DEMAND FOR SELECTED CLASSES OF CONVENIENCE FOOD IN THE UNITED STATES

by

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CHAPTER I

INTRODUCTION

Situation. The food system in the United States has undergone a startling transformation in just a few decades. A complex and highly integrated system has evolved, expanding far beyond the traditional functions of agricultural production and distribution. These changes may be characterized as a transformation of goals from the growing and selling of tangible products to the marketing of services. Marketing strategies and purchasing behavior tend to focus more and more on services as the shift in emphasis progresses from products to the nontangible services the products provide. Although these changes are seen throughout our industrialized society, the effects in the food system are among the most remarkable. The notion of the services embodied in food has been expanded from that of basic nourishment to a concept which includes all aspects of what may be called "convenience". A natural question which arises in this atmosphere of change is, "What are the economic and nutritional consequences to users of convenience products?"

Convenience food products transfer the time and activities of preparation from the homemaker to the food processor. New products and

variations in products have evolved along with the transformation of the food industry to a service industry. Convenience foods have already gained such prominence as to be considered an established part of the U.S. household diet. As early as 1963, it was recognized that the service component of some foods was already taken for granted to the extent that they were no longer considered convenience products (Harp and Dunham, 1963).

Many kinds of service or convenience are built into the various food products which make up the household shopping list. The purchase of prepared foods obviates the need for much of the homemaker's labor, time and culinary skill. Often the energy costs of preparation are reduced. Multiple ingredient products reduce shopping and planning time as well as storage space requirements when compared to the resources demanded by equivalent home-prepared meals. Further, processed product forms may increase shelf life over fresh ingredients and, in some cases, may even improve the quality of the product. Finally, the food processing industry provides products nearly impossible to produce at home, thereby expanding the opportunities of consumers to include goods they would otherwise do without. As a first step in determining the effect of convenience foods on the household diet and budget, it would be useful to determine who uses them and why.

According to Stafford and Wills (1979), demographic and lifestyle changes are among the factors that have materially affected the structure of food distribution and the increase in demand for

convenience in food products. Income, education level, declining household size and the proportion of women in the civilian work force are cited as factors which contribute to the increase in demand (1) for food away from home, (2) for services provided by convenience food stores and (3) for added convenience in foods purchased for home use. In addition, other household characteristics are likely to affect food expenditure patterns. The age-sex composition, race, occupation, region, urban setting and characteristics of the household head are all expected to determine the households' expenditure behavior to some degree.

Table 1 illustrates how incomes have risen in the past thirty years. Even in constant (1979) dollars, median family income in the U.S. has nearly doubled from $10,008 in 1950 to $19,661 in 1979. In undeflated dollars, the median family income was nearly six times as large in 1979 as in 1950. This trend in the growth of family income is expected to continue into the future. Its effect on food expenditures will be to increase the share going to services and convenience built into the food products (Stafford and Wills, 1979).

The education level of the population has also been increasing. Education affects knowledge, skills and attitudes about housework and nutrition. It also affects the value individuals place on their time. Table 2 describes the percentage of population completing 4 years or more of college. In 1960 only 7.7 percent of the population had attained this level of education. The percentage rose to 11.0% in 1970,

Table 1. Median family income in current and constant (1979) dollars

Measure	Year									
	1950	1955	1960	1965	1970	1975	1976	1977	1978	1979
Current $ ...	3,314	4,418	5,620	6,957	9,867	13,719	14,958	16,009	17,640	19,661
Constant $ .. (1979)	10,008	11,976	13,774	16,005	18,444	18,502	19,073	19,176	19,626	19,661

Source: U.S. Department of Commerce. 1981. Statistical Abstract of the United States. U.S. Government Printing Office, Washington, D.C.

Table 2. Percentage of population completing 4 or more years of college

Group	Year		
	1960	1970	1980
Total	7.7	11.0	17.0
White	8.1	11.6	17.8
Black	3.1	4.5	7.9

Source: U.S. Department of Commerce. 1981. Statistical Abstract of the United States. U.S. Government Printing Office, Washington, D.C.

and jumped to 17.0% by 1980. The widening disparity between white and black educational achievement is illustrated by comparing the 1960 and 1980 percentages for both races. The 1960 percentage of the white population completing college was 8.1%, five percentage points higher than the rate for the black population at 3.1%. By 1980, the percentage of whites finishing 4 years of college had grown to 17.8%, while the rate for blacks increased to only 7.9%. These data indicate that the racial composition of the population may potentially affect the important characteristics that determine demand for convenience foods.

Another key characteristic that is changing over time is the distribution of households of various sizes. The total number of households in the United States has not quite doubled since 1950, yet the growth in 1- and 2-person households has been enormous, while the number of larger households has actually declined since the middle 1960s. Table 3 shows how 1-person households have increased dramatically in the past thirty years, both in numbers and in percentage of all households. Percentage of single-person households more than doubled from 10.9% in 1950, to 22.5% in 1980. The growth in the share of two-person households was much more modest, from 28.8% to 31.3%, over the same period, even though the number of two-person households almost doubled. During the past thirty years there has been a decline in the proportion as well as absolute number of large households. The number of households with 7-or-more members increased up to the middle 1960s, but has declined steadily since. The share of total households

Table 3. Number of U.S. households, by number of persons

Households by size	Year									
	1950	1960	1965	1970	1975	1976	1977	1978	1979	1980
1 Person										
Millions	4.7	6.9	8.6	10.7	13.9	15.0	15.5	16.7	17.2	17.8
Percent	10.9	13.1	15.0	17.0	19.6	20.6	20.9	22.0	22.2	22.5
2 Persons										
Millions	12.5	14.6	16.1	18.1	21.8	22.3	22.8	23.3	23.9	24.7
Percent	28.8	27.8	28.1	28.8	30.6	30.6	30.7	30.7	30.9	31.3
7 or more persons										
Millions	2.1	2.9	3.5	3.2	2.5	2.4	2.3	1.9	1.8	1.7
Percent	4.9	5.4	6.1	5.1	3.5	3.2	3.7	2.5	2.3	2.2
Total										
Millions	43.5	52.6	57.3	62.9	71.1	72.9	74.1	76.0	77.3	79.1

Source: U.S. Department of Commerce. 1981. Statistical Abstract of the United States. U.S. Government Printing Office, Washington, D.C.

accounted for by households with 7-or-more declined from 6.1% in 1965 to 2.2% in 1980, even lower than the 1950 share of 4.9%. Gauger and Walker (1980) determined that on the average, the number of children a family has is positively related to the number of hours the wife spends at household work. This suggests that there may be more specialization in housework in large families. Although large households use more food, small households are expected to use more convenience foods per person because time for food preparation is more scarce and there is less tendency for a household member to specialize in housekeeping.

Another factor potentially affecting household demand for convenience and service products is participation of women in the labor force. Gauger and Walker (1980) found that employed wives used two fewer hours per day on housework than wives not employed outside the home. Table 4 shows that 37.7% of the civilian female population in 1960 participated in the labor force. By 1980 that participation rate grew to 51.6%. Conversely, the participation rate of males has declined in the last twenty years. Not only are women in general participating more in the labor force, married women specifically are more active in the labor market. Table 5 shows that the participation rate for married women with husbands present has increased from 30.5% in 1960 to 50.2% in 1980. The implication of this is that the stereotyped "stay-at-home" housewife is becoming more rare. For women with children between the ages of 6 and 17, the rate of participation in the labor force jumped from 39.0% to 61.8% over the same period. Even more profound is the

Table 4. Male and female civilian labor force participation rates*

Sex	Year						
	1960	1965	1970	1975	1978	1979	1980
Male	83.3	80.7	79.7	77.9	77.9	77.9	77.4
Female	37.7	39.3	43.3	46.3	50.0	51.0	51.6

* Based on annual average civilian non-institutuinal population, proportion of each specified group in civilian labor force.

Source: U.S. Department of Commerce. 1981. Statistical Abstract of the United States. U.S. Government Printing Office, Washington, D.C.

Table 5. Labor force participation rate of married women

Households by type	Year			
	1960	1970	1975	1980
Married, husband present	30.5	40.8	44.4	50.2
Children at home, 6 - 17 years..	39.0	49.0	52.3	61.8
Children at home, 0 - 6 years..	18.0	30.3	36.6	45.0

Source: U.S. Department of Commerce. 1981. Statistical Abstract of the United States. U.S. Government Printing Office, Washington, D.C.

change for women with children under 6 years of age, going from 18.6% in 1960 to 45.0% in 1980.

The role of the housewife and mother, although still an important cultural phenomenon, is changing with time. The time these women have available for housework and cooking is sharply cut when they enter the labor market. Their residual time will become more valuable and more scarce as they spend more time outside the home, and the household will need to rely on services and conveniences built into the products they purchase in the market, rather than having these produced in the home. For this reason, participation of women in the labor force is expected to increase the household demand for convenience foods.

Problem and objectives. Very little is known about the factors that influence the demand for convenience foods, or who uses these food products. The focus of this research is the problem of identifying the economic and demographic factors that determine household expenditure for convenience food in the United States. A major objective is to measure, for various classes of convenience food, the response of expenditures to changes in demand determinants so that food expenditure profiles can be simulated for households with different characteristics and constraints. Another major objective is to determine the effect of the meal preparer's value of time on household use of convenience food.

Selected household characteristics are proposed as explanatory variables in food expenditure functions for households. In addition,

other economic determinants of demand, notably the value of the meal preparer's time, are hypothesized to affect expenditures for several classes of convenience foods in the United States. The functions are specified from a theoretical model developed from the theory of the household production function.

The problem is important, first, because of the fact that while growth in market volume and variety of convenience foods has been phenomenal, little is known about who uses these foods and why. In particular, there is little understanding of the relationship between demand for convenience foods and the characteristics of the meal preparer (including value of time). Second, the determination of factors that affect expenditure patterns for convenience foods and nonconvenience foods will allow agricultural producers, food processors and food distributors to anticipate trends in retail markets, improve planning and provide better service to consumers. Finally, nutritionists who are concerned with the adequacy of household diets will be able to determine the heavy users of convenience foods and target the appropriate populations for research and educational programs.

The results of hypothesis tests have been reported along with the results of the statistical model. The hypothesis development relies on a theoretical model of the demand for convenience food and on the results of previous work on food demand. However, certain general hypotheses may be stated at the outset.

The characteristics of the meal preparer are expected to be important factors in determining demand for convenience and nonconvenience foods. The meal preparer characteristics which are hypothesized to affect demand were sex, market-orientation (i.e., employment status) and value of time. The effect of the meal preparer's value of time is expected to differ between male and female meal preparers. Although this is expected for several reasons, the primary one is that men are expected to be less labor efficient in producing nonconvenience meals, and some convenience meals, than women. In regression models of food expenditures a zero-one dummy variable is included as an intercept-shifter and a slope-shifter (on value of time) to account for differences in sex of the meal preparer.

Meal preparers who are market-oriented (i.e. working outside the home) and those who are nonmarket-oriented (i.e. not working outside the home). If market-oriented meal preparers have little discretion over the number of hours they work in the market in a given week, the hours spent working at home or in leisure become a residual, leftover after spending the (fixed) hours at work in the market. The time available for home production and leisure becomes more scarce for market-oriented meal preparers. Hence, in regression models of food expenditures, zero-one dummy variables are used as intercept- and slope-shifters to account for diffrences between (1) market-oriented meal preparers (2) nonmarket-oriented meal preparers without a wage earning "other head" and (3) nonmarket-oriented meal preparers with a wage-earning "other head"

present (referred to as "half-market-oriented" in this research). Specific hypotheses about differences in slopes and intercepts are formulated in Chapter IV.

All four food groups are hypothesized to have income elasticities and household size elasticities which fall between zero and one. In economic terms this implies that the food expenditures were hypothesized to be normal in response to income changes, and display size economies in response to changes in household size.

As a final general hypothesis, it is hypothesized that household size alone will not adequately explain expenditure patterns across households with varying age and sex make-up of members.

Definitions. In the interest of performing scientific research, but at the peril of robbing the concept of its richness of meaning, some effort has gone into defining and examining the meaning of the central term: convenience foods. This term is composed of a substantive term (foods) with a modifier (convenience). Defining the substantive appears unnecessary as it does not raise any issues. But the modifier, "convenience", causes some problems of definition. The term convenience conjures the notions of making work easier and increasing comfort or suitability. There was a need to settle on an operational definition of convenience foods that would allow the unambiguous categorization of all foods reported in the Nationwide Food Consumption Survey (NFCS) data set into convenience classes, and it was desirable that the definition be accordant with the essential nature of convenience.

Harp and Dunham (1963: 3) defined convenience foods as those "foods which have services added to the basic ingredients to reduce the amount of preparation required in the home." Later, Traub and Odland (1979: 3) defined convenience foods as "fully or partially prepared foods in which a significant amount of preparation time, culinary skills, or energy inputs have been transferred from the home kitchen to the food processor and distributor." This definition focuses our attention on three specific aspects of convenience, but the problem is not completely resolved since there is a need to decide what constitutes "significant" preparation time, culinary skills and energy. Traub and Odland (1979) provided a workable answer by defining nonconvenience foods and calling everything else convenience foods. Nonconvenience foods were nominally defined as either fresh or ingredient foods. Fresh foods include unprocessed food items such as meat, poultry, eggs and produce; ingredient foods include processed food products used in food preparation and are usually the most basic form in their category, such as flour, sugar, milk, etc. Most ingredient foods are commonly not prepared in the home (Traub and Odland, 1979). They further break convenience foods down into "established," defined as those introduced before 1960, and "new generation", defined as those introduced in or since 1960 (Traub and Odland, 1979).

These definitions are marred by a fault common to nominal definitions. That fault is that all objects are treated as black or white, while many may best be characterized as gray. In the

classification of all foods, the categorization of some prove questionable. But that is a necessary evil when devising an operational framework for quantitative analysis. Also, the basic definitions by Traub and Odland do provide a guide to classification that is in accord with the essence of the concept of convenience foods. However, the "new" and "established" convenience categories do not correspond well with the concepts since many multiple ingredient foods were introduced before 1960. So, for this research, foods have been characterized into other convenience classes. Therefore, with some modifications, we can settle on Traub and Odland's defintions for the analysis in this research.

A categorization of all foods reported in the NFCS data may be found in Havlicek, Capps and Axelson (1982), who, based on the definitions by Traub and Odland and some others, assigned one of the four categories of nonconvenience, basic convenience, complex convenience, and manufactured convenience to each food in the data set. This categorization will be used to analyze the demand for convenience foods of selected food types and convenience classes. The "nonconvenience" category of foods contains the unprocessed fresh or ingredient foods referred to by Traub and Odland. For examples of specific foods in this category, the top ten nonconvenience foods on money value basis in the data set are:

(1.) whole milk,

(2.) ground roast coffee,

(3.) fresh chicken,

(4.) lowfat milk,

(5.) pork chops,

(6.) bacon,

(7.) eggs,

(8.) tomatoes,

(9.) lean ground beef, and

(10.) fresh apples.

Meat, poultry, dairy and fresh produce dominate the nonconvenience food list. In addition to these are many low value, common condiments and ingredients.

The processing of foods in the "basic" sub-category of convenience foods is related more to a preservation method than ease of preparation. These foods usually have a single or limited number of ingredients, with some time or energy inputs incidentally included, but limited in terms of built-in culinary expertise. For the data set being used, the top ten basic convenience foods on a money value basis are:

(1.) instant powdered coffee,

(2.) frozen orange juice,

(3.) processed cheese, American or cheddar type,

(4.) lunchmeat ham,

(5.) commercially canned tuna in oil,

(6.) peanut butter, commercially prepared,

(7.) instant freeze dried coffee,

(8.) fresh orange juice,

(9.) soft tub margarine, and

(10.) commercially canned greenbeans.

The class of "complex" convenience foods includes foods that have a high level of time saving and/or energy inputs and built-in culinary expertise. Typically this category would include multi-ingredient mixtures. The top ten complex convenience foods in the data set, on money value basis, are:

(1.) beer and ale, canned, bottled, draft,

(2.) white bread,

(3.) frankfurters made from meat,

(4.) bologna, all kinds,

(5.) ice cream, except chocolate,

(6.) table wine,

(7.) potato chips,

(8.) chocolate ice cream,

(9.) whole wheat bread, and

(10.) luncheon meat loaf.

"Manufactured" convenience foods include products that have no home-prepared counterpart; that is, they could not or would normally not be made at home. Carbonated and alcoholic beverages dominate the list of the top ten ranked manufactured convenience foods:

(1.) soft drinks, cola type,

(2.) soft drinks, diet,

(3.) soft drinks, fruit type,

(4.) saltine crackers, matzo, oysterettes, soda,

(5.) gin and vodka,

(6.) scotch whiskey,

(7.) other whiskey,

(8.) corn snacks, with or without cheese,

(9.) milk chocolate candy bars, and

(10.) bourbon whiskey.

In addition to the beverages, crackers and candy bars, manufactured convenience foods include breakfast cereals and hard candy, as well as many other foods.

Plan and organization. The remainder of this dissertation is presented in four chapters. Chapter II contains a review of the relevant literature. The literature review has been organized into three major sections dealing with previous research on convenience foods, theory of the household production function, and demand for food in the context of the new theory of consumer behavior.

A theoretical model of demand for convenience foods is developed in Chapter III. A discussion of the ramifications of various assumptions and a priori expectations has been included. Along with the outcome of the confrontation between the theoretical model and the data, Chapter IV contains a discussion of the characteristics of the data and availability (or lack thereof) of appropriate information. Also the models have been interpreted for the economic effects implied by the empirical estimates. The summary, presented in Chapter V, includes a discussion of conclusions about the theory, the models, and the characteristics that affect consumer demand for convenience foods.

CHAPTER II

REVIEW OF LITERATURE

Recent recognition of the tendency of convenience food products to pervade the marketplace has prompted some researchers to determine the advantages, disadvantages and extent of use of these products. The major thrust of these research projects was to compare the costs, convenience and quality of various types of convenience foods. In addition, some effort has gone into determining the market share accounted for by convenience food products. In the first section of this chapter, the literature concerning convenience food was reviewed. It was verified that convenience products provide a considerable savings of preparation time. The growth in these products implies a trend towards time saving in the household behavior patterns. The second section contains an abbreviated treatment of a branch of economic theory that has great appeal in motivating the development of demand models for convenience foods, the theory of the household production function. The third section covers applications of the theory of the household production function to food demand.

Convenience food research. One of the earliest attempts to define and study convenience foods was by Harp and Dunham (1963: 3). They

defined convenience foods as "foods which have services added to the basic ingredients to reduce the amount of preparation required in the home. That is, convenience foods require less work or adding of ingredients in the home than the home-prepared counterpart." At the start of their report they recognized that the notion of convenience would be a relative one by noting that even the purchased ingredients to home-prepared foods have all been processed to some extent. Examples of foods considered to be convenience products included frozen dinners, canned stew, cake mixes, instant coffee, and dehydrated potatoes. The basic concept has not changed since that 1963 study; however, some differences in approach may be noted. Harp and Dunham did not include certain foods in their study because of lack of data on household preparation practices and sales volume. Soups were cited as an example, with the reason for their exclusion being that ingredients to the home-prepared counterpart (i.e., leftovers) have little or no value except as soup ingredients. All convenience foods in the study were compared to home-prepared counterparts, prepared in a kitchen by combining all the basic separate ingredients of the foods.

Harp and Dunham take note of a psychological phenomenon in consumers and researchers to identify convenience foods with newer or more exotic, multiple ingredient foods. However, when a food becomes a regular household purchase, the services embodied in the item are overlooked. Freshly baked food items were cited as examples of foods that are seldom mentioned as convenience foods; but such items have a high degree of processing embodied in them and are sold in large volume.

Of the 158 convenience foods studied by Harp and Durham, 116 were more expensive than home-prepared counterparts. However, when weighted by volume of sales, the larger volume, less expensive convenience foods more than offset the smaller volume, more expensive items. For every $100 spent in grocery stores, $14.03 was spent for the convenience items studied. The cost of the equivalent foods from fresh or home-prepared foods would have been $15.10, an increase of $1.07.

