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DEMAND FOR FOOD IN ECUADOR AND THE UNITED STATES: EVIDENCE FROM HOUSEHOLD-LEVEL SURVEY DATA

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ABSTRACT

This thesis consists of two essays focused on the estimation of food demand models from household-level data. The first essay examines the approach developed by Lewbel (1989) for the construction of household level commodity price indices (Stone-Lewbel prices) which can be used for the estimation of price effects in demand models. Stone-Lewbel prices are constructed using information on budget shares and Consumer Price Indices (CPIs) of the goods comprising the commodity groups. We consider three alternative CPIs for the construction of the Stone-Lewbel prices: monthly, quarterly and a constant (unity) price index (by a unity CPI we meant that all households face a unique same price). The unity CPI is used to simulate a scenario where no price index information is available. Data from the United States Consumer Expenditure Survey is used in the analyses. The EASI demand system is used as our parametric demand system. Two-stage estimate procedures are used to account for censoring in the data, and endogeneity of expenditures. Elasticities and marginal effect estimates from the demand models proved to be robust to the alternative CPIs considered in this study.

The second essay examines the demand for food commodities in Ecuador. We estimate three demand systems, one for the entire population, and one for urban and rural populations. The AIDS model is used as our parametric demand system. Specialized econometric procedures are used to account for censoring in the data, endogeneity of expenditures and the use of unit values as a proxy for prices. Estimated elasticities and marginal effects for the three systems are consistent with the theory. Substantial differences are observed between estimates for urban and rural populations.

DEDICATION

I wish to dedicate this work to God from whom I have received uncountable blessings and my family, who has provided me with all the love and support I could dream of.

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CHAPTER ONE

Preface

The two essays presented in this thesis focus on the estimation of food demand systems from household-level survey data. Our analyses use publicly available datasets from the United States and Ecuador, collected from national cross sectional household surveys.

A frequent limitation encountered in demand estimation from cross-sectional data is the absence of price variation, as observations are collected during a short time interval. This limitation is aggravated by the fact that most household-level surveys do not record information on prices paid for the commodities considered in the survey.

In the case of the United States, the consumer expenditure survey conducted by the Bureau of Labor Statistics (BLS) only collects expenditure information for each commodity. Consequently, price information needed for the estimation of price effects in demand models has to be incorporated from external sources. Chapter 2 estimates a food demand system for the United States. We consider three systems of demand equations to evaluate the robustness of three versions of the Stone-Lewbel (SL) price indices developed by Lewbel (1989). SL prices are relevant in consumer demand analysis because they allow for unobserved price variation to be recovered from household demographic information and Consumer Price Indices (CPIs). Elasticities and marginal effect estimates are then obtained and compared for the alternative demand systems. In this study we test the performance of SL prices in the absence of CPI information.

Demand elasticities' estimation from household survey data is common in the United States (where this data has been collected annually since 1980), however this is not the case for most developing countries. In Ecuador, the first national household survey was conducted in 1992, since then, the survey has been collected only four additional times. To the best of our knowledge, there is no record of a study that has estimated a demand system of equations for Ecuador, using this data.

Chapter 3 is concerned with the estimation of a demand system of equations for food commodities in Ecuador. The results from the 2005-2006 Ecuadorian national household survey are used to compute demand elasticity and marginal effect estimates for the entire country, as well as individual estimates for rural and urban areas. Given the absence of food demand studies for Ecuador, these estimates can be used as a base of comparison for future analyzes. Study results can also be used for the evaluation and formulation of food related policies.

CHAPTER TWO

Demand System Estimation in the Absence of Price Data: an Application of Stone-Lewbel Price Indices

2.1. Introduction

Estimation of demand systems allows economists to compute demand elasticities for composite or individual commodities. These estimates find applications in analyzing market changes, tax incidence, consumption patterns, international trade, etc. Demand systems' parameter estimates are also used in policy analysis, as most systems of equations allow for indirect utility and cost functions to be recovered.

A significant share of the demand analysis literature uses cross-sectional data from micro-level household surveys, due to higher availability and lower collection cost than for panel data. A common limitation with cross-sectional data is the lack of price information, an important variable in estimating demand systems[1]. For example, in the U.S. the Bureau of Labor Statistics (BLS) conducts an annual survey of consumer expenditures (Consumer Expenditure Survey (CEX)); but the survey does not collect price data for goods and services purchased.

There are several approaches used in the literature to overcome the lack of price data. Some consumer expenditure surveys collect data on both quantities purchased and expenditures, which allows for unit values to be calculated (expenditure divided by quantities) and used as proxies for prices (e.g., Cox and Wohlgenant, 1986; Deaton, 1988). Another common approach is to incorporate external sources of price variability,

[1] Though this problem is characteristic to cross-sectional data, is not endemic to it, Carliner (1973) experienced the same limitation when working with panel data.

such as Consumer Price Indices (CPIs), to account for missing prices (e.g., Seale Jr *et al*., 2003; Kastens and Brester, 1996). However, studies conducted by Slesnick (2005) and Hoderlein and Mihaleva (2008) have found this approach to be problematic as it does not account for spatial and household variability.

