PN-ABG-548
ISN 67005

DEMAND FOR MAJOR FOODS AND NONFOOD IN JAMAICA: ESTIMATES FROM 1975 AND 1977 HOUSEHOLD EXPENDITURE SURVEYS*

REPORT #3

February, 1986

*Supported by OICD/USDA-University of Missouri-Columbia cooperative agreement #58-319R-4-073. Prepared by Kamal Banskota, S.R. Johnson, and Gary Stampley.

I. Introduction

The household expenditure surveys conducted in 1975, 1976, and 1977 for Jamaica contain information that can be utilized to study the consumer demand for food. The importance of the parameters from these studies is largely derived from their use in formulating and evaluating food and agricultural policies, for forecasting trends and patterns in food demand. Additionally, these data and results can be utilized to test the appropriateness of selected propositions from demand theory for a developing nation such as Jamaica.

With the instability of world prices for food and other natural resource products, Jamaica with its small open economy is highly vulnerable to external influences that cannot be controlled. Slow productivity growth in the developing countries, when coupled with unstable world prices for primary products may result in high rates of inflation and unemployment. This problem is exacerbated in Jamaica where there is not a highly diversified economy. There is heavy reliance on a few sectors (agriculture or natural resources, generally) for export earnings. The impacts to the economy can be significant when world prices change.

In the wake of a deteriorating economic situation pricing policies, especially food pricing policies have become an important component of the development strategy in Jamaica and other developing countries. Policies to allow economically driven fluctuations in domestic food prices without causing undue adjustments and adjustment costs for consumers are desired. At the same time, the prices should provide proper incentives for productivity growth in the domestic

economy. The latter has become a prime concern for policy makers in many developing countries.

Price increases for food may be socially undesirable. Alternatively, if selected food items constitute staples for a vast majority of the poorer sector of the society, increasing prices may result in widespread decreases in real income and perhaps malnutrition and hunger. Transfers via food assistance plans to the poorer households may be necessary to compensate for effects of price changes. There are many food and nutrition policy options available to the governments of developing economies. What is crucial, however, is that the research base for design and implementation of these policies be sufficiently strong to assure that the anticipated outcomes materialize. Frequently major sectors of the economy and even the food production and distribution systems are so frail that miscalculations in setting policies can have devastating impacts.

The design and formulation of effective agricultural, food and nutrition policies must proceed from a fuller understanding of food consumption behavior of households. Demand structures of households for major foods and their relationships to exogenous income and price shocks can be assessed by analyzing household data from expenditure surveys that have been made in Jamaica. These demand systems parameters are valuable in anticipating consequences of and evaluating policy impacts and the incidence of policy outcomes.

This report is divided into nine sections. Section II outlines the importance of demand studies. The methodology utilized in this study is described in Section III. The data set is described in

Section IV. The topics of Section V cover the specification, estimation issues and described the hypotheses tests that will be conducted in the study. A brief review of previous related studies in the Jamaican context is contained in Section VI. The results are discussed in various subsections of Section VII. A comparison of the results of the present study with those of selected developing countries is conducted in Section VIII. Finally Section IX contains the symmary and conclusions. Other relevant materials pertaining to the present study are provided in the form of appendices.

II. Importance of the Study

An economy can be broadly divided into two broad sectors namely the final demand sector and the productive or supply sector. The final demand sector consists of household demand, investment demand and government demand. The productive sector or the supply sector consists of the numerous production enterprises of the economy which produce the goods and services demanded by the components of the final demand sector. The concern of this study is with a component of the final demand sector namely the household sector.

The household sector is a consuming unit and it is assumed that the forces which motivate household behavior is the desire to maximize satisfaction or utility through consumption of various goods and services. These goods and services are bought in the market place given the income distribution and prices. It should be noted that this study deals specifically with those goods that are of private consumption in nature as opposed to public goods and services. It is further assumed that each household, given the income distribution and relative prices of the consumption goods, knows the best consumption pattern that maximize satisfaction or utility. In other words each household constantly seeks to maximize its utility given the limited income it has and the prices it has to pay for the goods and services it purchases for consumption. Income and prices are hypothesized to be the relevant variables that shapes households demand. This is not to undermine other variables that are likely to influence demand. For instance besides income and prices, social, demographic or environmental variables could also affect households demand. In this

study variables besides income and prices and household size are not considered and may be noted as a limitation of this study. The present study is the first of its kind in the Jamaican context and introducing other variables in the demand study is best left as a future exercise.

The estimation of demand relationship is of interest in its own right as well as for various policy prescriptions. The estimation of the demand relationship provides an understanding of how households react to exogenous changes in income and relative prices. When the relative prices of the consumption item of a household changes, households are most likely to reallocate their expenditure in a manner that would achieve households to attain the maximum satisfaction given their limited resources. The allocation process would result households to substitute cheaper commodities for the ones whose prices have increased. How do households react to such changes in income and/or relative prices? What can be discerned about the relationship between households consumption goods in terms of substitutes and complements? The answers to such questions besides being directly relevant for policy makers for food and nutrition or taxation policies, is of relevance for the general purposes of economic planning (Lluch, Powell and Williams, 1977; Timmer, Falcon and Pearson, 1983).

In most countries of the world a major national goal is to maintain stability in food prices. Many developing countries' food supply situation is highly sensitive to weather conditions among other things. Situations of excess supply following favorable weather

conditions and vice versa are not uncommon in many developing countries. To design effective pricing policies in situations characterized by food shortages and food gluts, an understanding of households' food demand responses are necessary. Such key information is obtained from estimates of demand system.

International trade in food comodities have played an increasing role in many developing countries to offset domestic demand in situations of food shortages. Such countries have also made increasing efforts to boost domestic food production with the aim to be self reliant in food production. Changing patterns in the consumption of such foods necessarily have implications for trade policy.

Estimating demand system enable to compare the cost of living (indices) across different segments of the population as well as over time. Such information has implications for income redistribution policies aimed to improve the general welfare of target groups (Brown and Johnson, 1983).

A common approach in the past to estimate demand relationship has been to estimate each demand equation separately. Such an approach has the advantage of simplicity, but devoids economic theory as well as reality. Estimating single equation demand relationship assumes that households make expenditure decisions separately on each commodity group consumed. In reality it is the case that households make expenditure decisions in a joint manner, at least over broad groups. Hence, modeling households expenditure decisions would also be more realistic if it were modeled simultaneously over the broad

groups of commodities consumed. This is the approach that has been taken in this study.

Various models exist to model household demand. In the past the linear expenditure system pioneered by Stone (1954) and extensively studied by Lluch, Powell and Williams (1977) has been popular. However, this system has the disadvantage that inferior commodities are ruled out. In other words if households in a certain circumstance are forced to decrease the consumption of a commodity when income increases, such relationship cannot be captured by the linear expenditure system. Secondly, nonhomothetic preferences are not represented by this system. This means that the Engel curves are linear indicating a constant relationship (ratio) between quantities of commodities consumed at given relative prices.

The translog functional form (Jorgenson, Christensen and Lau, 1973; Christensen and Manser, 1976) is not restricted in the manner described above for the linear expenditure curve. The popularity of the translog system, however, is limited by the nonlinear nature of the demand equations. In this study a more recent model known as the Almost Ideal Demand System (AIDS) is utilized to model the expenditure behavior of Jamaican households. The AIDS system preserves the characteristic of nonhomothetic preferences and at the same time the estimating relationships in budget share forms are linear if an appropriate price index is selected.

III. Methodology of the Study

A. Engel Curves

The relationship between the proportion of a household's budget spent on a certain expenditure group, and its total income can be described by an Engel curve. Engel's law states that the proportion of expenditure on food declines when income rises, other things held constant. The "law" can also be stated alternatively as the result that the elasticity of expenditure on food with respect to income or total expenditure is less than one. Engel's law has been shown to hold true over time and in studies from many different countries.

The Engel curves, which define economically relationship between expenditure proportion and income or total expenditure, can be stated mathematically. There are several ways to specify the Engel's law algebraically (Prais and Houthakker, 1955; Lesser, 1963). Engel curves are essentially demand functions where price effects are held constant. It is thus a custom to use cross sectional data to estimate Engel curves, since prices to households can be presumed to satisfy the condition of constancy.

The semilog Engel curves utilized in this study can be written as in (1)

$$w_i = a_i + b_i \log Y \tag{1}$$

where w_i is the ith budget share, Y is income or total expenditure, a_i and b_i are the intercepts and income coefficient (Figure 1). Per capita income or expenditure is also often utilized instead of total income or expenditure. The semilog function has an income elasticity

coefficient which varies inversely with the quantities consumed. The marginal propensity to consume is inversely proportional to income. This function has the disadvantage that it does not provide for saturation at high income levels. However, in the context of developing countries where most food items would probably qualify as necessities, food saturation levels may not be a problem. For necessities the income elasticity for the semilog function is less than one but positive. Inferior goods are described by negative income elasticities.

One reason for selecting the semilog Engel curves is because when prices are held constant in the AIDS model discussed in the next section, the semilog function is obtained. Thus comparison of elasticities under zero price variability and otherwise becomes possible.

Income or expenditure has been the traditional variable hypothesized to influence household expenditure patterns. However, other socioeconomic variables are important in determining expenditure pattern of households. Single person households may have different expenditure patterns than larger households. For example, single member households may spend more on meals away from home than larger households. The sex of the household head may influence expenditure patterns, i.e., female head of households may be more efficient in food preparation than males (Capps, Tedford and Havlicek, 1985). Urban households may exhibit a different food preferences than rural households. Age of the household head may also influence expenditure

Previous Page Blank

patterns and finally, larger households may be more likely to experience economies of scale than smaller households.

The inclusion of these socio-demographic variables in estimating demand equations is not new (Barten, 1964). However, recently there has been increasing interest in the use of socio-demographic variables in addition to income and prices in estimating demand equations or systems (Howe, 1977; Banskota et al., 1986a; Muellbauer, 1980; Capps, Tedford and Havlicek, 1985; Pollak and Wales, 1981). Pollak and Wales (1981) have outlined theoretically consistent methods for introducing socio-demographic variables in estimating demand systems. The methods are known as scaling and demographic translating. Demographic "scaling" requires normalization of prices and income, whereas demographic "translating" affects the subsistence parameter.

In this study Engel curves are estimated using the traditional variable, namely expenditure as a proxy for household income. The use of the socio-demographic variables in estimating Engel curves for Jamaica can be found in Banskota et al. (1986).

B. Almost Ideal Demand Systems

Households expenditure habits are influenced by a variety of socioeconomic, demographic and other variables. However, income and relative prices have been hypothesized to be the traditional variables influencing households expenditure habits. In this section, therefore, prices along with household income and family size are jointly utilized to explain the food expenditure patterns of Jamaican households.

The theory of choice proceeds by postulating a utility function which households are assumed to maximize subject to the constraint imposed by finite and positive amount of disposable income available to the household and prices they face. But utility is an unmeasurable and incomparable phenomenon and provides little use in empirical work. However, recent work on duality theory allows preference structures to be represented by either a cost or a utility function (Deaton and Muellbauer, 1980a; Diewert, 1982). In other words this means that a cost function approach to the study of demand is equivalent to the utility maximization approach. In this study a cost function approach is, therefore, taken to analyze the demand for various foods and nonfood by Jamaican households. In particular, the Almost Ideal Demand System (AIDS) introduced by Deaton and Muellbauer (1980b) has been selected for the present purpose. Compared to the other forms of demand system such as the Linear Expenditure System (Stone, 1954; Lluch, Powell and Williams, 1977) or the constructed demand system (Hassan and Johnson, 1976; George and King, 1971), the AIDS has a number of desirable properties. The authors (Deaton and Muellbauer,

1980b) list a number of properties of AIDS, namely:

1. It provides an arbitrary first order approximation to any demand system.
2. The axioms of choice are satisfied.
3. Aggregation across individuals is perfect.
4. The functional form is consistent with observed household data.
5. The system in the linear form is easily interpreted.
6. The system can be used to test for homogeneity and symmetry.
7. Marginal utilities of commodities are not independent, i.e., AIDS does not impose substitution limitations on consumption.

The starting point for developing the AIDS is the selection of a cost function C(u,p),

$$\log C(u,p) = u \log (a(p)) + (1-u) \log (b(p)) \tag{2}$$

where p represents a vector of prices, u an index of utility and C the minimum cost necessary to obtain the utility level u. The utility index u lies between 0 (subsistence) and 1 (bliss), except in certain cases noted by the authors.

Specific functional forms have to be selected for applications of the AIDS. Deaton and Muellbauer use the following functional forms as a basis for the AIDS,

$$\log (a(p)) = \alpha_0 + \sum_i \alpha_i \log p_i + 1/2 \sum_{ij}\sum \gamma^*_{ij} \log p_i \log p_j \tag{3}$$

where

$$\log b(p) = \log a(p) + \beta_0 \Pi p_i^{\beta_i} . \tag{4}$$

Substituting equations (3) and (4) in equation (2) and applying Shephard's lemma to the cost function results in a system of Hicksian compensated demand functions in share form. (Details on Shephard lemma can be found in Shephard, 1970; Diewert, 1982 or Deaton and Muellbauer, 1980a). The compensated demand system, however, contains the unobservable utility index u as an argument (see Deaton and Muellbauer, 1980a). The utility index is eliminated from the system by inverting the cost function and substituting the value of u into the compensated demand system to obtain the corresponding Marshallian demand system of the AIDS,

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log (\frac{Y}{P}) \tag{5}$$

where w_i is the ith food budget share, Y is the income, and P is the price index defined as,

$$\log P = \alpha_0 + \sum_i \alpha_i \log p_i + 1/2 \sum_{ij}\sum \gamma_{ij} \log p_i \log p_j \tag{6}$$

with

$$\gamma_{ij} = 1/2 (\gamma^*_{ij} + \gamma^*_{ji}) .$$

At this stage, an intuitive interpretation of equation (5) can be made. The budget shares (w_i) are expressed in terms of prices (p_i's) and real income (Y/P). When all logarithmic prices and income are set to zero, the intercept α_i gives the average budget share. The coefficients γ_{ij} represents 10^2 times the effect on the ith budget

share when the jth price changes by one percent and all other prices and real income are held constant. Likewise, the β_i give the percent change in the budget share when real income changes and all prices are held constant.

For the AIDS, the own, cross and expenditure elasticities are defined as follows respectively (see Ray, 1980a) when the true price index is utilized.

$$\varepsilon_{ii} = -1 + \frac{1}{w_i} (\gamma_{ii} - \beta_i(\alpha_i + \sum_k \gamma_{ki} \log p_k)) , \tag{7}$$

$$\varepsilon_{ij} = \frac{1}{w_i} (\gamma_{ij} - \beta_i(\alpha_j + \sum_k \gamma_{kj} \log p_k)) , \tag{8}$$

and

$$\eta_i = 1 + \frac{\beta_i}{w_i} . \tag{9}$$

The price elasticities formulas (7 and 8), however, change depending on the form of price index utilized. For example the price index defined in equation (6) results in above two own and cross price elasticities formulations. Use of the above price index, however, tends to make the estimating equations nonlinear. Deaton and Muellbauer (1980b), have suggested the use of the Stone's index, defined as

$$\log P^* = \Sigma w_i \log P_i \tag{10}$$

where w_i are the food budget shares, corresponding to the food groups which households purchase given prices P_i's. Using the Stone's index

makes the demand system of equations linear and estimation can be carried out at lesser costs. It has been demonstrated empirically that Stone's index provides an excellent approximation to the true price index (equation 6) (Deaton and Muellbauer, 1980b). In this study, Stone's index will be utilized. The relevant price elasticities then become (see Barewal and Goddard, 1985 for price elasticities under different price index assumptions),

$$\varepsilon_{ii} = \frac{1}{w_i} (\gamma_{ii} - \beta_i w_i - w_i) \tag{7a}$$

$$\varepsilon_{ij} = \frac{1}{w_i} (\gamma_{ij} - \beta_i w_j) \tag{8a}$$

To maintain coherence or a rational set of consumer preferences, a number of restrictions are imposed based on the theoretical attributes of the demand system.

1. Consumers are allowed to reallocate their incomes over the commodities they consume but this reallocation should not violate the budget constraint. This condition is usually called Engel aggregation.
2. A change in the price of a commodity can result in reallocation of consumers' incomes but again the budget constraint cannot be violated. This condition is called Cournot aggregation.
3. If prices and income change in the same proportion, the quantity demanded of a commodity will be unaffected. This condition is called homogeneity.

4. Slutsky symmetry requires that the matrix of second order price derivatives be symmetric. Symmetry restriction has no clearer behavioral interpretation.

The details of the derivations of the above restrictions have been provided by Johnson, Hassan and Green (1984), Hassan and Johnson (1976) and Phlips (1974). For the AIDS, the above conditions require imposing the following restrictions on the parameters of equation (5),

i) For homogeneity $\Sigma \gamma_{ij} = 0$. (11)

ii) For Engel and Cournot (also called adding up condition),

$$\Sigma \alpha_i = 1; \sum_j \gamma_{ij} = 0; \sum_i \gamma_{ji} = 0; \Sigma \beta_i = 0 . \quad (12)$$

iii) Finally, for symmetry requires $\gamma_{ij} = \gamma_{ji}$. (13)

In equation (5) there are n, α_i's and β_i's and n^2, γ_{ij}'s, i.e., there are $2n + n^2$ unknowns. The above restrictions on the AID system help reduce the number of unknowns to be estimated. The above restrictions provide $(n^2 + n + 4)/2$ conditions on the parameters of the AIDS system and hence, the number of unknowns that remain to be estimated is $(n^2 + 3n - 4)/2$. (The details can be found in Johnson, Hassan, Green, 1984 and Phlips, 1974). Adding one more commodity in the system multiplies the number of parameters to be estimated by a factor greater than one and, thus there can cause estimation problems with larger demand systems.