The decreasing cost of some convenience foods was explained in terms of reduced marketing costs from the removal of water and inedible portions. Bulk, weight and perishability are reduced by processing, leading to better efficiency in transportation and storage. The specific convenience items found to save consumers the most money were frozen orange juice concentrate, canned cherries, frozen and canned peas, and instant coffee. These items alone accounted for a savings of $2.56 on every $100 spent for food in grocery stores, when compared to the cost of replacing them with nonconvenience items. The work of Harp and Dunham was restated in several companion projects of the same generation that focused on narrower market groups. These studies include Chapman et. al. (1965), Gilpin et. al. (1965), King et. al. (1962), Matthews et. al. (1963), and Sweeney et. al. (1962).

Traub and Odland (1976) initiated the next generation of convenience food studies, following closely in the footsteps of their predecessors. Their research compared the cost of purchased ingredients for 107 home-prepared foods, with the cost of 188 convenience foods. An

important contribution of their work was the development of a more accurate distinction of convenience food classes. Their definition of a convenience food was "any fully or partially prepared food in which significant preparation time, culinary skills or energy inputs have been transferred from the homemaker's kitchen to the food processor and distributor." Further, they made an operational distinction between "established" and "new-generation" convenience foods based on whether a food was introduced into the market before or since 1960.

Cost comparisons between convenience foods and these home-prepared counterparts first considered only the grocery store costs, ignoring time and energy costs of preparation. Average costs per serving were computed from prices collected in 4 cities for 12 months for 295 foods. Thirty-six percent of the convenience foods studied had a lower cost per serving than the home-produced counterpart. For the new generation convenience foods, only 19% were less expensive than the home produced counterpart. Nearly all the frozen, chilled or ready-to-serve baked goods were more expensive than home recipe counterparts. All frozen beef entrees and dinners were more expensive than their home-prepared counterpart, and out of nine chicken convenience products, eight were more costly than the home-prepared counterpart. Single ingredient canned or frozen vegetable products were generally cheaper than their fresh counterpart, but multiple ingredient food forms cost more to purchase than to make. Over 60% of the convenience fruit and berry products were more costly than their fresh counterpart.

Convenience products accounted for almost half the sales of food purchased for home use in 1973. Fifty-eight percent of the 166 convenience foods studied were more costly than their home-prepared counterpart, about 24% were less costly, and 18% had cost almost the same. These 166 convenience products in the study accounted for $7.58 out of every $100 spent for food. Even though most convenience items were more expensive, the cost-decreasing convenience foods were used in much larger volume. This resulted in an estimated cost of $9.50 of the same foods if they had been replaced with fresh or home-prepared foods. These results support the findings of Harp and Dunham that, overall, convenience foods decrease the grocery store cost of food.

In later stages of their research, Traub and Odland (1978 and 1979) estimated composite costs of home-prepared and convenience foods, taking fuel and preparation time into account. When the costs of fuel and preparation time were included in composite costs for the foods studied, 50 to 60% of the convenience foods were less expensive than their home-prepared counterparts. When evaluated for quality differences, only 3 out of 24 convenience foods were rated significantly lower than their home-prepared counterpart in appearance, flavor, texture and overall quality. In addition, 76% of all convenience products evaluated were given ratings of at least "good".

Convenience foods were shown to provide a sizeable advantage in their saving of active preparation time. In most cases, the imputed labor cost of preparation was appreciably lower for convenience products

than for foods prepared from a recipe. Frozen products exhibited savings in labor costs for 94% of the items, but some items required more total time to prepare. Canned products saved from one to three hours of total preparation time when compared with their home-prepared counterparts. When two or more convenience forms of an item could be compared, the form considered the highest in terms of convenience usually had the lowest preparation labor costs. For example, chilled-canned biscuits required only one-eighth the active preparation time used in home-prepared biscuits, and about one-sixth the time required than preparing from a complete mix. The results generated by Traub and Odland are important evidence supporting a non-traditional approach to modeling household demand for convenience foods. It is this time saving characteristic of convenience foods that explains the growth in their use in the past few decades, and it is this characteristic that impels consideration of the household production function in the choice of theoretical models.

In related research, frozen-prepared plate dinners and entrees were analyzed by Isom (1979). The basic finding was that the consumer usually pays for convenience. At 1978 prices, frozen-prepared dinners cost between 13% and 105% more than the home-prepared counterpart. The only frozen entrees that cost less were crabcakes and deviled crab, as these contained roughly half the amount of crabmeat found in the home-prepared product. Consumers who would prefer more meat, poultry or fish in their meals may find the frozen-prepared products lacking. Also,

there is less control over intake of certain substances such as fat, sugar and salt.

Similar analysis has been performed on the cost of fast food meals by Matsumoto (1979). Fast food refers to food away from home, specifically originating in a fast food outlet. The similarity of fast food to convenience is evident, when considering readiness: fast food is ready to eat. Consumers purchase meals from fast food restaurants for mainly the same reasons they use convenience products.

In his analysis of a fast food meal consisting of a special hamburger, french fries and a soft drink, Matsumoto determined that the restaurant cost of $1.61 was $0.78 more expensive than the equivalent meal at home. However, he suggests that the difference may well be worth the savings to the homemaker in the time and effort of preparing the equivalent meal at home.

Characteristics of consumers and their use of convenience foods was studied by Russell (1971). Age, employment status, educational level, income level and family size were tested for effect on use of selected convenience foods. Analysis of variance showed that no significant effects were present. The lack of fit of Russell's model may well be ascribed to the small sample size of 75 Knoxville homemakers, and to her selection of convenience foods. The survey made use of a checklist of 60 food items across three form categories: mixes, frozen and canned. The most frequently mentioned characteristics ascribed to a woman who serves primarily convenience foods were "busy", "active", "has little time for meal preparation" and "employed outside the home".

New consumer theory. There have been numerous expositions of the theoretical model known as the theory of the household production function (Becker, 1965; Lancaster, 1966; Muth, 1966; Gronau, 1973, 1977; Deaton and Muellbauer, 1980). The notation and terminology vary from one treatment to the next, as do the particular points of emphasis depending on the interests of the researchers. A concise treatment of the model and a statement of the assumptions of various empirical approaches has been presented by Pollak and Watcher (1975). Since the specific model that has been developed for the demand for convenience foods has been heavily influenced by Gronau (1973) and because his theoretical model captures most of the features found in the other models, it is his work that is reviewed in this section.

Issues involving the allocation of time are particularly important to the analysis of convenience foods, since they may be thought of as purchased substitutes for household labor. With this in mind, the relevant literature on which to focus may be narrowed down to "time" related studies. The work of Gronau (1973, 1977) has been particularly enlightening in explaining behavior and response with respect to factors that affect the value and intrafamily allocation of time.

Gronau (1973) proposed a three-way division of each household members' time among work in the market, work at home and leisure. In his formal model, leisure is very restrictively defined by a one-to-one correspondence between time not spent working (at home or in the market) and a direct argument of the utility function. The three situations of

specialization of household labor investigated by Gronau are (1) the case where both the husband and wife work in the market, but only the wife works at home, (2) the case where the wife does not work in the market, and (3) the case where the husband helps in home production. Formally, define a household utility function in market purchased goods, M, home produced goods, H, and leisure of husband and wife, L_1, and L_2.

$$U = U (M, H, L_1, L_2)$$

Gronau assumes that home production calls for time and market inputs in fixed proportions. He specifies the technology in Leontief production functions. The outputs of home production for husband and wife are

$$H_i = \min \left(\frac{X_i}{g_i}, \frac{T_{Hi}}{k_i} \right) \qquad i = 1,2$$

where X_i and T_{Hi} are the amount of market inputs and time used in the process. Also, $1/g_i$ and $1/k_i$ are marginal products of market goods and time. Total home production, H, is the sum of H_1, plus H_2. Assuming fixed proportions, the production relation inverts to

$$T_{Hi} = k_i H_i$$

$$X_i = g_i H_i$$

The marginal cost of producing a unit of H_i is

$$\pi_i = g_i P_X + k_i W_i^*$$

where W_i^* is person i's value of time and P_x is the price of market goods. Unless g_i, k_i and W_i^* are the same for both the husband and wife, one of them will tend to specialize in household production, the other dropping out of the process. With the wife specializing in home production, but both working in the market, H_1, T_{H1} and X_1 go to zero. The budget constraint for the household, in this case, becomes

$$I = P_m M + P_x X_2 = W_1(T_0 - L_1) + W_2(T_0 - T_{H_2} - L_2) + V$$

where P_m and P_x are the prices of purchased goods and inputs, T_0 is total available time for an individual, W_i is wage rate and V is nonwage income. Terms may be recombined and the constraint written in terms of shadow prices and full income (S).

$$\pi H + P_m M + W_1 L_1 + W_2 L_2 = (W_1 + W_2)T_0 + V = S$$

The problem proceeds with the maximization of utility subject to the full income constraint. Using Z to denote any of the arguments of the utility function (Z: M, H, L_1, L_2), the effect of wages on demand for factor Z are derived by totally differentiating the first order conditions with respect to W_1 and W_2 and solving for $(\partial Z / \partial W_i)$, i = 1,2. Gronau expands the marginal effects into elasticities and derives

$$E(Z,W_1) = \frac{W_1 L_1}{S} \sigma_{L_1 Z} + \frac{W T_{M1}}{S} E(Z,S))$$

where $\sigma_{L_1 Z}$ denotes the Allen partial elasticity of substitution between factor Z and the husband's leisure, and E(Z,S) is full income elasticity of demand. The two components correspond to the Hicksian substitution and income effects. The term which includes elasticity of substitution corresponds to the substitution effect in Hicksian demand theory. The elasticity of demand with respect to the wife's wage, W_2, includes a substitution effect for both the wife's leisure (operating through the time constraint), L_2, and the home produced goods, H_2 (operating through the production function), as well as an income effect:

$$E(Z,W_2) = \frac{W_2 L_2}{S} \sigma_{L_2 Z} + \frac{W_2 T_{H2}}{S} \sigma_{HZ} + \frac{W_2 T_{M2}}{S} E(Z,S)$$

For this case, where both husband and wife earn but only the wife works at home, Gronau explores the implications of the model. For example, the husband's labor supply depends on the relative strength of the negative substitution effect (through leisure) and the positive income effect of working. The wife's labor supply would have a lesser tendency to "bend backwards" than the husband's, because her elasticity of labor supply with respect to wage has the additional substitution term, in home

produced goods. As long as home produced goods are substitutes, i.e. not complements, for the wife's leisure, then the substitution effect will combine with the (positive) income effect, countering the (negative) "own" substitution effect.

The second case considered by Gronau was that of complete specialization by the husband (in wage earning) and the wife (in household production). This case would occur as household income raised, increasing the demand for the wife's leisure and home goods, eventually leading to the wife's exit from the labor market. This configuration breaks the link between the value of her time and market wage. The value of the wife's time and full price of home produced goods become shadow prices, reflecting endogenously determined values. Maximizing household utility takes place under two separate, unconnected restraints: one for (non-wage and husband's wage) income and one for the wife's time. A change in exogenous prices of goods and (husband's) time affects the optimal use of goods and time, as well as the prices placed on the wife's time and home-produced goods. The third case considered by Gronau allows the wife's shadow cost of time to rise enough to equate the cost of husband- and wife-produced nonmarket goods. The condition is

$$\pi_1 = g_1 P_x + k_1 W_1 = g_2 P_x + k_2 W_2^*$$

A rearrangement of this condition shows that the wife's shadow cost of time, W_2^*, is pegged to exogenously determined prices of goods and her husband's wage rate:

$$W_2^* = \left(\frac{g_1 - g_2}{k_2}\right)P + \left(\frac{k_1}{k_2}\right)W_1$$

If the husband and wife share exactly the same production function, then $g_1 = g_2$ and $k_1 = k_2$, and therefore her value of time equals the husband's wage rate. It is the husband who balances his use of time among three uses (wage earning, home-production, and leisure) and the wife who considers only two uses of time (leisure and home production).

The major contributions of Gronau's paper are (1) to consider intrafamily allocation of time and (2) to introduce leisure explicitly into the model. The model suggests several implications for modeling household use of convenience foods. First, an analogy may be made between home-produced goods and nonconvenience meals and the market purchased goods and convenience foods. The use of convenience foods does not usually drive home labor time to zero, but it should tend to reduce requirements for home labor. Another implication relates to the wife's value of time. Value of time should affect the use of convenience and nonconvenience foods. If the wife is a wage-earner, her value of time is pegged to the market wage. If she is not a wage-earner, market wage is a floor to her possible shadow cost of time. If the husband is a wage earner, and if he works at home at all, the wife's value of time is pegged to (although not necessarily equal to) the husband's wage rate.

Applications of the new theory to food demand. A comprehensive review of the literature on the demand for food would comprise an extremely long chapter. A review of all this literature is not only beyond the scope of this research, it is not necessary or relevant. The literature relevant to this research is comprised of those few attempts to apply the theory of the household production function to the demand for food.

The earliest attempt to derive a demand for food using the new theory of consumer demand was Prochaska and Schrimper (1973). Their focus was the demand for food-away-from-home, measuring consumption as "number of meals purchased and consumed away from home per unit of time (week)". The statistical model was estimated for twelve separate region-urbanization classes, using ordinary least squares. The demand function specified as the "true" relationship expressed number of away-from-home meals as a linear function of the full household income and full prices of meals away from home and meals at home. Since it was assumed that market prices were constant over households and that coefficients in full price would not vary significantly over households, the statistical form of the model included a wage slope shift for employed and unemployed individuals, family size and intercept shifts for 1, 2 or more preschool children, 1, 2, 3, or more school age children, and race.

For estimation of the model, the authors used the spring portion of the 1965-66 USDA Household Food Consumption Survey. Households were

deleted from the estimation sample if data were missing on key variables or if the homemaker was 65 years of age or older. Wage rates were not reported, but were estimated exogenously (using 1960 census data, and a quadratic function of age and education).

The resulting estimates show that the income elasticity of demand for meals away from home is consistently positive, although far less than unity. The greatest income elasticity of demand occurred in the urban Northeast at 0.61, the least in the farm West at 0.09, with highest elasticitities for all regions (except the South) occurring in urban areas. Rural nonfarm areas are generally next largest after urban areas, and farm areas consistently show the smallest elasticities.

The estimated market opportunity wage was the measure used to proxy for the opportunity cost of time. For all households with employed homemakers, this variable had a positive, often significant, effect on meals away from home. The marginal effect of opportunity cost of time on meals per week ranged from 0.22 in the rural Northeast to 8.70 in the rural West, although most of the coefficients ranged between 1.5 and 3.0.

The interpretations of family composition effects are comparatively sensible. Preschool children decrease the number of meals eaten away from home, but school age children have mixed effects on the model. The effect of nonwhite races on meals away from home is positive in the Northeast and North Central regions, but negative in the South and West.

Finally, the authors show that the specification bias which neglecting value of time would cause is consistently positive. The implication is that income elasticities would be biased upwards, often significantly higher than the true elasticities if the opportunity cost of time were omitted.

The next authors to use this approach were Kinnucan and Sexauer (1978) on a very different food problem: demand for home-produced food by rural families. The contribution of home-produced food to family food supply can be substantial, and the full price of producing food for home use may include a large indirect cost through the labor required. Kinnucan and Sexauer follow Prochaska and Schrimper in their specification of a demand function and in substituting an estimated market opportunity wage for the value of time. They include wage income, nonwage income, family size, sex of head of household and a zero-one variable for the effect of nonfarm residence on demand. For the dependent variable, they use the annual retail value of food produced for home-use.

The data used for estimation of the model were the 1971 survey data of 628 rural families. Weighted least squares was used to estimate the coefficients. Both nonwage and wage income came out with negative coefficients, and market opportunity wage had a negative effect on demand for home-produced food. Family size had a positive effect, and the effect of a female-headed household was strongly negative. The effect of nonfarm residence was extremely negative.

One obvious shortcoming of the study is that only the time costs of the chief household income earner were used, while many other members may participate in the production process. However, the estimates are plausible and would tend to explain patterns of home production of food through time: a secular decline in demand as wage opportunities rise. This is more in the line of a price effect than an income effect, although rising real incomes have contributed to the decline as well.

Redman (1980) was the next to apply the new theory to the demand for food. Her article tested several hypotheses formulated by Gronau (1977) in his revised model of household production. Redman used expenditure on meals away from home and expenditure on "prepared" foods to test the model. The hypotheses she tested are:

> (a) If an employed woman's wage rate increases or an unemployed woman's nonwage income . . . increases, the time that woman spends on household production will decrease.
>
> (b) As children grow older, the real wage of the mother in terms of market substitutes increases (older children require less parenting time), which implies that household production time decreases and market time increases. Employed mothers substitute between market and leisure time, rather than market and household time.
>
> (c) A woman's time spent on household production bears a negative relationship to the level of her education.
>
> (d) Among employed women, the woman's age positively affects time spent in household production and leisure and negatively affects

time in the market; among unemployed women, age negatively affects time spent in household production. (Redman, 1980: 324)

If less total household time is equated with more use of prepared foods and meals away, then households with older children would be expected to spend more on these meals than households with younger children, other things equal. However, if meal preparation is not considered a child-related activity, then as children grow older more time would be available for meal preparation and more meals would be prepared from scratch. In either case, the total demand for food would rise since older children require more food. The appropriate way to test for the effect on expenditure working through the housewife's value of time would be to include family size or an adult equivalent scale to control for the positive effect on demand working through the total demand for food.

Redman estimated four expenditure models; two for meals away from home and two for prepared foods. One model for each dependent variable was used to test the effect of family size, the other was used to test the effect of age and number of children. Redman expected family income, education of the woman, and age of children to have a positive effect on the expenditures measured. An increase in the age of the wife was expected to increase use of prepared foods, although the expected effect on meals away from home was not clear. Redman also expected employed wives to spend more on prepared foods than unemployed wives.

A major difference between Redman's approach and the Prochaska-Schrimper or Kinnucan-Sexauer approach is that Redman does not explicitly include a value of time measure. Instead, she includes variables that would be expected to affect the value of time or allocation of time. The results of model estimation generally agree with Redman's expectations, although there may be some disagreement as to whether the models actually test Gronau's hypotheses.

Family income was significant and was positively related to meals away from home and to prepared foods. Employment of the wife was not significant (except in one prepared foods model) nor was the sign consistent across equations. Meals away from home declined with family size but prepared foods increased. When family composition was included as the number of children in various age groups, all groups showed a negative effect on meals away from home, the effect dampening as older groups were considered. Families with no children or older children spend more on meals away than families with smaller children. The number of children in all age groups increases expenditure on prepared foods, younger children increasing expenditure the least and older children increasing expenditure the most. Redman interpreted this as verification of Gronau's hypothesis that the real wage of the mother increases as children grow older. Another interpretation would be that older children eat more, so the household with older children must spend more on all categories of food than the household with younger children.

The effect of presence of a college educated woman on household expenditure was positive for meals away from home, but negative for prepared foods. The negative effect on prepared foods was a surprise, explained as the raising of the woman's nutrition-consciousness, with college educated women being more selective of ingredients and, therefore, less likely to buy prepared foods.

The age of the woman also had opposite effects, significantly decreasing expenditures on meals away from home but significantly increasing use of prepared foods. Some regional differences were significant, with the North central households spending significantly less on meals away from home, and new england households spending significantly more on prepared foods. Black households spent significantly less on meals away from home and on prepared foods than other races. Metropolitan households spent significantly more on meals away from home, and urban households spent significantly more on prepared foods. Redman suggested that metropolitan households eat out while urban households purchase prepared foods, both to solve time allocation problems.

In conclusion, although the coefficient of determination for all four equations ranged between about .16 and .19, Redman felt that the results indicate that the characteristics that affect women's allocation of time also affect expenditures on meals away from home and prepared foods. She suggested that the restaurant industries should cater to young families without small children, while prepared food manufacturers

should cater to older families with the wife in the labor force. These sectors should benefit from increases in income and the trend of women entering the labor force.