In this paper we empirically evaluate the approach proposed by Lewbel (1989) that allows for the construction of household level price indices (Stone-Lewbel (SL) prices) for commodity groups using as inputs CPIs and the budget shares of the sub-groups of the commodities of interest. Hoderlein and Mihaleva (2008) found that relative to the use of CPIs only, the use of SL price indices results in a more precise and plausible estimated demand model. Nevertheless, a question remains about the selection of the CPIs for the construction of SL prices.

The time period for which a CPI is measured might range from a month to a year, and can be regionally or demographic specific. Therefore, the question of how dependent the demand estimation results are to the selected CPI for the construction of SL prices becomes relevant in practical settings. In this study we consider three alternative CPIs for the construction of SL prices which in turn are utilized to estimate three demand systems for eight food commodities using household level data for the United States. Elasticities, marginal effects and parameter estimates are compared across the systems using each of the price series to derive conclusions regarding the effect of using alternative CPIs.

The paper is organized as follows. In the next section we provide a brief review on SL prices and the selected parametric demand system, followed by a brief description of our survey data. Next, we discuss estimation procedures and results. Finally, we make some concluding remarks.

2.2. Conceptual framework

2.2.1. SL Price Indices

Lewbel (1989) derives the SL price indices by generalizing Barten's (1964) equivalence scales.[2] The generalized equivalence scales are defined as

$$M_{li}(q_{li}, a) = u_i(q_i, z^*)/u_{li}(q_{li}, z_l), \tag{1}$$

where M_{li} is the equivalence scale for commodity group *i*, household *l*; q_i is a vector of quantities for the goods comprising commodity group *i*; and z^* and z_l are vectors of demographic characteristics for the average household (*) and a given household (*l*), respectively.

By assuming that the utility function is homothetically separable it follows that there exist commodity group price indices (v_{li}) for each household, which are functions of the demographic characteristics for the average household (z^*) and a vector of within-group prices (p_i). Hence, Lewbel (1989) shows that equation (1) can be rewritten as

$$M_{li}(q_{li}, z_l) = v_{li}(p_i, z_l)/v_i(p_i, z^*), \tag{2}$$

thus the equivalence scale M_{li} depends only on relative prices and demographic characteristics. Furthermore, because of the weak homotheticity property, the commodity group price indices (v_{li}) are the cost function for the goods comprising the commodity, such that

$$w_{lik} = \partial \log v_{li} / \partial \log p_{ik}, \tag{3}$$

[2] For a detailed explanation on equivalent scales see Muellbauer (1974).

where w_{lik} and p_{ik} are the budget share and price for a particular good *k* within commodity group *i* for a given household *l*. Equation (3) implies that upon observing sub-group budget shares for individual commodities, we can integrate back these estimates and recover the commodity group price index, that is

$$\log\big(v_{li}(p_i, z_l)\big) = p_{ik} \int h_{lik}(p_i, z_l)\, dp_{ik}, \tag{4}$$

where $h_{lik}(p_i, z_l)$ is defined to be the functional form for w_{lik}, and v_{li} is the SL price index for commodity group *i*, household *l*. Hence, the variation in the composition of expenditures within commodity groups allows for the identification of household level commodity price indices. In particular, if the within-group utility functions are assumed to be of the Cobb-Douglas form, say

$$u_{li}(q_{li}, z_l) = k_i \prod_{j=1}^{n_i} q_{lij}{}^{w_{lij}}, \tag{5}$$

where k_i is a scaling factor for commodity group *i* constructed using the sub-group budget shares of the reference household ($k_i = \prod_{j=1}^{n_i} \bar{w}_{ij}{}^{-\bar{w}_{ij}}$), then SL prices take the form (Lewbel, 1989)

$$v_{li} = \frac{1}{k_i} \prod_{j=1}^{n_i} \left(\frac{p_{ij}}{w_{lij}}\right)^{w_{lij}}, \tag{6}$$

where p_{ij} are within commodity group price estimates. Equation (6) implies that household level price indices can be calculated using sub-groups budget shares (w_{lij}) and price indices (p_{ij}).

2.2.2. The LA/EASI Demand System

In this study we use the Exact Affine Stone Index (EASI) demand system recently proposed by Lewbel and Pendakur (2009). This demand system has several advantages relative to traditional demand systems such as the AIDS and Rotterdam models. The EASI demand system allows for nonlinear Engel curves and can be integrated back to the original cost function. The budget share error terms can be rationalized as unobserved preference heterogeneity and demographic effects can easily be incorporated into the model. Like the AIDS model, the EASI demand system possesses a convenient linear approximation (LA) that uses the stone price index[3] to circumvent a nonlinear specification for real expenditures.

The LA/EASI demand budget share equations are defined as

$$w_{it} = \sum_{r=0}^{5} b_{ri} y_t^r + \sum_{m=1}^{M} (C_{mi} z_{mt} + D_{mi} z_{mt} y_t) + \sum_{k=1}^{N} A_{ki} \log p_{kt} + \sum_{k=1}^{N} B_{ki} \log p_{kt} y_t + \varepsilon_{it}, \quad (7)$$

where index *i* correspond to commodity and index *t* correspond to household, y_t is total real expenditures ($y_t = \ln x_t - \sum_{i=1}^{N} w_{it} \log p_i$), x_t is total nominal expenditures, p_k is the price index for commodity group k, w_{it} is the demand budget share, the z_{mt}'s are demographic characteristics; and the $C_{mi}'s$, $D_{mi}'s$, $A_{ki}'s$, $B_{ki}'s$, and $b_{ri}'s$ are parameters to be estimated.