When the above restrictions are imposed on the AIDS, the dependent variables, i.e., the budget shares all add to one as required. A number of advantages are associated with the imposition

of the above restrictions in a demand system. First, the number of parameters that have to be estimated is significantly reduced. However, it is common to make further assumptions to reduce the number of parameters to be estimated.

The AIDS theory is idealized to individual consuming units (individuals or households). In reality, however, data are generally available for groups of consuming units. When group data are utilized to estimate demand systems, market demand system is actually being estimated (Brown, Green and Johnson, 1985; Safyurtlu, Johnson and Hassan, 1985). The question then is how consistent is market demand system with individual demand system in representing a rational set of group preference? Stated differently, does the market demand system fulfill the properties (listed above) of the individual demand system? The answer to the question is not simple. The AIDS system is, however, one in which these conditions are imposed implicitly, via a set of separability conditions (see Brown, Green and Johnson, 1985).

Recall that imposing restrictions on the demand system reduces the number of parameters to be estimated. However, the number of parameters to be estimated is still large for applications like the one contemplated for Jamaica. Thus, further restrictions associated with composite commodities are required. Closely related commodities are grouped. For example, the various types of food consumed by households can be grouped into "composite" meat products, dairy products, vegetables, etc. A major reason for using the composite commodity formulation is the lack of adequate observations (and price

ariation) to estimate highly disaggregated demand systems. (For more detail see Johnson, Hassan and Green, 1984).

Aggregation, however, leads to several pertinent questions that have to be addressed before the market demand system is estimated. For instance is it justifiable to aggregate households that have dissimilar tastes and preferences? Households may be purchasing different types of foods and facing different prices and when aggregation is done, which price to use? Similar problems arise in obtaining income and quantities (Safyurtlu, Johnson and Hassan, 1985; Brandt, Johnson, Goungetas and Womack, 1985). A detailed discussion of the various approaches that economists have employed to estimate market demand system is beyond the needs of this study. References can, however, be made to George and King, 1971; Hassan and Johnson, 1976; Huang and Haidacher, 1984; Pollak and Wales, 1981; Safyurtlu, Johnson and Hassan, 1985; and Brandt, Johnson, Goungetas and Womack, 1985; Blanciforti and Green, 1983 for details.

It suffices to say here for the present purposes that the micro theory of choice when carried on to market theory is not consistent. This means that the Slutsky restrictions consisting of homogeneity, Engel aggregation and symmetry are not always satisfied by market demand system. Recent work by Safyurtlu, Johnson and Hassan (1985) and Brandt, Johnson, Goungetas and Womack (1985) among others, provides a starting point to estimate market demand systems. This approach proceeds by estimating the AIDS along with the Slutsky restrictions specified stochastically.

Finally, most demand systems including the AIDS, use separability assumptions. A model such as the AIDS uses a flexible form system. That is, the system (cost function) has enough first and second order derivatives (parameters) which "can be set equal to those of an arbitrary cost function" (Deaton and Muellbauer, 1980b). This approach helps to characterize more flexibly consumer responses to price and income. In this study the AIDS is estimated at the household level only.

IV. Data

A. General Remarks

The household expenditure surveys conducted by STATIN in 1975 and 1977 are utilized for the present food and nonfood demand analysis of Jamaican households. Even though a survey was conducted in 1976, the negligible price variations observed in 1976 and 1977 precluded use of the 1976 survey. As well, the 1976 sample exhibited other questionable characteristics when compared to the other two samples.

The survey identifies over three hundred food items. To estimate the demand system these food items have to be aggregated into food groups to derive meaningful results. Furthermore, the aggregation has to be conducted across fairly homogeneous food items, such that expenditure on food items in a given food group are fairly independent of the expenditure on food items in other food groups. This assumption--called separability--allows food items to be aggregated into food groups.

To note at this point is that not all households have reported purchase of all food items. It is unlikely that households will purchase all the food items identified in the survey questionnaire. Due to differences in taste, availability of the food items, differences in prices faced by households and income differences, households may opt not to purchase some food items. However, in the aggregation the number of households not reporting purchase of a food group will decline, but nevertheless some households may still report nil purchase of some food groups. Such nil purchases may not reflect that such households do not consume the food. In fact, it may be that

the household did not purchase the food items in the food group during the survey week. The household may have purchased the food item prior to the survey week, or may have stocked the food item when it was available at lower prices. There could be other reasons as well. Whatever the reason there is no way to delete household from the analysis on the basis of nil purchase reported in the samples. As a result, all households that report nil purchase of some food groups are also included in the analysis.

However, some households had to be deleted from the analysis. The households that were deleted were based on the following criterion. If a household's total annual expenditure was equal to only the annual food expenditure or nonfood expenditure, such households were deleted. It is very unlikely that households spend all their total annual expenditure on either only food or on nonfoods. Consequently the number of households that were deleted amounted to only 0.6 percent of the sample and it is unlikely that the results will be much influenced by deletion of this small percentage of households.

The expenditure groups included in the analysis are as follows:

1) meats, poultry and fish
2) dairy products
3) oils and fats
4) cereals and starchy foods
5) fruits and vegetables
6) sugar and sugar products
7) beverages

8) miscellaneous foods

9) purchased meals

10) nonfood

B. Calculation of Budget Shares

Food group budget shares are calculated for each household by dividing each group expenditure by the total annual expenditure of the household.

C. Calculation of Prices

To estimate the parameters of the demand system food group prices are required. STATIN reports CPI series for food. But the CPI series contains a different set of food groups than what is currently here. The CPI series reported by STATIN for nonfood group has been used to represent the nonfood group price. These CPI series are reported for 1975 and 1977. Adjustments were made to account for the regional variations in the nonfood CPI, since the regional CPI's do not account for the regional price variations. At a point in the past all the regional CPI series converge to unitary.

To adjust the CPI to account for the variability across regions as well, the base period nonfood relative (rural areas) budget share is utilized as weight. An alternative would be to utilize the CPI for nonfood reported for the whole of Jamaica, but then the variability in the nonfood price would be severely limited and this approach was not pursued.

The food group prices utilized in this study come from the sample itself. STATIN obtained prices of each food item purchased by

household during the survey. Thus, calculating the food group price was a relatively simple task. For each food item in a food group the food item budget share was first obtained. The food group price was then calculated as a weighted price with the food item budget share as the weight. The food group price was calculated for each household. Since the prices of food items are utilized to calculate food group prices, price variability arising due to product differentiation--quality differences, regional availability, packaging, etc.--are also accounted for to the extent that the food item price reflects such variations. Where a food group price was missing the average price for a household belonging to a given occupation class (household head's occupation used), age class, location, income class, family size group and the survey year was inserted. Calculating average prices in the above manner thus allows limited amount of taste variation across households. In other words, the above approach to calculating food group prices assumes that a household in a given occupation and age class, location, income group, family size group and time would face similar prices (see Deaton and Muellbauer, 1980a). Finally, the purchased meal price was calculated as the price per meal for each household having reported taking meals away from home. Missing values were inserted in the manner aforementioned.

D. Per Capita Expenditures

First all reported expenditure by households are aggregated. To this value the value of home produce consumed by household is further added to arrive at the total annual household expenditure. Thus the total annual household expenditures includes expenditure on food and

beverages, fuel and household goods, household operation expenses, durable goods, clothing expenses, recreation and transport, personal care and health, value of home produce consumed at home, expenditure on meals consumed away from home, and miscellaneous expenses.

Since a large number of households did not report their incomes, the income variable could not utilized. Thus throughout this report household expenditure, or per capita expenditures are loosely called simply expenditure or income. Per capita expenditures/incomes were obtained for each household by dividing the household expenditure or income by the reported number of members in a household.

E. Sample Partitions

An examination of the data set revealed two fairly distinct expenditure patterns of households. Households with incomes less than J$ 5,000 appeared to exhibit a different expenditure pattern than households with incomes greater than J$ 5,000. Thus, households were partitioned into two samples, those with less than J$ 5,000 and those with greater than J$ 5,000. The demand system is estimated for both the sample partition of households as well as for the entire sample.

V. Specification, Estimation and Hypotheses Test

A. Specification

For estimation purposes the prices are normalized by the household size variable (see Ray, 1980a). When the household size variable is used to normalize the prices, the AIDS equations appear as in (14)

$$w_i = \alpha_i + \Sigma_j \gamma_{ij} \log p_j + \beta_i \log (\frac{Y}{P}) + \sigma_i \log s_i \qquad (14)$$

where s_i is the household size of the ith household and $\sigma_i = \Sigma_j \gamma_{ij}$. This form of the AIDS model is the unrestricted form. This unrestricted model is estimated for the full sample, the low income households and high income households.

Homogeneity is then imposed in (14) and the models are re-estimated. Note that when homogeneity is imposed $\sigma_i = 0$, which would imply the scale economies parameter in the homogeneity model to be zero. But as Ray (1980a) has argued, if σ_i turns out to be zero, scale economies would still operate through y (the per capita income) in (14). Also it is possible that in the homogeneity model σ_i may not turn out to be zero, since the household size variable incorporates size and composition effects as well. When homogeneity is imposed one less parameter has to be estimated for each equation, i.e., 10 parameters in total.

Finally homogeneity and symmetry are imposed in the unrestricted model. Imposing symmetry reduces the number of parameters to be estimated considerably. Symmetry is imposed by setting $\gamma_{ij} = \gamma_{ji}$.

Engel curves are estimated without scaling the per capita income since the assumption of zero price variability is assumed. The household size variable is also included.

B. Estimation

The unrestricted and the homogeneity model are estimated in the OLS fashion. An error term assumed to be distributed normally with mean zero and a finite variance are appended to each budget share equation and estimation is carried out. Similar approach is taken in estimating the Engel curves. Finally the models with homogeneity and symmetry form a system of seemingly unrelated equations. The appropriate technique to estimate such a system is to use iterative Zellner technique, which results in estimates that are equivalent to the maximum likelihood estimates (see Zellner, 1962; Kmenta and Gilbert, 1968).

C. Hypotheses Test

A number of hypotheses tests will also be carried out. First Chow's test is conducted to ascercain whether the consumption pattern or the demand structure of the low and high income households are significantly different from one another (Chow, 1960).

Second the log likelihood ratio test is utilized to select which of the estimated models, namely the unrestricted, the homogeneity or the homogeneity and symmetry model best represents the consumption pattern or the demand structure of the households for all three samples. The details on conducting the Chow and likelihood ratio test

(Fomby, Hill and Johnson, 1984) are outlined in Appendix B and C respectively.

VI. Previous Studies on Jamaica

Few and relatively dated empirical studies on demand exist for Jamaica. Among the earlier studies analyzing the expenditure pattern of households in Jamaica are those by Harris (1964), Taylor (1965) and Adams (1968). Studies for some other Caribbean nations are also available (Mayers, 1977; Cumper, 1960). Taylor estimated the following type of Engel curve:

$$X_i = \alpha_i + \beta_i Y + \gamma_i \log P$$

where X_i is the expenditure on commodity i, Y is total household expenditure and includes value of home produce consumed by the households, and P is a weighted geometric average of household size defined as,

$$\log P = \sum_j \sigma_j \log p_j \ .$$

where σ is the portion of household members in the age group j. The sum of the weights add to one. Harris, one the other hand, estimated a semi-log and double log forms of the Engel curves. Adams (1968) utilized linear, semi-log and double log forms and utilized time series data as opposed to the 1958 household expenditure data utilized by Harris and Taylor.

Also, Harris and Adams both used value of actual per capita consumption as the dependent variable. Adams included commodity prices as well in his study besides income, given the broader objective, i.e., to study import demand for food as well, of this latter study.

Adams is an aggregate demand study whereas the other two are household demand and hence income elasticities for the three regions (Kingston, other towns and rural areas) are also provided in these two studies. A similar study for St. Kitts and Nevis, using a semi-log function is also available (Mayers, 1979). All the studies estimated Engel curves for a broad range of food groups. In Section VIII of this study some of the results from earlier studies will be compared with those obtained in this study.

VII. Results

A. Allocation of Household Budgets

Average annual per capita expenditure and budget shares of households for the two income groups and overall Jamaica are presented in Table 1. It should be recalled that the division of households into high and low income groups are based on the total household annual expenditure. Reported income could not be used mainly because a large percentage of households in the 1975 as well as 1977 sample did not report incomes. Throughout this report, therefore, expenditure is often referred to as income. Furthermore, low income households refer to households whose annual total expenditure is less than $J 5,000 and high income households are those with total annual expenditure greater than $J 5,000.

From Table 1 the average low income household allocates over 60 percent of its income on food. A typical high income household on the other hand allocates about 40 percent of its income on food. For Jamaica as a whole an average household allocates about 57 percent of its total income on food (see University of Missouri (UMC) Memorandum #1 and Memorandum #2, 1985 for more details on household budgets).

Among the food groups meat, poultry and fish occupy the most important position in household food expenditure. Low income households meats budget shares are higher than the high income households, but in terms of actual expenditure the picture would be different. The budget shares of most food groups are higher for low income households than high income households. Cereals and starchy food budget share of high income households is less than half that of

Table 1

Food and Nonfood Budget Shares by Household Type and Year: Jamaica, 1975 and 1977

Expenditure Shares	All Households		Low Income Households		High Income Households	
	1975	1977	1975	1977	1975	19.7
Meats, Poultry and Fish	0.1930(0.102)*	0.1552(0.095)	0.2066(0.104)	0.1644(0.098)	0.1477(0.080)	0.1181(0.070)
Dairy Products	0.0545(0.034)	0.0498(0.034)	0.0582(0.036)	0.0533(0.035)	0.0422(0.230)	0.0356(0.022)
Oils and Fats	0.0215(0.020)	0.0185(0.021)	0.0249(0.022)	0.0208(0.023)	0.0101(0.008)	0.0088(0.0089)
Cereals and Starchy Foods	0.1605(0.093)	0.1631(0.107)	0.1821(0.091)	0.1848(0.107)	0.0890(0.055)	0.0752(0.045)
Fruits and Vegetables	0.0802(0.052)	0.0658(0.056)	0.0862(0.054)	0.0697(0.059)	0.0605(0.037)	0.0500(0.036)
Sugar and Other Sweets	0.0165(0.013)	0.0141(0.015)	0.0177(0.014)	0.0157(0.016)	0.0104(0.007)	0.0075(0.007)
Beverages	0.0249(0.024)	0.0219(0.024)	0.0262(0.026)	0.0233(0.026)	0.0203(0.018)	0.0161(0.016)
Miscellaneous Foods	0.0266(0.038)	0.0195(0.043)	0.0260(0.038)	0.0192(0.043)	0.0287(0.035)	0.0209(0.039)
Purchased Meals	0.0506(0.084)	0.0572(0.087)	0.0484(0.087)	0.0543(0.091)	0.0581(0.070)	0.0688(0.069)
Nonfood	0.3717(0.188)	0.4350(0.189)	0.3231(0.161)	0.3944(0.172)	0.5330(0.183)	0.5989(0.163)
Annual Per Capita Expenditure	1153.98(1140.98)	1120.39(1430.29)	789.46(733.11)	776.68(749.32)	2362.12(2298.18)	2509.23(2378.63)
Sample Size	3,473	993	2,668	796	805	197

*Standard deviations are provided in parentheses.

the low income households indicating the relative importance of this food group among low income households. Purchased meals budget shares among the two groups is similar.

The general pattern observed in food group budget shares is in conformity with economic theory in that the proportionate expenditure on food items declines with increased incomes.

The above results are informative but provide little knowledge about how households expenditure behavior change when their incomes and the commodity prices (relative), both of which from the households point of view are exogenous, change. For example, given household incomes, how does a household react to an exogenous price shock. Households are most likely to reallocate their expenditure--increasing their expenditures on some food perceived more necessary than others and at the same time curtailing expenditure on less necessary consumption items. Also, if income changes, how do households respond to such changes?

An understanding of the forces that determine the pattern of household demand and households reactions to exogenous shocks (relative prices and income) can be determined by operationalizing the theories discussed earlier. The next section will be devoted to applying the theories to provide a sound understanding of household demand for food and nonfood.

B. Engel Curves

The results of the Engel curves estimated are reported in Tables A.1-A.3 in Appendix A. These Engel curves utilize the expenditure shares as the dependent variable and per capita household expenditure and a demographic scale consisting of the number of members in a household as the independent variables. Furthermore, the semilog Engel curves are fitted to the full sample (all households), low income households and high income households separately for each year.

The semilog Engel curves with the expenditure or the budget shares as the dependent variable are estimated assuming zero price variability and follows from the AIDS model (under conditions of zero price variability). Thus households budget shares are assumed to be influenced by their per capita total expenditure, also loosely called income throughout the report and the household size.

Examination of the results reported in Table A.1-A.3 in the appendix reveals that most of the estimated coefficients are statistically significant at the 5% level or better. Also noticeable is the fact that most of the estimated food expenditure coefficients are negative, implying that the food groups are necessities to the households. The R^2 values reported in the last two columns in the tables varies a great deal and moreover, these values are not very high. These R^2 values measure the variation in the budget shares as explained by the independent variables. Clearly, the per capita expenditure and the household size variables do not appear to be sufficient in explaining the variations in per capita expenditure, even though in most cases these two variables are significant.

Perhaps the inclusion of other socioeconomic variables in the form of demographic scaling or translating may boost the R^2.