Most recently, Fletcher (1981) has applied the new theory of consumer behavior to expenditures for food away-from-home and food at-home. Fletcher's approach was to consider the implications of the life-cycle model of behavior (Ghez and Becker, 1975; Blinder and Weiss, 1976; and Mincer, 1963) on family expenditures on food in the respective classes. Changes in socioeconomic and demographic characteristics of households, such as number of working wives and household income, in addition to age distribution of the population, were hypothesized as factors affecting food expenditure behavior. The objectives of his research were to outline an economic model of food expenditure patterns over a life cycle and to estimate and statistically test the significance of variations in food expenditures for different stages of the life cycle. The economic model developed by Fletcher explained changes in behavior over the life cycle as a function of shifting resource restraints, production technologies and stock of human capital. He assumed that households optimize their activities in a two-stage process by which they first determine their lifetime consumption path and second maximize a static utility function given their stage in the life cycle and their resource constraints. Derived household demand for a purchased good is expressed as a function of money income, opportunity cost of time and "environmental augmenting factors." These factors

affect the setting of the household production process, and are represented by household size, composition, race, urbanization and region. Size and composition of the household were accounted for by an adult equivalent scale.

Shadow price of time was proxied by the earned income of the individual adult who spent most time at home. For nonmarried households, this individual was the head. Also for married households, with head unemployed, but spouse employed, the individual was the head. If both head and spouse were employed or spouse not employed, the individual with more home time was considered the spouse.

Since earnings were used to measure shadow price of time, market opportunity earnings were estimated for unemployed individuals using Heckman's sample selection bias procedure (Heckman, 1979). The sample was divided into two subsets of market-oriented and nonmarket-oriented, depending on whether the selected homemaker was employed or not. Finally, dummy variables were used to generate separate income response measures for each of several age-of-head (i.e. life cycle stage) categories.

Heckman's sample selection procedure was used since there were nonpurchasing households in some cases. Income responses for food away from home showed differences among various age groups, and differences between market-oriented and nonmarket-oriented households. For market-oriented households, expenditure elasticities for food away from home declined with age until the sixty-five and older group, when the

elasticity jumped to its highest level. For nonmarket-oriented households, the away-from-home elasticity increased until the 35-44 age group, declining until the 65-and-older group where, again it jumped to its highest level.

The shadow price of time came out with positive effects and significant coefficients on food away from home for both the market-oriented and nonmarket-oriented households. The effects on food-at-home were negative, although only marginally significant, or not significant (the Heckman procedure results in biased estimates of standard errors, so t-statistics are not exact). The implication is that the higher the price of time, the more households shift expenditures from at-home food to food-away. Black households spent less on food away than other races, as did rural households. Northeastern households consistently spent more on all food categories than any other region.

CHAPTER III

THEORETICAL MODEL

Issues of model specification. Since convenience foods are purchased to substitute for the meal preparer's time the demand for convenience foods may best be modeled by the theory of the household production function. Pollak and Watcher (1975) have addressed issues of model specification under the household production framework. The authors have shown that the Beckerian model, with its emphasis on full prices and commodities, is only relevant under the assumptions that household production technologies exhibit constant returns to scale (i.e., linear homogeneous cost functions) and nonjointness (i.e., no joint products are produced). If these assumptions do not hold, then the full prices of commodities vary with the households consumption patterns, and the approach is deemed irrelevant because the major determinants of demand, full prices (i.e., marginal costs), are endogenous. As a further source of irrelevances of the approach, Pollak and Watcher cite the nebulous nature of some of the commodities to which the theory is applied. When the "commodity" investigated is something like "child quality" the outputs themselves reflect the preference ordering of the household, not production technology. In this case, the

output is more akin to utility or numbers representing preference orderings. However, it is possible to circumvent the problems of the assumptions of nonjointness and constant returns to scale as well as the problem of confounding production technologies with utility indicies, by focusing on the allocation of market goods and time within the household. The practical result is that demand for purchased goods and time are expressed as functions of (observable) market prices, wages and nonwage income. The drawback is that a lot of the richness in economic interpretation is subsumed in the model specification, and the applications are much closer to traditional demand analysis than to Becker's new consumer demand models.

Maximizing the household utility function subject to the full income constraint gives a set of commodity demand functions.

$$Z_i = g^i(\pi, W, V)$$

where Z_i is the commodity that enters the utility function, π is the vector of commodity shadow prices, W is the wage rate and V is nonwage money income. These demands are estimable because the π's are independent of the level of Z by the assumptions of nonjointness and homogeneity. Relaxing either assumption prohibits treating π's as exogenous. Even if the endogeneity of prices were not an estimation issue, they are only analytically useful in a very restrictive sense. When the commodity prices depend on the household consumption pattern, interpretation of the model is difficult. Households with identical cost functions and feasible sets, but different tastes, will consume

different commodity bundles and, hence, face different commodity "prices". To attribute the difference in choice to the difference in commodity prices would be misleading since prices depend on tastes.

Pollak and Watcher argue that when shadow prices depend on the preference function, an alternative demand specification is required. They argue that the nonjointness assumption is very restrictive, since it requires a model specification for which households are indifferent among alternative tasks. Jointness is pervasive in time allocation models because time spent at various tasks is a direct source of disutility as well as a productive resource, and therefore does not have a neutral effect on the utility function.

Pollak and Watcher suggest an alternative approach to demand analysis, given the household production framework and all it implies. They believe that fruitful demand applications may be achieved by focusing on input demands as functions of market prices, wages and nonwage income. Formally, the model requires each input, including time, be partitioned into activity specific amounts: $M_i = (M_{i1},...M_{in})$ and H_i the market goods and time inputs to the ith activity. Then the vector specifying the allocation of goods and time among productive activities is (M,H). Using the utility function (of commodities) it is possible to assign a utility to each activity input vector and redefine utility in terms of the purchased factors or goods. This utilitiy function is maximized subject to a full income constraint in terms of market goods and time of each productive activity. Pollak and Watcher

derive the system of demand functions for activity inputs implied by this model. The vector of prices of market goods is P.

$$M_{ij} = d^{ij}(P,W,V)$$

$$H_i = d^{Hi}(P,W,V)$$

or

$$(M,H) = d(P,W,V)$$

Alternatively, nonwage income could be replaced by total money income. Even with joint production, nonconstant returns to scale and the inability to observe or measure outputs these demands are still estimable. This approach to demand requires fewer assumptions than the study of commodities and it relieves us of the need to define and measure commodity outputs.

This approach is a most sensible one to take in analyzing the demand for convenience foods for several reasons. First, defining the final goods is difficult and leaves the model open to misspecification because of the nebulous nature of final goods. For example, raw purchased food may be used to produce several outputs. The output may be identified as a physical meal, as hunger abatement, as nutrition of various types, as palate satisfaction and as entertainment. Undoubtedly, others could be identified as well. Second, since many final goods may be unobservable, they may become difficult to measure and cause problems in distinguishing between production output and preference orderings (e.g., quality or palatibility of a meal).

Finally, the primary relationships in which we are interested are the factor demands. It is the expression of preferences through buying behaviour that is most important to market analysis. The major drawbacks of this approach in connection to demand for convenience foods are that the more subtle and enlightening implications of using shadow prices are lost and hypotheses about effects of variables are hard to formulate. As a compromise, the input demands may be specified as suggested, but hypotheses formulated on the basis of a richer theoretical model.

In order to develop a theoretical model and to draw inferences about the demand for convenience foods, the outputs of productive household activities must be defined. Defining the commodities produced by convenience foods as meals or servings may be fruitful. Inputs to the production process include purchased food ingredients, other variable inputs such as fuel or electricity, units of physical and human capital and labor time. As long as physical and human capital are not "used up" by the process their costs would not enter the full cost, but their stock levels would affect marginal productivity of physical inputs and labor. Other things that would affect the marginal products are environmental factors such as family size and composition.

The treatment of commodities in the utility function is a major consideration for a formal model. Meals or servings from convenience foods and nonconvenience counterparts may be treated as identical or as separate commodities. The appropriate way to model the commodities

would change depending on the type of meal considered and the discrimination of the household. If a store-bought, fully-prepared meal is a perfect substitute in the utility function for a home-produced counterpart, then it would be appropriate to treat purchased ingredients to both meals as production substitutes, producing a single commodity. If the two meals did not have the same capacity to satisfy the consuming household, then it would be better to treat them as consumption substitutes (albeit close substitutes) and the ingredients as inputs to two different productive processes. If both meals are treated as the same commodity, the summary condition of maximization reduces further to an identity. It would no longer be necessary to consider utility maximization, allowing research to focus on the minimum cost of producing meals.

The nature and characteristics of the meal production process are important considerations. There is evidence that meal preparation exhibits economies of size. If this is correct the conditions do not allow full costs to be treated as invariant to perferences. In 1959 Rockwell (1959) reported that total household use of food was positively related to family size but per capita requirements declined as family size increased.

Taking family size to be exogenous, the opportunities to take advantage of scale economies are limited in any given household. Food can be prepared ahead of time and preserved until used, but for the most part meal preparation activities tend to be specific to the meal

occasion. For example, persons living alone will seldom prepare ten servings of a meal just to take advantage of scale economies, if only because they will be faced with nine more servings of the same meal. Even though single persons may prepare two servings and save one for a subsequent meal, it is clear that there is a limit to the region for which scale economies are effective. Therefore, for a given household of a given size, constant returns to scale may not be too unreasonable an assumption.

There would also seem to be a limit to the substitution of inputs in meal preparation. Even though a stew may be prepared with more starch and less meat, recipes are critical to the quality of many foods (e.g. more meat is preferred to more potatoes; even more critical, without the proper proportion of leavening agents, dough will not rise). If recipes are taken as specifications of fixed proportion production technologies then convenience products and scratch ingredients would be mutually exclusive, alternative technologies to producing a meal. If meals were not differentiated in the utility function, then optimization would lead to complete specialization in the least-cost method of producing a meal. From this point of view, the per-serving costs of convenience foods and home-prepared counterparts, as estimated by Harp-Dunham and Traub-Odland are estimates of the Beckerian shadow prices of the servings. The per-serving cost may be taken as the "unit cost function", with the unit of output measured as a serving. Assuming fixed proportions of inputs makes it simple to compute the effects of market price or wage changes.

For an example of how the value of time affects the shadow cost of food servings, compare costs reported in Traub and Odland (1979) for baking powder biscuits in three alternative forms: (1) prepared from scratch, (2) prepared from a complete mix and (3) prepared from a chilled can.

The costs per serving are broken down as follows:

	Per Serving Costs			
	Total	Labor	Fuel	Ingredients
	---------- cents ----------			
Home Prepared Biscuits	7.2	3.0	1.5	2.7
Complete Mix Biscuits	7.0	2.5	1.4	3.1
Chilled Canned Biscuits	6.0	0.6	1.4	4.0

Although Traub and Odland also compute the cost of using electric appliances and active and passive time at various wage rates, the costs cited in the example only consider gas appliances, active time and minimum wage. The labor costs are computed by multiplying the labor required per serving by the minimum wage ($2.05 per hour, or 3.42¢ per minute). The labor requirements for home prepared, complete mix and chilled canned biscuits are 0.876, 0.734 and 0.182 minutes per serving. Under fixed proportions production these numbers represent the marginal effect of a (per-minute) wage change on the full price of the respective

servings. A change in the value of the homemakers' time affects full price of home prepared biscuits the most, complete mix biscuits a little less, and canned biscuits the least. The effect on full price of home-prepared biscuits is almost five times as great as that for canned biscuits. Households with different values of time or different productivity of time will choose different technologies for preparing biscuits. If all three processes produce output of similar quality, to consider all three as the same commodity may be reasonable.

These results would vary if the fixed proportions and constant returns to scale conditions are not met. However, the food technologists at the Consumer and Food Economics Institute believe that the relationship between servings and purchased inputs may be approximated by fixed proportions. Fulton, Davis and Matthews (1978), present a guide to calculate amounts of foods to purchase based on the number of servings required. Listing a total of 727 entries over different market forms of many foods, they provide the number of servings derived from a purchased unit, and an amount-to-buy factor. The suggested use of the factor is to determine the amount of food to buy for the number of servings required, by multiplying required servings by the amount-to-buy factor. As a result, servings are represented as simple proportions of purchased ingredients. Even though many of the servings are reported as forms other than final, the implicit assumption of the authors is that returns to scale are constant and ingredients are used in fixed proportions. The treatment of

convenience foods and home prepared counterparts as production substitutes is useful, but it does not explain why households may be observed to use more than one process. To explain that behavior, one must assume different marginal utilities of servings of each meal, implying that they are really considered consumption substitutes.

Theoretical elasticities of demand. The derivation and formal discussion of the demand determinants using the household production function framework in a theoretical model very similar to Gronau's (1973) is developed in Appendix A. The elasticities of demand determinants which are derived in the appendix are summarized here. The theoretical elasticities have been derived to make predictions about the sign of total elasticities of demand determinants. They have been broken down into components solely to determing the overall effect, and individual components have not been estimated because of data limitations. The money income elasticity of demand for purchased market good M_i is written $E(M_i,I)$.

$$E(M_i,I) = \frac{I}{S} E(Z_i,S)$$

where S is full income. The money income elasticity of demand equals the full income elasticity of demand for commodity Z_i times the ratio of money income to full income. This ratio must be greater than zero and less than one by definition. Since the full income elasticity is expected to be positive and less than one, the same is expected of the money income elasticity of demand.

The price elasticities of demand for purchased market goods are written

$$E(M_i,P_j) = \frac{M_jP_j}{S} (\sigma_{ij} - E(Z_i,S))$$

where σ_{ij} is the Allen partial elasticity of substitution in consumption. When i=j, $E(M_i,P_j)$ is the own-price elasticity of demand. In all cases the own partial elasticity of substitution must be negative, and assuming normal goods, and commodities, the income elasticity of demand must be positive, resulting in a negative own-price elasticity. When $i \neq j$ the partial elasticity of substitution is negative for consumption complements and positive for consumption substitutes. Assuming that commodities i and j are consumption substitutes leaves a positive substitution effect and a negative income effect, resulting in an inderminate sign on the cross-price elasticity of demand.

The value of time elasticity of demand for purchased good M_i is written

$$E(M_i,W) = \frac{WH_1}{S} \sigma_{i1} + \frac{WH_2}{S} \sigma_{i2} + \frac{WL}{S} \sigma_{i3} + \frac{WN}{S} E(M_i,S)$$

with three substitution terms and one income term. Each of the three substitution elasticities is weighted by the share of full income contributed by the respective uses of time (e.g., the first substitution

elasticity, σ_{il}, is weighted by the number of hours used to produce commodity 1, H_1, times the wage rate, W, the product divided by full income, S). Also, the full income elasticity is weighted by the share of full income contributed by earned income (i.e., the weight is the product of hours worked in the market, N, with the wage rate, W, the product divided bu full income, S). The sign of the overall elasticity is indeterminate because the own- and cross-substitution terms have opposite signs, even though the income term is positive. It is important to note that the terms are weighted by the full income shares associated with each use of household time. Activities which account for a relatively large share of household time will display a tendency to be negative because the negative own-elasticity of substitution will receive a relatively large weight.

CHAPTER IV

STATISTICAL MODELS

From the theoretical model described in the preceding chapter, an empirical version of the household demand functions may be specified. Demand for market goods (M_i) can be expressed as a function of market prices (P_i), income (I) and value of time of the meal preparer (VOT). Other variables that enter the model are household characteristics that serve as proxies for differences in tastes and preferences (T), labor productivity, human capital, physical capital, and environmental factors (E), such as the size and age-sex composition of the household, also, factors that affect the meal preparer's value or availability of time. The specification of this demand model is

$$M_i = d^i(P_1, \ldots, P_n, I, VOT, T, E)$$

The theoretical model only included two meal types to keep the number of terms to a mimimum, but the classification scheme allows for four convenience classes of food. Therefore four equations were estimated.

Variable selection. The data used to estimate the models was the 1977-78 Nationwide Food Consumption Survey (NFCS). The 1977-78 NFCS contains food-use and expenditure survey data for households in the

United States. A stratified probability sample of households was surveyed over four seasons from Spring 1977 through Winter 1978. The household survey includes almost 15,000 households across the 48 contiguous states. Trained interviewers were used to obtain the kind, form, cost and quantity of each food used during the previous week. Information on eating habits and socioeconomic and demographic characteristics such as the household age-sex composition, income, size, etc. was recorded as well. Only housekeeping households, defined as those households with at least one person having ten or more meals from the household supply during the survey period, were included in the estimation sample. The price differences that would be expected to occur over regions, seasons and urban settings were accounted for by including dummy variables for these effects, and prices were not included explicitly in the statistical model. Since prices were not explicitly included, money value of food used in each convenience class was chosen in favor of quantity as the appropriate measure of consumption. The appropriate person for whom value of time was to be measured was the household meal preparer, identified as male head or female head or both in the data set. For this research, if another member including male head was identified along with female head as meal preparer, the female head was determined to be the meal preparer.

Once the meal preparer was determined, a measure of value of time was needed. Theoretically, the value of time for an income earner would be the individual's earned income per period divided by number of hours

worked in the period. The survey recorded individuals' income by source, but the various categories were reported using incompatible time periods. Specifically, earned income included the reported income catagories "wages and salaries" plus "net income from farm" plus "net income from business or profession." Other reported sources of income (Social Security, Aid to Families with Dependant Children, pensions, disability, estates, trusts, dividends, etc.) were determined to be unearned income. Within the earned income category, wages and salaries were reported on a monthly basis while net incomes were reported on an annual basis. To make matters worse, hours worked were reported on a weekly basis. To develop a measure of wage or hourly earned income, net incomes and wages and salaries were converted to a weekly basis, combined, and divided by hours worked. The measurement errors inherent in this procedure were too great to be overlooked, resulting in computed hourly wages that ranged from fractions of a cent to hundreds of dollars. The average wages were fairly reasonable (between two and six dollars per hour for various individuals) but the dispersion was enormous. For these reasons another measure of value of time was chosen.

Following Fletcher (1981) earnings were used to proxy for the value of time. Net incomes and wages and salaries were converted to a weekly basis and combined to form the measure of earnings. This procedure provides a value of time proxy for meal preparers with earned income, but for those who don't work outside the home there is no such

information reported. Again, following Fletcher (1981) market opportunity earnings were estimated using Heckman's sample selection bias procedure (Heckman, 1979). The procedure and results are reported in appendix B.

The elasticity of a change in expenditure with respect to value of time was expected to differ between male and female meal preparers. Although this was expected for several reasons, the primary one was that men were expected to be less labor efficient in producing nonconvenience meals, and some convenience meals, than women. A dummy variable has been included as an intercept-shifter and a slope-shifter (on value of time) to account for differences in sex of the meal preparer.

It was also expected that differences would occur between those meal preparers who were market-oriented (i.e. working outside the home) and those who were nonmarket-oriented (i.e. not working outside the home). If market-oriented meal preparers have little discretion over the number of hours they work in the market in a given week, the hours spent working at home or in leisure would be a residual, leftover after spending the (fixed) hours at work in the market. The time available for home production and leisure is more scarce for market-oriented meal preparers.

Differences between elasticities from market-oriented and nonmarket-oriented meal preparers may have another source in the appropriateness of market opportunity earnings as a proxy for value of time. Gronau (1977) contends that potential wage rate for non-working

women does not affect time allocation. If the costs of market entry were negligible and work hours were flexible, potential wage would consistently underestimate the value of time for nonworking women. In fact, he reported that potential wage of wives who were not employed did not affect their allocation of time among work at home and leisure. Finally, even if the potential earnings of unemployed meal preparers do have a bearing on the value of time, inaccurate predictions for unemployed meal preparers would cause differences in elasticity measures.