Equation (7) is a reduced form of Lewbel and Pendakur's (2009) original demand equation where we have omitted an interaction term between socio-demographic characteristics and prices to reduce the number of estimated parameters[4].The system of N equations of the form in (7) satisfies adding-up and homogeneity restrictions if

$\sum_{i=1}^{N} b_{0i} = 1$, $\sum_{i=1}^{N} b_{ri} = 0$ for $r \neq 0$,

[3] Lewbel and Pendakur (2009) conduct an empirical comparison between the actual model and its linear approximation without finding any major differences.

[4] To analyze the sensitivity of the results to the exclusion of this interaction, we estimated a LA/EASI model with the interaction terms between prices and socio-demographic variables, but the results were similar to those using the reduced model in (7).

and $\sum_{i=1}^{N} A_{ki} = \sum_{i=1}^{N} C_{mi} = \sum_{i=1}^{N} D_{mi} = \sum_{i=1}^{N} B_{ki} = 0 \ \forall \ i,$ (8)

where symmetry of the Slutsky matrix is ensured by symmetry of the *nxn* matrices **A** and **B** which are composed of parameters A_{ki} and B_{ki}.

In short, the LA/EASI model possesses a set of desirable properties while retaining the familiar features that popularized the AIDS model. Nevertheless, the model does not yield traditional Marshallian demand functions, but rather what Lewbel and Pendakur (2009) describe as implicit Marshallian demand equations.

Implicit Marshallian demand equations of the form in (7) are Hicksian demands were the utility term has been approximated using total real expenditures. As a consequence, Marshallian demand elasticities cannot be directly derived from equation (7). We follow Lewbel and Pendakur's (2009) suggestion and estimate compensated (Hicksian) demand and expenditure elasticities and subsequently recover the uncompensated (Marshallian) demand elasticities using the Slutsky equation[5].

2.3. Data

2.3.1. Description

From the Bureau of Labor and Statistics (BLS) we obtained Consumer Expenditure Survey (CEX) data in addition to monthly and quarterly Consumer Price Indices (CPIs). The CEX data consists of two independent surveys: the Diary Survey and the Interview Survey. In the CEX Diary Survey, which was the only one used in this study, households kept a two-week diary of all daily food purchases. The survey also collected information on household characteristics. Households daily expenditures on

[5] See Lewbel and Pendakur (2009) page 836 and Appendix 5.10

specific food products were added together to obtain bi-weekly expenditures on aggregate food sub-groups and groups (Table 2.1). We constructed pooled cross-sectional data by grouping CEX and CPIs data from years 2002 to 2006.

Our pooled cross-sectional dataset initially contained 36,364 households. Observations with values of income and total expenditures below or equal to zero were discarded. Observations with missing values for socio demographic variables as well as outliers[6] in commodity group expenditures were also deleted. The resulting final data set contained 30,768 households.

Using established USDA nutrition-based guidelines from the Quarterly Food At Home Price Database (QFAHPD) we consider the following eight commodity groups: 1) Cereal and Bakery products, 2) Meats and Eggs, 3) Dairy, 4) Fruits and Vegetables, 5) Nonalcoholic Beverages, 6) Fats and Oils, 7) Sugar and Other Sweets, and 8) Miscellaneous foods. Detail information on food groups and sub-groups is shown in Table (2.1). This classification is consistent with that used by the BLS for the construction of CPIs.

2.3.2. Summary Statistics

Summary statistics and commodity groups' composition are presented in Table 2.1. The degree of purchase censoring (at two-week frequencies) ranged from 6% for Cereal and Bakery products to 35% for Fats and Oils. Those groups with the highest percentage of purchase censoring are associated with the smallest budget shares.

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[6] Outliers were identified as extreme observations in the upper 1[th] percentile of commodity group expenditures.

To produce consistent monthly and quarterly CPIs series over time, we used the average CPI from 2002 to 2006 as the base period (2002-2006=100). Because the BLS does not estimate regional CPI series, we constructed regional CPIs by deflating the national level CPIs using the constructed regional CPIs for all items (Slesnick, 2005; Raper, *et al*., 2002).

Descriptions and summary statistics of demographic variables employed to account for household heterogeneity are detailed in Table 2.2. In 84% of the households the reference person[7] is over 30 years old, while the predominant racial group is Caucasian. Also, 86% of the households have at least one adult female and 11% of the reference persons self-identify as Hispanics. To assess the representativeness of the CEX data, the statistics presented in Table 2.2 were compared with summary statistics for the same variables from the United States Census Bureau Current Population Survey (CPS) for the 2003 to 2006 period. The results from both surveys are very similar.

2.4. Estimation Procedures

2.4.1. SL Price Indices for Censored Observations

Three series of SL prices are constructed using alternative regional CPIs (monthly, quarterly, and unity) in place of the input prices (p_{ij}) described in equation (6). By a unity CPI we mean that all households face an identical unique price, which for convenience is chosen to be 100. The idea behind this approach is to simulate a scenario were no price information is available, thus the SL price indices are directly derived from

[7] The reference person is defined by the BLS as the person who owns or rents the home.

the subgroup budget shares. Although intuitively a more disaggregated CPI would be preferred; there might be situations where this is not possible[8].