The estimated expenditure and household size elasticities are also reported in Tables A.1-A.3. For example, the expenditure elasticities provide an estimate of the percentage change in the quantity demanded of say meats by households when per capita expenditure changes by one percent. The estimated expenditure coefficients for most food groups for all the three samples and the two years are negative, indicating that for the households most of the food groups are necessities. The expenditure elasticities reported are in general less than one for most food groups and hence if the per capita expenditure of households increase by one percent, food demanded by households in most cases increase by less than one percent. Also, an effect of an increase in household size on the quantity of food demanded by households are in general negative. Stated differently, an increase in household size tends to reduce the food demanded by households, which may be due to the presence of scale economies in the household. Scale economies may be realized through the use of left over foods, purchase of food in bulk, especially perishable foods when household size increases and so on. Clearly, the results reported in Tables A.1-A.3 are consistent with the observed pattern of household expenditure behavior.

A comparison of the results reported in Tables A.1-A.3 are in order. In Table 2 below, some of the results from Table A.1-A.3 are reproduced. The general pattern observed in Table 2 is that the expenditure elasticities are larger among low income households than

Table 2

Expenditure and Household Size Elasticities: Jamaica, 1975 and 1977

	All Households				Low Income Households				High Income Households			
	1975		1977		1975		1977		1975		1977	
Expenditure Groups	Expenditure Elasticity	Household Size Elasticity	EE	HSE	EE	HSE	EE	HSE	EE	HSE	EE	HSE
Meats, Poultry and Fish	0.8197	-0.1202	0.8557	0.0206	0.9313	-0.0508	1.0748	0.2476	0.5714	-0.3067	0.4225	-0.5360
Dairy Products	0.8367	-0.1064	0.7992	-0.1827	0.9433	-0.0567	0.7017	-0.2889	0.6493	-0.1919	0.3567	-0.6124
Oils and Fats	0.5442	-0.3163	0.5081	-0.3946	0.5341	-0.3293	0.4856	-0.4038	0.4554	-0.2178	0.4091	-0.3636
Cereals and Starchy Foods	0.6380	-0.1558	0.6242	-0.1502	0.7029	-0.1362	0.6347	-0.1239	0.3618	-0.1933	0.3404	-0.3125
Fruits and Vegetables	0.7544	-0.1633	0.8891	0.0024	0.8840	-0.0882	1.2310	0.2999	0.5083	-0.3113	0.3140	-0.6240
Sugar and Other Sweets	0.6909	-0.0848	0.6453	-0.2624	0.7486	-0.0328	0.6815	-0.1529	0.5000	-0.1923	0.2933	-0.8267
Beverages	0.7751	-0.0201	0.6986	-0.1684	0.8365	0.0038	0.9442	0.1717	0.6897	0.0018	0.4534	-0.7391
Miscellaneous Foods	1.0188	-0.2180	0.7897	-0.5282	1.2077	-0.1231	0.8177	-0.5521	0.7282	-0.4146	0.6316	-0.6220
Purchased Meals	0.6482	-0.5059	0.6889	-0.2640	0.6942	-0.5351	0.9994	-0.2357	0.5301	-0.5352	0.3899	-0.2892
Nonfood	1.4288	0.2884	1.3303	0.1617	1.3451	0.2599	1.1912	0.0172	1.4064	0.2563	1.4074	0.3238
Total Food	0.7713	-0.01226	0.7813	-0.1046	0.9694	0.0056	0.9921	0.0324	0.7547	0.0437	0.6719	-0.0097

among high income households, as expected. Low income households are more sensitive to expenditure resulting from changes in income than high income households because the former type of households (by definition) have to make expenditure decisions under a tighter budget constraint. Notice that the nonfood expenditure elasticity is greater than one in all cases, indicating this particular expenditure as more of a luxury. The total food expenditure elasticity reported in the last row of Table 2 is also as expected, with low income households having a larger overall food expenditure elasticity than high income households. Also notice that purchased meals expenditure elasticities are lower for high icome households than low income households.

The household size elasticity measures the change in demand for a given commodity resulting from a change in household size. Negative values of such elasticities imply the presence of economies of scale, i.e., household expenditures on the given expenditure group reduces as a result of an additional member. Such reductions in the quantity demanded of especially food may be due to a whole host of factors. For instance larger households may be able to exploit better the purchase of food in bulk available at discount prices. Furthermore if such larger households have food storage facilities, higher economies of scale in consumption will be realized relative to households who do not have such facilities. This scale economies issue will be taken up later in more detail below while discussing the AIDS models.

This section has explored the expenditure pattern of households under a very restrictive condition, namely that all types of household face similar price or equivalently prices were assumed not to vary.

The Engel curves estimated nevertheless provided interesting insights about households expenditure habits or food and nonfood demand. The results are consistent with economic theory as well as with results reported in other studies which will be dealt with later. In the next section, the assumption that all households face similar prices is abandoned and households food and nonfood demand is explored utilizing the Almost Ideal Demand System.

C. Almost Ideal Demand Systems

(i) Hypotheses Tests

While discussing the Engel curves, households were grouped into low and high income households. An implicit assumption of such a grouping is that the expenditure pattern of low and high income households is different. Common sense would dictate that such an assumption would most likely be true. It would, however, be more desirable to test such a hypothesis. This section formalizes the grouping of the households into low and high income groups and employs Chow's test to test the null hypothesis that the two income groups have the same consumption structure against the alternative hypothesis that the null hypothesis is false. This test will be carried out under the assumption that the consumption technology can be reasonably represented by the AIDS. In Appendix B the details of the Chow test is provided and here the results alone will be discussed.

Several different versions of the AIDS model have been estimated for the two income groups and the full sample. In particular the models estimated are the unrestricted AIDS model, AIDS model with homogeneity imposed and AIDS model with homogeneity and symmetry imposed. For each of these three models AIDS is estimated for all households, for the low income households and the high income households.

The relevant statistics pertaining to Chow's test are presented in Table 3. In all cases, i.e., unrestricted model, homogeneity model and homogeneity and symmetry model, the null hypothesis is rejected. Hence the division of households into low and high income groups

Table 3

Results on Chow's Test: Jamaica, 1975 and 1977

AIDS Model	Degrees of Freedom		Calculated F-Value	Tabulated F-Value*	Null Hypothesis is
	Numerator	Denominator			
Unrestricted	130	4202	3.1446	1.000	Rejected
Homogeneity	120	4226	30.7653	1.000	Rejected
Homogeneity and Symmetry	108	4250	6.2956	1.000	Rejected

*The degrees of freedom is infinity for both numerator and denominator.

appears to be statistically valid. In other words the low income and high income households in Jamaica appear to have two different consumption technologies. It is thus necessary to conduct the remaining analysis of the demand system of Jamaican households separately for these two groups.

At this point it has been possible to ascertain statistically that the consumption technology or the preference structures of the two classes of Jamaican households are different. However, it is also necessary to be able to distinguish for each class of household the relevant functional form that characterizes best the consumption technology of the households. Thus, whether the unrestricted model, or the model with homogeneity imposed or the model with homogeneity and symmetry imposed has to be selected for each group of the households.

The likelihood ratio test is employed to select one model out of the three estimated. The selected model is then assumed to reflect reasonably well the consumption structure of the households. The details of the likelihood ratio test is outlined in Appendix C and here the results are only presented (Table 4).

The likelihood ratio follows a Chi-squared distribution with the number of restrictions imposed equaled to the degrees of freedom. The null hypothesis or maintained model (unrestricted) is tested against a competing model (homogeneity or homogeneity and symmetry) or alternative hypotheses. If the calculated Chi-squared value using the log likelihood ratio is greater than the tabulated Chi-squared value for the given degrees of freedom, the null hypothesis cannot be

Table 4

Log Likelihood Ratio Tests: Jamaica, 1975 and 1977, AIDS Model

Sample	Unrestricted-Homogeneity	Unrestricted-Homogeneity and Symmetry	Homogeneity-Homogeneity and Symmetry
All Households	747.1613	1115.6731	368.5117
Low Income Households	358.1009	637.4849	279.3840
High Income Households	160.5895	236.9079	76.3184
Number of Restrictions	10	35	45
Chi-Square Values:			
1%	23.209	23.209	23.209

accepted. If such is the case, the next hypothesis test would be conducted between homogeneity and homogeneity and symmetry model. If the calculated Chi-squared value again turns out to be greater than the tabulated value the homogeneity model too cannot be accepted and the homogeneity and symmetry model is selected. The test results for each sample and between the three competing models are highlighted in Table 4.

The number of independent restrictions or the degrees of freedom and the corresponding Chi-square values are also presented in Table 4, along with the calculated Chi-square values. Between the unrestricted and the homogeneity model, the latter model is preferred for all samples. Also between the homogeneity and homogeneity and symmetry model, the latter is selected. In other words, the AIDS model with homogeneity and symmetry imposed appears to be the relevant model for all the three samples which represents reasonably well the demand structure of Jamaican households.

(ii) General Results

The estimated parameters and the associated t-values of the AIDS unrestricted (Model A), homogeneity (Model B) and homogeneity and symmetry (Model C) models are reported in Appendix A under Tables A6, A7 and A8 for the three samples, namely all households, low income households, and high income households. All these models utilized Stone's index as an approximation to the true but nonlinear price index.

In all the tables it is noticeable that a large number of the estimated coefficients are statistically significant as indicated by their corresponding t-values of two or greater. The significance of the estimated parameters indicate the sensitivity of household budgets to exogenous changes in relative prices, per capita income/expenditure and household size.

Some of the coefficients reported in Tables A6, A7 and A8 appear to be sensitive to the restrictions imposed. This sensitivity may be judged by the change in the signs of the coefficients across Model A, B and C as well as their statistical significance. In some cases coefficients that are not significant in Model A and B appear significant in Model C. As an example consider in Table A6, the dairy product demand equation. The oils and fats price coefficient has a negative value and is insignificant in Model A. The sign of this coefficient becomes positive in Model B but is still insignificant. Finally in Model C, the sign reverses to be negative, but this time it becomes statistically significant. Similar examples can be pointed out in Tables A7 and A8 as well. However, it is noted that the sign

reversal of the coefficients are associated with coefficients that are in most cases statistically insignificant. Another observation that can be made is that a greater degree of similarity occurs among the coefficients estimated of the full sample and the low income group. This is largely due to the fact that the full sample is predominantly households of the low income group.

In all models estimated the own price coefficients are positive as well as significant. This indicates that the household budget shares increase as own price increase. Of course the quantity demanded elasticities are all negative and will be discussed later. A vast majority of the cross price coefficients are also significant indicating a fair degree of substitution between commodities consumed by households due to external price shocks.

Majority of per capita income/expenditure coefficients are negative. Thus most of the commodities consumed by households are necessities. There are exceptions, however, with low income households having more commodities that fall in the "luxury" category than the high income households. For the low income households meats, poultry and fish, fruits and vegetables, beverages and miscellaneous foods appear to be relative "luxuries". For the high income households only nonfood commodities qualifies as a luxury. These issues will be taken up later for discussion.

A large number of the household size coefficients are positive for both the low and high income households. Negative values would imply economies of scale in consumption and positive values imply

diseconomies of scale. Further discussion of these results will also be taken up below.

Among the ten different commodity demand equations estimated the miscellaneous food demand equation appears to have the least number of coefficients that are significant in all models and across all three samples. The own price coefficient is highly significant, however, in all the models. The miscellaneous food group consists of all food groups besides the eight included in the demand analysis. A large number of food items that come in different quality, units and at varying prices are all lumped into this category. It may be because of the heterogeneous aggregates into this miscellaneous category that is causing a large number of cross price coefficients to be insignificant.

Finally, the attention will now be turned to the estimated income, price and household size elasticities. Recall that hypothesis test has indicated that the division of households into low and high income groups is statistically valid. Second, the likelihood ratio test has further made it possible to ascertain that Model C provides the best representation of household preference structures. The rest of the discussions that follow will therefore be based on Model C for the low and high income groups. For the purpose of comparison, further results presented for the two groups will also be presented for the full sample, but the discussion will focus on the two income groups only.

(iii) Income, Price and Household Size Elasticities: AIDS

The discussion to follow in this section is based on the homogeneity and symmetry model or Model C. The uncompensated price elasticities estimated at the sample means for the low and high income households are reported in Tables A7 and A8. Interested readers will find similar elasticities for all households, i.e., full sample in Table A9 in the appendix.

In Table 5 below the own price and income elasticities for the low and high income groups have been reproduced. As predicted by economic theory for normal commodities, all own price elasticities have the expected negative signs. In most cases the values for these own price elasticities are greater for low income households than high income households. This means that low income households respond more sharply to quantities demanded when its price changes than high income households. As an example consider the own price elasticity of meats, poultry and fish for the low income households (-0.4352) and high income households (-0.3646). If suppose all households realize a ten percent increase in the price of meats, poultry and fish, the low income households curtail their demand by about 4.35 percent, whereas the high income households curtail their demand by about 3.65 percent. The case of purchased meals, however, presents a different picture with high income households appearing to be more sensitive to own price increase of purchased meals than low income households. A reason for this may be that the nature of purchased meals consumed by low and high income households may be more expensive. Also notice that the own price elasticity for nonfood is among the highest for

Table 5

Income and Own Price Elasticities for Low and High Income Groups: Jamaica, 1975 and 1977

Expenditure Groups	Income Elasticity		Own-Price Elasticity	
	Low Income Households	High Income Households	Low Income Households	High Income Households
Meats, Poultry and Fish	1.1269	0.9690	-0.4352	-0.3646
Dairy Products	0.8573	0.8269	-0.5046	-0.5947
Oils and Fats	0.7730	0.7482	-0.2935	-0.0815
Cereals and Starchy Foods	0.9378	0.8451	-0.9262	-0.7555
Fruits and Vegetables	1.3091	0.9666	-0.6969	-0.6494
Sugar and Other Sweets	0.6987	0.7923	-0.4011	-0.4262
Beverages	1.0881	0.8083	-0.3649	-0.2733
Miscellaneous Foods	1.5543	0.7215	-0.6468	-0.3462
Purchased Meals	0.7891	0.1712	-0.0085	-0.2379
Nonfood	0.9247	1.1696	-0.9017	-0.7877

both groups of households. The cereals and starchy foods own price elasticity for the low income households is very close to one and at the same it has the highest value as well. A value equal to one would cause equi-proportionate change in quantity demanded of cereals and starchy foods due to its price change. A reason for this fairly high own price elasticity may be reflecting the recent introduction of rice in Jamaican diets. Rice is a commodity that is mostly imported in Jamaica and households, especially the low income households may be reflecting the sensitivity of this imported food price on the one hand and declining domestic production on the other.

The income elasticities are higher for low income households in most cases than the high income households. The exceptions are sugar and other sweets and nonfood commodities. These elasticities, it should be noted are in fact expenditure elasticities and the true income elasticities would undoubtedly be smaller for all the commodities consumed by the households in both the high and low income groups, perhaps excluding miscellaneous foods for the low income households. The income elasticity for nonfood food is less than one for the low income households, qualifying nonfood as a necessity. It may be that the low income households given their low levels of income purchase only those items that are absolutely necessary in this nonfood category. High income households, having a larger income, may perhaps have extra income to spend on nonfood besides for the absolutely necessary items, thus qualifying the nonfood group as a luxury for these types of households.

The cross price elasticities in most cases for both types of households are smaller than the own price elasticities (refer to Table A7 and A8 in Appendix A. This is an indication that households demand for commodities are less sensitive to price changes of other commodities than own price change. However, it has already been pointed out that a vast majority of the cross price coefficients were significant. It is therefore the case that a fair degree of substitution between commodities consumed occur among households when prices change.

An examination of the signs of the cross price elasticities indicate whether the commodities in question are complements or substitutes. Negative values of the cross price elasticities qualify such commodities as complements, whereas positive values qualify them as substitutes. This reasoning of complements and substitutes can be explained with an example. If two commodities (A and B) are complements, then an increase in price of A would cause the quantity of B to decline. Since B is a complement to A, its quantity will also decline. In the case of substitutes the reasoning is opposite causing the sign to be positive. More specifically the substitutes and complements are called gross substitutes and gross complements for reasons that will be made clear shortly.

Examine the uncompensated elasticity matrix for the low income households (Table A7). Except purchased meals all commodities appear to be complements in the meat, poultry and fish equation. That is, an increase in the price of all commodities except purchased meals leads to a reduction in the quantity of meats, poultry and fish demanded by

households. However, increase in the price of purchased meals leads to an increase in the demand for meats, poultry and fish. No configuration in the substitution-complementarity relationship between meats, poultry and fish and other commodities is observed. However, examining the dairy product demand equation, for example, it may be noticed that sugar and other sweets appears as a complement, whereas dairy products appears to be a substitute in the sugar and other sweets demand equation. Such examples can be observed in other cases as well as in Table A7 for the high income households.

The explanation for this configuration between substitutes and complements becomes fairly clear if it is realized that the uncompensated price elasticities are not free of the income effect. What this means is that in a situation where households realize a change in the relative price of a commodity, households real income also changes. This change in real income results in a further reallocation of household expenditures. Consequently, it may be that two pairs of commodities may classify as complements or substitutes in two different demand equations, depending upon which price has changed. Even though in the present case this internal inconsistency is not devastating, it nevertheless serves to derive the income-compensated price elasticities.

The income-compensated price elasticities are derived using what is called the Slutsky equation and is reported in Tables A10, A11 and A12 for the low income, high income and all households. In the context of compensated price elasticities, commodities are classified as net complements and net substitutes as opposed to gross complements

and gross substitutes, because the compensated elasticities are free from income effect.