Because of Gronau's result that potential wage was not important, a substitute measure for value of time was used where available. Gronau has shown that nonmarket-oriented meal preparer's value of time would be pegged to the market wage of a wage-earning spouse. Therefore, for households with nonmarket-oriented meal preparers, but market-oriented heads of opposite sex, the earnings of the "other head" were used to proxy for value of time. Hence, dummy variables have been used as intercept- and slope-shifters to account for diffrences between (1) market-oriented meal preparers (2) nonmarket-oriented meal preparers without a wage earning "other head" and (3) nonmarket-oriented meal preparers with a wage-earning "other head" present (hereafter referred to as "half-market-oriented"). The following list details the dependent and independent variables that entered the models, along with a brief description. Where the variable is specifically defined as a logarithm, the natural logarithm has been used. Otherwise, as for all zero-one dummy variables, the values are actual numbers as defined.

VALUE1

The logarithm of money value of nonconvenience food used by a household in the survey week.

VALUE2

The logarithm of money value of basic convenience food used by a household in the survey week.

VALUE3

The logarithm of money value of complex convenience food used by a household in the survey week.

VALUE4

The logarithm of money value of manufactured convenience food used by a household in the survey week.

NMO

A zero-one dummy variable taking on the value of one if the meal preparer and the other household head (if there is one) are nonmarket-oriented, zero otherwise.

HMO

A zero-one dummy variable taking on the value of one if the meal preparer is half-market-oriented, zero otherwise.

FPREP

A zero-one dummy variable taking on the value of zero if meal preparer is the male head, one if the female head.

VOT

The logarithm of the proxy for value of time. For households with market-oriented meal preparers, this is the meal preparer's weekly value of earnings.

For households with nonmarket-oriented meal preparers but with market-oriented other heads (i.e. half-market-oriented), this is the other head's weekly value of earnings. For households with nonmarket-oriented meal preparers and no other wage earning head, this is the estimated potential market earnings of the meal preparer.

VOTNMO

Interaction of value of time with NMO.

VOTHMO

Interaction of value of time with HMO.

VOTFPREP

Interaction of value of time with FPREP.

R1, R2, R3

Zero-one variables for region: Northeast, north central, southern. The base category is the west.

S1, S2, S3

Zero-one variables for season: spring, summer, fall. The base category is winter.

HR1, HR2

Zero-one variables for the race of household: white, black. The base category is "other".

U1, U2

Zero-one variables for the urbanization of households: central city, suburban. The base category is non-metropolitan.

FARMER

Zero-one variable, one for the reported occupation of household head as farmer, zero otherwise.

C0TO2, C2TO5, C6TO11, CTEEN

Zero-one variables representing the presence (versus absence) of at least one child by age categories 0 to 2 years, 3 to 5 years, 6 to 11 years, and 12 years of age and older.

M21TO54, M55TO74, M75TO99

Zero-one dummy variables representing the presence (versus absence) of at least one adult male age group 21 to 54 years, 55 to 74 years and over 75 years.

F21TO54, F55TO74, F75TO99

Zero-one dummy variables representing the presence (versus absence) of at least one adult female age group 21 to 54 years, 55 to 74 years and over 75 years.

HHSIZE

The logarithm of household size, based on actual count of members.

INCOME

The logarithm of household money income converted to a weekly basis.

Out of all 14,032 housekeeping households, 5,053 were deleted because information on the variables (mostly individuals' incomes) was not available, or because the household head's computed wage fell in the upper and lower five percent of the wage distribution. Out of the 8,979 households that were left, 32 were deleted because they reported zero level of use of manufactured convenience foods. The final sample size for model estimation was 8,947 households.

Since there is little theoretical guidance as to the appropriate functional form for estimating food demand or expenditure models, the double-logrithamic form was chosen for two main reasons. Simple logarithmic transformation of dependent and independent variables allows the model to be estimated in linear form using ordinary least squares regression. The ease of interpretation of parameters is evident in the fact that partial regression coefficients are estimates of elasticities. Also, the double-logarithmic form has desirable properties for income and household size effects: with parameter etimates between zero and one, the effects of variables are increasing at a decreasing rate (i.e. evidence of economies of scale and the classic Engel income relationship).

Hypotheses about the signs and magnitudes of coefficients of the independent variables in the food expenditure models have been formulated. The alternative hypotheses are formulated such that the rejection of the null hypotheses is equivalent to the acceptance of the null hypotheses (i.e., they are the converse of the expected

relationships). The null hypotheses are the objects of the statistical tests, to be accepted or rejected. Table 6 summarizes the alternatative hypotheses which are specific to the coefficients of variables in all of the various convenience food and nonconvenience food models. The results of ordinary least squares regression estimation of the models are presented in table 7. The F-statistics for all five models are highly significant, indicating that, overall, the models significantly effect the money value of food used by households. The coefficient of determination is between .305 and .50 for all four models, which is moderate to good explanatory power for crossection data on such a large data base (8,947 households).

Value of time and characteristics of meal preparers. The overall effect of the value of time on food expenditures can not a priori be determined based on the theoretical model, so no hypotheses are formulated about the coefficient of the logarithm of earnings, the value of time proxy. However, hypotheses have been formulated about the differences in coefficients of VOT for meal preparers of different characteristics. The effects of sex and market-orientation of meal preparers have been accounted for by intercept-shifitng and slope-shifitng dummy variables which have related hypotheses associated with their coefficients.

The theoretical elasticities derived from the model imply that the value of time elasticity for a food class will be the lesser for households that spend a lot of time preparing foods of that class, and

Table 6. Alternate hypotheses for partial regression coefficients in models of household food expenditure on nonconvenience and basic, complex and manufactured convenience classes of food

Independent Variable	Nonconvenience Food	Basic Convenience Food	Complex Convenience Food	Manufactured Convenience Food
Intercept	$b \neq 0$**	$b \neq 0$**	$b \neq 0$**	$b \neq 0$
NMO	$b > 0$**	$b < 0$**	$b < 0$**	$b < 0$*
HMO	$b > 0$	$b < 0$**	$b < 0$	$b < 0$**
FPREP	$b > 0$**	$b < 0$**	$b < 0$**	$b < 0$
VOT	$b \neq 0$**	$b \neq 0$**	$b \neq 0$	$b \neq 0$
VOTNMO	$b < 0$*	$b > 0$**	$b > 0$*	$b > 0$*
VOTHMO	$b < 0$	$b > 0$**	$b > 0$	$b > 0$**
VOTFPREP	$b < 0$**	$b > 0$**	$b > 0$	$b > 0$
INCOME	$b > 0$**	$b > 0$**	$b > 0$**	$b > 0$**
	$b < .17$**	$b < .17$**	$b < .17$**	$b < .17$**
HHSIZE	$b > 0$**	$b > 0$**	$b > 0$**	$b > 0$**
	$b < 1$**	$b < 1$**	$b < 1$**	$b < 1$**
R1	$b > 0$**	$b > 0$**	$b > 0$**	$b > 0$**
R2	$b \neq 0$**	$b \neq 0$	$b \neq 0$**	$b \neq 0$*
R3	$b \neq 0$	$b \neq 0$**	$b \neq 0$**	$b \neq 0$
S1	$b \neq 0$**	$b \neq 0$**	$b \neq 0$**	$b \neq 0$
S2	$b > 0$**	$b < 0$**	$b < 0$**	$b < 0$
S3	$b > 0$	$b < 0$**	$b < 0$**	$b < 0$
HR1	$b < 0$**	$b > 0$	$b > 0$**	$b > 0$**
HR2	$b > 0$	$b < 0$**	$b < 0$*	$b < 0$
U1	$b < 0$	$b > 0$**	$b > 0$**	$b > 0$*
U2	$b < 0$	$b > 0$**	$b > 0$**	$b > 0$**
FARMER	$b > 0$**	$b < 0$*	$b < 0$**	$b < 0$
M21TO54	$b > 0$**	$b > 0$	$b > 0$**	$b > 0$*
M55TO74	$b \neq 0$**	$b \neq 0$	$b \neq 0$	$b \neq 0$**
M75TO99	$b \neq 0$	$b \neq 0$**	$b \neq 0$**	$b \neq 0$**
F21TO54	$b \neq 0$*	$b \neq 0$*	$b \neq 0$**	$b \neq 0$**
F55TO74	$b \neq 0$**	$b \neq 0$	$b \neq 0$**	$b \neq 0$**
F75TO99	$b < 0$	$b < 0$	$b < 0$**	$b < 0$**
C0TO2	$b < 0$**	$b < 0$*	$b < 0$**	$b < 0$**
C3TO5	$b < 0$**	$b < 0$**	$b < 0$**	$b < 0$**
C6TO11	$b \neq 0$**	$b \neq 0$	$b \neq 0$	$b \neq 0$
CTEEN	$b > 0$**	$b > 0$	$b > 0$**	$b > 0$**

* - significant at the .10 level; one-tail critical t=1.282; two-tail critical t=1.645

**- significant at the .05 level; one-tail critical t=1.645; two-tail critical t=1.960

Table 7. Partial regression coefficients and standard errors[a] for models of household food expenditure on nonconvenience and basic, complex and manufactured convenience classes of food

Independent Variable	Nonconvenience Food	Basic Convenience Food	Complex Convenience Food	Manufactured Convenience Food
INTERCEPT	1.6396	1.3366	1.0793	-0.2111
	(0.1708)	(0.2335)	(0.2328)	(0.3019)
NMO	0.4410	-1.3770	-0.6736	-0.6813
	(0.2416)	(0.3303)	(0.3293)	(0.4250)
HMO	-0.1633	-0.4316	-0.0288	-0.4738
	(0.1119)	(0.1530)	(0.1526)	(0.1978)
FPREP	0.4423	-0.4957	-0.5339	-0.3343
	(0.1752)	(0.2395)	(0.2389)	(0.3097)
VOT	0.0907	-0.0910	-0.0278	-0.0312
	(0.0323)	(0.0442)	(0.0440)	(0.0571)
VOTNMO	-0.0786	0.2833	0.1152	0.1208
	(0.0480)	(0.0657)	(0.0655)	(0.0849)
VOTHMO	0.0388	0.0922	0.0041	0.0859
	(0.0213)	(0.0292)	(0.0291)	(0.0377)
VOTFPREP	-0.0646	0.0852	0.0580	0.0502
	(0.0339)	(0.0464)	(0.0463)	(0.0600)
INCOMES	0.0290	0.0673	0.0593	0.0806
	(0.0073)	(0.0100)	(0.0100)	(0.0130)
HHSIZE	0.7380	0.6667	0.8595	0.8147
	(0.0227)	(0.0310)	(0.0309)	(0.0401)

a - Standard errors are in parentheses.

Table 7 (continued)

Independent Variable	Nonconvenience Food	Basic Convenience Food	Complex Convenience Food	Manufactured Convenience Food
R1	0.0466 (0.0170)	0.2217 (0.0232)	0.1996 (0.0231)	0.0975 (0.0300)
R2	-0.0516 (0.0172)	-0.0239 (0.0235)	0.1170 (0.0234)	0.0558 (0.0304)
R3	-0.0109 (0.0165)	-0.0836 (0.0226)	-0.1066 (0.0226)	0.0057 (0.0292)
S1	-0.0369 (0.0152)	-0.0783 (0.0208)	-0.0790 (0.0207)	-0.0007 (0.0269)
S2	0.0561 (0.0151)	-0.1161 (0.0207)	-0.0385 (0.0207)	0.0286 (0.0269)
S3	-0.0051 (0.0144)	-0.0405 (0.0197)	-0.0694 (0.0197)	-0.0281 (0.0255)
HR1	-0.2223 (0.0312)	0.0181 (0.0426)	0.1175 (0.0425)	0.1286 (0.0551)
HR2	-0.1180 (0.0343)	-0.1157 (0.0469)	-0.0668 (0.0467)	-0.0098 (0.0606)
U1	0.0615 (0.0141)	0.1118 (0.0193)	0.0936 (0.0193)	0.0409 (0.0250)
U2	0.0077 (0.0133)	0.0556 (0.0182)	0.0871 (0.0181)	0.0588 (0.0235)
FARMER	0.1589 (0.0407)	-0.0781 (0.0557)	-0.1255 (0.0555)	-0.0911 (0.0720)

Table 7 (continued)

Independent Variable	Nonconvenience Food	Basic Convenience Food	Complex Convenience Food	Manufactured Convenience Food
M21TO54	0.1262 (0.0185)	0.0256 (0.0253)	0.1103 (0.0252)	0.0438 (0.0327)
M55TO74	0.1788 (0.0198)	-0.0094 (0.0270	0.0061 (0.0269)	-0.0734 (0.0349)
M75TO99	0.0412 (0.0314)	-0.1670 (0.0430)	-0.1539 (0.0428)	-0.1655 (0.0555)
F21TO54	0.0436 (0.0241)	0.0620 (0.0330)	-0.1087 (0.0329)	-0.0887 (0.0426)
F55TO74	0.0697 (0.0235)	0.0292 (0.0321)	-0.1988 (0.0320)	-0.1950 (0.0415)
F75TO99	-0.0290 (0.0288)	-0.0293 (0.0394)	-0.2296 (0.0392)	-0.2731 (0.0509)
C0TO2	-0.1384 (0.0220)	-0.0465 (0.0301)	-0.0608 (0.0300)	-0.0942 (0.0389)
C3TO5	-0.1165 (0.0191)	-0.0737 (0.0260)	-0.0807 (0.0260)	-0.0920 (0.0337)
C6TO11	-0.0756 (0.0169)	-0.0349 (0.0231)	-0.0270 (0.0230)	0.0447 (0.0298)
CTEEN	0.0418 (0.0182)	0.0156 (0.0249)	0.0456 (0.0249)	0.0513 (0.0322)
MSE[b]	0.252	0.471	0.469	0.789
F RATIO	262.40	134.83	236.44	130.45
R-SQUARE	0.469	0.312	0.443	0.305

b- Mean Square Error

the greater for households that spend relatively little time preparing foods of that class. Women were expected to use more nonconvenience foods while men were expected to use more convenience foods. Therefore, the coefficient of FPREP (the intercept shift for female meal preparers) was hypothesized to be positive for nonconvenience foods, but negative for convenience foods. Table 6 shows that the alternate hypothesis on coefficients of FPREP is accepted at the .05 level of significance in all models except for the manufactured convenience food model. The coefficient of VOTFPREP (the shope shift for female meal preparers) is hypothesized to be negative for nonconvenience foods but positive for convenience foods. The statistical tests bear this out only in the nonconvenience and basic convenience food models, although all coefficients of VOTFPREP have the expected sign even where they are not significant. These relationships between the coefficients of FPREP and VOTFPREP are hypothesized to hold for the coefficients of HMO, VOTHMO, NMO and VOTNMO since, like women, nonmarket-oriented and half-market-oriented meal preparers are expected to use more nonconvenience foods and less convenience foods than market-oriented meal preparers (the base category). Statistical tests generally support the expectations with some exceptions. The coefficients of HMO and VOTHMO in the nonconvenience food model had opposite to expected signs, and in the complex convenience model they were not significant.

Table 8 contains a summary across models of the intercept shifts representing effects of attributes of meal preparers on money value of

Table 8. Intercept shifts[a] for meal preparers with different attributes from models of household expenditure on nonconvenience and basic, complex and manufactured convenience classes of food

Attribute	Non-convenience	Basic convenience	Complex convenience	Manufactured convenience
Nonmarket-oriented	.441	-1.377	-6.74	-.681
Half-market-oriented	-.163	-.431	-.029	-.474
Female	.442	-.496	-.534	-.334

a - Ceteris paribus differences from market-oriented males

food used. The pattern is consistent that, ceteris paribus, male market-oriented meal preparers use more convenience foods than other meal preparers. The only parameter inconsistent with expectations that appears is that half-market-oriented meal preparers use less nonconvenience food than other meal preparers, including market-oriented ones.

Since the coefficients of interaction terms of meal preparer attributes on the value of time elasticity are interpreted as differences from the base category, they must be added to the base elasticity to discover the level of their elasticities. Table 9 shows how value of time elasticities compare across convenience foods for different attributes of the meal preparer. For the three convenience classes, nonmarket- and half-market-oriented female meal preparers all have positive elasticities of the value of time. Except for the basic convenience food model, the market-oriented female meal preparers have positive value of time elasticities.

The nonmarket-oriented and half-market-oriented female meal preparers have negative elasticities of value of time in the nonconvenience class. Although the theoretical elasticity has an indeterminate sign these results agree with the tendencies anticipated by the theoretical model. The tendency of market-oriented male meal preparers to have a positive elasticity in the nonconvenience class, and negative elasticities in other classes was also anticipated from the theoretical model. Nonmarket-oriented male meal preparers have

Table 9. Value of time elasticities for meal preparers with different attributes from models of household expenditure on nonconvenience and basic, complex and manufactured convenience classes of food.

	Non-convenience		Basic convenience		Complex convenience		Manufactured convenience	
Attribute	Male	Female	Male	Female	Male	Female	Male	Female
Market-oriented	.090	.026	-.100	-.015	-.028	.030	-.031	.019
Nonmarket-oriented	.012	-.053	.183	.268	.087	.145	.090	.140
Half-Market-oriented	.052	-.013	-.008	.077	-.024	.034	.055	.105

contradictory characteristics that make predictions about the sign of the value of time elasticity difficult.

Household size and income. The logarithm of household size is hypothesized to be positively related with the logarithm of expenditures in all food categories, since more food is required by larger households. Also, since economies of size are expected to prevail (i.e. food expenditures per person decline as household size increases) and since the partial regression coefficients in the double-logarithmic equation form are elasticities, the coefficient of household size was hypothesized to be less than one in all four food expenditure models. Table 6 shows that, for all models, the elasticity of household size falls in the expected range. This is indicated by the significance of the tests on the upper and lower range of the coefficients. The coefficients of HHSIZE range from 0.67 for basic convenience foods to 0.86 for complex convenience foods.

The coefficient of the logarithm of household money income was also hypothesized to fall between zero and one, since none of the food groups was considered an inferior good (with negative income elasticity) or a luxury good (with income elasticity greater than one). Typical income elasticities of food expenditure fall in the 0.17 to 0.3 range (see George and King (1972), Prochaska and Schrimper (1973), and Salathe (1979) for examples). Mincer (1963) and Prochaska and Schrimper (1973) have pointed out that estimates of income elasticities in models that do not account for the value of time will be biased upward. Therefore, in

all four estimated models, the coefficient of the logarithm of income should be considerably less than one, and even less than the 0.17 to 0.3 range typically reported.

The income elasticity of food expenditure in each equation is seen to fall in the expected range. The estimated coefficients range from 0.03 in the nonconvenience food expenditure model to 0.08 in the complex convenience food model. All income coefficients have been found significantly greater than zero and significantly less than 0.17, the most conservative estimate of the income elasticity of expenditure for food at home reported by Salathe (1979). This verifies that the food categories investigated are neither inferior nor luxury goods, and that demand models that ignore the effects of the value of time overestimate the elasticity of expenditure with respect to income.

Region and season. The base category of the region dummy variables is the west. Therefore the coefficients of R1, R2, and R3 are all relative to the western region. Fletcher (1981) reported that Northeast households spent the most on all food at home, and that north central households spent the least of food away from home. Redman (1980) found that households in the Northeast and north central regions spent more on prepared food than households in the south and west. Based on these findings, the Northeast was expected to spend the most on any food category and the coefficient of R1 was hypothesized to be positive in all models. Since the published evidence on north central households' behavior was mixed, no hypotheses were formulated with respect to the

sign of the coefficient of R2. Also, since the south and west have previously shown similar behavior, no sign expectations have been made with respect to the coefficient of R3.

As expected, the intercept shift for Northeast region (the coefficient of R1) was significantly positive in all four models. The effect on the intercept was least in the nonconvenience model at 0.05 and greatest in the basic convenience model at 0.22. The coefficient of R2 was significantly different from zero in all but the basic convenience model, and the coefficient of R3 was significantly different from zero in only the basic and complex convenience food models. The Northeast households spent the most in all food classes while the south and west generally used the least. One exception was with nonconvenience foods for which the north central households spent the least (a result that contradicts the findings of Redman).