Summary statistics for monthly, quarterly and unity CPI based SL price indices for the uncensored observations are provided in Table 2.3. Notice that the mean, standard deviation, maximum and minimum values for the monthly, quarterly and unity based SL price indices are roughly equivalent for all the categories.

As evidenced by equation (6) the SL price index is undefined when one or more of the sub-group commodity shares w_{lij} is equal to zero. Hoderlein and Mihaleva (2008) avoided the problem by dropping observations with zero w_{lij}'s. This solution, though plausible for lower levels of censoring, severely restricts data sets with higher censoring levels. Therefore, we adopted the regression imputation approach employed in demand studies of cross-sectional data (with censored expenditures) that use unit values to proxy for prices (see Cox and Wohlgenant, 1986; Alfonzo and Peterson, 2006; and Lopez, 2011). We use the estimates of SL price indices for uncensored observations obtained from equation (6) and regress the log of these indices on a set of demographic characteristics. Ordinary Least Square (OLS) parameters estimates are then use to recover log SL prices for households with censored expenditure information[9].

[8]To assess the relevance of SL prices for our data, we estimated a complete demand system using only monthly CPIs as proxy for prices. Results obtained for this system included positive compensated own-price elasticity for one of the commodity groups.

[9] To test the sensitivity of our results to the presence of censored observations, we run a full system of equations using only the uncensored observations. We found our estimates to be robust even when using only households with positive expenditures.

2.4.2. Censored Approximated LA/EASI Demand Model

The high proportion of individuals reporting zero expenditure for some food groups requires the use of procedures that account for the censored distribution of these responses. Several methods are available to estimate a system of censored demand equations. In this study, we use the two-step procedure of Shonkwiler and Yen (1999).

The procedure is as follows. Consider the system of equations:

$$w_{it}^{*} = f(\boldsymbol{p}, \boldsymbol{z}_t, y_t;\ \boldsymbol{\theta}_i) + \varepsilon_{it} \qquad d_{it}^{*} = \boldsymbol{s}'_t \boldsymbol{\rho}_i + \mu_{it} \tag{9}$$

$$d_{it} = \begin{cases} 1\ if\ d_{it}^{*} > 0 \\ 0\ if\ d_{it}^{*} \leq 0 \end{cases} \qquad w_{it} = d_{it} w_{it}^{*} \tag{10}$$

$$(i = 1, 2, \ldots, N; t = 1, 2, \ldots, T),$$

where, for the i^{th} commodity group and t^{th} observation, w_{it}^{*} is the latent variable for demand budget share, d_{it}^{*} is a latent variable defining the sample selection in (9), w_{it} and d_{it} are the observed dependent variables; $f(\boldsymbol{p}, \boldsymbol{z}_t, y_t;\ \boldsymbol{\theta}_i)$ represents a demand equation of the form in (7), where $\boldsymbol{\theta}_i$ is a vector of parameter estimates, $\boldsymbol{p}$ is a vector of prices, $\boldsymbol{z}_t$ is a vector of socio-demographic characteristics, and y represents real expenditures; $\boldsymbol{s}_t$ is a vector of household characteristics explaining the sample selection process, and $\boldsymbol{\rho}_i$is the vector of parameters for the sample selection equation.

The procedure involves the following three steps: 1) Maximum Likelihood (ML) probit estimates are obtained for $\boldsymbol{\rho}_i$; 2) the vector of parameter estimates $\widehat{\boldsymbol{\rho}}_i$is then used to calculate $\widehat{\Phi}_{it}$ and $\widehat{\phi}_{it}$, which represent estimates for the cdf and pdf of μ_{it}; and 3) estimates for the parameters in $\boldsymbol{\theta}_i$ are obtained using equations of the form:

$w_{it} =$

$\widehat{\Phi}_{it}\left(\sum_{r=0}^{5} b_{ri} y_t^r + \sum_{m=1}^{M}(C_{mi} z_{mt} + D_{mi} z_{mt} y_t) + \sum_{k=1}^{N} A_{ki} \log p_{kt} + \sum_{k=1}^{N} B_{ki} \log p_{kt} y_t\right) +$

$$\sigma_i \widehat{\phi}_{it} + \varepsilon_{it}, \tag{11}$$

which is the censored LA/EASI demand equation for commodity group *i*.

Elasticities and demographic effects can be derived from equation (11) (Yen *et al.*, 2002; Yen and Lin, 2006). It can be shown that compensated (Hicksian) price elasticities (e_{ij}^*) in the censored LA/EASI demand systems are given by

$$e_{ij}^* = \frac{1}{w_i} \widehat{\Phi}_i \left(A_{ji} + B_{ji} y\right) + w_j - \delta_{ji}, \tag{12}$$

where δ_{ji} is the kronecker delta. In the case of *N* goods we have N^2 simultaneous equations for expenditure elasticities (η_{ix}) of the form

$\eta_{ix} = \frac{1}{w_i} \Phi_i\left(1 - \sum_{k=1}^{N} w_k \log p_k (\eta_{kx} - 1)\right)\left(\sum_{r=1}^{5} r b_{ri} y^{r-1} + \sum_{m=1}^{M} D_{mi} z_m +\right.$

$$\left.\sum_{k=1}^{N} B_{ki} \log p_k\right) + 1, \tag{13}$$

where η_{ix} is the expenditure elasticity of commodity group *i* with respect to nominal expenditures *x*. The system of simultaneous equations in equation (13) can be solved for η_{ix}.