The internal inconsistency is no longer present in the new tables. For the low income households all commodities except nonfood are substitutes for purchased meals. Beverages appears to have the least substitutes for the low income households. Meats, poultry and fish also appears to have fewew substitutes than most other food groups consumed by the low income households. In the case of nonfood all food groups besides purchased meals and miscellaneous foods are substitutes.

Examine the compensated elasticity matrix for the high income households. Clearly substitution possibilities between commodities consumed by the high income households are greater. Oils and fats appears to be the least substitute for other commodities. Meats, poultry and fish and fruits and vegetables display the greatest substitution possibilities. Purchased meals appears to be a complement for all commodities consumed except meats, poultry and fish and nonfood. Nonfood and sugar and other sweets also appear to be more of a substitute than complements with other commodities. Clearly the results indicate that high income households are faced with greater opportunities for substitution among commodities consumed than low income households.

The household size elasticities are also reported in Tables A7, A8 and A9. The discussion of household size elasticities will also be confined to the low and high income groups of households only. As indicated earlier a large number of the household size elasticities

are positive. For the low income households economies of scale appear to be present in the consumption of oils and fats, dairy products, sugar and other sweets, purchased meals and nonfood. For the high income households economies of scale appear to exist in the consumption of miscellaneous foods, purchased meals and nonfood. Economies of scale imply that an additional member in the household would increase the quantity demanded of the consumption commodity less than proportionately.

The results on the household size elasticity has to be interpreted with caution. In this study the heroic assumption that has been made is that irrespective of the age-sex composition of household members, all members are treated as equivalents. It is most likely the case that children have a somewhat different preference for food than adults. For example milk may be consumed more by children than adults. Furthermore, besides the differences in the type of foods consumed between children and adults, there could be differences in the quantity of food consumed by males and females, young and old, etc. The inclusion of the age-sex composition of household members into the demand system framework, though more realistic could not be undertaken in this present exercise. This neglect of the age-sex composition of household members may be considered as a limitation of this study. It is hoped that future research work in this context will devote more attention to the household size variable.

VIII. Evaluation

A.

It is the purpose of this section to evaluate the results of this study. First, the results from the Engel curve analysis and those of AIDS model will be compared. Also, the results from this study will be copared with available results for Jamaica from earlier studies. Finally, the present results will be compared with results from some selected studies for some developing countries.

B. Income Elasticities: Engel Curves vs AIDS

The income or expenditure elasticities estimates are provided in Tables 2 and A7-A9 obtained from Engel curves and AIDS model. The estimates of the income elasticities obtained from the two models (Engel curves and AIDS) vary somewhat. For the high income households the income elasticities from the AIDS model generally are higher than those from the Engel curves. For the low income households the results are more varied across the two models.

The estimation of the parameters of Engel curve was conducted under the assumption that households in a given year faced identical commodity prices which justified dropping out the price variables in the Engel curves. The comparative results indicate that the assumption of constant prices is not fully justified given the variations in the income elasticities estimated using Engel curves and AIDS model. The variations in the income elasticities estimated shows greater variation for the low income households than the higher income households. It appears that commodity prices are more important to low income households in expenditure decisions than to high income households. Thus, when commodity prices data are available it appears that utilizing them in estimating demand parameters are more justified than estimating Engel curves on the pretense that prices to household are constant. Such an assumption can lead to Engel curve results that are biased, especially so if price variations are correlated with household incomes. However, in the absence of price data or when variations in prices faced by households may be negligible, Engel curves do provide a starting point in studying household demand.

C. Comparison of Results: Previous and Present Studies

In Table 6, selected results reported by Harris (1964) and Adams (1968) are reproduced. A comparison of our results to those of Harris and Adams is not strictly appropriate for several reasons. First, the food groups utilized by Harris and Adams differ from those of this study. Second, both Harris and Adams utilized the value of actual per capita consumption as the dependent variable while we used budget shares. Savings was also included along with all reported expenditure and income in kind expressed in per capita values to form the independent variable in Harris study. Adams, on the other hand, used per capita disposable income. Harris (1964) also noted that the reported income data were unsatisfactory for use. The sample partition in this study is low ($\leq$ J$5,000) and high income (J$5,000 >) households and in Harris study it is Kingston, other towns and rural areas. Finally, the present study utilizes a demand systems approach, whereas the other two studies utilize a single equation estimation approach. Even, with all the above differences, it is useful to make broad comparisons of some of the results. For comparison purposes the results based on the AIDS model will be utilized from this study.

For some broadly comparable food groups the income elasticities estimated using the 1975-1977 data sets and time series appear different. First, some food groups are seen to be inferior in the time series study. The dairy products meat income elasticity is fairly high in the time series study than our estimates. Between the time series and Harris study the income elasticities estimated in the former

Table 6

Estimated Income Elasticities: Jamaica, 1958 and 1950-1961

	1958: Cross Section (Semi-Log Model)			1950-1961 Time Series (Semi-Log Model)		
					Jamaica	
Commodity Groups	Kingston	Main Towns	Rural Areas	Commodity Groups	Income Elasticities	Price Elasticities
Fresh Meat and Poultry	1.082	1.072	1.484	Meat	1.43	--
Tinned and Pickled Meat	0.790	1.314	0.212			
Fresh Fish	0.106	-0.086	1.610	Fish	0.58	--
Tinned and Pickled Fish	0.165	0.523	0.606			
Starchy Food	0.128	0.423	0.518	Root Crops	-0.50	-1.34
Fresh Vegetables	0.600	0.606	0.594			
Fresh Fruits	0.932	1.069	1.012	Fruits and Vegetables	-0.40	-0.74
Other Fruits and Vegetables	0.653	0.630	0.648			
Dairy Products and Eggs	0.853	0.760	1.479	Dairy Products	1.07	-0.65
Oils and Fats	0.196	0.246	0.695	Oils and Fats	0.47	-0.47
Cereals and Baked Products	0.383	0.650	0.690	Bread and Cereals	0.62	-1.16
Sugar and Condiments	0.667	0.530	0.488			
Beverages	0.722	0.685	0.833	Miscellaneous Food Items	0.57	-0.42
Outside Meals	0.512	1.212	1.712			
Total Food	0.575	0.702	0.849			

Note: -- indicates price elasticities not available for the food groups.
Source: Harris (1964), Table 5 and Adams (1968), Table 7.

study appear to generally lie in between the upper and lower values of compared elasticities in Harris study. The same, however, cannot be said between the earlier two studies and the present one.

The own price elasticities reported by Adams and those estimated in this study are also quite different from one another.

The income annd own price elasticities for the different food groups have changed in the intervening 20 years. These changes may have been caused by several factors. First, the population has nearly doubled in Jamaica over the 20 year period. During the period covered by Adams' study, the population grew at a faster rate (2.00%) than output of the agricultural sector (Adams, 1968).

A second important factor that may have caused income elasticities to change may be due to the change in income distribution that has occurred in Jamaica in the 20 years. Ahiram (1964) utilized the 1958 household budget data to analyze the income distribution in Jamaica. The 1977 household data was also utilized to derive results that could be compared with those reported by Ahiram (see Memorandum #3, Analysis of Household Expenditure Surveys, 1985). The income share of the lowest decile group had almost doubled in 1977 relative to 1958. Also the Gini concentration ratio calculated indicated a moderate improvement in income equality in 1977 (Gini = 0.4589) relative to 1958 (Gini = 0.5766). This shift in the income distributed may be responsible for some of the observed changes in the elasticities.

Another factor that may have contributed to changes in the income elasticities is the increasing importance of imported food in Jamaican

dicts. This was an observation noted by Adams in his study. Domestic food production has lagged behind population and food imports have increased. Also, food aid may not have stimulated domestic food production.

The separate effects of changes in relative prices of food and nonfood over time may have also contributed to changes in the income elasticities. Population growth, declining domestic food supplies and imported food may have changed relative domestic food prices.

D. Comparison of Results: Jamaica and Selected Developing Countries

It is the purpose of this section to provide information on the income and own price elasticities reported in other studies for some developing countries and to compare the results of this present study with those from the developing countries reported here. The number of studies for developing countries are limited. The table (7) below provides results on the income and own price elasticities estimated for India and Thailand.

The results are not strictly comparable for various reasons. First, the data base utilized refers to different time periods. Second, the definition of food groups differs considerably between the studies. These two reasons are enough to make the estimated income and own price elasticities to differ between countries as well as within countries. Furthermore, no attempt is made to review the studies cited here for comparison. For greater detail interested readers can refer to the original studies.

The general observation is that the elasticities reported in this study are within the range reported in Table 7. For both AIDS models reported in Table 7 and some own price elasticities are positive. The income elasticities reported by Radhakrishna (1978) are in general higher than the ones estimated for Jamaica in this study.

Table 7

Income/Expenditure and Own Price Elasticities:
Selected Countries

Expenditure Groups	Expenditure Elasticities		Own Price Elasticities	
	Rural	Urban	Rural	Urban
Ray (1980a)[1]:				
Food	0.727	0.342	-0.614	-0.331
Clothing	1.071	2.141	-1.430	-0.698
Fuel and Light	0.935	0.574	0.130	-0.759
Other Non-Food	2.321	2.269	0.983	-0.630
Kennes (1983)[2]:	Farm	NonFarm	Farm	NonFarm
Rice	0.45	0.42	-0.31	0.11
Sugar	1.32	0.84	-0.17	-0.29
Meat	1.20	1.02	-0.51	-0.65
Vegetables	0.75	0.91	-0.58	-0.52
Fish	0.65	0.71	-0.82	-0.77
Nonagricultural	1.44	1.20	-0.86	-0.82
Radhakrishna (1978) (LES)[3]:	Middle Income		Middle Income	
	Rural	Urban	Rural	Urban
Food Grains	0.440	0.392	-0.325	-0.410
Milk and Milk Products	1.828	1.434	-0.777	-0.181
Edible Oil	1.005	0.749	-0.421	-0.643
Meats, Eggs and Fish	1.258	1.281	-0.524	-1.077
Sugar and Gur	1.262	0.855	-0.526	-0.729
Other Food	0.867	0.968	-0.419	-0.844
Clothing	1.776	1.985	-0.769	-1.586
Fuel and Light	0.819	0.749	-0.365	-0.651
Other Non-Food	1.727	1.517	-0.766	-1.193

[1]Country of Study: India. Type of Sample: National sample survey of rural, ruban and city households, rounds 4 to 23. Period Covered: April 1952-June 1969. Model: Unrestricted AIDS with household size variable and Stone's price index.

[2]Country of Study: Thailand. Type of Sample: Aggregate time series and cross section. Period Covered: 1961-1980 and 1975-1976. Model" Unrestricted AIDS without household size and Stone price index.

[3]Country of Study: India. Type of Sample: National sample survey of rural, urban and city households, rounds 8-14. Period Covered: July 1954-March 1955 to June 1958-June 1959. Model: Linear expenditure system (LES).

IX. Summary and Conclusion

The present study has analyzed demand for eight food groups and a nonfood group consumed by Jamaican households. The household expenditure surveys conducted by STATIN in 1975 and 1977 provided the data base for this study.

This study has been the first of its kind in estimating a system of demand equations in the Jamaican context. It also appears that this study is among the few such studies for developing countries. Semilog Engel curves and the Almost Ideal Demand System were estimated. Household per capita expenditure adjusted for at home production and goods received as gifts or payments and household size variables were used as the independent variables in estimating the Engel curves. Relative commodity prices were added in addition to the above two variables in estimating the nine commodity demand system.

The Chow test conducted revealed that the preference structure of low and high income households were different. The analysis was therefore conducted over these two groups. Furthermore, the likelihood ratio test conducted made it possible to utilize the homogeneity and symmetry imposed AIDS model to analyze the demand for food and nonfood in Jamaica among the low and high income households.

The results are in conformity with economic theory. Income or expenditure elasticities based on Engel curves for most food groups were found to be generally higher for the low income households than for the high income households. The estimated elasticities (income) based on the AIDS model varied somewhat from the Engel curve estimates, indicating that the constancy of prices may not be totally

appropriate, especially in a nationwide cross sectional survey. For the high income households only nonfood qualified as a luxury, whereas for the low income households meats, poultry and fish, beverages and purchased meals qualified as luxuries.

The own price demand elasticities were negative in all cases and for all groups analyzed, as expected. In most cases these own price elasticities were larger for the low income households than the high income households. In other words, low income households given a tighter budget constraint respond more sharply to changes in food prices than the high income households.

The substitution-complementarity relationships between commodities consumed by households was also examined. The compensated demand elasticity matrix consisting of price elasticities that were free from income effects was derived. The examination of the signs and magnitudes of the elasticities indicated that Jamaican households were sensitive to relative price changes. A fair degree of substitution between commodities consumed by households was apparent. However, the high income households given their higher income levels had greater opportunities for substitution than the lower income households.

Scale elasticities were also evaluated. Economies of scale was present in the consumption of commodities for both groups of households.

Results of this study were compared with those of some previous studies. Strict comparability of the results among the studies was not possible and the reasons were noted in the text. However, the broad

conclusion that emerges from the comparison is that demand parameters appeared to have changed in the intervening 20 years, i.e., period covered by the earlier two studies and the period covered by the present study.

An attempt was made to evaluate the differences in the demand parameter changes. Some important factors responsible for the changes observed were attributed to the decreased inequality in the income distribution in Jamaica within 20 years, population growth, and greater reliance on imported food among other things.

The results from this study were compared with those for some selected developing countries (India and Thailand). To the extent the results are comparable the demand parameters estimated for Jamaica appeared to lie within reasonable bounds of the demand parameters reported in the other studies.

In Section II of this report the importance of demand studies was outlined. It is time now to briefly demonstrate how the results established by this study can be utilized for such purposes.

A first key issue for economic planning and policy to be realized is that the consumption structure of Jamaican households can be broadly classified into two groups. The way the two groups respond to income and price shocks are different and hence it appears that planners and policy makers should take this into account in order to realize effective outcomes of their policies.

The own price elasticity of cereals and starchy food was -0.9262 and -0.7555 for the low and high income groups respectively. These values are high. Any extra demand for this commodity created through

some autonomous source is most likely to create inflationary forces in the market for cereals and starchy food without a parri-passu increase in domestic supply. If shortages are expected to last traders are likely to accentuate price by hoarding stocks. In the same token if domestic supplies increase (through increased domestic production or food aid) prices are likely to crash.

Finally, the parameters of the estimated demand system can be utilized to estimate the cost of living of different sections of the population (Banskota, Johnson and Stampley, 1986; Brown and Johnson, 1983). The AIDS are derived from a cost function and the estimated parameters can be inserted back into the cost function. With a little bit of algebraic manipulations, the cost of living index can be compared across different groups of the population. The results can be utilized for income redistribution policies.

The above listed issues are beyond the scope of this study even though are closely related. It is hoped that future researchers will find it interesting to explore the above issues and beyond.

References

Adams, Nassau A. 1968. "An Analysis of Food Consumption and Food Import Trends in Jamaica, 1950 1960." Social and Economic Studies (March):1-22.

Ahiram, E. 1964. "Income Distribution in Jamaica." Social and Economic Studies (September):333-339.

Banskota, K., R.R. Booth, S.R. Johnson, S. Pryor and G.L. Stampley. 1986a. "An Analysis of the Expenditure Patterns of Jamaican Households." Paper presented at the 18th West Indian Agricultural Economics Conference, University of the West Indies, Jamaica, April 7-10.

Banskota, K., S.R. Johnson and G.L. Stampley. 1986b. "Income Distribution and Sources of Income Variation in Jamaica."

Banskota, K., S.R. Johnson and G.L. Stampley. 1986c. "The Cost of Living Indices ~~in Jamaica~~." Comparisons Among Selected Partitions of Jamaican Households."

Barten, A.P. 1984. "Family Composition, Prices, and Expenditure Patterns." Econometric Analysis for National Economic Planning. Edited by P.E. Hart, G. Mills and J.K. Wittaker. London: Butterworth.

Barewal, S. and D. Goddard. 1985. The Parameters of Consumer Food Demand in Canada. Agriculture Canada.

Blanciforti, L. and R. Green. 1983. "An Almost Ideal Demand System Incorporating Habits: An Analysis of Expenditures on Food and Aggregate Commodity Groups." Review of Economics and Statistics (August):511-515.

Brandt, J.A., S.R. Johnson, B. Goungetas, and A.W. Womack. 1985. "Market Demand Systems for Food Groups: Linking Theoretical Restrictions with Empirical Applications." Paper presented at NCR-134 Conference on Applied Commodity Price Analysis Forecasting and Market Risk Management, Chicago, IL (May 2).

Brown, M. and S.R. Johnson. 1983. "Food Stamps: Program Parameters and Standards of Living for Low Income Households." Southern Journal of Agricultural Economics (July):43-49.

Brown, M., R. Green and S.R. Johnson. 1985. "Preferences and Optimization: Tests Within Almost Ideal Demand System."

Capps, O., Jr., J.R. Tedford and J. Havlicek, Jr. 1985. "Household Demand for Convenience and Nonconvenience Foods." American Journal of Agricultural Economics (November):862-869.

Christensen, L.R., D.W. Jorgenson and L.J. Lau. 1975. "Transcendental Logarithmic Utility Functions." American Economic Review (65):367-383.

Christensen, L.R. and Manser.

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

Cumper, G.E. 1960. "West Indian Household Budgets," Social and Economic Studies (9):355-365.

Deaton, A. and J. Muellbauer. 1980a. Economics and Consumer Behavior. Cambridge: Cambridge University Press.

Deaton, A., and J. Muellbauer. 1980b. "An Almost Ideal Demand System." American Economic Review (June):312-26.