The base category of the seasonal dummy variables is winter. Therefore the coefficients on S1, S2 and S3 are all relative to the winter season. During the fall and summer (S2 and S3) households should find low priced, high quality fresh food items in plenty, so more nonconvenience items would be used. The coefficients of S2 and S3 were hypothesized to be negative for convenience foods but positive for nonconvenience foods. Spring (S1) is not expected to be very different from winter in availability of fresh foods so no hypothesis was formed about the expected sign of its coefficient. The effect of spring tested significantly different from zero in the manufactured convenience food

model, and was less than zero in all four models. The effects of fall and summer were significantly negative on basic and complex convenience foods, but mixed in sign and significance in the other models.

Race and urbanization. Although Fletcher reported mixed results of the effects of race on at-home food expenditure, Redman found that whites used more prepared food than blacks. It was hypothesized that the coefficients of HR1 would be positive and the coefficients of HR2 would be negative for the three convenience food models, and the converse hypothesized for the nonconvenience food model. The sign expectations were generally verified, but not all coefficients were significant. White households used significantly less nonconvenience foods than others, as well as significantly more complex and manufactured convenience foods. Blacks used significantly less basic and complex convenience foods.

Rural households were found by Fletcher to spend less than metropolitan households on all food at home, and Redman's findings support the same pattern for prepared foods. Therefore it was hypothesized that the coefficients of U1 (central city dummy variable) and U2 (metropolitan area dummy variable) would both be negative for nonconvenience foods, but positive for convenience foods models. Table 7 shows that all coefficients of U1 and U2 were positive, indicating that the base category of rural (i.e. nonmetropolitan) households spend less than nonrural (i.e. central city and suburban) households on each category of food, leading to the the rejection of the null hypotheses in

the convenience food models, but no rejection in the nonconvenience food model.

Farm families. Kinnucan and Sexauer have shown that farm families use more home-produced food than nonfarm families. The value of home-produced food would show up in the nonconvenience category of food as defined for the present analysis. Therefore food expenditures for farm households should be greater for nonconvenience foods and less for convenience foods. The coefficient of FARMER was hypothesized to be negative for convenience foods and positive for nonconvenience foods. Estimated coefficients all had the predicted signs, and all were significant except for the effect on manufactured convenience food.

Age and sex composition. The age and sex composition of survey households has been represented by dummy variables indicating the presence of family members in a specific category. Hypotheses about the effect of the presence of at least one individual from various age and sex categories are based on the expected food requirements of individuals in the various categories relative to a "typical" or middle range individual. The description of individuals in equivalent nutrition units (ENU's) for food energy verifies the basic expectations about food requirements. ENU's describe the nutrient requirements of an individual in terms of an index relative to the requirements of an adult male (USDA, 1981). The ENU's for food energy indicate that young adult men and teens require the most food energy, while small children and elderly women require the least. These relationships must be translated into hypotheses about coefficients of variables in the models.

In terms of the dummy variables representing the age-sex composition of households, the coefficient is the effect of the presence of at least one individual from the specific age and sex group represented by the variable. Intuition about food requirements, backed up by the ENU's for food energy suggest that the coefficients of CTEEN and M21T054 should be positive, and the coefficients of C0T02, C3T05, F55T074 and F75T099 should be negative. The food energy requirements of other age-sex groups fall in a middle range, making it difficult to form hypotheses about coefficients of M55T074, M75T099, F21T054 or C6T011. The age-sex composition showed generally significant and plausible effects in the estimated models. The coefficients of M21T054 and CTEEN were positive in all four models, and significant in all but the basic convenience food model. The coefficient of F75T099 was negative in all four models, but significant only in the complex and manufactured convenience models. The coefficients of C0T02 and C3T05 were negative in all four models and tested significantly less than zero in all cases.

Tests performed on the null hypothesis that coefficients of the other age-sex variables were equal to zero provided mixed results. One interesting pattern that emerged was that the effects of adult women (F21T054 and F55T074) were positive on nonconvenience and basic convenience food use but negative on complex and manufactured convenience food use, and the coefficients were significantly different than zero in all but one case. Of all age-sex effects, only adult males age 21 to 54 and teenage children increased money value of complex

convenience foods significantly. The interpretation is that, ceteris paribus only presence of teenagers and young adult males increase the use of complex convenience foods. Age-sex composition of the household also had mixed effects on manufactured convenience foods. Presence of adult males from 21 to 54, and teenagers had positive effects on value of manufactured convenience food used by the household. All other categories except children aged 6 to 11 significantly reduce household use of manufactured convenience foods.

Table 10 shows how the presence of household members in different age-sex categories affects money value of household food in the various convenience classes. The table shows that small children very consistently decrease value of food in all classes, but the effect is much greater on nonconvenience foods than any of the convenience foods. Teens and adult males are the only groups that consistently increase money value of all classes of food (ceteris paribus). The parameters should not be interpreted as the effect of adding an individual of a given class to the household, since the ceteris paribus assumption is violated if household size changes. Rather, they should be interpreted as differences occurring between two households, holding size (and every other characteristic) constant, but one household with a specific age-sex group represented, the other without it.

Food expenditure profiles. To illustrate the usefulness of the regression models in predicting market behavior of households, several profiles have been developed for food expenditures by households with

Table 10. Intercept shifts[a] for presence of household members of different age and sex categories in models of household expenditure on nonconvenience and basic, complex and manufactured convenience classes of food

Age-sex group	Non-convenience	Basic convenience	Complex convenience	Manufactured convenience
Children:				
0 to 2	-0.138	-0.047	-0.061	-0.094
3 to 5	-0.117	-0.074	-0.081	-0.092
6 to 11	-0.076	-0.035	-0.027	0.045
Teens	0.042	0.016	0.046	0.051
Males:				
21 to 54	0.126	0.026	0.110	0.043
55 to 74	0.179	-0.009	0.006	-0.073
75 to 99	0.041	-0.167	-0.154	-0.166
Females:				
21 to 54	0.044	0.062	-0.109	-0.089
55 to 74	0.070	0.029	-0.199	-0.195
75 to 99	-0.029	-0.029	-0.230	-0.273

a - Ceteris paribus effects for presence versus absence.

different characteristics and economic constraints. Table 11 presents the predicted weekly expenditures on each food class by weekly income for several scenarios of household characteristics. In all four profiles income has been varied from $100 per week to $800 per week. Choosing an appropriate number for the value of time variable (i.e., earnings) was a problem.

For the purpose of demonstrating the model predictions, earnings were set equal to income. Thus, the profiles are applicable to households which had only earned income, and the expenditure patterns reflect both income and value of time effects as income is varied from $100 to $800. Profiles 1 and 2 show the predicted expenditures for single person households. The single household member was taken to be a representative of the 21 to 54 year age group. Predictions were made for both males and females of this age group. The differences between expenditures by males and females are seated in the intercept shifts for the sex of the meal preparer and the age-sex composition variables, as well as in the slope shift in the value of time elasticity for the sex of the meal preparer. The rest of the household characteristics for profile 1 were chosen so as to simulate relatively low use of convenience foods. Specifically, the characteristics are: region - south, season - summer, urban setting - nonmetropolitan, meal preparer - nonmarket-oriented, race - black and occupation - farmer.

The income elasticities were relatively low, even for food expenditures. This fact coupled with the fact that the value of time

Table 11. Profiles of the money value of food used by households of various characteristics: nonconvenience and basic, complex and manufactured convenience classes of food

Income	Non-convenience		Basic convenience		Complex convenience		Manufactured convenience	
	Male	Female	Male	Female	Male	Female	Male	Female
	dollars-per-week							
Profile 1[a]:								
100 ...	11.97	12.74	2.20	2.05	2.35	1.45	0.88	0.69
200 ...	12.31	12.53	2.63	2.61	2.60	1.67	0.99	0.81
300 ...	12.52	12.41	2.92	3.00	2.76	1.81	1.06	0.88
400 ...	12.67	12.33	3.15	3.31	2.88	1.92	1.11	0.94
500 ...	12.79	12.26	3.34	3.58	2.98	2.01	1.15	0.99
600 ...	12.88	12.21	3.50	3.81	3.06	2.09	1.19	1.03
800 ...	13.04	12.13	3.77	4.21	3.19	2.21	1.25	1.10
Profile 2[b]:								
100 ...	9.05	9.63	4.98	4.65	5.73	3.52	1.39	1.10
200 ...	9.83	10.01	4.90	4.86	5.85	3.75	1.44	1.17
300 ...	10.32	10.23	4.85	4.98	5.93	3.89	1.46	1.22
400 ...	10.68	10.40	4.82	5.07	5.98	3.99	1.49	1.26
500 ...	10.97	10.52	4.79	5.14	6.03	4.07	1.50	1.29
600 ...	11.22	10.63	4.77	5.20	6.06	4.14	1.52	1.31
800 ...	11.61	10.80	4.74	5.29	6.12	4.24	1.54	1.35

a - Household characteristics in Profile 1: household size - 1; meal preparer - male/female and nonmarket-oriented; region - south; season - summer; urban setting - nonmetropolitan; race - black; occupation - farmer; age-sex characteristic - male/female age 21 to 54.

b - Household characteristics in Profile 2: household size - 1; meal preparer - male/female and market-oriented; region - Northeast; season - winter; urban setting - central city; race - white; occupation - nonfarm; age-sex characteristic - male/female age 21 to 54.

Table 11. (continued)

Income	Non-convenience	Basic convenience	Complex convenience	Manufactured convenience
		dollars		
Profile 3[c]:				
100	27.42	13.55	17.70	4.13
200	29.79	13.33	18.09	4.28
300	31.28	13.20	18.33	4.36
400	32.37	13.11	18.49	4.43
500	33.25	13.04	18.62	4.48
600	33.98	12.99	18.73	4.52
800	35.17	12.90	18.90	4.58
Profile 4[d]:				
100	26.88	11.41	12.07	2.98
200	28.69	12.69	12.88	3.39
300	29.80	13.50	13.38	3.66
400	30.61	14.11	13.74	3.86
500	31.26	14.61	14.03	4.02
600	31.80	15.02	14.27	4.16
800	32.67	15.70	14.66	4.38

c - Household characteristics in Profile 3: household size - 4; meal preparer - male and market-oriented; region - Northeast; season - winter; urban setting - central city; race - white; occupation - nonfarm; age-sex characteristics - one male plus one female age 21 to 54, plus two teenage children.

b - Household characteristics in Profile 4: household size - 4; meal preparer - female and half-market-oriented; region - Northeast; season - winter; urban setting - central city; race - white; occupation - nonfarm; age-sex characteristics - one male plus one female age 21 to 54, plus two children age 0 to 2.

elasticities for some of the meal preparers were negative has lead to a low, or even negative, response to increases in income/vlaue of time. Males exhibit a tendency to use more food in general than females, with the exceptions that lower income (less than $200 per week) males use less nonconvenience food than low income females, and higher income (greater than $200 per week) males use less basic convenience foods than higher income females. The nonmarket-oriented female meal preparers are heavy users of nonconvenience foods and have strongly negative value of time elasticities that lead to a decline in the predicted use of nonconvenience foods as income/value of time increases.

Profile 2 compares the predicted weekly expenditures of male and female single person households for a set of other characteristics which lead to relatively heavy use of convenience foods. Specifically, the characteristics are market-oriented meal preparer, Northeast region, winter season, white race, central city urban setting, and nonfarm occupation. Comparisons between male and female households show patterns similar to those for profile 1. An interesting result is that even though males eat more than females, the low income males actually use less nonconvenience foods than the low income females for both profiles 1 and 2.

The market-oriented male meal preparers have strongly negative value of time elasticities for basic convenience foods that lead to a decline in their predicted level of use as income/value of time increases. The profile 2 households have been predicted to use more

convenience foods (in all three convenience classes and at all equivalent income levels) and less nonconvenience foods than the profile 1 households. The results imply that, in general, households consisting of a single female are lower consumers of convenience foods than households consisting of a single male.

Socioeconomic characteristics other than the sex of the meal preparer are extremely important in determining the level of use of convenience foods, especially in combinations. However, there is a tendency for females to rely more heavily on basic convenience foods as their income and value of time increase. The males, who are heavy users of basic convenience foods at even low income/value of time, tend to rely less heavily on basic convenience foods as their income and value of time increase.

Profiles 3 and 4 continue the simulations, but for households with four members instead of just one. Households in both profiles 3 and 4 have the Northeast, white, winter, central city and nonfarm characteristics, just like the heavy users of convenience food in the profile 2 simulation. Households in both profiles 3 and 4 have a male plus a female in the 21 to 54 year age group. The differences between profiles 3 and 4 are in the meal preparer and children. Profile 3 households have a market-oriented male meal preparer and teenage children and are heavy users of convenience foods.

Profile 4 households have half-market-oriented female meal preparers with children in the 0 to 2 year age group. Profile 4

households use less food in all food groups than profile 3 households except for basic convenience foods at higher income (greater than $300 per week) levels. Again, the nonmarket-oriented male meal preparers in profile 3 households exhibit a decline in use of basic convenience foods as income/value of time rises. Lower income households in profile 3 have been predicted to spend almost $8.00 more on convenience foods ($35.38) than nonconvenience foods ($27.42). This is a relatively high share of the food dollar going to convenience foods when compared to the mean share (just under 50%).

At a household income of only $100 per week, the market-oriented male meal preparer of profile 3 households relies relatively heavily on convenience foods, with 56% of the household food dollar going to these products. At the highest income of $800 per week the reliance on convenience foods has declined to 51% of the food dollar, much closer to the mean.

The half-market-oriented female meal preparers of profile 4 households use their food dollar differently than profile 3 households. At the lowest income of $100 per week, the share of food dollar going to convenience foods is about 50%. At an income of $800 per week the share occupied by convenience foods climbs, but only to about 52%. However, the distribution of expenditures among convenience food classes is changeable. The profile 4 households rely more heavily on basic convenience foods, which embody relatively low levels of labor and culinary expertise (e.g., single ingredient frozen or canned items).

The market-oriented male meal preparers of the profile 3 households are relatively heavy users of complex and manufactured convenience foods. These foods embody the highest level of labor saving and culinary services which can be purchased for at-home food consumption. The lowest income households in profile 4 spend about the same ($26.00 to $27.00) on convenience foods as nonconvenience foods.

A comparison of profile 3 households to the profile 2 male households illustrates the differences between households of different size with similar characteristics except for the 3 additional household members. Of course, the larger household uses more food in all categories. Yet, because of size economies and the needs of different individuals, the larger household uses less food per person (compare the total food expenditure $21.15 for the profile 2 single-person male household at the lowest income, with $15.70 per person for the profile 3 four-person household).

The share of the food dollar accounted for by convenience foods is nearly identical for profiles 2 and 3. Also, the mixture of expenditure on basic, complex and manufactured convenience foods are very similar. This is an indication that the age-sex composition of the household, while important in determining the level of expenditures, may be less important than the characteristics of the meal preparer in determining the relative food expenditure mixtures.

These profiles have been presented to show the potential usefulness of the models. Profiles could be worked up for any set of characteristics which the models take into account.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary. The recent growth in convenience and service components of the food industry in the United States has been evident. Almost one half the total food sales in 1973 went to convenience products. Convenience embodies many kinds of purchased service or utility that replaces home requirements of homemaker's labor, time and culinary skill, energy, and storage space. These processed food products often have higher quality and greater diversity than home-prepared counterparts. The factors that affect the structure of the food distribution industry include trends in income, household size and women in the work force. In the household, the characteristics of the meal preparer, age-sex composition and other demographic factors will affect food buying behavior.

The objective of this research was to identify household characteristics that affect convenience food use and to statistically test for differences among household types. This objective required the development of a theoretical model of the demand for convenience food. Even a cursory review of available theory suggests that the appropriate theory for application to the demand for convenience food is the theory

of the household production function. The final objective was to identify and measure effects of demand determinants on an expenditure model.

The definitions and classification of foods were taken from Havlicek, Capps and Axelson (1982). A comprehensive approach to the problem of determining household demand for convenience food required a mutually exclusive and exhaustive classification of food into various convenience classes. The classification scheme provided for classes of nonconvenience, basic convenience, complex convenience and manufactured convenience food. Nonconvenience foods are raw, unprocessed foods or ingredient foods. Basic convenience foods are single ingredient foods with limited culinary expertise embodied, usually providing a type of preservation convenience. Complex convenience foods are multiple ingredient, highly prepared foods. Manufactured convenience foods include products which have no home prepared counterpart.

Several pieces of research on convenience foods that shed some light on the nature of the products and the issues of importance have been reviewed. The most notable ones are Harp and Dunham (1963) and Traub and Odland (1976, 1978, 1979). In their efforts to compare the costs of convenience foods and home prepared counterparts they adopted a cost-per-serving approach that included the costs of ingredients, fuel and labor.

Although the demand for convenience food has been estimated using market expenditure and income data, the theoretical shadow cost approach

to the model was fruitful in making key predictions about the effects of wages and meal preparer's characteristics on food expenditures. The expenditure models show a pattern in household use of convenience foods that is both sensible and predictable. A careful consideration of the theoretical model has lead to the developoment of a statistical model which goes beyond previous specifications. For instance, Redman (1981) presumed that the woman would be the meal preparer and did not account for characteristics of men. Prochaska and Schrimper (1973) and Fletcher (1981) allowed either males or females to be homemakers. Although they tested for differences betweeen market-oriented and nonmarket-oriented households, they did not account for differences between meal preparers of different sexes or between nonwage-earning homemakers with and without wage-earning spouses.

Value of time. Consideration of the value of time is unique to the new theory of demand which has motivated the model of demand for convenience foods. Prochaska and Schrimper (1973) reported positive value of time elasticities for expenditure on food away from home, with unemployed homemakers having smaller elasticities than employed homemakers. The predicted relationship between value of time elasticities of employed and unemployed homemakers is opposite to their reported results. Fletcher (1981) reported positive value of time elasticities for food away from home, negative for food at home. In a summary table he reported that the away from home food expenditure elasticity for shadow price of time was 0.162 for market-oriented

households and 0.111 for nonmarket-oriented households. Again, these patterns are opposite to those which the simple theoretical model developed in this research would predict. One way to account for the inconsistency between the expected behavior and Prochaska and Schrimper's results is in their model specification. They did not allow for intercept shifts between homemaker types in their model, and the coefficients may be sensitive to estimated wage and proxies for the value of time. Neither they nor Fletcher allowed for differences in the sex or half-market-orientation of meal preparers. Value of time elasticities have been compared across convenience foods for different attributes of the meal preparer. For the three convenience classes, nonmarket- and half-market-oriented female meal preparers all had positive elasticities of the value of time. Except for the basic convenience food model, the market-oriented female meal preparers had positive value of time elasticities.

The nonmarket-oriented and half-market-oriented female meal preparers had negative elasticities of value of time in the nonconvenience class. Although the theoretical elasticity has an indeterminate sign these results agreed with the tendencies anticipated by the theoretical model. Nonmarket-oriented male meal preparers have contradictory characteristics that make predictions about the sign of the value of time elasticity difficult. Since the sex and market-orientation of meal preparers turned out to be important factors in determining household behavior, this research has made an important

contribution by considering them. Some further research should be undertaken to reconcile the differences in value of time elasticities between this research and others'. Other suggestions for further research are made below.

Income and household size. The income elasticity for all food classes was seen to fall in the expected range between zero and one. The estimated coefficients ranged from 0.03 in the nonconvenience food expenditure model to 0.08 in the complex convenience food model. The income elasticity for all food classes was first hypothesized to fall between zero and one, since none of the food groups was considered an inferior good (with negative income elasticity) or a luxury good (with income elasticity greater than one). Typical income elasticities of food expenditure fall in the 0.17 to 0.3 range (see George and King (1972), Prochaska and Schrimper (1973), and Salathe (1979) for examples). All income coefficients have been found significantly greater than zero and significantly less than 0.17, the most conservative estimate of expenditure elasticities for food at home reported by Salathe (1979). The income elasticity for all food classes was second hypothesized to fall between zero and 0.17, since Mincer has hypothesized that models that do not account for the value of time should have and upward bias in estimated income elasticities. The significance of statistical tests on the range of income elasticities verifies that the food categories investigated are neither inferior nor luxury goods, and they verify Mincer's contention that demand models

that ignore the effects of the value of time overestimate the elasticity of expenditure with respect to income.