Marginal effects of socio-demographic characteristics can also be derived from equation (11); however the formula is dependent upon the presence of the socio-demographic characteristic in the share equation or probit model only, or in both equations[10].

The SAS MODEL procedure was used to estimate the Seemingly Unrelated Regression (SUR) estimators of the parameters in (11) using all *N* equations. Use of all *N*

[10] A complete derivation for demand elasticities and marginal effects is available at appendix 2.1.

equations is possible since the system of censored demand equations (11) does not have a singular variance-covariance residual matrix (Yen *et al*., 2002; Drichoutis *et al*., 2008).

Given the likely correlation between error terms in each equation and total real expenditures (y) (Lewbel and Pendakur, 2009; p.834; LaFrance, 1991), we used the approach suggested by Blundell and Robin (2000) where each equation in (11) is augmented with the error term v from a reduced form of y. As a result, the error term ε_i in (11) is rewritten as the orthogonal decomposition $\varepsilon_i = \omega_i v + u_i$ where $E(u_i | lnx, z_1, \dots, z_m, \log p_1, \dots, \log p_n) = 0$. The reduced form of y follows Blundell and Robin's (2000) specification and is defined as a function of a linear trend, log prices, demographic variables, interaction terms between socio-demographic characteristics and log income, and linear and higher order terms of log income. The hypothesis that the ω_i parameters are different from zero is used to test the endogeneity of y (Blundell and Robin, 2000; Boonsaeng *et al*., 2008)

To account for the use of two-step estimation procedures and the heteroskedasticity of the disturbances in the system of equations of the form in (11) (Shonkwiler and Yen, 2001), we estimated standard errors for parameter, elasticities, and marginal effect estimates using the non-parametric bootstrapping procedure outlined in Wooldridge (2002: 379) using 900 replications.

2.4.3. Comparison of Elasticities and Marginal Effects

Compensated (Hicksian) elasticities and expenditure elasticities are estimated for the average household using the equations (12) and (13). Uncompensated (Marshallian elasticities) are recovered using the Slutsky equation. Marginal effects are also estimated for the average household.

Two procedures were used to assess differences across our demand systems' estimates. First, we compare the percentage error of the elasticities obtained when using monthly CPI based SL prices relative to those obtained when using quarterly and unity CPI based SL prices. To formally analyze the statistical difference between parameter estimates and functions we use bootstrapping procedures because the samples used to estimate the standard errors for parameters and elasticity estimates are not drawn from independent populations but in fact the same population, hence statistical methods of comparison of means such as the student's t-test are inappropriate.

The comparison using bootstrapping procedures involved the following three steps: 1) we used the parameter estimates from the bootstrapping samples to obtain the elasticities and marginal effect estimates for each sample; 2) for each bootstrap sample we calculate the difference in parameters, elasticities and marginal effects between the systems using quarterly and unity CPI based SL prices and the estimates of the system with monthly CPI based SL prices (i.e., these estimates are used as benchmark); and 3) using the distributions of differences, we construct 95% confidence intervals for all parameter, elasticity and marginal effect estimates.

2.5. Results

The results section begins by reporting and discussing the tests of endogeneity of expenditures, as well as, testing the demand system for homogeneity and symmetry. Next we compare the estimation results from demand models calculated using the three alternative CPIs. Finally, we discuss elasticities and marginal effects values.

The null hypothesis that real expenditure is exogenous is rejected (5% level) in five of the eight demand equations for the systems using monthly and quarterly CPI based SL prices, and in six of the eight demand equations for the system using unity CPI based SL prices. However, the bias caused by endogeneity seems to be small as the parameter, elasticity and marginal effect estimates of the models where robust to the correction for endogeneity.

Symmetry and adding-up conditions were tested and imposed in our censored LA/EASI demand systems. Homogeneity is not tested nor imposed, as it is implicitly satisfied if the symmetry and adding-up conditions hold. Table 2.4 summarizes the results for the tests from the theory. The Wald test rejects both null hypotheses for symmetry and adding-up conditions for all demand systems. Parameter estimates from the restricted systems of equations were then used for estimation of elasticities and marginal effects.

2.5.1. Comparison of Models

Percentage errors for expenditure and own-price elasticities obtained using monthly CPI based SL prices relative to those obtained when using quarterly and unity CPI based SL prices are presented in Table 2.5. Elasticities obtained using the three specifications are shown in Tables 2.7, 2.8 and 2.9. The percentage error for expenditure elasticities ranged (in absolute terms) from 0.002% to 0.05% for the quarterly CPI based SL prices, and from 0.02% to 0.86% for the unity CPI based SL prices. For own-price elasticities, percentage error (from absolute differences) ranged from 0.004% to 0.20% for the quarterly CPI based SL prices, and from 0.09% to 2.09% for the unity based SL prices, respectively.