Diewert, E.R. 1981. "Duality Approaches to Microeconomic Theory." Volume II. Handbook of Mathematical Economics. Edited by K.J. Arrow and M.D. Intriligator. Amsterdam: North Holland.

Fomby, T.B., R.C. Hill, and S.R. Johnson. 1984. Advanced Econometric Methods. Springer-Verlag.

George, P.S., and G.A. King. 1971. Consumer Demand for Food Commodites in the United States with Projections for 1980. Giannini Foundation Monograph 26, University of California, Davis.

Harris, D.J. 1964. "Econometric Analysis of Household Consumption in Jamaica." Social and Economic Studies (December):471-487.

Hassan, Z. and S.R. Johnson. 1976. Consumer Demand for Major Foods in Canada. Agriculture Canada, Pub. No. 76/2, April.

Howe, H. 1977. "Cross-Section Application of Linear Expenditure Systems: Responses to Sociodemographic Effects." American Journal of Agricultural Economics (February):141-148.

Huang, K.S. and R.C. Haidacher. 1983. "Estimation of a Composite Food Demand System for the United States." Journal of Business and Economic Statistics (1):285-291.

Johnson, S.R., Z. Hassan and R. Green. 1984. Demand Systems Estimation: Methods and Applications. Ames: Iowa State University Press.

Kmenta, J. and R.F. Gilbert. 1968. "Small Sample Properties of Alternative Estimators of Seemingly Unrelated Regressions." Journal of Econometrics (7):281-312.

Kennes, W. 1983. "Estimating Demand for Agricultural Commodities in Thailand: Combining Time-Series and Cross-Section Data." European Review of Agricultural Economics (10):357-375.

Lesser, C.E.V. 1963. "Forms of Engel Functions." Econometrica (October):694-703.

Lluch, C., A.A. Powell and R.A. Williams. 1977. Patterns in Household Demand and Saving. Oxford: Oxford University Press.

Mayers, J.M. 1977. "An Analysis of Household Consumption in St. Kitts and Nevis." Social and Economic Studies (September):516-533.

Muellbauer, J. 1974. "Household Composition, Engel Curves and Welfare Comparisons Between Households." European Economic Review (5):103-122.

Phlips, L. 1974. Applied Consumption Analysis. Amsterdam: North Holland Publishing Company.

Pollack, R.A. and T.J. Wales. 1978. "Estimation of a Complete Demand System from Household Budget Data: The Linear and Quadratic Expenditure System." American Economic Review (June):348-359.

Prais, D.W. and H.S. Houthakker. 1955. An Analysis of Family Budgets. Cambridge: Cambridge University Press.

Radhakrishna, R. 1978. "Demand Functions and Their Development Implications in a Dual Economy: India." The Developing Economies (June):199-210.

Ray, R. 1980. "Analysis of a Time Series of Household Expenditure Surveys for India." Review of Economics and Statistics (November):595-602.

Safyurtlu, A.N., S.R. Johnson, and Z.A. Hassan. "Recent Evidence on Market Demand Systems for Food in Canada." Forthcoming, Canadian Journal of Agricultural Economics.

Shephard, R. 1970. The Theory of Cost and Production Functions. Princeton, N.J.: Princeton University Press.

Stone, J.R.N. 1954. "Linear Expenditure System and Demand Analysis: An Analysis to the Pattern of British Demand." Economic Journal (September):511-27.

Taylor, L. 1965. Consumer's Expenditure in Jamaica. Institute of Social and Economic Research, University of West Indies.

Timmer, P.C., W.P. Falcon and S.R. Pearson. 1983. Food Policy Analysis. The John Hopkins University Press.

University of Missouri. 1985. "Memorandum #1: Analysis of Changed Expenditure Patterns in Jamaica: 1975-1977." Analysis of the 1975, 1976 and 1977 Jamaican Household Expenditure Surveys. Draft Memoranda and Reports.

University of Missouri. 1985. "Memorandum #2: Food Expenditure Patterns of Households in Jamaica: 1975-1977." Analysis of the 1975, 1976 and 1977 Jamaican Household Expenditure Surveys. Draft Memoranda and Reports.

University of Missouri, 1985. "Memorandum #3: Income Distribution in Jamaica, 1975-1977." Analysis of the 1975, 1976 and 1977 Jamaican Household Expenditure Surveys. Draft Memoranda and Reports.

Zellner, A. 1962. "An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests for Aggregation Bias." Journal of the American Statistical Association (57):348-368.

Table A1

Estimated Coefficients of Semilog Engel Curves: All Jamaican Households, 1975, 1977

Expenditure Groups	Intercept		Total Per Capita Expenditure				Household Size				R^2	
			Coefficient		Elasticity		Coefficient		Elasticity			
	1975	1977	1975	1977	1975	1977	1975	1977	1975	1977	1975	1977
Meats, Poultry and Fish	0.4480 (17.77)*	0.2930 (4.79)	-0.0348 (11.23)	-0.0224 (3.03)	0.8197	0.8557	-0.0232 (6.06)	0.0032 (0.30)	-0.1202	0.0206	0.0922	0.0594
Dairy Products	0.1182 (13.93)	0.1255 (6.77)	-0.0089 (8.53)	-0.0101 (4.47)	0.8367	0.7992	-0.0058 (4.55)	-0.0091 (2.81)	-0.1064	-0.1327	0.0555	0.0756
Oils and Fats	0.0943 (29.71)	0.0898 (11.51)	-0.0098 (25.04)	-0.0091 (9.75)	0.5442	0.5081	-0.0068 (14.08)	-0.0073 (5.43)	-0.3163	-0.3946	0.3349	0.2796
Cereals and Starchy Foods	0.5660 (35.30)	0.5806 (13.21)	-0.0581 (29.45)	-0.0613 (11.56)	0.6380	0.6242	-0.0250 (10.31)	-0.0245 (3.22)	-0.1558	-0.1502	0.4325	0.3815
Fruits and Vegetables	0.2310 (16.53)	0.1103 (3.69)	-0.0197 (11.44)	-0.0073 (2.02)	0.7544	0.8891	-0.0131 (6.21)	0.0004 (0.82)	-0.1633	0.0024	0.0953	0.0254
Sugar and Sugar Products	0.0516 (16.01)	0.0518 (6.81)	-0.0051 (12.90)	-0.0050 (5.47)	0.6909	0.6453	-0.0014 (2.90)	-0.0037 (2.78)	-0.0848	-0.2624	0.1398	0.1095
Beverages	0.0644 (9.77)	0.0736 (5.50)	-0.0056 (6.95)	-0.0066 (4.09)	0.7751	0.6986	-0.0005 (0.46)	-0.0038 (1.60)	-0.0201	-0.1684	0.0529	0.0670
Miscellaneous Foods	0.0359 (3.37)	0.0666 (3.63)	-0.0004 (0.35)	-0.0041 (1.87)	1.0188	0.7897	-0.0058 (3.59)	-0.0103 (3.23)	-0.2180	-0.5282	0.0179	0.0409
Purchased Meals	0.2477 (11.02)	0.2410 (4.17)	-0.0178 (6.45)	-0.0177 (2.54)	0.6482	0.6889	-0.0256 (7.52)	-0.0151 (1.51)	-0.5059	-0.2640	0.0476	0.0257
Nonfood	-0.8571 (19.73)	-0.6323 (6.50)	0.1594 (29.83)	0.1437 (12.60)	1.4288	1.3303	0.1072 (16.30)	0.0701 (4.22)	0.2884	0.1617	0.4171	0.4060
Total Food	1.6212 (34.61)	1.3992 (16.05)	-0.1315 (22.58)	-0.1150 (10.16)	0.7713	0.7813	-0.0705 (13.34)	-0.0550 (5.41)	-0.1226	-0.1046	0.1285	0.0956

*t-values are provided in parentheses.

Table A2

Estimated Coefficients of Semilog Engel Curves: Low Income* Jamaican Households, 1975, 1977

Expenditure Groups	Intercept		Total Per Capita Expenditure				Household Size				R^2	
			Coefficient		Elasticity		Coefficient		Elasticity			
	1975	1977	1975	1977	1975	1977	1975	1977	1975	1977	1975	1977
Meats, Poultry and Fish	0.2953 (5.88)**	0.0159 (0.12)	-0.0142 (2.19)	0.0123 (0.69)	0.9313	1.0748	-0.0105 (1.59)	0.0407 (2.20)	-0.0508	0.2476	0.0063	0.0294
Dairy Products	0.0782 (4.50)	0.1698 (3.93)	-0.0033 (1.49)	-0.0159 (2.82)	0.9433	0.7017	-0.0033 (1.45)	-0.0154 (2.62)	-0.0567	-0.2889	0.0031	0.0527
Oils and Fats	0.1083 (15.66)	0.1018 (5.28)	-0.01160 (12.96)	-0.0107 (4.27)	0.5341	0.4856	-0.0082 (9.04)	-0.0084 (3.21)	-0.3293	-0.4038	0.1847	0.1081
Cereals and Starchy Foods	0.5398 (16.69)	0.6184 (5.60)	-0.0541 (12.93)	-0.0675 (4.71)	0.7029	0.6347	-0.0248 (5.84)	-0.0229 (1.52)	-0.1362	-0.1239	0.2257	0.1870
Fruits and Vegetables	0.[illegible]604 (5.48)	-0.0696 (1.09)	-0.0100 (2.64)	0.0161 (1.95)	0.8840	1.2310	-0.0076 (1.99)	0.0209 (2.42)	-0.0882	0.2999	0.0091	0.0373
Sugar and Sugar Products	0.0470 (6.63)	0.0500 (2.72)	-0.0046 (4.97)	-0.0050 (2.10)	0.7486	0.6815	-0.0006 (0.68)	-0.0024 (0.97)	-0.0328	-0.1529	0.0666	0.3319
Beverages	0.0546 (4.12)	0.0290 (0.91)	-0.0043 (2.48)	-0.0013 (0.32)	0.8363	0.9442	0.0001 (0.08)	0.0040 (0.93)	0.0038	0.1717	0.0228	0.0246
Miscellaneous Foods	-0.0001 (0.05)	0.0628 (1.49)	0.0054 (2.13)	-0.0035 (0.64)	1.2077	0.8177	-0.0032 (1.27)	-0.0106 (1.85)	-0.1231	-0.5521	0.0363	0.0331
Purchased Meals	0.2277 (4.94)	0.1235 (0.92)	-0.0148 (2.49)	-0.0001 (0.01)	0.6942	0.9994	-0.0259 (4.[illegible]3)	-0.0128 (0.70)	-0.5351	-0.2357	0.0264	0.0085
Nonfood	-0.5111 (6.63)	-0.1017 (0.51)	0.1115 (11.18)	0.0755 (2.89)	1.3451	1.1912	0.0840 (8.31)	0.0068 (0.25)	0.2599	0.0172	0.1418	0.1124
Total Food	0.7587 (12.69)	0.5801 (5.08)	-0.0191 (2.53)	-0.0045 (0.30)	0.9694	0.9921	0.0035 (0.55)	0.0184 (1.49)	0.0056	0.0324	0.0069	0.0076

*Same as in Table 2.
**t-values are provided in parentheses.

Table A3

Estimated Coefficients of Semilog Engel Curves: High Income* Jamaican Households, 1975, 1977

Expenditure Groups	Intercept		Total Per Capita Expenditure				Household Size				R^2	
			Coefficient		Elasticity		Coefficient		Elasticity			
	1975	1977	1975	1977	1975	1977	1975	1977	1975	1977	1975	1977
Meats, Poultry and Fish	0.6943 (10.39)**	0.7388 (4.66)	-0.0633 (8.71)	-0.0682 (3.99)	0.5714	0.4225	-0.0453 (4.97)	-0.0632 (2.79)	-0.3067	-0.5360	0.1647	0.1570
Dairy Products	0.1648 (7.74)	0.2442 (5.45)	-0.0148 (6.37)	-0.0229 (4.75)	0.6493	0.3567	-0.0081 (2.77)	-0.0218 (3.39)	-0.1919	-0.6124	0.1166	0.2057
Oils and Fats	0.0553 (8.41)	0.0537 (3.84)	-0.0055 (7.74)	-0.0052 (3.44)	0.4554	0.4091	-0.0022 (2.45)	-0.0032 (1.58)	-0.2178	-0.3636	0.1948	0.1588
Cereals and Starchy Foods	0.5431 (12.80)	0.4908 (5.50)	-0.0568 (12.31)	-0.0496 (6.11)	0.3618	0.3404	-0.0173 (2.98)	-0.0235 (2.18)	-0.1933	-0.3125	0.4125	0.4172
Fruits and Vegetables	0.3135 (9.43)	0.3606 (4.36)	-0.0297 (8.20)	-0.0343 (3.85)	0.5083	0.3140	-0.0188 (4.14)	-0.0312 (2.63)	-0.3113	-0.6240	0.1623	0.1484
Sugar and Sugar Products	0.0528 (7.84)	0.0581 (3.58)	-0.0052 (7.07)	-0.0053 (3.05)	0.5000	0.2933	-0.0020 (2.15)	-0.0062 (2.67)	-0.1923	-0.8267	0.1709	0.0932
Beverages	0.0680 (3.85)	0.1018 (3.47)	-0.0063 (3.25)	-0.0088 (2.79)	0.6897	0.4534	0.0001 (0.01)	-0.0118 (2.83)	0.0018	-0.7391	0.0707	0.0864
Miscellaneous Foods	0.1073 (3.28)	0.0980 (2.04)	-0.0073 (2.20)	-0.0077 (1.50)	0.7282	0.6316	-0.0119 (2.67)	-0.0130 (1.88)	-0.4146	-0.6220	0.0145	0.0379
Purchased Meals	0.3277 (5.70)	0.4303 (3.10)	-0.0273 (4.35)	-0.0420 (2.81)	0.5301	0.3899	-0.0311 (3.96)	-0.0199 (1.00)	-0.5352	-0.2892	0.0383	0.1315
Nonfood	-1.3268 (9.92)	-1.5761 (5.85)	0.2166 (14.89)	0.2440 (8.41)	1.4064	1.4074	0.1366 (7.488)	0.1939 (5.03)	0.2563	0.3238	0.3905	0.4789
Total Food	1.1553 (8.39)	1.2447 (5.13)	-0.1005 (6.53)	-0.1179 (4.27)	0.7547	0.6719	0.0179 (1.20)	-0.0035 (0.13)	0.0437	-0.0097	0.1731	0.2060

*Same as in Table 3.
**t-values are provided in parentheses.

Table A4

Estimated Coefficients of Several AIDS Models:
All Jamaican Households, 1975 and 1977

	Model A*		Model B**		Model C***	
	Coefficients	t-values	Coefficients	t-values	Coefficients	t-values
Demand for: Meats, Poultry and Fish						
Intercept	0.3059	9.91	0.2702	8.63	1.4671	
Price of:						
Meats, Poultry and Fish	0.0959	20.87	0.1014		0.1214	
Dairy Products	-0.0036	1.08	0.0001	0.23	-0.0028	
Oils and Fats	-0.0008	0.22	0.0145	4.00	-0.0013	
Cereals and Starchy Foods	-0.0182	5.11	-0.0179	4.96	-0.0387	
Fruits and Vegetables	-0.0066	2.33	-0.0133	4.76	-0.0136	
Sugar and Other Sweets	-0.0102	5.10	-0.0089	4.40	-0.0056	
Beverages	-0.0150	7.89	-0.0190	9.95	-0.0078	
Miscellaneous Foods	-0.0015	0.92	-0.0007	0.46	-0.0009	
Purchased Meals	-0.0001	0.27	0.0036	1.37	-0.0048	
Nonfood	-0.1995	16.58	-0.0598	8.71	-0.0459	
Per Capita Expenditure	-0.0131	4.17	-0.0118	3.70	-0.0170	
Household Size	-0.0042	1.50	-0.0015	0.53	-0.0044	
Demand for: Dairy Products						
Intercept	0.1709	16.19	0.1704	16.25	0.1627	18.10
Price of:						
Meats, Poultry and Fish	-0.0078	4.99	-0.0072		-0.0028	
Dairy Products	0.0248	21.61	0.0250	21.92	0.0255	24.24
Oils and Fats	-0.0002	0.15	0.0003	0.26	-0.0023	4.14
Cereals and Starchy Foods	-0.0012	1.01	-0.0014	1.19	-0.0069	6.69

*Unrestricted model.
**Homogeneity imposed.
***Homogeneity and symmetry imposed.