The household size elasticities are also very plausible, indicating stronger economies of size for the less convenient foods. It has been verified for all models that the elasticity of household size falls in the expected range, between zero and one. This is indicated by the significance of the tests on the upper and lower range of the coefficients. The elasticity of household size ranges from 0.67 for basic convenience foods to 0.86 for complex convenience foods.

Who uses convenience foods? The profile of households that are heavy users of convenience foods is directly related to the parameter estimates in the four models presented in this research. Households that have market-oriented (i.e. those who are wage, salary or profit earners) meal preparers spend the most on convenience food in all three convenience categories. Households that have nonmarket-oriented (i.e. nonworking) meal preparers spend the least on convenience food in all three convenience categories and the most on nonconvenience food. Households that have half-market-oriented (e.g. work at home while the other household head works outside the home) meal preparers spend the least on nonconvenience food.

Households that have female meal preparers spend more than male meal preparers on nonconvenience food and less on convenience food. The trend for more women to enter the work force, pointed out by Stafford and Wills (1979), will lead to more market-oriented meal preparers and

more male meal preparers as the housewives leave the home to earn an income. The model estimates verify that this trend will increase the demand for convenience foods.

White households spend more on convenience foods and less on nonconvenience foods than black households. For the nonmetropolitan urbanization the value of food used in all categories was the least. For central city households the value of food used in all categories was the greatest with the exception of value of manufactured convenience food which was greatest for suburban households.

Farm households used less convenience foods and more nonconvenience foods than nonfarm households. Money value of all food categories was greatest for households in the Northeast. The greater the money income of a household the more it spends on all categories of food. Since the income elasticity was smallest for nonconvenience foods the trend toward higher incomes will result in households spending an increasing share of their food dollar on convenience foods. Although larger households spend more on all categories of food, the household size elasticities (less than one) imply that the larger the household, the less spent per person. The trend for declining household size pointed out by Stafford and Wills (1979) implies that households will spend an increasing amount per person on all food. Since the household size elasticity is smallest for basic convenience food and largest for complex convenience food it is hard to predict the overall effect of this trend on share of food dollar spent on all convenience food.

The age-sex composition of the household has been included in a set of dummy variables that represent the effect of the presence of at least one person in a given category. This formulation has allowed specific hypotheses to be tested about the effect of the presence or absence of an age-sex group on food use. The patterns observed with regard to small children are exactly as predicted: the effects are all negative but most negative for nonconvenience foods. The success of these variables in significantly explaining variation in the dependent variables implies that household size alone is not an adequate measure of food requirements. Small children reduce the amount spent on all food classes but the effect requires some special interpretation. Since household size is a variable in the model, the parameters of the age-sex characteristics are interpreted as the effects holding household size constant. Therefore, these are not the effects of adding a member of a given category, they are the effects of replacing a typical member with a member of a given category. While the presence of small children in a household indicates less spent than the typical household of a given size, the addition of a small child would increase the amount spent on food with the greatest increase for basic convenience food, and the smallest increase for nonconvenience food. The presence of teenagers or men aged 21 to 54 in a household indicates more spent on all food than the typical household of a given size. The addition of a teenager or adult male would increase the amount spent on nonconvenience and complex convenience food about equally. Females and elderly males cause more to be spent on nonconvenience foods.

To illustrate the usefulness of the regression models in predicting market behavior of households, several profiles were developed for food expenditures by households with different characteristics and economic constraints. Weekly expenditures on each food class by weekly income for several scenarios of household characteristics were predicted and presented in table 11. In all four profiles income was varied from $100 per week to $800 per week.

For the purpose of demonstrating the model predictions, earnings were set equal to income. Thus, the profiles were applicable to households which had only earned income, and the expenditure patterns reflect both income and value of time effects as income is varied from $100 to $800. Profiles 1 and 2 showed the predicted expenditures for single person households. The single household member was taken to be a representative of the 21 to 54 year age group. Predictions were made for both males and females of this age group. Other household characteristics for profile 1 were chosen so as to simulate relatively low use of convenience foods. Specifically, the characteristics were: region - south, season - summer, meal preparer - nonmarket-oriented, race - black and occupation - farmer.

The income elasticities were relatively low, even for food expenditures. This fact coupled with the fact that the value of time elasticities for some of the meal preparers were negative has lead to a low, or even negative, response to increases in income/vlaue of time. Males exhibited a tendency to use more food in general than females,

with the exceptions that lower income (less than $200 per week) males used less nonconvenience food than low income females, and higher income (greater than $200 per week) males used less basic convenience foods than higher income females. The nonmarket-oriented female meal preparers were heavy users of nonconvenience foods and had strongly negative value of time elasticities that lead to a decline in the predicted use of nonconvenience foods as income/value of time increases.

Profile 2 compared the predicted weekly expenditures of male and female single person households for a set of other characteristics which lead to relatively heavy use of convenience foods. Specifically, the characteristics are market-oriented meal preparer, Northeast region, winter season, white race, central city urban setting, and nonfarm occupation. Comparisons between male and female households showed patterns similar to those for profile 1. An interesting result was that even though males ate more than females, the low income males actually used less nonconvenience foods than the low income females for both profiles 1 and 2.

The market-oriented male meal preparers had strongly negative value of time elasticities for basic convenience foods that lead to a decline in their predicted level of use as income/value of time increased. The profile 2 households have been predicted to use more convenience foods (in all three convenience classes and at all equivalent income levels) and less nonconvenience foods than the profile 1 households. The results imply that, in general, households consisting of a single female

are lower consumers of convenience foods than households consisting of a single male.

Socioeconomic characteristics other than the sex of the meal preparer are extremely important in determining the level of use of convenience foods, especially in combinations. However, there was a tendency for females to rely more heavily on basic convenience foods as their income and value of time increased. The males, who were heavy users of basic convenience foods at even low income/value of time, tended to rely less heavily on basic convenience foods as their income and value of time increased.

Profiles 3 and 4 show predicted household expenditures as do profiles 1 and 2, but for households with four members instead of just one. Households in both profiles 3 and 4 had the Northeast, white, winter, central city and nonfarm characteristics, just like the heavy users of convenience food in the profile 2 simulation. Households in both profiles 3 and 4 had a male plus a female in the 21 to 54 year age group. The differences between profiles 3 and 4 were in the meal preparer and children. Profile 3 households had a market-oriented male meal preparer and teenage children and were heavy users of convenience foods.

Profile 4 households had half-market-oriented female meal preparers with children in the 0 to 2 year age group. Profile 4 households used less food in all food groups than profile 3 households except for basic convenience foods at higher income (greater than $300 per week) levels.

Again, the nonmarket-oriented male meal preparers in profile 3 households exhibited a decline in use of basic convenience foods as income/value of time increased. Lower income households in profile 3 were predicted to spend almost $8.00 more on convenience foods ($35.38) than nonconvenience foods ($27.42). This is a relatively high share of the food dollar going to convenience foods when compared to the mean share (just under 50%).

At a household income of only $100 per week, the market-oriented male meal preparer of profile 3 households relied relatively heavily on convenience foods, with 56% of the household food dollar going to these products. At the highest income of $800 per week the reliance on convenience foods declined to 51% of the food dollar, much closer to the mean.

The half-market-oriented female meal preparers of profile 4 households used their food dollar differently than profile 3 households. At the lowest income of $100 per week, the share of food dollar going to convenience foods was about 50%. At an income of $800 per week the share occupied by convenience foods climbed, but only to about 52%. However, the distribution of expenditures among convenience food classes was changeable. The profile 4 households relied more heavily on basic convenience foods, which embody relatively low levels of labor and culinary expertise (e.g., single ingredient frozen or canned items). The market-oriented male meal preparers of the profile 3 households were relatively heavy users of complex and manufactured convenience foods.

These foods embody the highest level of labor saving and culinary services which can be purchased for at-home food consumption. The lowest income households in profile 4 spend about the same ($26.00 to $27.00) on convenience foods as nonconvenience foods.

A comparison of profile 3 households to the profile 2 male households illustrated the differences between households of different size with similar characteristics except for the 3 additional household members. Of course, the larger household used more food in all categories. Yet, because of size economies and the needs of different individuals, the larger household used less food per person (compare the total food expenditure $21.15 for the profile 2 single-person male household at the lowest income, with $15.70 per person for the profile 3 four-person household).

The share of the food dollar accounted for by convenience foods was nearly identical for profiles 2 and 3. Also, the mixture of expenditure on basic, complex and manufactured convenience foods were very similar. This is an indication that the age-sex composition of the household, while important in determining the level of expenditures, may be less important than the characteristics of the meal preparer in determining the relative food expenditure mixtures.

In summary, the major findings are that the effects of meal preparer's characteristics are important as well as predictable, and should not be ignored in food demand research. Demographic trends in the proportion of married women entering the work force and in single

family households imply that there will be more market-oriented as well as more male meal preparers in the population of the United States. This translates to an increase in demand for convenience foods. The parameter estimates bear out the theoretical result that the sign of the value of time elasticity is not determinate. This implies that, for food demand models in general, the sign of estimated value of time elasticities may not necessarily be anticipated even when models have been carefully specified.

Although the sign of the effect is not determinate, this does not imply that the value of time is unimportant, or that it may be ignored. The statistical results have shown that the value of time is important. Further, the results imply that the source of income (i.e., earned versus unearned) can be as important as its level.

Suggestions for further research. Several extensions of this research would be beneficial in verifying the models, resolving inconsistencies and making more detailed predictions. Keeping with the broad approach taken in this research, some further research as to nutritional implications of household behavior should be investigated. The nutritional adequacy of the broad food groups should lead to policy implications. For instance, if convenience foods are not as nutritious as nonconvenience foods, there may be a special need for educational programs target for heavy users of convenience foods.

Some other demand research would be fruitful as well. Since this research has shown that the model works well for broad groups, a

reasonable next step would be to apply the same approach to more specific commodities, where including analysis of price effects is more appropriate. The model suggested would be to estimate the quantity demanded for more specific food groups as functions of market prices, income, value of time, characteristics of the meal preparer, and age-sex composition of the household.

To take the model to the limit of its capabilities, i.e. to to draw implications about household allocation of members' labor time, would require an enormous amount of data. If the total time available to a household could be partitioned into activity specific tasks, and time at each task measured along with prices and quantities of other inputs to each task, Barnett's (1977) "household structural form" could be estimated. In that case, assumptions about returns to scale and jointness of products would not need to be so stringent, and shadow prices could be derived from the reduced form of the structure. Estimation of such a system of demand and production equations is a desirable goal and should be earnestly considered. However, the information requirements will probably remain prohibitive until surveys and data sets are collected with the full model requirements specifically in mind.

REFERENCES

Adrian, John and Ray Daniel, "Impact of Socioeconomic Factors on Consumption of Selected Food Nutrients in the United States," American Journal of Agricultural Economics, 58 (1976): 31-38.

Barnett, William A, "Pollak and Watcher on the Household Production Function Approach," Journal of Political Economy, 85 (1977): p. 1073.

Becker, Gary S., "Theory of the Allocation of Time," The Economic Journal, 75 (1965): p. 493.

Bentham, J., Principles of Legislation, Harcourt, Brace and Co., NY, 1931.

Blinder, A.S. and Yoram Weiss, "Human Capital and Labor Supply: A Synthesis," Journal of Political Economy, 84 (1976): 449-472.

Brown and Deaton, "Surveys in Applied Economics: Models of Consumer Behavior," Economic Journal, 82 (1972): 1145-1236.

Buse, Reuben and Larry Salathe, "Adult Equivalent Sclaes: An Alternative Approach," American Journal of Agricultural Economics, 60 (1978): 460-468.

Chapman, V. J., J. P. Sweeney, M. E. Martin and E. H. Dawson, "Fruits: Consumer Quality Characteristics, Yield and Preparation Time of Various Market Forms," USDA, Home Economics Res. Rpt., 29 (1965).

Chow, G. C., "Tests of Equality Between Sets of Coefficients in Two Linear Regressions," Econometrica, 28 (1960): 591-605.

Cohen, A. C., Jr., "Estimating the Mean and Variance of Normal Populations from Singly and Doubly Truncated Samples," Annals of Mathematical Statistics, (1950): 557-569.

Dean, E., "Economic Analysis and African Response to Price," unpublished Ph.D. dissertation, Columbia University, 1963.

Deaton, Angus and John Muellbauer. Economics and Consumer Behavior, Cambridge University Press, 1975.

Fletcher, Stanley M., "Economic Implictions of Changing Household Away-From-Home and At Home Food Expenditure Patterns", unpublished Ph.D. Dissertation, North Carolina State University, 1981.

Gauger, William and Kathryn Walker, The Dollar Value of Household Work, Information Bulletin (60), NY State College of Human Ecology, Cornell University, Ithaca, NY, 1980.

Ghez, Gilbert R. and Gary S. Becker, The Allocation of Time and Goods over the Life Cycle, NY: Columbia University Press (for NBER), 1975.

Giplin, G. L., E. W. Murphy, A. C. March, E. H. Dawson, F. Bowman, R. G. Kerr and D. G. Snyder, "Meat, Fish, Poultry and Cheese: Home Preparation Time, Yield and composition of Various Market Forms," USDA, Home Economics Research Report, 30 (1965).

Gronau, Reuben, "The Intrafamily Allocation of Time: The Value of the Housewives' Time," American Economic Review, 63 (1973).

Gronau, Reuben, " The Effect of Children on the Housewife's Value of Time," Journal of Political Economy, 81 (1973b): s198-s199.

Gronau, Reuben, "Leisure, Home Production, and Work - The Theory of the Allocation of Time Revisited," Journal of Political Economy, 85 (1977).

Harp, Harry H., and Denis F. Dunham, "Comparative Cost to Consumers of Convenience Foods and Home Prepared Foods," Marketing Research Report No. 609, USDA, ERS, Marketing Economics Division, 1963.

Havlicek, Jr. Joseph, Oral Capps, Jr., and Julein Axelson, "Impacts of Convenience Foods on the Diets of U.S. Households," Report Number 2 to Consumer Nutrition Center, USDA, Virginia Tech, Blacksburg, Virginia, February 1982.

Heckman, James J., "Shadow Prices, Market Wages and Labor Supply," Econometrica, 42 (1974): 679-694.

Heckman, James J., "The Common Structure of Statistical Models of Truncation," The Annals of Economic and Social Measurement, 5 (1976): 475-492.

Heckman, James J., "A Life Cycle Model of Earnings, Learning and Consumption," Journal of Political Economy, 84 (part II): s11-s44.

Heckman, James J. and Robert Willis, "A Beta-logistic Model for the Analysis of Sequential Labor Force Participation by Married Women," Journal of Political Economy, 1 (1977).

Heckman, James J., "Sample Selection Bias as a Specification Error," Econometrica, 47 (1979): 153-161.

Isom, Pamela, "Frozen-Prepared Plate Dinners and Entrees-Cost vs. Convenience," Family Economics Review, (1979): 18-19.

King, P. L., G. L. Giplin and E. H. Dawson, "Comparison of Several Market Forms of Potato Products," Journal of Home Economics, 54 (1962).

Kinnucan, H. and B. Sexauer, "The Demand for Home-Produced Food by Rural Families," American Journal of Agricultural Economics, 60 (1978): 338-344.

Ladd and Suvannunt, "A Model of Consumer Goods Characteristics," American Journal of Agricultural Economics, 58 (1976): 504-510.

Matthews, R. H., E. W. Murphey, A. C. March and E. H. Dawson, "Baked Products: Consumer Quality, Consumption, Yield, and Preparation Time of Various Market Forms," USDA, Home Economics Research Report, 22 (1963).

Mincer, Jacob, "Labor Force Participation of Married Women," Aspects of Labor Economics, Princeton University Press, (1962).

Mincer, Jacob, "Market Prices, Opportunity Costs, and Income Effects," in Measurement in Economics, Stanford University Press, (1963): 66-82.

Mitchell, W. C., "The Backward Art of Spending Money," American Economic Review, II (1912): 269-281.

Nelson, F. D., "Censored Regression Models with Unobserved Stochastic Censoring Thresholds," Working Paper 63 (1974), NBER Computing Center, Cambridge, Massachusetts.

Owen, J., "The Supply of Labor and the Demand for Recreation," unpublished Ph.D. dissertation, Columbia University, 1981.

Pollak, Robert A. and Michael L. Watcher, "The Relevance of the Household Production Functions and its Implications for the Allocation of Time," Journal of Political Economy, 83 (1975).

Pollak, Robert A. and Michael L. Watcher, "Reply: Pollak and Watcher on the Household Production Approach," Journal of Political Economy, 85 (1977): 1083.

Prato, A. A. and J. J. Bagali, "Nutrition and Non-Nutrition Consumption of Demand For Food Items," American Journal of Agricultural Economics, 58 (1976): 563-567.

Prais and Houthakker, The Analysis of Family Budgets, London Cambridge University Press, (1955).

Prochaska, Fred, and R. A. Schrimper, "Opportunity Cost of Time and Other Socioeconomic Effects on Away-From-Home Food Consumption," American Journal of Agricultural Economics, 55 (1973): 595-603.

Redman, Barbara J., "The impact of Women's Time Allocation on Expenditure for Meals Away from Home and Prepared Foods," American Journal of Agricultural Economics, 62 (1980): 234-237.

Rockwell, G. R., Jr., "Income and Household Size: Their Effects on Food Consumption," USDA Agricultural Marketing Service Research Report, 340.

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

Rosenzweig, Mark R., "Demand for Children in Farm Households," Journal of Political Economy, 85 (1977): 123-146.

Russell, Maxine, "Consumer use of Selected Convenience Foods in Knoxville, Tennessee, 1971" MS Thesis, University of Tennessee.

Salathe, Larry E., "Household Expenditure Patterns in the United States," Technical Bulletin No. 1603, USDA, ESCS, 1979.

Samuelson, Paul A., "Social Indifference Curves," Quarterly Journal of Economics, 70 (1956): 1-22.

Schultz, T. W., "The Formation of Human Capital by Education," Journal of Political Economy, (1960).

Sexauer, Benjamin, "The Effect of Demographic Shifts and Changes in the Income Distribution on Food Away From Home Expenditure," American Journal of Agricultural Economics, 61 (1979): 1046-1057.

Stafford, Thomas and John Wills, "Consumer Demand Increasing for Convenience in Food Products," National Food Review, (1979), ESCS NFR-6.

Stigler, G. J. and G. S. Becker, "De Gustibus non est disputandum" ("Tastes Do Not Change'), American Economic Review, 67 (1977): 29-90.

Sweeney, J. P., V. J. Chapman, M. E. Martin, P. L. King and E. H. Dawson, "Vegetables: Consumer Quality, Yield, and Proportion Time of Various Market Farms," USDA, Home Economics Research Report, 17 (1962).

Sydenstricker and King, "The Movement of Relative Economic Status of Families," Quarterly Publication of the American Statatistical Association, 18 (1921): 842-857.

Traub, L. G. and D. Odland, "Convenience Foods - 1975 Cost Update," Family Economis Review, (1976): 26-53.

Traub, L. G. and D. Odland, "Convenience Foods and Home-Prepared Foods: Comparative Costs, Yield and Quality," USDA, ESCS Agricultural Economics Report, 429 (1979).

Traub, L. G. and D. Odland, "Convenience Foods vs. Home-Prepared Costs, Yield, and Quality," National Food Review, ESCS, USDA, (1978).

Traub, L. G. and D. Odland, "Convenience Food Cost Update," National Food Review, USDA, ESCS, (1980): 17-19.