The mean percentage errors (from absolute differences) for cross-price elasticities were of 1.36% and 10.36% for the quarterly and the unity CPI based SL prices, respectively. Similarly, marginal effects' mean percentage errors were of 5.91% and 12.57% for the quarterly CPI and unity based SL prices[11]. The higher mean percentage errors for cross-price elasticities and marginal effects relative to own-price and expenditure elasticities, is explained by the higher number of parameter estimates not statistically different from zero (5% level) for cross-price elasticities and marginal effects.

In short, differences in elasticity estimates and marginal effects obtained using the three alternative CPIs are relatively small. Elasticity estimates using quarterly CPI based SL prices are closer to the estimates obtained using monthly CPI based SL prices than those estimates obtained from using unity CPI based SL prices. Generally speaking, the elasticity estimates obtained using the three alternative specifications are approximately the same.

[11] We also estimated percentage errors for parameter estimates. Mean percentage errors for quarterly and unity CPI based SL prices were of 1.08% and 415%, respectively. The high mean percentage error for unity based SL prices is explained by the presence of parameter estimates not statistically different from zero. See table of parameter estimates in appendix 2.2.

Even though the elasticities obtained using the alternative specifications are similar, the tests of the differences using bootstrapping procedures revealed statistically significant differences (at a 5% level) across models. Specifically, 7 out of 8 own-price and expenditure elasticities from the model using quarterly CPI based SL prices were statistically different than those obtained from the model using monthly CPI based SL prices. All the own-price elasticities and 4 out of 8 expenditure elasticities obtained from the demand model using the unity CPI based SL prices are statistically different than those obtained from the model using monthly CPIs. Regarding statistical differences between cross-price elasticities, 22 of the 56 were statistically different between the systems using quarterly and monthly CPI based SL prices. Similarly, 20 of the 56 cross-price elasticities were statistically different between the models employing monthly CPI and unity based SL prices.

Estimates for marginal effects from systems using monthly, quarterly, and unity CPI based SL prices are provided in Tables 2.10, 2.11 and 2.12, respectively. Results from the bootstrapping procedure indicate that at the 5% level 102 out of 120 marginal effects are not statistically different between the systems using quarterly versus monthly CPI based SL prices. In a similar fashion, 94 of the 120 marginal effect estimates were not statistically different between the models using monthly CPI versus unity based SL prices.

Another concern is whether the use of different CPIs had effects in the precision of parameter, elasticity and marginal effect estimates. Empirical evidence discarded this possibility as estimated standard errors for elasticities and marginal effects in Tables 2.7

to 2.12 were similar. A comparison of the number of significant (5% level) parameter, elasticity and marginal effect estimates is presented in Table 2.6. Though the number of significant parameters is smaller for the system using unity based SL prices, differences in the number of significant elasticities and marginal effect are found to be small across the three systems.

The similarity between the empirical results from the models using unity and quarterly CPI based SL prices and the ones obtained from the model with monthly CPI based SL prices are very likely a consequence of the remarkable similarity in the CPIs, as evidenced in Table 2.3.

2.5.2. Elasticities and marginal effects

This section focuses on elasticities and marginal effects obtained from the system using monthly CPI based SL prices, since the model is used as the benchmark. Moreover, as shown above, the elasticity values and marginal effects across the three alternative specifications were similar.

Consistent with the theory, all own-price uncompensated elasticities are negative and statistically significant (5% level). For each commodity group, expenditure elasticities indicate no commodity group is inferior, an expected result given the broad level of aggregation. Absolute values for estimated cross-price elasticities are less than one and cross-price effects indicate complementary relations across goods. Again, this can be seen as a consequence of the high level of aggregation.

Marginal effect results are consistent with general expectations. Households with a less educated reference person tend to spend less in fruits and vegetables and more on sweets. Larger households spend more on all commodity groups with exception of the Fats & Oils group. White households spend the most on the Dairy and Sweets commodity groups, Asian households spend the most on the Fruit &Vegetables commodity group, while Black households spend the most on the Meats commodity group. When age is used to identify the reference person the households with a younger reference person spend the most on the Miscellaneous group; this is associated with a higher consumption level of ready-to-eat food and snacks. Moreover, households with an older reference person seem to spend more in most of the categories, possibly due to larger household size or/and a higher income.

Our estimated own-price elasticities for the groups of Cereals, Meats, Dairy, Fruits & vegetables, and Fats & oils are more inelastic than those found in the literature (see Raper *et al*., 2002). Differences are also noticed in the estimates for expenditure elasticities. In particular, our expenditure elasticity for the Meats group is more inelastic than the presented by Raper *et al*. (2002). The difference might be a consequence of differences in the chosen commodity groups included in the system, as well as within-group aggregation. Moreover, data used by Raper *et al*. (2002) is from 10 years prior to our study. The magnitude of demand responsiveness of United States consumers may have change over time

We also compared our estimates with those presented by Leffler (2012) who used U.S. Homescan data from the ACNielsen database to estimate a demand system with the same eight commodity groups considered in this study. Our own-price elasticities for the groups of Cereals, Nonalcoholic beverages, Fats, Sweets, and Miscellaneous goods are similar to those obtained by Leffler (2012). Bigger differences were observed between the own-price elasticities for the groups of Meats, Dairy, and Fruits & Vegetables; our elasticities being more inelastic than the ones presented by Leffler (2012). A second major difference is observed in the estimates for expenditure elasticities, as Leffler (2012) found the groups of Meats and Fruit & Vegetables to fall in the category of luxury goods, whereas our results classified the groups of Cereals, Fruit & Vegetables, Fats, and Miscellaneous goods as luxuries. While most of our cross-price elasticities indicated a complementary relationship between commodity groups, Leffler (2012) found several groups to be substitutes. These inconsistencies could be due to differences in the data used in both studies. For instance, the ACNielsen Homescan data provides information on market prices for all individual commodities, circumventing our price identification issue. Also, the ACNielsen Homescan data is an annual record, while the CEX data used in this study is limited to a biweekly period.