Table A4--Continued

	Model A*		Model B**		Model C***	
	Coefficients	t-values	Coefficients	t-values	Coefficients	t-values
Fruits and Vegetables	-0.0053	5.49	-0.0058	6.04	-0.0034	4.31
Sugar and Other Sweets	-0.0009	1.27	-0.0008	1.18	-0.0012	3.69
Beverages	-0.0012	1.81	-0.0013	2.01	0.0002	0.47
Miscellaneous Foods	-0.0009	1.58	-0.0008	1.55	-0.0005	0.96
Purchased Meals	-0.0007	0.85	-0.0005	0.66	0.0001	0.18
Nonfood	-0.0121	2.93	-0.0075	3.28	-0.0087	4.29
Per Capita Expenditure	-0.0127	11.84	-0.0127	11.92	-0.0142	13.70
Household Size	-0.0102	10.80	-0.0101	10.73	-0.0110	11.95
Demand for: Oils and Fats						
Intercept	0.0774	12.71	0.0741	12.16	0.0868	14.55
Price of:						
Meats, Poultry and Fish	-0.0032	3.57	-0.0029		-0.0013	
Dairy Products	-0.0025	3.72	-0.0020	3.06	-0.0023	4.14
Oils and Fats	0.0145	19.85	0.0162	23.06	0.0146	21.76
Cereals and Starchy Foods	-0.0016	2.22	-0.0017	2.44	-0.0029	4.45
Fruits and Vegetables	-0.0004	0.72	-0.0005	0.93	-0.0005	0.99
Sugar and Other Sweets	-0.0011	2.73	-0.0009	2.39	-0.0004	1.35
Beverages	-0.0024	6.43	-0.0029	7.79	-0.0013	3.98
Miscellaneous Foods	-0.0004	1.14	-0.0003	0.84	-0.0001	0.48
Purchased Meals	-0.0005	0.89	0.0001	0.09	0.0002	0.49
Nonfood	-0.0206	8.66	-0.0051	3.81	-0.0060	4.59
Per Capita Expenditure	-0.0071	11.47	-0.0070	11.22	-0.0082	13.47
Household Size	-0.0047	8.68	-0.0045	8.23	-0.0053	9.83
Demand for: Cereals and Starchy Foods						
Intercept	0.2930	11.30	0.2438	8.98	0.4039	16.52
Price of:						
Meats, Poultry and Fish	-0.0619	16.05	-0.0562		-0.0387	

Table A4--Continued

	Model A*		Model B**		Model C***	
	Coefficients	t-values	Coefficients	t-values	Coefficients	t-values
Dairy Products	-0.0211	7.50	-0.0154	5.21	-0.0069	6.69
Oils and Fats	0.0009	0.30	0.0212	6.77	-0.0029	4.45
Cereals and Starchy Foods	0.0242	8.10	0.0252	8.05	0.0066	2.48
Fruits and Vegetables	-0.0075	3.17	-0.0159	6.45	-0.0134	9.75
Sugar and Other Sweets	-0.0151	9.01	-0.0136	7.69	-0.0047	11.83
Beverages	-0.0160	10.05	-0.0216	13.07	-0.0086	12.95
Miscellaneous Foods	0.0018	1.35	0.0028	1.97	0.0025	2.70
Purchased Meals	-0.0109	5.00	-0.0052	2.28	-0.0004	0.25
Nonfood	-0.1072	10.61	0.0787	13.23	0.0665	14.83
Per Capita Expenditure	-0.0293	11.15	-0.0274	9.93	-0.0436	16.87
Household Size	-0.0089	3.83	-0.0052	2.11	-0.0154	6.56
Demand for: Fruits and Vegetables						
Intercept	0.0270	1.62	0.0168	1.00	0.0382	2.53
Price of:						
Meats, Poultry and Fish	-0.0204	8.22	-0.0216		-0.0136	
Dairy Products	-0.0004	0.30	0.0008	0.42	-0.0034	4.31
Oils and Fats	-0.0017	0.85	0.0049	2.50	-0.0005	0.99
Cereals and Starchy Foods	-0.0073	3.79	-0.0067	3.44	-0.0134	9.75
Fruits and Vegetables	0.0222	14.55	0.0238	15.59	0.0252	18.19
Sugar and Other Sweets	-0.0021	1.99	-0.0019	1.74	-0.0015	5.09
Beverages	-0.0044	4.34	-0.0066	6.44	-0.0025	4.88
Miscellaneous Foods	-0.0049	5.65	-0.0044	5.02	-0.0026	4.05
Purchased Meals	-0.0050	3.58	-0.0029	2.08	-0.0011	0.93
Nonfood	-0.0456	7.03	0.0146	3.98	0.0134	4.69
Per Capita Expenditure	0.0053	3.16	0.0057	3.31	0.0031	1.92
Household Size	0.0028	1.89	0.0033	2.21	0.0020	1.39

Table A4--Continued

	Model A*		Model B**		Model C***	
	Coefficients	t-values	Coefficients	t-values	Coefficients	t-values
Demand for: Sugar and Other Sweets						
Intercept	0.0724	19.12	0.0686	17.84	0.0775	20.50
Price of:						
Meats, Poultry and Fish	-0.0071	12.70	-0.0066		-0.0056	
Dairy Products	-0.0026	6.32	-0.0021	4.99	-0.0012	3.69
Oils and Fats	0.0001	0.007	0.0019	4.28	-0.0004	1.35
Cereals and Starchy Foods	-0.0025	5.65	-0.0025	5.59	-0.0047	11.83
Fruits and Vegetables	-0.0013	3.78	-0.0019	5.37	-0.0015	5.09
Sugar and Other Sweets	0.0091	37.08	0.0092	36.93	0.0095	43.06
Beverages	-0.0015	6.60	-0.0020	8.75	-0.0008	4.35
Miscellaneous Foods	-0.0001	0.30	0.0001	0.16	0.0002	1.00
Purchased Meals	-0.0009	2.71	-0.0003	1.00	0.0001	0.32
Nonfood	-0.0128	8.67	0.0042	4.99	0.0044	5.75
Per Capita Expenditure	-0.0066	17.15	-0.0065	16.51	-0.0075	19.40
Household Size	-0.0026	7.51	-0.0023	6.54	-0.0029	8.29
Demand for: Beverages						
Intercept	0.0652	9.40	0.0601	8.62	0.0596	8.95
Price of:						
Meats, Poultry and Fish	-0.0093	9.07	-0.0085		-0.0078	
Dairy Products	-0.0025	3.35	-0.0018	2.40	0.0002	0.47
Oils and Fats	0.0017	2.05	0.0043	5.43	-0.0013	3.98
Cereals and Starchy Foods	-0.0050	6.33	-0.0051	6.32	-0.0086	12.95
Fruits and Vegetables	-0.0022	3.53	-0.0028	4.47	-0.0025	4.88
Sugar and Other Sweets	-0.0002	0.35	0.0001	0.11	-0.0008	4.35
Beverages	0.0151	35.40	0.0143	33.65	0.0157	40.07
Miscellaneous Foods	-0.0019	5.17	-0.0017	4.75	-0.0009	3.12
Purchased Meals	-0.0023	3.98	-0.0016	2.67	-0.0008	1.44
Nonfood	-0.0212	7.83	0.0028	1.82	0.0068	5.22
Per Capita Expenditure	-0.0039	5.48	-0.0037	5.21	-0.0043	6.27
Household Size	-0.0010	1.63	-0.0006	1.02	-0.0005	0.85

Table A4--Continued

	Model A*		Model B**		Model C***	
	Coefficients	t-values	Coefficients	t-values	Coefficients	t-values
Demand for: Miscellaneous Foods						
Intercept	0.0023	0.19	0.0027	0.22	-0.0162	1.54
Price of:						
Meats, Poultry and Fish	-0.0022	1.23	-0.0022		-0.0009	
Dairy Products	0.0006	0.48	0.0006	0.45	-0.0005	0.96
Oils and Fats	0.0017	0.79	0.0011	0.77	-0.0001	0.48
Cereals and Starchy Foods	-0.0012	0.88	-0.0013	0.93	0.0025	2.70
Fruits and Vegetables	-0.0003	0.23	-0.0001	0.02	-0.0026	4.05
Sugar and Other Sweets	0.0008	1.06	0.0008	1.05	0.0002	1.00
Beverages	0.0012	1.62	0.0012	1.66	-0.0009	3.12
Miscellaneous Foods	0.0111	17.53	0.0111	17.52	0.0111	17.62
Purchased Meals	-0.0010	1.00	-0.0010	1.04	-0.0021	2.51
Nonfood	-0.0093	1.95	-0.0102	3.84	-0.0067	3.51
Per Capita Expenditure	0.0065	5.24	0.0065	5.25	0.0080	7.10
Household Size	-0.0015	1.40	-0.0016	1.45	-0.0002	0.17
Demand for: Purchased Meals						
Intercept	0.1368	5.00	0.1537	5.61	0.0974	4.35
Price of:						
Meats, Poultry and Fish	0.0076	1.85	0.0058		-0.0048	
Dairy Products	0.0014	0.46	-0.0007	0.25	0.0001	0.18
Oils and Fats	-0.0009	0.29	-0.0088	2.77	0.0002	0.49
Cereals and Starchy Foods	-0.0015	0.47	-0.0010	0.34	-0.0004	0.25
Fruits and Vegetables	-0.0011	0.46	0.0006	0.23	-0.0011	0.93
Sugar and Other Sweets	0.0053	3.00	0.0047	2.64	0.0001	0.32
Beverages	0.0025	1.50	0.0047	2.82	-0.0008	1.44
Miscellaneous Foods	-0.0029	2.06	-0.0034	2.37	-0.0021	2.51
Purchased Meals	0.0188	8.19	0.0166	7.19	0.0153	6.80
Nonfood	0.0531	4.98	-0.0185	3.08	-0.0161	4.33

Table A4--Continued

	Model A*		Model B**		Model C***	
	Coefficients	t-values	Coefficients	t-values	Coefficients	t-values
Per Capita Expenditure	-0.0093	3.34	-0.0099	3.53	-0.0047	1.88
Household Size	-0.0108	4.41	-0.0120	4.88	-0.0083	3.66
Demand for: Nonfood						
Intercept	-0.1510	2.65	-0.0604	1.02	-0.2277	4.04
Price of:						
Meats, Poultry and Fish	0.0087	1.03	-0.0020		-0.0459	
Dairy Products	0.0059	0.96	-0.0051	0.79	-0.0087	4.29
Oils and Fats	-0.0147	2.15	-0.0557	8.15	-0.0060	4.54
Cereals and Starchy Foods	0.0143	2.18	0.0125	1.83	0.0666	14.83
Fruits and Vegetables	0.0026	0.50	0.0159	2.95	0.0134	4.69
Sugar and Other Sweets	0.0143	3.89	0.0114	2.96	0.0044	5.75
Beverages	0.0217	6.21	0.0332	9.20	0.0068	5.22
Miscellaneous Foods	-0.0005	0.18	-0.0026	0.83	-0.0067	3.51
Purchased Meals	0.0032	0.66	-0.0085	1.72	-0.0161	4.33
Nonfood	0.3751	16.92	0.0009	0.07	-0.0078	0.67
Per Capita Expenditure	0.0700	12.15	0.0668	11.09	0.0884	15.22
Household Size	0.0411	8.07	0.0345	6.48	0.0460	8.82

Table A5

Estimated Coefficients of Several AIDS Models:
Low Income Jamaican Households, 1975 and 1977

	Model A*		Model B**		Model C***	
	Coefficients	t-values	Coefficients	t-values	Coefficients	t-values
Demand for: Meats, Poultry and Fish						
Intercept	0.0408	1.09	-0.0204	0.55	-0.0181	
Price of:						
Meats, Poultry and Fish	0.1027	20.20	0.1076		0.1162	
Dairy Products	-0.0024	0.62	0.0003	0.09	-0.0038	
Oils and Fats	-0.0087	2.01	0.0011	0.25	-0.0019	
Cereals and Starchy Foods	-0.0116	2.77	-0.0109	2.59	-0.0368	
Fruits and Vegetables	-0.0085	2.69	-0.0143	4.56	-0.0164	
Sugar and Other Sweets	-0.0119	5.31	-0.0113	5.01	-0.0060	
Beverages	-0.0128	5.95	-0.0152	7.11	-0.0076	
Miscellaneous Foods	0.0035	1.72	0.0046	2.28	0.0004	
Purchased Meals	0.0075	2.42	0.0117	3.81	0.0080	
Nonfood	-0.1773	12.60	-0.0736	9.39	-0.0521	
Per Capita Expenditure	0.0233	5.78	0.0287	7.15	0.0250	
Household Size	0.0217	6.29	0.0273	7.95	0.0244	
Demand for: Dairy Products						
Intercept	0.1215	9.04	0.1256	9.53	0.1360	10.68
Price of:						
Meats, Poultry and Fish	-0.0086	4.74	0.0080		-0.0038	
Dairy Products	0.0270	19.74	0.0269	19.78	0.0278	21.68
Oils and Fats	-0.0014	0.91	-0.0020	1.31	-0.0023	3.36
Cereals and Starchy Foods	-0.0008	0.55	-0.0014	0.93	-0.0079	6.14

*Unrestricted model.
**Homogeneity imposed.
***Homogeneity and symmetry imposed.

Table A5--Continued

	Model A*		Model B**		Model C***	
	Coefficients	t-values	Coefficients	t-values	Coefficients	t-values
Fruits and Vegetables	-0.0063	5.54	-0.0063	5.61	-0.0045	4.84
Sugar and Other Sweets	-0.0009	1.15	-0.0009	1.13	-0.0012	3.07
Beverages	-0.0011	1.39	-0.0009	1.16	0.0002	0.33
Miscellaneous Foods	-0.0003	0.49	-0.0004	0.59	-0.0006	0.95
Purchased Meals	0.0016	1.41	0.0014	1.26	0.0016	1.55
Nonfood	-0.0025	0.49	-0.0084	3.03	-0.0093	3.82
Per Capita Expenditure	-0.0062	4.31	-0.0067	4.67	-0.0081	5.81
Household Size	-0.0058	4.69	-0.0061	5.02	-0.0072	6.01
Demand for: Oils and Fats						
Intercept	0.0640	7.89	0.0561	7.02	0.0660	8.42
Price of:						
Meats, Poultry and Fish	-0.0034	3.08	-0.0030		-0.0019	
Dairy Products	-0.0026	3.13	-0.0023	2.77	-0.0023	3.36
Oils and Fats	0.0162	17.16	0.0176	19.23	0.0168	19.17
Cereals and Starchy Foods	-0.0016	1.76	-0.0018	1.94	-0.0035	4.16
Fruits and Vegetables	-0.0003	0.39	-0.0002	0.27	-0.0006	0.98
Sugar and Other Sweets	-0.0013	2.75	-0.0013	2.66	-0.0004	1.21
Beverages	-0.0025	5.42	-0.0029	6.32	-0.0014	3.48
Miscellaneous Foods	-0.0002	0.40	0.0001	0.01	-0.0001	0.26
Purchased Meals	0.0001	0.19	0.0008	1.16	0.0007	1.07
Nonfood	-0.0218	7.12	-0.0070	4.12	-0.0073	4.46
Per Capita Expenditure	-0.0052	5.99	-0.0045	5.17	-0.0054	6.37
Household Size	-0.0033	4.40	-0.0026	3.50	-0.0033	4.45
Demand for: Cereals and Starchy Foods						
Intercept	0.0806	2.45	-0.0182	0.54	0.1764	5.79
Price of:						
Meats, Poultry and Fish	-0.0659	14.75	-0.0599		-0.0368	

Table A5--Continued

	Model A*		Model B**		Model C***	
	Coefficients	t-values	Coefficients	t-values	Coefficients	t-values
Dairy Products	-0.0239	7.14	-0.0200	5.79	-0.0079	3.36
Oils and Fats	-0.0049	1.28	0.0105	2.76	-0.0035	4.16
Cereals and Starchy Foods	0.0320	8.68	0.0339	8.93	0.0114	3.40
Fruits and Vegetables	-0.0092	3.30	-0.0161	5.67	-0.0124	7.46
Sugar and Other Sweets	-0.0170	8.66	-0.0164	8.08	-0.0054	10.71
Beverages	-0.0168	8.88	-0.0211	10.90	-0.0088	10.77
Miscellaneous Foodsd	0.0063	3.56	0.0081	4.44	0.0065	5.55
Purchased Meals	-0.0070	2.59	-0.0003	0.10	0.0042	1.94
Nonfood	-0.0823	6.65	0.0813	11.51	0.0527	10.34
Per Capita Expenditure	-0.0024	0.68	0.0066	1.81	-0.0114	3.28
Household Size	0.0098	3.25	0.0189	6.11	0.0067	2.23
Demand for: Fruits and Vegetables						
Intercept	-0.1433	6.92	-0.1657	8.09	-0.1319	7.13
Price of:						
Meats, Poultry and Fish	-0.0225	7.98	-0.0244		-0.0164	
Dairy Products	-0.0031	1.47	-0.0027	1.28	-0.0045	4.84
Oils and Fats	-0.0065	2.72	-0.0023	0.98	-0.0006	0.98
Cereals and Starchy Foods	-0.0043	1.84	-0.0031	1.34	-0.0124	7.46
Fruits and Vegetables	0.0239	13.66	0.0259	14.95	0.0271	16.76
Sugar and Other Sweets	-0.0034	2.79	-0.0036	2.93	-0.0019	5.10
Beverages	-0.0043	3.63	-0.0058	4.87	-0.0024	3.96
Miscellaneous Foods	-0.0047	4.18	-0.0040	3.52	-0.0023	2.88
Purchased Meals	0.0020	1.19	0.0001	0.02	0.0007	0.48
Nonfood	-0.0254	3.27	0.0199	4.60	0.0127	4.02
Per Capita Expenditure	0.0264	11.83	0.0286	12.90	0.0255	12.15
Household Size	0.0169	8.87	0.0188	9.96	0.0166	9.16