U.S. Department of Agriculture, "Food Consumption Survey in the United States, 1977-78, Procedures for Computing Variables to Appear on the Data Tapes," (Mimeographed), 1981

APPENDIX A

THEORETICAL MODEL OF DEMAND FOR CONVENIENCE FOODS

The model of demand for convenience foods and home-prepared counterparts has been developed, specifically assuming fixed proportions production functions and allowing for differences in the utility function of convenience and home-prepared meals. The inspiration behind the model development and the specification of the formal model is heavily dependent upon the work of Gronau (1973). To simplify the model expression, assume a single household utility function (alternatively, the utility function of the meal preparer). Assume that utility is a function of three arguements: convenience meals (Z_1), home-prepared meals (Z_2) and leisure (L). Formally,

$$U = U(\ Z_1,\ Z_2,\ L\ )$$

The meals are produced by fixed proportion, constant returns production technologies using purchased market inputs (M_1, M_2) and household labor time (H_1, H_2). The formal expression of production technologies is:

$$Zi = \min\left(\frac{M_i}{g_i}, \frac{H_i}{k_i}\right) \qquad i = 1,2$$

where $1/g_i$ is the (constant) average product and also the marginal product of M_i in producing Z_i. Also $1/k_i$ is the (constant) average product of household time, H_i, in producing Z_i.

The technologies are invertible to give

$$H_i = k_i Z_i$$

$$M_i = g_i Z_i$$

The total time available to the meal preparer is T_0 which is allocated among H_1, H_2, L and time working in the labor market, N. This is a constraint on household activity, expressed as

$$T_0 = H_1 + H_2 + L + N$$

Another constraint that is imposed on the household is the budget, requiring expenditures on purchased inputs to be less than or equal to money income.

$$P_1 M_1 + P_2 M_2 = NW + V$$

Where P_1 and P_2 are prices of market goods, W is the market wage rate and V is money income other than wage income. By expressing N as the residual of total time minus the other uses, the two resource constraints can be combined into one.

$$P_1 M_1 + P_2 M_2 = (T_0 - H_1 - H_2 - L)W + V$$

By multiplying through by wage and bringing the time measures over to the left hand side, the equation expresses the constraint on "full

income", full income defined as the total money income the household could possibly earn by devoting all its time to market labor supply:

$$P_1 M_1 + WH_1 + P_2 M_2 + WH_2 + WL = WT_0 + V$$

Substituting $g_i Z_i$ and $k_i Z_i$ for M_i and H_i and factoring Z_i out, the full income constraint can be written in terms of commodities (meals) and full prices (π's):

$$Z_1 \pi_1 + Z_2 \pi_2 + WL = WT_0 + V$$

where π_i is (Pigi + Wki). The Lagrangian function may be set up as

$$\text{Max } G = U(Z_1, Z_2, L) + \lambda(- Z_1 \pi_1 - Z_2 \pi_2 - WL + WT_0 + V)$$

The first order conditions of maximization are:

$$\frac{\partial G}{\partial Z_1} = U_1 - \lambda\pi_1 = 0$$
$$\frac{\partial G}{\partial Z_2} = U_2 - \lambda\pi_2 = 0$$
$$\frac{\partial G}{\partial L} = U_3 - \lambda W = 0$$
$$\frac{\partial G}{\partial \lambda} = -Z_1\pi - Z_2\pi - WL + WT_0 + V = 0$$

Where U_1, U2 and U3 are marginal utilities of Z_1, Z_2 and L.
The demands for commodities Z_1, Z_2 and L may be expressed as functions of π_1, π_2, W and S (S defined as "full income"). The Lagrange

multiplier is the marginal utility of full income. The conditions are typically summarized by equating the ratios of marginal utility to price across commodities. From this representation it is clear that W is the shadow price or value of time. Price and income slopes of the system may be derived by totally differentiating each first-order-condition equation with respect full prices, wage and income. This yields a set of linear equations which can be solved for the unknown effects, as is traditionally done. The system of equations which results from this process may be summarized in matrix form as

$$U\ Z_{\pi} = B$$

where the matrices are defined as follows:

$$U = \begin{bmatrix} U11 & U12 & U13 & -\pi_1 \\ U21 & U22 & U23 & -\pi_2 \\ U31 & U32 & U33 & -W \\ -\pi_1 & -\pi_2 & -W & 0 \end{bmatrix}$$

where Uij is the term $\frac{\partial U_i}{\partial Z_j}$.

$$Z_{\pi} = \begin{bmatrix} \frac{\partial Z_1}{\partial \pi_1} & \frac{\partial Z_1}{\partial \pi_2} & \frac{\partial Z_1}{\partial W} & \frac{\partial Z_1}{\partial S} \\ \frac{\partial Z_2}{\partial \pi_1} & \frac{\partial Z_2}{\partial \pi_2} & \frac{\partial Z_2}{\partial W} & \frac{\partial Z_2}{\partial S} \\ \frac{\partial L}{\partial \pi_1} & \frac{\partial L}{\partial \pi_2} & \frac{\partial L}{\partial W} & \frac{\partial L}{\partial S} \\ \frac{\partial \lambda}{\partial \pi_1} & \frac{\partial \lambda}{\partial \pi_2} & \frac{\partial \lambda}{\partial W} & \frac{\partial \lambda}{\partial S} \end{bmatrix}$$

$$B = \begin{bmatrix} \lambda & 0 & \lambda k_1 & 0 \\ 0 & \lambda & \lambda k_2 & 0 \\ 0 & 0 & L & 0 \\ Z_1 & Z_2 & -N & 1 \end{bmatrix}$$

The term B43 has already been simplified from $(Z_1k_1 + Z_2k_2 + L - T_0)$ to $(-N)$. To solve for the effects of full prices wage and income, invert U and premultiply both sides of the equation. By defining the determinant of U as J and the cofactors as Jij, the model solution is represented as

$$Z_{\pi} = U^{-1}B$$

where

$$U^{-1} = \frac{1}{J} \begin{bmatrix} J11 & J12 & J13 & J14 \\ J21 & J22 & J23 & J24 \\ J31 & J32 & J33 & J34 \\ J41 & J42 & J43 & J44 \end{bmatrix}$$

Individual price, wage and income slopes are determined by multiplying out the rows and columns of the right-hand side expression. Using E(y,x) to denote the elasticity of y with respect to x (relative percentage change in y associated with a one percent change in x) and σ_{ij} to denote the Allen partial elasticity of substitution, and converting to elasticities, the price elasticities are

$$E(Z_i, \pi_j) = \frac{Z_j \pi_j}{S} (\sigma_{ij} - E(Z_i, S))$$

where $E(Z_i, S)$ is the full income elasticity of demand for commodity i. For the effects of full prices, these elasticities are analogous to the Hicksian elasticities with income and substitution effects. "Normal" goods are expected to have positive income elasticities, so the income effect is negative. When i=j the own-substitution effect must be negative since second order conditions of maximization require J_{ii}/J to be negative, so σ_{ii} must be negative. For $i \neq j$, σ_{ij} is positive for Hicksian type consumption substitutes, and negative for consumption complements (Allen, 1961: 513).

The effect on leisure of a change in the full price of a commodity, in elasticities, becomes

$$E(L, \pi_j) = \frac{Z_j \pi_j}{S} (\sigma_{3j} - E(L, S))$$

stating that the full price of a meal affects demand for leisure in much the same way it affects demand for other commodities. The interesting case to examine is the effect of wages on demand for commodities and leisure. Since the third column of the B-matrix has a non-zero element for every row, the total effect of wages is composed of three substitution effects and one income effect.

$$E(Z_i,W) = \frac{WH_1}{S} \sigma_{i1} + \frac{WH_2}{S} \sigma_{i2} + \frac{WL}{S} \sigma_{i3} + \frac{WN}{S} E(Z_i,S)$$

It is important to note that this multiple break down occurs because of the common use of a limited resource (time) in the generation of commodities, leisure and income. Further, this is the result of a model making use of extreme simplifying assumptions about the production technologies. If the production technologies displayed nonconstant returns to scale, or jointness in outputs, or even non-zero rates of input substitution the terms in the elasticity would be even more numerous (and the expression would not be nearly as neat or elegant).

So the total elasticity with respect to value of time (wage), even in a simplified model, has multiple terms. Each of the terms must be examined to see what predictions can be made about the effect of value of time on demand.

Taking Z_1 to represent convenience meals and Z_2 to represent home-prepared meals, the elasticities can be made specific to commodities. To determine the sign of the elasticity for convenience meals, examine the sign of each term. The sign of the first term would be negative since the "own partial elasticity substitution" is negative. The magnitude would depend on the partial elasticity of substitution and the share of full income accounted for by convenience food meal production hours. The second term would be positive in sign, and the cross-elasticity of substitution would approach infinity as the substitution of convenience for nonconvenience meals becomes easier (Allen, 1961: 343). The magnitude of the term, then, depends on ease of substitution and on the share of full income accounted for by non-convenience meal production hours. The third term is indeterminate in sign. If the convenience meals were consumption complements with leisure, the sign would be negative. Magnitude would depend on the degree of substitutability or complementarity, and on the share of full income accounted for by leisure hours. Finally, the fourth (income) term is expected to be positive unless consumption behavior exhibited an inferiority in the convenience meals. The sign of the overall wage elasticity is therefore indeterminate.

All of the above discussion on components of the convenience meal-wage elasticity applies to the nonconvenience meals. As with $E(Z_1, W)$ the sign of $E(Z_2, W)$ is indeterminate. What of the relative magnitude of $E(Z_1, W)$ and $E(Z_2, W)$? Can one be said to be more positive than the other? Without making some assumptions, the answer is no. For the following discussion, assume that the income effect and the leisure-goods substitution effect are both the same across commodities. That leaves differences only in the own- and cross-substitution effects (one positive, the other negative) between commodities. The magnitude of these remaining effects depends on the own- and cross-elasticities of substitution and on the relative full income shares of time in preparing each meal. Since the cross-elasticity of substitution of 1 for 2 is symmetric with the cross-elasticity of substitution of 2 for 1, making the further assumption that the own-elasticity of substitution is the same for 1 and 2 places the entire determination of elasticity differences on the differences in full income share. Ultimately the difference in share of full income is determined by the number of hours devoted to production of each meal. Although the time devoted to preparation of a convenience meal or serving may be short because of the large productivity of time, total time devoted to production of all convenience meals per time period (say, a week) is determined by average hours per unit at meal preparation and level of the commodity produced:

$$H_1 = k_1 Z_1$$

The same relationship holds for commodity 2. As a result, households which spend more of their meal preparation time in convenience meal preparation will have convenience meal-wage elasticities, $E(Z_1, W)$, that tend to be more negative, and nonconvenience meal-wage elasticities, $E(Z_2, W)$, that tend to be more positive. The converse is true for households that spend more of their meal preparation time preparing nonconvenience meals (for instance, housewives that don't work outside the home).

All of the above discussion is further dependent upon the assumption that the leisure and income effects are nonvariant and are about the same. The assumption that substitution effects between commodities and leisure are the same across convenience classes is not directly testable, but its validity is suspect on intuitive grounds. If food enjoyment is related to the household leisure pattern there could very well be a complementary relationship between household consumption of time saving meals or foods and leisure. This effect would be particularly strong if one group of foods included a lot of snack foods and beverages, while the other did not.

The final elasticity of interest is the leisure-wage relationship. Multiplying the third column of the B matrix by the third row of the U^{-1} matrix and

expanding to elasticities gives

$$E(L, W) = \frac{WH_1}{S}\sigma_{31} + \frac{WH_2}{S}\sigma_{32} + \frac{WL}{S}\sigma_{33} + \frac{WN}{S}E(L, S)$$

The components include a negative own-substitution effect, a positive (assuming normality) income efect, and two positive (assuming substitutes) cross-substitution effects. By differentiating between leisure and home working time, the model shows how leisure time can be borrowed from home as well as market activities. Following Gronau (1973) the elasticity of labor supply can be derived by converting the elasticity of leisure demand as follows:

$$E(N,W) = (L/N)E(L,W)(\partial N/ \partial L)$$

From the time constraint, it is clear that $(\partial N/ \partial L) = -1$, so the elasticity of labor supply is the negative of the elasticity of leisure demand times the proportion of leisure to labor hours. The elasticity of labor supply, then has three negative effects and one positive one. For the labor supply curve to "bend backwards" the negative income effect may be augmented by the negative cross-substitution effects to overcome the positive substitution effect.

The demand elasticities for purchased market goods with respect to wage are identical with the commodity elasticities because the marginal and average products are identical, and demand elasticities of market goods with respect to full prices are identical to the commodity elasticities. The elasticity of market goods with respect to market prices is similar to the commodity-shadow price elasticity:

$$E(M_i, P_j) = \frac{M_j P_j}{S} (\sigma_{ij} - E(M_i, S))$$

and since $M_j P_j$ is less than $Z_j \pi_j$, the market goods-market price elasticity is less elastic than the commodity-shadow price elasticity, but the same relative substitution and income effects hold. The reason for this result is that commodities have been modeled as separate arguments of the utility function, and with mutually exclusive purchased inputs to each production function.

These models could have been expressed in terms of money income and money income elasticities rather than full income. The relationship of the money income elasticity of demand and full income elasticity of demand is

$$E(Z_j, I) = (I/S)E(Z_j, S)$$

However, the other elasticities have been more neatly expressed using full income than if money income elasticity were used.

Finally, the income elasticities for market goods are identical to those for commodities:

$$E(M_j, I) = E(Z_j, S)$$

These results have been summarized and hypotheses formulated in the text of the dissertation.

APPENDIX B

HECKMAN'S SAMPLE SELECTION BIAS PROCEDURE APPLIED TO EARNINGS

The theoretical model of demand developed in Appendix A shows that the value of the homemaker's time is a demand determinant. There were measurement problems in the data that precluded development of an accurate hourly wage, so value of time has been proxied for by earnings of the meal preparer. When the meal preparer reported earned income, the reported earnings were converted to a weekly basis (the period for which food use was reported) and used as the value of time proxy. If the meal preparer did not have any earned income, potential market earnings were estimated.

The problem of estimating potential earnings and labor supply has plagued economists for years with its special problems to overcome. The special problems arise from the fact that behavior provides the observer with a selected sample: only those who actually work have reported market earnings. To include the nonworking individuals in the estimation would pull the estimated function towards zero earnings inappropriately since zero earnings are generally not representative of the individuals' potential, rather his choice not to work. Excluding the nonworkers from estimation introduces a sample selection bias that invalidates any inferences about nonworkers and their potenteal earnings.

Heckman (1979) has devised a procedure for estimating statistical models for sample selection, truncation and limited dependent variables. The procedure involves estimating a proxy for the expected value of the error term given the sample selection rule, and including that as a

regressor in the least squares regression on the selected sample. Heckman used a two equation structure for a random sample of I observations. The model structure for each observation, i, is

$$Y_{1i} = X_{1i}\,B_1 + u_{1i}$$
$$Y_{2i} = X_{2i}\,B_2 + u_{2i}$$

Using $\mathcal{E}[\ ]$ to represent expected value, as a consequence of random sampling the error terms are related as

$$\mathcal{E}[u_{ji}] = 0$$

$$\mathcal{E}[u_{ji}\ u_{j'i''}] = \sigma \quad i=i''$$
$$= 0 \quad i\neq i''$$

Heckman assumes that the joint distribution of error terms is bivariate normal. If the data is censored so that there are observations on Y_{1i} only when Y_{2i} is greater than zero, the expected value of the disturbance term u_{1i} is found by taking expectation of a truncated bivariate normal distribution. To show how this is developed, express the population regression for Y_{1i} for the case that all data were available (i.e. so the coefficients are consistent and unbiased for ordinary least squares on a random sample):

$$\mathcal{E}[Y_{1i}\,|X_{1i}] = X_{1i}\,B_1$$

The regression for the incomplete sample is :

$$\mathcal{E}[Y_{1i}\,|X_{1i}, \text{Sample Selection Rule}] = X_{1i}\,B_1 + \mathcal{E}[u_{1i}\,|\text{Sample Selection Rule}]$$

Using, for example the selection rule $Y_1 > 0$ is equivalent to the Tobit model, leading to the regression:

$$\mathcal{E}[Y_{1i} | X_{1i}, Y_{1i} > 0] = X_{1i}\beta_1 + \mathcal{E}[u_{1i} | Y_{1i} > 0]$$

Using the rule $Y_2 > 0$ is more general since the Tobit model is a special case where both equations are identical. If the conditional expectation of the disturbance term is zero, the the model may be estimated by least squares with no modification. But that is the case only when the error terms from both structural equations are independent. With a sample selection rule of $Y_{2i} > 0$, and with the joint density, $h(u_{1i}, u_{2i})$ bivariate normal, the expected value will not be zero. An alternative way to write the sample selection rule is

$$u_{2i} > -x_{2i}\beta_2$$

so that the subsample regression is:

$$\mathcal{E}[Y_{1i} | X_{1i}, Y_{2i} > 0] = X_{1i}\beta_1 + \mathcal{E}[u_{1i} | u_{2i} > -X_{2i}\beta_2]$$

If the disturbance terms are distributed bivariate normal, the conditional expectation of a term requires taking expectation of that variate over a truncated bivariate normal distribution. Using the notation $\tilde{f}(z)$, $\tilde{F}(z)$ for the untruncated probabililty distribution function (pdf) and cumulative function (cdf), and $f(z)$, $F(z)$ for the truncated pdf and cdf

we may write

$$\tilde{f}(z) = \frac{f(z)}{F(B)-F(A)} \quad (A < z < B)$$

or

$$\tilde{f}(z) = f\left(\frac{x - \mu}{\sigma}\right) \quad (A < z < B)$$

Taking the expected value over the truncated range to derive $\tilde{E}[x]$,

$$\tilde{E}[x] = \mu + \frac{f\left(\frac{A - \mu}{\sigma}\right) - f\left(\frac{B - \mu}{\sigma}\right)}{F\left(\frac{B - \mu}{\sigma}\right) - F\left(\frac{A - \mu}{\sigma}\right)}\sigma \quad (A < z < B)$$

With only a lower truncation, i.e. if B is infinitely large, then the pdf of the upper truncation term is zero and the cdf is one. Then the expected value for the singly truncated distribution is simplified to:

$$\tilde{E}[x] = \mu + \frac{f\left(\frac{A - \mu}{\sigma}\right)}{1 - F\left(\frac{A - \mu}{\sigma}\right)}\sigma$$

Applied to the expectation taken in the Heckman procedure, the mean over the population of u_{1i} is zero, so the mean drops out of the expression.

The expected value of one variate in a bivariate distribution may be derived using its marginal distribution since the marginal distribution of a variate is itself normal. So, by replacing the marginal pdf with the truncated marginal pdf, and integrating over the variate from h to infinity, we can treat the truncated bivariate case like the univariate case. Defining $z_h = (h - \mu)/\sigma$, we may write

$$\mathcal{E}[u_{2i} \mid u_{2i} > h] = \frac{f(z_h)}{1 - F(z_h)} \sqrt{\text{var}(u_2)}$$

Next, note the following relationship between means in a bivariate normal distribution.

$$\mathcal{E}[u_2 \; u_1] = \rho \mathcal{E}[u_1]$$

where ρ is the pretruncation correlation of u_1 with u_2. This leads to the expected value of u_1 where the truncated variate is u_{2i},

$$\mathcal{E}[u_{1i} \mid u_{2i} > h] = \frac{\text{cov}(u_1, u_2)}{\text{var}(u_2)} \left(\frac{f(z_h)}{1 - F(z_h)} \sqrt{\text{var}(u_2)} \right)$$

since the mean of u_2 is zero. The following the definitions allow a condensation of the expected value.

$$\mathcal{E}[u_{ji} \; u_{j'i}] = \sigma_{jj'}$$

$$\lambda_i = \frac{f(z_i)}{1 - F(z_i)}$$

The term λ_i represents the expected value of the normalized truncated variate and is also known as the inverse of Mill's ratio (Heckman, 1979). From this we may finally write:

$$E[u_{1i} | u_{2i} > h] = \frac{\sigma_{12}}{\sqrt{\sigma_{22}}} \lambda_i$$

which is the expected value Heckman derives. He then writes the subsample regression as

$$E[Y_{1i} | X_{1i}, Y_{2i} > 0] = X_{1i} B_1 + \frac{\sigma_{12}}{\sqrt{\sigma_{22}}}$$

$$E[Y_{2i} | X_{2i}, Y_{2i} > 0] = X_{2i} B_2 + \frac{\sigma_{22}}{\sqrt{\sigma_{22}}}$$

To complete the procedure, derive an estimate of λ_i from the parameter of a probit model on the probability of each observation being selected into the sample:

$$z_h = F^{-1}(P) = -x_2 B_2^*$$

$$\hat{z}_i = -x_2 \hat{B}_2^*$$

$$\hat{\lambda}_i = \frac{f(\hat{z}_i)}{1 - F(\hat{z}_i)}$$

Finally, run a least squares regression on the subsample of data using x_{1i} and $\hat{\lambda}_i$ as regressors. The regression estimates of B_1 and $\sigma_{12}/\sqrt{\sigma_{22}}$ (the coefficient of $\hat{\lambda}_i$) are consistent and unbiased. Tables B-1 through B-6 provide the estimates of probit and least squares models used in estimating earnings for males (MERNHAT) and females (FERNHAT).