Andreyeva *et al*. (2010) review a total of 160 food demand studies conducted in the United States from 1838 to 2007and provide mean values and ranges for the uncompensated own-price elasticities of sixteen commodity groups. Their study does not account for differences in methodology, year of the study, or data sources as their intention is to provide a benchmark of the reported price elasticities for major groups of food consumption in the literature. We found that our estimated own-price elasticities for the groups of Fruits & Vegetables, Dairy, Nonalcoholic beverages and Cereals where similar to the mean values reported for these groups by Andreyeva *et al*. (2010). Estimates for the own-price elasticities for the groups of Fats & Oils, Sugar & other

Sweets, and Meats, where within the range reported for these groups by Andreyeva *et al*. (2010).

2.6. Summary and Conclusions

Lewbel (1989) developed an approach for the construction of household level commodity price indices (SL prices) using only budget shares and CPIs of the goods comprising the commodity groups. In this study, we consider three alternative CPIs for the construction of SL prices used in the estimation of a demand system. The three CPIs consider are: monthly, quarterly and unity. Where the unity CPI is used to simulate a scenario where no price index information is available. The evaluation of the performance of the three SL prices is carried out by comparing estimated elasticities, marginal effects and parameters obtained from demand models using household level data for the United States.

Our results suggest that current estimates of CPIs from the BLS have little variability, such that their influence in the performance of SL price indices is small. Elasticities and marginal effect estimates from the demand models proved to be robust to the alternative CPIs considered in this study (even to the absence of one). Though statistical differences were found across estimates from the models using different SL price indices, the empirical differences we found across our model are quite small. Specifically, these differences are substantially smaller in comparison with those found when comparing our estimates with those from other studies. That is, differences in elasticity estimates due to changes in the construction of SL prices are smaller to those found when employing different data sets (Leffler, 2012) or methodologies (Raper *et al*., 2002).

We conclude that incorporation of CPI data in the calculation of SL prices plays a limited role, thereby making it possible to accurately estimate a demand system in the absence of price information. However, more research is needed to evaluate the performance of unity based SL prices with other datasets.

The study has several limitations. Currently, the BLS does not provide regional CPIs for groups or sub-groups of commodities. The “regional” CPIs used in this study were approximated using the national commodities CPIs and the aggregate regional CPIs. Even though this approximation represents a more disaggregate measure than the national price indices used by Hoderlein and Mihaleva (2008), future studies could use regional specific CPIs provided by the national statistical entities in several countries. For instance, these estimates are available for Ecuador, Mexico, and Colombia.

The use of household-level surveys with information on expenditures and consumed quantities for individual commodities allows the estimation of quality-corrected unit values (Deaton, 1988; Cox and Wohlgenant, 1986). A comparison of SL price indices relative to the use of quality-corrected unit values would provide another measure of the performance of SL indices as approximations for unobserved prices. A further comparison could be conducted using a privately owned database such as the AC Nielsen Homescan data, which provides market price information of all commodities within the survey.

Table 2.1
Commodity groups' composition and summary statistics

Commodity groups	Group composition	Mean budget share	Level of censoring
Cereals & Bakery	1) Cereals 2) Bakery products	15%	6%
Meats & Eggs	1) Beef 2) Pork 3) Poultry 4) Fish & sea food 5) Eggs 6) Other meats	23%	9%
Dairy	1) Milk 2) Cheese 3) Ice cream 4) Other dairy products	12%	8%
Fruit & Vegetables	1) Fresh fruit 2) Fresh vegetables 3) Processed fruit and vegetables	15%	9%
Nonalcoholic Beverages	1) Juice & soda 2) Coffee & tea	12%	11%
Fats & Oils	1) Butter & margarine 2) Salad dressing 3) Fats & oils 4) Other fats	3%	35%
Sugar & other Sweets	1) Sugar 2) Candies 3) Other sweets	4%	33%
Miscellaneous Goods	1) Soups 2) Prepared foods 3) Snacks 4) Seasoning 5) Baby food 6) Other foods	16%	11%

Table 2.2
Descriptive statistics of household composition and household characteristics