Table A5--Continued

	Model A*		Model B**		Model C***	
	Coefficients	t-values	Coefficients	t-values	Coefficients	t-values
Demand for: Sugar and Other Sweets						
Intercept	0.0607	12.39	0.0517	10.57	0.0607	12.62
Price of:						
Meats, Poultry and Fish	-0.0080	12.00	-0.0073		-0.0060	
Dairy Products	-0.0028	5.72	-0.0025	4.89	-0.0012	3.07
Oils and Fats	-0.0003	0.58	0.0013	2.25	-0.0004	1.21
Cereals and Starchy Foods	-0.0027	4.88	-0.0026	4.75	-0.0054	10.71
Fruits and Vegetables	-0.0016	3.96	-0.0020	4.92	-0.0019	5.10
Sugar and Other Sweets	0.0099	34.14	0.0100	33.79	0.0105	39.59
Beverages	-0.0018	6.57	-0.0023	8.06	-0.0012	5.25
Miscellaneous Foods	0.0002	0.61	0.0004	1.34	0.0004	1.53
Purchased Meals	-0.0004	1.06	0.0003	0.72	0.0006	1.50
Nonfood	-0.0119	6.47	0.0047	4.58	0.0046	5.03
Per Capita Expenditure	-0.0051	9.76	-0.0043	8.14	-0.0053	10.17
Household Size	-0.0012	2.74	-0.0004	0.89	-0.0010	2.22
Demand for: Beverages						
Intercept	0.0192	2.18	0.0088	1.01	0.0095	1.15
Price of:						
Meats, Poultry and Fish	-0.0093	7.79	-0.0085		-0.0076	
Dairy Products	-0.0028	3.07	-0.0023	2.58	0.0002	0.33
Oils and Fats	0.0013	1.27	0.0032	3.20	-0.0014	3.48
Cereals and Starchy Foods	-0.0051	5.11	-0.0050	5.09	-.0088	10.77
Fruits and Vegetables	-0.0023	3.04	-0.0026	3.57	-0.0024	3.96
Sugar and Other Sweets	-0.0008	1.59	-0.0008	1.44	-0.0012	5.25
Beverages	0.0157	31.20	0.0152	30.27	0.0163	34.50
Miscellaneous Foods	-0.0023	4.71	-0.0020	4.20	-0.0012	2.99
Purchased Meals	-0.0015	2.03	-0.0006	0.88	0.0001	0.12
Nonfood	-0.0163	4.93	0.0034	1.84	0.0060	3.91
Per Capita Expenditure	0.0018	1.90	0.0028	2.95	0.0023	2.47
Household Size	0.0030	3.75	0.0040	4.98	0.0042	5.28

Table A5--Continued

	Model A*		Model B**		Model C***	
	Coefficients	t-values	Coefficients	t-values	Coefficients	t-values
Demand for: Miscellaneous Foods						
Intercept	-0.0489	3.22	-0.0446	2.99	-0.0521	3.95
Price of:						
Meats, Poultry and Fish	-0.0012	0.61	-0.0017		0.0004	
Dairy Products	0.0004	0.26	0.0002	0.13	-0.0006	0.95
Oils and Fats	-0.0004	0.22	-0.0011	0.66	-0.0001	0.26
Cereals and Starchy Foods	0.0011	0.66	0.0010	0.61	0.0065	5.55
Fruits and Vegetables	-0.0001	0.01	0.0004	0.29	-0.0023	2.88
Sugar and Other Sweets	0.0005	0.55	0.0005	0.53	0.0004	1.53
Beverages	0.0015	1.75	0.0018	1.99	-0.0012	2.99
Miscellaneous Foods	0.0091	11.13	0.0090	11.03	0.0090	11.06
Purchased Meals	0.0007	0.60	0.0004	0.32	0.0007	0.67
Nonfood	-0.0027	0.47	-0.0105	3.35	-0.0114	5.13
Per Capita Expenditure	0.0131	8.02	0.0127	7.88	0.0135	8.93
Household Size	0.0020	1.45	0.0016	1.18	0.0023	1.75
Demand for: Purchased Meals						
Intercept	0.1548	4.49	0.1937	5.70	0.1647	5.70
Price of:						
Meats, Poultry and Fish	0.0073	1.56	0.0054		0.0080	
Dairy Products	0.0040	1.15	0.0024	0.69	0.0016	1.55
Oils and Fats	-0.0009	0.23	-0.0074	1.90	0.0007	1.07
Cereals and Starchy Foods	0.0014	0.35	0.0020	0.53	0.0042	1.94
Fruits and Vegetables	-0.0022	0.77	-0.0003	0.10	0.0007	0.48
Sugar and Other Sweets	0.0051	2.50	0.0049	2.35	0.0006	1.50
Beverages	0.0044	2.21	0.0060	3.07	0.0001	0.12
Miscellaneous Foods	-0.0017	0.90	-0.0025	1.35	-0.0007	0.67
Purchased Meals	0.0088	3.09	0.0059	2.10	0.0054	1.99
Nonfood	0.0510	3.94	-0.0164	2.28	-0.0206	4.99

Table A5--Continued

	Model A*		Model B**		Model C***	
	Coefficients	t-values	Coefficients	t-values	Coefficients	t-values
Per Capita Expenditure	-0.0099	2.66	-0.0133	3.61	-0.0105	3.09
Household Size	-0.0140	4.40	-0.0174	5.53	-0.0155	5.26
Demand for: Nonfood						
Intercept	0.6505	10.38	0.8129	12.83	0.5888	9.71
Price of:						
Meats, Poultry and Fish	0.0089	1.05	-0.0003		-0.0521	
Dairy Products	0.0061	0.96	-0.0001	0.01	-0.0093	3.82
Oils and Fats	0.0057	0.79	-0.0209	2.89	-0.0073	4.46
Cereals and Starchy Foods	-0.0084	1.20	-0.0121	1.69	0.0527	10.34
Fruits and Vegetables	0.0065	1.23	0.0155	2.89	0.0127	4.02
Sugar and Other Sweets	0.0198	5.29	0.0189	4.92	0.0046	5.03
Beverages	0.0177	4.92	0.0252	6.88	0.0060	3.91
Miscellaneous Foods	-0.0099	2.94	-0.0132	3.81	-0.0114	5.13
Purchased Meals	-0.0077	1.49	-0.0196	3.37	-0.0206	4.99
Nonfood	0.2899	12.28	0.0066	0.49	0.0247	2.03
Per Capita Expenditure	-0.0357	5.29	-0.0507	7.39	-0.0256	3.83
Household Size	-0.0292	5.06	-0.0441	7.54	-0.0272	4.75

Table A6

Estimated Coefficients of Several AIDS Models:
High Income Jamaican Households, 1975 and 1977

	Model A*		Model B**		Model C***	
	Coefficients	t-values	Coefficients	t-values	Coefficients	t-values
Demand for: Meats, Poultry and Fish						
Intercept	0.2542	3.93	0.2103	3.33	0.1838	
Price of:						
Meats, Poultry and Fish	0.0850	9.30	0.0875		0.0896	
Dairy Products	0.0011	0.19	0.0048	0.82	0.0051	
Oils and Fats	0.0088	1.51	0.0142	2.54	-0.0002	
Cereals and Starchy Foods	-0.0109	1.97	-0.0107	1.92	-0.0112	
Fruits and Vegetables	0.0021	0.40	0.0013	0.25	0.0013	
Sugar and Other Sweets	-0.0008	0.22	0.0004	0.11	-0.0009	
Beverages	-0.0107	3.15	-0.0116	3.40	-0.0053	
Miscellaneous Foods	0.0022	0.99	0.0024	1.08	-0.0005	
Purchased Meals	0.0008	0.21	0.0023	0.57	-0.0020	
Nonfood	-0.1358	6.73	-0.0906	7.42	-0.0759	
Per Capita Expenditure	-0.0105	1.57	-0.0062	0.93	-0.0044	
Household Size	0.0206	3.10	0.0258	4.00	0.0274	
Demand for: Dairy Products						
Intercept	0.1314	7.10	0.1340	7.45	0.1255	7.14
Price of:						
Meats, Poultry and Fish	0.0045	1.72	0.0038		0.0051	
Dairy Products	0.0181	10.53	0.0178	10.65	0.0163	11.74
Oils and Fats	0.0007	0.43	0.0004	0.23	-0.0017	2.38
Cereals and Starchy Foods	0.0037	2.30	0.0037	2.33	0.0043	3.49

*Unrestricted model.
**Homogeneity imposed.
***Homogeneity and symmetry imposed.

Table A6--Continued

	Model A*		Model B**		Model C***	
	Coefficients	t-values	Coefficients	t-values	Coefficients	t-values
Fruits and Vegetables	-0.0006	0.39	-0.0005	0.32	0.0027	2.40
Sugar and Other Sweets	0.0004	0.36	0.0003	0.25	-0.0005	1.14
Beverages	0.0001	0.12	0.0002	0.17	0.0003	0.50
Miscellaneous Foods	0.0003	0.52	0.0003	0.48	-0.0003	0.52
Purchased Meals	-0.0023	2.01	-0.0024	2.12	-0.0037	3.61
Nonfood	-0.0208	3.64	-0.0241	6.94	-0.0225	7.08
Per Capita Expenditure	-0.0078	4.05	-0.0081	4.29	-0.0071	3.81
Household Size	0.0007	0.38	0.0004	0.22	0.0009	0.50
Demand for: Oils and Fats						
Intercept	0.0367	6.22	0.0366	6.37	0.0372	4.00
Price of:						
Meats, Poultry and Fish	-0.0008	0.93	-0.0007		-0.0002	
Dairy Products	-0.0003	0.55	-0.0003	0.59	-0.0017	2.39
Oils and Fats	0.0094	17.61	0.0094	18.53	0.0091	11.77
Cereals and Starchy Foods	-0.0006	1.24	-0.0006	1.18	0.0007	0.98
Fruits and Vegetables	0.0002	0.34	0.0001	0.26	0.0008	1.08
Sugar and Other Sweets	0.0006	1.92	0.0006	1.92	0.0003	0.97
Beverages	-0.0007	2.11	-0.0007	2.13	-0.0002	0.53
Miscellaneous Foods	-0.0002	1.14	-0.0002	1.16	-0.0004	1.11
Purchased Meals	-0.0006	1.65	-0.0006	1.70	-0.0008	1.42
Nonfood	-0.0067	3.67	-0.0070	6.32	-0.0076	4.26
Per Capita Expenditure	-0.0026	4.22	-0.0028	4.30	-0.0025	2.56
Household Size	0.0005	0.75	0.0005	0.80	0.0005	0.49
Demand for: Cereals and Starchy Foods						
Intercept	0.0264	6.87	0.1965	5.10	0.1624	4.40
Price of:						
Meats, Poultry and Fish	-0.0187	3.44	-0.0149		-0.0112	

Table A6--Continued

	Model A*		Model B**		Model C***	
	Coefficients	t-values	Coefficients	t-values	Coefficients	t-values
Dairy Products	0.0004	0.12	0.0064	1.78	0.0043	3.49
Oils and Fats	0.0115	3.30	0.0199	5.86	0.0007	0.98
Cereals and Starchy Foods	0.0176	5.32	0.0180	5.28	0.0199	7.52
Fruits and Vegetables	0.0014	0.44	-0.0004	0.11	-0.0003	0.16
Sugar and Other Sweets	-0.0010	0.47	0.0013	0.57	-0.0005	1.14
Beverages	-0.0047	2.36	-0.0060	2.94	-0.0015	1.78
Miscellaneous Foods	-0.0004	0.33	-0.0001	0.01	-0.0015	1.41
Purchased Meals	-0.0058	2.42	-0.0035	1.42	-0.0068	3.48
Nonfood	-0.0933	7.78	-0.0207	2.79	-0.0031	0.50
Per Capita Expenditure	-0.0220	5.50	-0.0153	3.80	-0.0134	3.40
Household Size	0.0188	4.76	0.0268	6.83	0.0298	7.75
Demand for: Fruits and Vegetables						
Intercept	0.1358	4.48	0.1222	4.13	0.0907	3.20
Price of:						
Meats, Poultry and Fish	-0.0053	1.25	-0.0039		0.0013	
Dairy Products	0.0010	3.54	0.0112	4.07	0.0027	2.40
Oils and Fats	0.0081	2.94	0.0097	3.69	0.0008	1.08
Cereals and Starchy Foods	-0.0053	2.03	-0.0049	1.88	-0.0003	0.16
Fruits and Vegetables	0.0195	7.80	0.0184	7.38	0.0204	9.89
Sugar and Other Sweets	0.0024	1.37	0.0030	1.75	0.0002	0.53
Beverages	-0.0017	1.04	-0.0020	1.24	-0.0008	1.00
Miscellaneous Foods	0.0004	0.41	0.0005	0.51	-0.0005	0.59
Purchased Meals	-0.0035	1.84	-0.0031	1.65	-0.0047	2.96
Nonfood	-0.0424	4.48	-0.0289	5.06	-0.0191	3.89
Per Capita Expenditure	-0.0055	1.74	-0.0041	1.34	-0.0020	0.65
Household Size	0.0057	1.82	0.0073	2.42	0.0097	3.26

Table A6--Continued

	Model A*		Model B**		Model C***	
	Coefficients	t-values	Coefficients	t-values	Coefficients	t-values
Demand for: Sugar and Other Sweets						
Intercept	0.0399	7.39	0.0355	6.72	0.0343	5.98
Price of:						
Meats, Poultry and Fish	-0.0016	2.05	-0.0014		-0.0009	
Dairy Products	-0.0003	0.66	0.0001	0.10	-0.0005	1.14
Oils and Fats	0.0006	1.16	0.0011	2.33	0.0003	0.97
Cereals and Starchy Foods	-0.0008	1.78	-0.0008	1.68	-0.0005	1.14
Fruits and Vegetables	0.0001	0.07	-0.0001	0.31	0.0002	0.53
Sugar and Other Sweets	0.0058	18.69	0.0059	19.31	0.0056	19.33
Beverages	0.0003	1.03	0.0002	0.72	0.0008	3.16
Miscellaneous Foods	0.0001	0.26	0.0001	0.40	-0.0001	0.33
Purchased Meals	-0.0007	2.02	-0.0005	1.62	-0.0008	2.21
Nonfood	-0.0091	5.40	-0.0046	4.53	-0.0041	3.92
Per Capita Expenditure	-0.0026	4.65	-0.0022	3.95	-0.0020	3.43
Household Size	0.0012	2.10	0.0017	3.12	0.0018	3.01
Demand for: Beverages						
Intercept	0.0864	7.05	0.0794	6.63	0.0637	5.28
Price of:						
Meals, Poultry and Fish	-0.0059	3.39	-0.0054		-0.0053	
Dairy Products	-0.0010	0.91	-0.0004	0.39	0.0003	0.50
Oils and Fats	0.0021	1.91	0.0029	2.79	-0.0002	0.53
Cereals and Starchy Foods	-0.0013	1.25	-0.0012	1.17	-0.0015	1.78
Fruits and Vegetables	-0.0013	1.30	-0.0016	1.62	-0.0008	1.00
Sugar and Other Sweets	0.0028	4.05	0.0031	4.43	0.0008	3.16
Beverages	0.0136	21.14	0.0135	20.94	0.0141	24.09
Miscellaneous Foods	0.0006	1.38	0.0006	1.47	0.0005	1.35
Purchased Meals	-0.0015	1.96	-0.0013	1.69	-0.0019	2.61
Nonfood	-0.0172	4.50	-0.0102	4.41	-0.0060	2.87
Per Capita Expenditure	-0.0056	4.38	-0.0049	3.92	-0.0037	2.92
Household Size	0.0006	0.48	0.0014	1.18	0.0024	1.93

Table A6--Continued

	Model A*		Model B**		Model C***	
	Coefficients	t-values	Coefficients	t-values	Coefficients	t-values
Demand for: Miscellaneous Foods						
Intercept	0.1206	4.52	0.1149	4.42	0.1180	4.83
Price of:						
Meats, Poultry and Fish	-0.0063	1.66	-0.0058		-0.0005	
Dairy Products	-0.0002	0.10	0.0002	0.08	-0.0003	0.52
Oils and Fats	0.0031	1.28	0.0037	1.62	-0.0004	1.11
Cereals and Starchy Foods	-0.0042	1.83	-0.0040	1.76	-0.0015	1.41
Fruits and Vegetables	-0.0039	1.75	-0.0041	1.86	-0.0005	0.59
Sugar and Other Sweets	0.0004	0.27	0.0006	0.38	-0.0001	0.33
Beverages	0.0008	0.60	0.0007	0.51	0.0005	1.35
Miscellaneous Foods	0.0179	19.46	0.0179	19.51	0.0175	19.99
Purchased Meals	-0.0033	1.95	-0.0031	1.87	-0.0044	3.67
Nonfood	-0.0113	1.35	-0.0061	1.22	-0.0103	3.08
Per Capita Expenditure	-0.0084	3.03	-0.0078	2.89	-0.0076	2.86
Household Size	-0.0076	2.76	-0.0069	2.60	-0.0064	2.49
Demand for: Purchased Meals						
Intercept	0.4194	7.70	0.4334	8.17	0.4680	9.55
Price of:						
Meats, Poultry and Fish	0.0002	0.03	-0.0004		-0.0020	
Dairy Products	-0.0151	2.98	-0.0164	3.33	-0.0037	3.61
Oils and Fats	-0.0012	0.25	-0.0034	0.72	-0.0008	1.42
Cereals and Starchy Foods	-0.0088	1.88	-0.0094	2.00	-0.0068	3.48
Fruits and Vegetables	-0.0037	0.82	-0.0038	0.86	-0.0047	2.96
Sugar and Other Sweets	0.0038	1.21	0.0030	0.97	-0.0008	2.21
Beverages	-0.0064	2.25	-0.0060	2.11	-0.0019	2.61
Miscellaneous Foods	-0.0048	2.55	-0.0049	2.63	-0.0044	3.67
Purchased Meals	0.0436	12.76	0.0429	12.65	0.0429	12.78
Nonfood	0.0177	1.04	-0.0016	0.15	-0.0178	2.71