Earnings have been modeled as a function of age, region, season, urbanization, race, education and $\hat{\lambda}_i$ represented by the variable name ELAMBDA. The probabililty of working is a function of these plus the presence of children in various age categories, household expenditures on utilities, mortgage and food, and the age, education and income of the other head of household (if there was one). Separate earnings functions were estimated for males and females. Since characteristics of the other head were included in the models of the probability of working, a separate probit was estimated for households with one head and for households with two heads. This resulted in a total of four probits: one for for males with no female head present, a second for males with a female head present, a third for females with no male head present, and a fourth females with a male head present. The probit estimates were used to generate a value for ELAMBDA and to construct the weights for the regressions on earnings. The variables that were included in the estimation of probit and weighted least squares equations are defined below.

UTILS = Household utilities expenses (gas, water, electric).

MORT = Monthly mortgage or rental expenses.

TOTVAL = Total value of food used during the survey week.

NMEMS = Number of household members.

ALOTHINC = Income other than earned income of a head of household.

AGEI = Age of the person for whom earnings are measured.

AGEISQ = The square of AGEI.

AGEJ = Age of the other head of household.

AGEJSQ = The square of AGEJ.

EDI0 = Dummy variable for education of the person for whom earnings are measured, representing no schooling.

EDI1 = Dummy variable for education of the person for whom earnings are measured, representing only some elementary schooling.

EDI2 = Dummy variable for education of the person for whom earnings are measured, representing some college.

EDI3 = Dummy variable for education of the person for whom earnings are measured, representing college graduate or higher.

EDJ0 = Dummy variable for education of the other head of household, representing no schooling.

EDJ1 = Dummy variable for education of the other head of household, representing only some elementary schooling.

EDJ2 = Dummy variable for education of the other head of household, representing some college.

EDJ3 = Dummy variable for education of the other head of household, representing college graduate or higher.

AVERNJ = The average weekly value of earnings of the other head of household.

R1 = Dummy variable for the region of the household representing the northeast region.

R2 = Dummy variable for the region of the household representing the north central region.

R3 = Dummy variable for the region of the household representing the southern region.

U1 = Dummy variable for the urban setting of the household representing center city.

U2 = Dummy variable for the urban setting of the household representing suburban.

S1 = Dummy variable for the season of the interview representing spring.

S2 = Dummy variable for the season of the interview representing summer.

S3 = Dummy variable for the season of the interview representing fall.

HR1 = Dummy variable for the race of the household representing white race.

HR2 = Dummy variable for the race of the household representing black race.

AGE0TO2 = Number of children present in the household in the age category 0 years to 2 years.

AGE3TO5 = Number of children present in the household in the age category 3 years to 5 years.

AGE6TO11 = Number of children present in the household in the age category 6 years to 11 years.

AGE12T18 = Number of children present in the household in the age category 12 years to 18 years.

ELAMBDA = The expected value of the normalized error term from the regression on the selected (i.e. truncated) sample. Also, the inverse of Mill's ratio.

Table B-1. Maximum likelihood estimates of probit coefficients, standard errors and t-ratios of coefficients of the probability of working for male household head with no female head present

Independent variables	Parameter estimates	Standard errors	T-ratios
AGEI	.21325D-01	.29755D-01	.71670
AGEISQ	-.33056D-03	.32308D-03	-1.0231
EDI0	-.94071	.85674	-1.0980
EDI1	-.37490	.22768	-1.6466
EDI2	.40496D-01	.23812	.17007
EDI3	.21561	.24831	.86830
NMEMS	-.42956	.13365	-3.2140
ALOTHINC	-.54283D-03	.32121D-03	-1.6900
R1	-.73323D-02	.23736	-.30890D-01
R2	-.79641D-01	.24131	-.33004
R3	.18715	.23320	.80252
U1	-.34912	.20484	-1.7044
U2	-.17205	.22130	-.77747
S1	.38013	.22652	1.6781
S2	.28686	.22769	1.2599
S3	.19858	.21755	.91280
HR1	.38747	.36588	1.0590
HR2	.24075	.41758	.57653
AGE3TO5	.17369D-01	1.3335	.13025D-01
AGE6TO11	.21058	.40461	.52044
AGE12T18	.45905	.20724	2.2151
UTILS	.94693D-02	.33487D-02	2.8277
MORT	.46010D-02	.11923D-02	3.8588
TOTVAL	.89877D-03	.44283D-02	.20296
CONSTANT	.10414	.77204	.13489

Likelihood ratio test ... 70.4659 with 24 D.F.
Residual variance 0.12
Sum of absolute errors ... 106.15

Table B-2. Maximum likelihood estimates of probit coefficients, standard errors and t-ratios of coefficients of the probability of working for male household head with female head present

Independent variables	Parameter estimates	Standard errors	T-ratios
AGEI	.57306D-01	.27145D-01	2.1111
AGEISQ	-.68266D-03	.25439D-03	-2.6835
EDI0	-1.0517	.34426	-3.0551
EDI1	-.52745	.92728D-01	-5.6881
EDI2	-.49579D-01	.10490	-.47262
EDI3	.12307	.12944	.95083
NMEMS	.33355	.65604D-01	5.0843
ALOTHINC	-.30759D-02	.28853D-03	-10.661
R1	-.13973	.11446	-1.2208
R2	-.74957D-02	.11678	-.64189D-01
R3	-.16656	.10867	-1.5326
U1	-.15632	.87880D-01	-1.7788
U2	.17109	.84417D-01	2.0267
S1	.70176D-01	.97293D-01	.72129
S2	-.55904D-01	.94822D-01	-.58957
S3	.25938D-01	.92156D-01	.28146
HR1	.43971	.15829	2.7779
HR2	.33850	.18314	1.8483
AGE0TO2	-.48539	.13295	-3.6509
AGE3TO5	-.35747	.10794	-3.3118
AGE6TO11	-.26852	.83769D-01	-3.2054
AGE12T18	-.41589	.73266D-01	-5.6764
UTILS	.29959D-02	.10078D-02	2.9727
MORT	-.76017D-04	.26177D-03	-.29040
TOTVAL	.25150D-02	.16804D-02	1.4967
AGEJ	-.10230D-01	.26722D-01	-.38283
AGEJSQ	-.11566D-03	.25951D-03	-.44569
EDJ0	-.82818	.78803	-1.0509
EDJ1	-.39194	.96266D-01	-4.0714
EDJ2	.26517	.11815	2.2443
EDJ3	.15788	.14839	1.0640
AVERNJ	-.12024D-02	.16765D-01	-.71723D-01
CONSTANT	.10876	.41814	.26011

Likelihood ratio test ...	639.474 with	32 D.F.
Residual variance	0.47D-01	
Sum of absolute errors ...	448.97	

Table B-3. Maximum likelihood estimates of probit coefficients, standard errors and t-ratios of coefficients of the probability of working for female household head with no male head present

Independent variables	Parameter estimates	Standard errors	T-ratios
AGEI	.14541	.16116D-01	9.0229
AGEISQ	-.18232D-02	.17348D-03	-10.509
EDI0	-.73588	.46225	-1.5920
EDI1	-.88210	.10161	-8.6810
EDI2	.25216	.10917	2.3099
EDI3	.62205	.13896	4.4766
NMEMS	.32570	.59679D-01	5.4576
ALOTHINC	-.53754D-02	.52918D-03	-10.158
R1	-.12277	.11737	-1.0461
R2	.72250D-01	.12336	.58570
R3	.94914D-01	.11825	.80267
U1	-.11803D-01	.92553D-01	-.12753
U2	.19565	.10077	1.9415
S1	.13299	.10540	1.2618
S2	.11059	.10616	1.0417
S3	.72866D-01	.96545D-01	.75473
HR1	.66279	.18044	3.6731
HR2	.35576	.18529	1.9200
AGE0TO2	-.87502	.15265	-5.7321
AGE3TO5	-.67310	.11295	-5.9590
AGE6TO11	-.56061	.74689D-01	-7.5059
AGE12T18	-.45210	.70256D-01	-6.4351
UTILS	.43427D-02	.10618D-02	4.0901
MORT	.17192D-02	.50797D-03	3.3844
TOTVAL	-.36698D-02	.18344D-02	-2.0006
CONSTANT	-2.9653	.40686	-7.2882

Likelihood ratio test ... 876.832 with 25 D.F.
Residual variance 0.14679
Sum of absolute errors ... 526.19

Table B-4. Maximum likelihood estimates of probit coefficients, standard errors and t-ratios of coefficients of the probability of working for female household head with male head present

Independent variables	Parameter estimates	Standard errors	T-ratios
AGEI	.10025	.17094D-01	5.8648
AGEISQ	-.14765D-02	.18681D-03	-7.9037
EDI0	-5.7433	1046.2	-.54899D-02
EDI1	-.28762	.72094D-01	-3.9895
EDI2	.24840	.52838D-01	4.7011
EDI3	.56798	.70133D-01	8.0986
NMEMS	.17637	.35044D-01	5.0328
ALOTHINC	-.10896D-02	.23215D-03	-4.6937
R1	.44474D-01	.60236D-01	.73834
R2	.11147	.59145D-01	1.8846
R3	-.58347D-01	.58806D-01	-.99219
U1	.13949	.50709D-01	2.7508
U2	.23872D-01	.44028D-01	.54220
S1	.57254D-01	.51895D-01	1.1033
S2	-.39470D-01	.52561D-01	-.75094
S3	.33103D-01	.49880D-01	.66365
HR1	.13087	.11264	1.1618
HR2	.33307	.12767	2.6089
AGE0TO2	-.69964	.68306D-01	-10.243
AGE3TO5	-.65257	.56572D-01	-11.535
AGE6TO11	-.36820	.41418D-01	-8.8898
AGE12T18	-.17991	.39857D-01	-4.5138
UTILS	.11836D-02	.48107D-03	2.4603
MORT	.27882D-03	.15524D-03	1.7961
TOTVAL	-.20230D-02	.92316D-03	-2.1914
AGEJ	-.19083D-01	.15635D-01	-1.2205
AGEJSQ	.17429D-03	.15686D-03	1.1111
EDJ0	-.32926	.29447	-1.1182
EDJ1	-.63017D-01	.64631D-01	-.97502
EDJ2	.54646D-01	.52927D-01	1.0325
EDJ3	-.10514	.62323D-01	-1.6870
AVERNJ	-.31745D-01	.56479D-02	-5.6206
CONSTANT	-1.2744	.25439	-5.0096

Likelihood ratio test ... 1007.28 with 32 D.F.
Residual variance 0.2055
Sum of absolute errors ... 2215.8

Table B-5. Weighted least squares estimates of regression parameters used to predict the earnings of male head of household

Independent variable	Parameter estimate	Standard error	T-ratio
INTERCEPT.....	-142.973698	24.847356	-5.7541
AGEI.....	17.131854	0.992349	17.2639
AGEISQ.....	-0.177199	0.011361	-15.5967
R1.....	-15.202696	6.521818	-2.3311
R2.....	-7.198065	6.490559	-1.1090
R3.....	-35.000348	6.260031	-5.5911
S1.....	-4.786212	5.802721	-0.8248
S2.....	-3.962074	5.849397	-0.6773
S3.....	-8.773741	5.571117	-1.5749
U1.....	-12.793572	5.533366	-2.3121
U2.....	11.321791	4.949668	2.2874
HR1.....	30.229374	11.509109	2.6266
HR2.....	-16.852776	13.210431	-1.2757
EDI0.....	-50.655077	32.484926	-1.5593
EDI1.....	-44.664968	6.822362	-6.5468
EDI2.....	39.082420	5.672265	6.8901
EDI3.....	103.195651	5.588499	18.4657
ELAMBDA.....	-42.231410	9.272805	-4.5543
F ratio.....	74.60		
Mean square error...	24972.26		
R-square.....	0.2096		

Table B-6. Weighted least squares estimates of regression parameters used to predict the earnings of female head of household

Independent variable	Parameter estimate	Standard error	T-ratio
INTERCEPT.....	99.087470	18.611988	5.3239
AGEI.....	3.041856	0.720735	4.2205
AGEISQ.....	-0.026832	0.008630632	-3.1089
R1.....	-5.395539	4.302069	-1.2542
R2.....	-11.758027	4.329836	-2.7156
R3.....	-10.817579	4.182890	-2.5861
S1.....	-8.835085	3.848797	-2.2955
S2.....	-1.684070	3.933053	-0.4282
S3.....	-3.191116	3.671699	-0.8691
U1.....	7.161504	3.638666	1.9682
U2.....	7.709173	3.324658	2.3188
HR1.....	-18.992155	8.267525	-2.2972
HR2.....	-24.596563	9.031718	-2.7234
EDI0.....	-62.173434	43.466514	-1.4304
EDI1.....	-18.306102	5.366147	-3.4114
EDI2.....	15.813820	3.680728	4.2964
EDI3.....	58.896976	4.384523	13.4329
ELAMBDA.....	-37.680714	4.725224	-7.9744
F-ratio.....	33.47		
Mean square error..	12444.08		
R-square.....	0.15		

APPENDIX C

SUMMARY STATISTICS FOR VARIABLES IN THE FOOD EXPENDITURE MODELS AND EARNINGS MODELS

Table C-1. Summary statistics for variables in the food expenditure models and earnings models

Variable	Number of Observations	Mean	Standard Deviation	Minimum Value	Maximum Value
MERNHAT.....	6551	247.208	73.832	25.907	415.835
MAGE.....	6551	46.544	15.804	18.000	75.000
MAGESQ.....	6551	2416.132	1537.406	324.000	5625.000
R1.....	8979	0.238	0.426	0.000	1.000
R2.....	8979	0.238	0.426	0.000	1.000
R3.....	8979	0.352	0.477	0.000	1.000
S1.....	8979	0.227	0.419	0.000	1.000
S2.....	8979	0.227	0.419	0.000	1.000
S3.....	8979	0.276	0.447	0.000	1.000
U1.....	8979	0.311	0.463	0.000	1.000
U2.....	8979	0.348	0.476	0.000	1.000
HR1.....	8979	0.838	0.367	0.000	1.000
HR2.....	8979	0.129	0.335	0.000	1.000
MED0.....	8979	0.005	0.075	0.000	1.000
MED1.....	8979	0.130	0.336	0.000	1.000
MED2.....	8979	0.123	0.329	0.000	1.000
MED3.....	8979	0.130	0.337	0.000	1.000
FERNHAT.....	8340	155.173	24.985	56.458	249.881
FAGE.....	8340	46.368	17.071	14.000	97.000
FAGESQ.....	8340	2441.414	1699.773	196.000	9409.000
FED0.....	8979	0.004	0.067	0.000	1.000
FED1.....	8979	0.158	0.365	0.000	1.000
FED2.....	8979	0.151	0.358	0.000	1.000
FED3.....	8979	0.107	0.310	0.000	1.000

Table C-1 (continued)

Variable	Number of Observations	Mean	Standard Deviation	Minimum Value	Maximum Value
VALUE1.....	8979	24.548	15.960	0.000	162.149
VALUE2.....	8979	8.124	6.276	0.000	77.579
VALUE3.....	8979	8.766	7.291	0.000	92.829
VALUE4.....	8979	3.384	3.859	0.000	86.419
NMO.....	8979	0.311	0.463	0.000	1.000
HMO.....	8979	0.261	0.439	0.000	1.000
FPREP.....	8979	0.912	0.282	0.000	1.000
VOT.....	8947	181.053	127.721	4.602	2301.390
VOTPFPREP...	8192	178.695	127.176	4.602	2301.390
INCOMES.....	8979	260.619	212.106	0.000	4487.708
HHSIZE.....	8979	2.918	1.649	1.000	14.000
R1.....	8979	0.238	0.426	0.000	1.000
R2.....	8979	0.238	0.426	0.000	1.000
R3.....	8979	0.352	0.477	0.000	1.000
S1.....	8979	0.227	0.419	0.000	1.000
S2.....	8979	0.227	0.419	0.000	1.000
S3.....	8979	0.276	0.447	0.000	1.000
HR1.....	8979	0.838	0.367	0.000	1.000
HR2.....	8979	0.129	0.335	0.000	1.000
U1.....	8979	0.311	0.463	0.000	1.000
U2.....	8979	0.348	0.476	0.000	1.000
FARMER.....	8979	0.017	0.131	0.000	1.000
M21TO54.....	8979	0.522	0.499	0.000	1.000
M55TO74.....	8979	0.206	0.404	0.000	1.000
M75TO99.....	8979	0.042	0.201	0.000	1.000
F21TO54.....	8979	0.622	0.484	0.000	1.000
F55TO74.....	8979	0.260	0.438	0.000	1.000
F75TO99.....	8979	0.068	0.251	0.000	1.000
C0TO2.....	8979	0.081	0.273	0.000	1.000
C3TO5.....	8979	0.126	0.332	0.000	1.000
C6TO11.....	8979	0.226	0.418	0.000	1.000
CTEEN.....	8979	0.262	0.440	0.000	1.000

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DEMAND FOR SELECTED CLASSES OF CONVENIENCE FOOD IN THE UNITED STATES

by

David B. Hull

(ABSTRACT)

The focus of this research was the problem of identifying the economic and demographic factors that determine household expenditure for convenience food in the United States. A major objective was to measure, for various classes of convenience food, the response of expenditures to changes in demand determinants so that food expenditure profiles can be simulated for households with different characteristics and constraints. Another major objective was to determine the effect of the meal preparer's value of time on household use of convenience food.

The work of others on similar models of food demand has been extended to include analysis of the effects of the sex and employment status (market-orientation) of the meal preparer, the value of the meal preparer's time, household size, income and age-sex composition. Other factors in the models include region, race, urban setting and season. The functions were specified from a theoretical model developed from the theory of the household production function.

Foods used by households as reported in the 1977-78 Nationwide Food Consumption Survey were divided into classes of nonconvenience, basic convenience, complex convenience and manufactured convenience food. Nonconvenience foods are raw, unprocessed foods or ingredient foods. Basic convenience foods are single ingredient foods with limited culinary expertise embodied, usually providing a type of preservation convenience. Complex convenience foods are multiple ingredient, highly prepared foods. Manufactured convenience foods include products which have no home prepared counterpart.

For the three convenience classes, nonincome-earning female meal preparers all had positive elasticities of the value of time. Except for the basic convenience food model, the income-earning female meal preparers had positive value of time elasticities. The nonmarket-oriented female meal preparers had negative elasticities of value of time in the nonconvenience class.

The income elasticity for all food classes ranged from 0.03 in the nonconvenience food expenditure model to 0.08 in the complex convenience food model. The significance of statistical tests on the range of income elasticities verifies that the food categories investigated are neither inferior nor luxury goods, and that demand models for all food at home that ignore the effects of the value of time would overestimate the elasticity of expenditure with respect to income.