purchases of most of the fishery products for home use except other-prepared crabs, total crabs, and canned shellfish. Household size elasticities were found to be generally lower for shellfish species than for finfish species.

In agreement with the works of Nash (1970), Miller and Nash (1971), and Capps (1982), geographic region was a statistically significant factor in explaining the variation of household expenditures on seafood at home. Significant differences in expenditure due to urbanization were found for nine of the 19 shellfish categories and 18 of the 27 finfish categories. The results in regard to geographic region and urbanization provide information which may be used for planning market development strategies.

In agreement with the works of Perry (1981) and Capps (1982), ceteris paribus, occupation was of little importance in explaining the variation in household expenditures on aggregate fishery products. In addition, all other factors constant, education level

of the household head was not a key factor in explaining the variation in household expenditure on fish and shellfish products.

Households with employed household managers generally had lower expenditures on fishery products than did households with unemployed household managers. This result suggests that the higher opportunity cost of the working household manager's time may lead the household to consume more fishery products away from home in various eating-out establishments and to reduce at-home consumption of these products.

Households with household managers less than 44 years of age typically purchased fewer shellfish products for home consumption than did households with older household managers. The impact of age of the household manager on household expenditures for finfish products consumed at home was mixed.

Presence of children was a statistically important factor in explaining the variation in the at-home household purchases of finfish products, but generally not for shellfish products. Households with children generally had lower expenditures on finfish commodities than did households with no children.

Religion was not a statistically important factor in explaining household expenditures on most of the categories of finfish and shellfish products consumed at home. Where statistical significance was noted, households with religious affiliation were generally found to have lower expenditure levels than households with no religious affiliation.

In agreement with the works of Purcell and Raunikar (1968), Nash (1970), Perry (1981), and Capps (1982), race was a statistically important factor influencing household expenditure on fish and shellfish. Black and other nonwhite households generally purchased more of all categories of fishery products than white households.

Significant seasonal differences in household expenditures for fish and shellfish products were found. In general, households spent more on seafood products in the spring, summer, and fall than in the winter. Expenditure patterns for some products - fresh and fresh-frozen cod, for example - closely followed the patterns of the seasonal landings of these products. The results suggest that product availability affects the household decision to purchase particular seafood products.

Furthermore, household expenditure behavior for most selected seafood categories varied by the type of seafood outlets. Households generally spent significantly less on all categories of canned fishery products at the supermarket and the grocery store than at other seafood outlets. In general, however, households

have fairly strong preferences for purchasing fresh and fresh-frozen shellfish at the supermarket and the grocery store. Since the supermarket and the grocery store are the places in which the households purchase the major part of their food for at-home consumption, there exist opportunities for the supermarket and the grocery store to become important marketing outlets for fresh and fresh-frozen shellfish products. This information can be used to develop effective marketing programs and promotional campaigns for fishery products to make seafood purchases a more integral part of the food-shopping experience.

7.2 IMPLICATIONS FOR FURTHER RESEARCH

The most direct and useful extension of this research would be additional research examining effects of the same, or similar, factors on household away-from-home consumption of seafood commodities. This research would enhance the understanding of household expenditure and consumption patterns of fishery products consumed at restaurants, cafeterias, and other away-from-home establishments. This current work on at-home consumption and the additional study on household away-from-home consumption of fishery products would aid in the formulation of successful marketing programs and marketing strategies concerning the distribution of seafood commodities through retail stores and through various eating-out establishments. Extensions examining household expenditure patterns of more narrowly defined fish and shellfish species such as sea scallops, bay scallops, Eastern oysters, and Pacific oysters should also be made. This additional species disaggregation suggests the use of more refined data sets. At present, such data bases are not available, with the possible exception of scanner data bases (see Capps, 1986). Further, qualitative research contributing to the knowledge of those attitudes, feelings, and beliefs which influence household behavior regarding seafood consumption is clearly in order. The insights from this qualitative research would also aid in the formulation of successful marketing programs and strategies. The 1981 SCS provides attitudinal information on seafood obtained from the panel of 9,422 households.

Given the lack of general acceptance of the functional form for the Engel curve relationships, alternative functional forms merit investigation. In addition, this study ignores cross-price effects of red meat and poultry on household consumption of seafood products. Information on the interdependencies of red meat, poultry, and fish and shellfish consumption is important to assess substitutability, complementarity, and independence of the various products. As such, additional studies incorporating prices of red meat and poultry into the Engel functions for fish and shellfish are worthwhile.

Furthermore, due to the lack of information about the age and sex of individual household members in the 1981 SCS, adult equivalent scales were not incorporated into the empirical model in this research. Additional research that takes into account differences in needs or requirements of individual household members due to differences in age and sex is certainly of merit. In summary, the information provided by this research and by the additional research outlined above will pay dividends to the seafood industry, primarily in the formulation of successful marketing programs.

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Virginia's Agricultural Experiment Stations

1—Blacksburg
Virginia Tech, Main Station
Dairy, Poultry, and all other topics

2—Steeles Tavern
Shenandoah Valley Agricultural Experiment Station
Beef, Forages, Fruit, Insect and Pest Control, Sheep

3—Orange
Northern Piedmont Agricultural Experiment Station
Alfalfa, Corn, Crops, Small Grains

4—Winchester
Winchester Agricultural Experiment Station
Fruit, Insect and Pest Control

5—Middleburg
Middleburg Agricultural Experiment Station
Beef, Forages

6—Warsaw
Eastern Virginia Agricultural Experiment Station
Field Crops, Insect and Pest Control

7—Holland Station, Suffolk
Tidewater Agricultural Experiment Station
Corn, Peanuts, Pest Control, Small Grains, Soybeans, Swine

8—Blackstone
Southern Piedmont Agricultural Experiment Station
Forages, Horticulture Crops, Small Grains, Tobacco, Turfgrass

9—Critz
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Aquaculture, Forestry, Wildlife

10—Glade Spring
Southwest Virginia Agricultural
Experiment Station
Beef, Burley Tobacco, Sheep

11—Hampton
Virginia Seafood Agricultural Experiment Station
Seafood

12—Virginia Beach
Hampton Roads Agricultural Experiment Station
Ornamentals, Vegetables, Insect and Pest Control

13—Painter
Eastern Shore Agricultural Experiment Station
Fruit, Field Crops, Herbs, Insect and Pest Control, Vegetables