Table A6--Continued

	Model A*		Model B**		Model C***	
	Coefficients	t-values	Coefficients	t-values	Coefficients	t-values
Per Capita Expenditure	-0.0469	8.28	-0.0484	8.75	-0.0499	9.34
Household Size	-0.0340	6.06	-0.0358	6.61	-0.0379	7.19
Demand for: Nonfood						
Intercept	-0.4882	3.43	-0.3630	2.60	-0.2836	2.13
Price of:						
Meats, Poultry and Fish	-0.0512	2.52	-0.0598		-0.0759	
Dairy Products	-0.0126	0.96	-0.0233	1.79	-0.0225	7.08
Oils and Fats	-0.0431	3.35	-0.0578	4.70	-0.0076	4.26
Cereals and Starchy Foods	0.0108	0.88	0.0100	0.81	-0.0031	0.50
Fruits and Vegetables	-0.0138	1.17	-0.0093	0.79	-0.0191	3.89
Sugar and Other Sweets	-0.0144	1.76	-0.0181	2.24	-0.0041	3.92
Beverages	0.0094	1.25	0.0117	1.56	-0.0060	2.87
Miscellaneous Foods	-0.0161	3.27	-0.0167	3.38	-0.0103	3.08
Purchased Meals	-0.0267	2.99	-0.0306	3.43	-0.0178	2.71
Nonfood	0.3190	7.19	0.1939	7.19	0.1664	7.04
Per Capita Expenditure	0.1120	7.56	0.0995	6.83	0.0926	6.55
Household Size	-0.0065	0.44	-0.0213	1.49	-0.0282	2.05

Table A7

Uncompensated Demand Elasticity Matrix: Low Income Households, Jamaica, 1975 and 1977

Expenditure Groups	Elasticities with respect to price of										Elasticity with respect to	
	Meats, Poultry, Fish	Dairy Products	Oils and Fats	Cereals and Starchy	Fruits and Vegetables	Sugar and Sugar Products	Beverages	Miscel-laneous Foods	Purchased Meals	Nonfood	Income	Household Size
Meats, Poultry and Fish	-0.4352	-0.0265	-0.0127	-0.2099	-0.0937	-0.0327	-0.0418	-0.0011	0.0343	-0.3076	1.1269	0.1239
Dairy Products	-0.0386	-0.5046	-0.0375	-0.1119	-0.0676	-0.0185	0.0068	-0.0069	0.0347	-0.1149	0.8573	-0.1261
Oils and Fats	-0.0348	-0.0843	-0.2935	-0.1055	-0.0069	-0.0132	-0.0521	0.0011	0.0399	-0.2285	0.7730	-0.1381
Cereals and Starchy Foods	-0.1891	-0.0395	-0.0178	-0.9262	-0.0623	-0.0282	-0.0467	0.0369	0.0369	0.0259	0.9378	0.0367
Fruits and Vegetables	-0.2603	0.3095	-0.0726	-0.0149	-0.6969	-0.2065	-0.0280	-0.0365	-0.0357	-0.0071	1.3091	0.2015
Sugar and Sugar Products	-0.2800	0.0496	-0.0506	-0.0161	-0.2476	-0.4011	-0.0799	-0.0602	0.0280	0.0472	0.6987	-0.0565
Beverages	-0.3146	0.3644	0.0020	-0.0564	-0.3609	-0.0992	-0.3649	-0.0486	-0.0493	-0.0013	1.0881	0.1641
Miscellaneous Foods	-0.0922	0.2033	-0.0560	-0.0177	0.1633	-0.1407	0.0052	-0.6468	-0.0635	-0.0534	1.5543	0.0943
Purchased Meals	0.2026	-0.6555	0.0437	0.0189	0.1222	0.0310	0.0152	0.0069	-0.0085	-0.3435	0.7891	-0.3119
Nonfood	-0.1386	-0.0231	-0.0198	0.1689	0.0437	0.0150	0.0195	-0.0318	-0.0571	-0.9017	0.9247	-0.0801

Table A8

Uncompensated Demand Elasticity Matrix: High Income Households, Jamaica, 1975 and 1977

Expenditure Groups	Elasticities with respect to price of										Elasticity with respect to	
	Meats, Poultry, Fish	Dairy Products	Oils and Fats	Cereals and Starchy	Fruits and Vegetables	Sugar and Sugar Products	Beverages	Miscel-laneous Foods	Purchased Meals	Nonfood	Income	Household Size
Meats, Poultry and Fish	-0.3646	0.0372	-0.0011	-0.0762	0.0110	-0.0001	-0.0367	-0.0029	-0.0122	-0.5176	0.9690	0.1930
Dairy Products	0.1493	-0.5947	-0.0391	0.1212	0.0764	-0.0010	0.0112	-0.0025	-0.0810	-0.4549	0.8269	0.0223
Oils and Fats	0.0157	-0.1585	-0.0815	0.0573	0.0924	0.0364	-0.0185	-0.0294	-0.0689	-0.6333	0.7482	0.0506
Cereals and Starchy Foods	-0.1079	0.0567	0.0102	-0.7555	0.0060	-0.0044	-0.0142	-0.0129	-0.0698	0.0485	0.8451	0.3445
Fruits and Vegetables	0.0271	0.0478	0.0133	-0.0016	-0.6494	0.0041	-0.0124	-0.0078	-0.0791	-0.3088	0.9666	0.1661
Sugar and Sugar Products	-0.0622	-0.0400	0.0361	-0.0343	0.0347	-0.4262	0.0858	-0.0007	-0.0656	-0.3065	0.7923	0.1717
Beverages	0.2449	0.0242	-0.0099	-0.0598	-0.0278	0.0432	-0.2733	0.0323	-0.0849	-0.2048	0.8083	0.1231
Miscellaneous Foods	0.0213	0.0005	-0.0105	-0.0302	-0.0024	0.0004	0.0249	-0.3462	-0.1470	-0.2274	0.7215	-0.2362
Purchased Meals	0.0843	-0.0282	-0.0056	-0.0419	-0.0303	-0.0046	-0.0151	-0.0513	-0.2379	0.1576	0.1712	-0.8289
Nonfood	-0.1415	-0.0481	-0.0156	-0.0203	-0.0449	-0.0093	-0.0144	-0.0235	-0.0427	-0.7877	1.1696	-0.0513

Table A9

Uncompensated Demand Elasticity Matrix: All Households, Jamaica, 1975 and 1977

Expenditure Groups	Elasticities with respect to price of										Elasticity with respect to	
	Meats, Poultry, Fish	Dairy Products	Oils and Fats	Cereals and Starchy	Fruits and Vegetables	Sugar and Sugar Products	Beverages	Miscel-laneous Foods	Purchased Meals	Nonfood	Income	Household Size
Meats, Poultry and Fish	-0.3254	-0.0103	-0.0051	-0.1948	-0.0666	-0.0289	-0.0400	-0.0026	-0.0212	-0.2131	0.9079	-0.0238
Dairy Products	-0.0033	-0.5092	-0.0371	-0.0859	-0.0428	-0.0179	-0.0141	-0.0020	0.0166	-0.0608	0.7335	-0.0602
Oils and Fats	0.0103	-0.0885	-0.2911	-0.0763	0.0060	-0.0113	-0.0515	0.0030	0.0323	-0.1359	0.6067	-0.0092
Cereals and Starchy Foods	-0.1903	-0.0283	-0.0124	-0.9150	-0.0621	-0.0249	-0.0468	0.0222	0.0114	0.5174	0.7292	-0.7452
Fruits and Vegetables	-0.1841	-0.0460	-0.0074	-0.1799	-0.6767	-0.0207	-0.0328	-0.0352	-0.0162	0.1583	1.0397	0.0124
Sugar and Sugar Products	-0.2635	-0.0492	-0.0132	-0.2193	-0.0606	-0.3971	-0.0400	0.0232	0.0307	0.4552	0.5294	-0.1750
Beverages	-0.2895	0.0182	-0.0488	-0.3261	-0.0874	-0.0310	-0.3471	-0.0359	-0.0226	0.3487	0.8220	-0.0219
Miscellaneous Foods	0.0230	-0.0355	-0.0124	0.0475	-0.1299	0.0021	-0.0469	-0.5612	-0.0994	-0.3925	1.3206	-0.0080
Purchased Meals	-0.0753	0.0076	0.0066	0.0061	-0.0140	0.0033	-0.0127	-0.0375	-0.7012	-0.2740	0.9103	-0.1593
Nonfood	-0.1613	-0.0349	-0.0203	0.1355	0.0170	0.0077	0.0120	-0.0232	-0.0536	-1.1087	1.2292	0.1192

Table A10

Compensated Demand Elasticity Matrix: Low Income Households, Jamaica, 1975 and 1977

Expenditure Groups	Elasticities with respect to price of									
	Meats, Poultry, Fish	Dairy Products	Oils and Fats	Cereals and Starchy	Fruits and Vegetables	Sugar and Sugar Products	Beverages	Miscel-laneous Foods	Purchased Meals	Nonfood
Meats, Poultry and Fish	-0.2133	0.0378	-0.0143	-0.0040	-0.0008	-0.0128	-0.0130	0.0264	0.0903	0.0750
Dairy Products	0.0104	-0.4557	-0.0169	0.0447	0.0029	-0.0033	0.0287	0.0139	0.0773	0.1762
Oils and Fats	-0.0162	-0.0403	-0.2749	0.0357	0.0568	0.0005	-0.0323	0.0199	0.0783	0.0339
Cereals and Starchy Foods	-0.0178	0.0139	0.0047	-0.7549	0.0147	-0.0116	-0.0227	0.0598	0.0725	0.6278
Fruits and Vegetables	-0.1524	0.0020	0.0165	0.0327	-0.5891	-0.0048	-0.0030	-0.0038	0.0579	0.4941
Sugar and Sugar Products	-0.2676	-0.0107	0.0006	-0.1199	-0.0224	-0.3888	-0.0423	0.0451	0.0819	0.6016
Beverages	-0.2865	0.0640	-0.0303	-0.1621	-0.0095	-0.0293	-0.3370	-0.0227	0.0528	0.5727
Miscellaneous Foods	0.0543	0.0327	0.0196	0.4472	-0.0126	0.0327	-0.0238	-0.6088	0.0219	-0.3371
Purchased Meals	0.2418	0.0886	0.0378	0.2664	0.0960	0.0291	0.0272	0.0108	-0.8407	-0.0756
Nonfood	0.1753	0.0296	0.0024	0.3378	0.1199	0.0314	0.0432	-0.0092	-0.0111	-0.5878

Table A11

Compensated Demand Elasticity Matrix: High Income Households, Jamaica, 1975 and 1977

Expenditure Groups	Elasticities with respect to price of									
	Meats, Poultry, Fish	Dairy Products	Oils and Fats	Cereals and Starchy	Fruits and Vegetables	Sugar and Sugar Products	Beverages	Miscel-laneous Foods	Purchased Meals	Nonfood
Meats, Poultry and Fish	-0.2270	0.0768	0.0085	0.0073	0.0676	0.0097	-0.0178	0.0235	0.0459	0.0114
Dairy Products	0.1551	-0.5609	-0.0309	0.1925	0.1247	-0.0018	0.0273	0.0199	-0.0312	-0.0035
Oils and Fats	0.0171	-0.1279	-0.0741	0.1618	0.1361	0.0438	-0.0039	-0.0091	-0.0238	-0.2248
Cereals and Starchy Foods	0.0121	0.0913	0.0185	-0.6826	0.0553	0.0039	0.0022	0.0101	-0.0189	0.5099
Fruits and Vegetables	0.1644	0.0873	0.0230	0.0817	-0.5930	0.0137	0.0065	0.0184	-0.0209	0.2189
Sugar and Sugar Products	0.0503	-0.0076	0.0439	0.0340	0.0809	-0.4184	0.1012	0.0208	-0.0178	0.1261
Beverages	-0.3597	0.0573	-0.0020	0.0099	0.0193	0.0512	-0.2576	0.0542	-0.0362	0.2365
Miscellaneous Foods	0.1238	0.0300	-0.0033	0.0319	0.0397	0.0076	0.0389	-0.3266	-0.1036	0.2339
Purchased Meals	0.1085	-0.0211	-0.0039	-0.0271	-0.0203	-0.0029	-0.0117	-0.0466	-0.2276	0.2511
Nonfood	0.0246	-0.0003	-0.0041	0.0806	0.0234	0.0023	0.0084	0.0083	0.0277	-0.1492

Table A12

Compensated Demand Elasticity Matrix: All Households, Jamaica, 1975 and 1977

Expenditure Groups	Elasticities with respect to price of									
	Meats, Poultry, Fish	Dairy Products	Oils and Fats	Cereals and Starchy	Fruits and Vegetables	Sugar and Sugar Products	Beverages	Miscel-laneous Foods	Purchased Meals	Nonfood
Meats, Poultry and Fish	-0.1583	0.0382	0.0138	-0.0485	0.0033	-0.0144	-0.0180	0.0201	0.0261	0.1372
Dairy Products	0.1317	-0.4700	-0.0219	0.0321	0.0137	-0.0062	0.0282	0.0164	0.0548	0.2222
Oils and Fats	0.1220	-0.0561	-0.2785	0.0214	0.0528	-0.0017	-0.0368	0.0182	0.0638	0.0981
Cereals and Starchy Foods	-0.0561	0.0107	0.0028	-0.7978	-0.0060	-0.0133	-0.0291	0.0405	0.0494	0.7987
Fruits and Vegetables	0.0073	0.0095	0.0145	-0.0125	-0.5967	-0.0041	-0.0076	-0.0092	0.0379	0.5594
Sugar and Sugar Products	-0.1660	-0.0209	-0.0022	-0.1341	-0.0198	-0.3886	-0.0272	0.0364	0.0582	0.6594
Beverages	-0.1382	0.0622	-0.0316	-0.1937	-0.0241	-0.0179	-0.3272	-0.0154	0.0202	0.6658
Miscellaneous Foods	0.2661	0.0350	0.0151	0.2602	-0.0282	0.0232	-0.0149	-0.5282	-0.0306	-0.1111
Purchased Meals	0.0923	0.0562	0.0255	0.1527	0.0561	0.0178	0.0094	-0.0147	-0.6538	0.0772
Nonfood	0.0650	0.0308	0.0053	0.3334	0.1117	0.0273	0.0418	0.0076	0.0104	-0.6345

APPENDIX B

Chow Test

An interesting question to pose is whether low income households have a different consumption structure than high income households. To ascertain this question statistically Chow test can be employed.

Chow test utilizes the F-ratio based on the residual sum of squares (SSE). The F-ratio tests whether by altering the model (low and high income demand models instead of all households demand model), the variation in the budget shares (w_i) not explained by the regression (SSE) are significantly lowered. In other words Chow test asks whether the SSE is reduced by splitting the data into the two groups and fitting two different demand systems to each data set. If the data fits the two samples better than the full sample the SSE should reduce and the calculated F-ratio should be significant.

Let n and m be the number of low income households in the low and high income groups respectively after the sample is partitioned. Also let (K+1) be the number of parameters including the intercept estimated from each sample and the full sample. Each demand system has r equations. Further let SSE_n and SSE_m be the SSE for the two partitioned data sets and $SSE_{(n+m)}$ be the SSE for the full sample. Now if it was better to fit two separate demand systems a significant reduction in SSE is expected. This reduction is measured by

$$SSE_{(n+m)} - \left| SSE_n + SSE_m \right| \qquad (1)$$

The F-ratio to be computed will compare the reduction (1) with the SSE

on the better fitting models,

$$SSE_n + SSE_m \tag{2}$$

The corresponding degrees of freedom for (1) is

$$\underbrace{\left|(m+n) - r(K+1)\right|}_{SSE_{(n+m)}} - \underbrace{\left|\left(n-r(K+1)\right)\right|}_{SSE_n} + \underbrace{\left|\left((m-r(K+1)\right)\right|}_{SSE_m}$$

$= r(K+1)$

= number of regression coefficients estimated

The degrees of freedom corresponding (2) is

$$\left|n-r(K+1)\right| + \left|m-r(K+1)\right|$$

$n+m - 2r(K+1)$

= total number of observations minus twice the number of regression coefficients estimated in each equation.

The F-ratio then is,

$$F_{\left(K+1,\ m+n\ -\ 2r(K+1)\right)} = \frac{\left(SSE_{(m+n)} - \left|SSE_n + SSE_m\right|\right)/r(K+1)}{(SSE_n + SSE_m)/\left(m+n - 2r(K+1)\right)}$$

If the calculated F values are significantly large it can be concluded that the reduction in SSE due to fitting two separate models is significant. The null hypothesis that low and high income households have similar demand systems therefore cannot be accepted.

For details on the Chow test see Chow, 1961.

APPENDIX C

Likelihood Ratio Test

The likelihood ratio test is based on the maximum likelihood estimation. The likelihood function is a formula corresponding to the joint distributions of the variables of interest in a given sample where the variables are assumed to be fixed but the parameters are allowed to vary. Maximizing this function with respect to the unknown parameters gives the maximum likelihood estimates.

If suppose the likelihood value of an unrestricted model is L_U and that of a restricted model is L_R, then the likelihood ratio (LR) takes the form

$$\lambda = \frac{L_U}{L_R}$$

If the restricted model holds then λ tends to be small given the number of restrictions imposed on the restricted model. In other words the likelihood value under the alternative hypothesis tends to be larger than under the null hypothesis. An equivalent way of describing the likelihood ratio test is to evaluate

$$\lambda = \left| \, |D_R| \, / \, |D_U| \, \right|^{-\frac{T}{2}}$$

where $|D_R|$ and $|D_U|$ are the determinants of the disturbance covariance matrix respectively and T is the sample size. Hypothesis test is carried out by evaluating $-2 \log \lambda$ which is distributed as a χ^2 with degrees of freedom qual to the number of independent restrictions

imposed. For details see Harvey (1981) or Fomby, Hill and Johnson (1984).