Category	Variable	Definition	Mean	Std. Dev.	Min	Max
Continuous Variables						
	Family Size[*†•]	N of members living in the household	2.56	1.460	1	9
	Proportion of persons below 18[†•]		0.36	0.481	0	1
	Annual Income[•]	Annual family income before taxes	57007.23	53222.170	1	694723
	Total food expenditures	Bi-weekly food expenditures	136.18	103.20	0.25	970.99
Dummy Variables (yes=1, no=0)						
Education level of the reference person	No College[*†•]	Reference person has less than college education	0.14	0.345	0	1
	Some College[*†•]	Reference person has some college education	0.56	0.496	0	1
	College	Reference person has at least college education	0.30	0.457	0	1
Region of Residence	North Region[*†•]	Household is located in the north region of the country	0.18	0.385	0	1
	Mid West Region[*†•]	Household is located in the mid west region of the country	0.26	0.436	0	1
	South Region[*†•]	Household is located in the south region of the country	0.33	0.472	0	1
	West Region	Household is located in the west region of the country	0.23	0.421	0	1
Age of the reference person	< 25[*†•]	Reference person is younger than 25	0.06	0.243	0	1
	≥25-30 [*†•]	Reference person is at least 25 but younger than 30	0.07	0.263	0	1
	≥30-40 [*†•]	Reference person is at least 30 but younger than 40	0.20	0.398	0	1
	≥40-50 [*†•]	Reference person is at least 40 but younger than 50	0.22	0.413	0	1
	≥50-60 [*†•]	Reference person is at least 50 but younger than 60	0.24	0.429	0	1
	>60	Reference person is older than 60	0.20	0.402	0	1
Racial group of the reference person	White[*†•]	Reference person self-identifies as white	0.84	0.368	0	1
	Black[*†•]	Reference person self-identifies as black	0.11	0.309	0	1
	Asian[*†•]	Reference person self-identifies as asian	0.04	0.192	0	1
	Other	Reference person self-identifies as neither white, black or asian	0.02	0.125	0	1
Year in which the survey was collected	2002[†•]	Household was interviewed in year 2002	0.18	0.385	0	1
	2003[†•]	Household was interviewed in year 2003	0.19	0.394	0	1
	2004[†•]	Household was interviewed in year 2004	0.21	0.407	0	1
	2005[†•]	Household was interviewed in year 2005	0.21	0.409	0	1
	2006	Household was interviewed in year 2006	0.20	0.404	0	1
	Hispanic[†•]	Reference person self-identifies as Hispanic	0.11	0.311	0	1
	Female adult unemployment[†•]	Reference person is female and unemployed	0.13	0.341	0	1
	Presence of a female adult[†•]	There is at least one female member older than 20 in the hh	0.86	0.351	0	1
	Age of female adult[†]	There is at least one female adult younger than 35 in the hh	0.26	0.439	0	1

*Refers to demographic variables used in the Censored LA/EASI model.
[†]Refers to demographic variables used in the PROBIT model.
[•]Refers to demographic variables used to regress SL prices

Table 2.3
Summary statistics for the SL price index series for uncensored observations

Commodity groups	N	Monthly CPI based SL price indices				Quarterly CPI based SL price indices				Unity CPI based SL price indices			
		Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Cereals & Bakery	29014	83.655	20.738	49.416	110.339	83.657	20.739	49.610	109.902	83.647	20.645	52.822	105.643
Meats & Eggs	27925	54.735	23.158	16.258	115.775	54.740	23.155	16.605	115.318	54.725	23.088	18.844	111.801
Dairy	28188	64.417	26.005	27.180	125.438	64.422	26.001	27.659	124.787	64.416	25.932	30.026	120.044
Fruit & Vegetables	27937	74.121	21.814	31.437	107.365	74.126	21.793	31.828	106.176	74.187	21.724	33.982	101.945
Nonalcoholic Beverages	27469	77.818	23.283	57.228	127.820	77.811	23.281	57.524	127.713	77.843	23.275	60.382	120.765
Fats & Oils	20015	52.896	25.078	27.808	128.602	52.900	25.085	28.341	129.163	52.881	24.974	30.875	123.412
Sugar & other Sweets	20701	57.815	23.421	37.433	123.093	57.816	23.416	37.886	122.139	57.826	23.376	39.677	118.986
Miscellaneous Goods	27392	55.527	24.432	19.396	130.660	55.535	24.430	19.592	130.590	55.611	24.442	20.974	125.688

Table 2.4
Tests of the demand restrictions

Price serie used to estimate de system	Restriction Tested	Test type	Value of the Statistic	Probability of rejecting the null hypothesis
Monthly CPI based SL prices	Symmetry	Wald	717.29	<0.0001
	Adding-up	Wald	2008.6	<0.0001
Quarterly CPI based SL prices	Symmetry	Wald	716.61	<0.0001
	Adding-up	Wald	2010.9	<0.0001
Unity CPI based SL prices	Symmetry	Wald	675.06	<0.0001
	Adding-up	Wald	2012.6	<0.0001

Table 2.5
Comparison of percent errors in elasticities

Commodity groups	Monthly vs. Quarterly CPI based SL prices		Monthly vs. Unity CPI based SL prices	
	Uncompensated Own-price	Expenditure	Uncompensated Own-price	Expenditure
Cereals & Bakery	0.004%	0.023%	-0.166%	0.362%
Meats & Eggs	0.068%	0.002%	0.294%	-0.198%
Dairy	-0.010%	0.022%	-0.431%	0.071%
Fruit & Vegetables	0.133%	-0.027%	0.897%	-0.261%
Nonalcoholic Beverages	-0.070%	-0.047%	-0.095%	-0.725%
Fats & Oils	-0.154%	0.035%	-2.093%	0.018%
Sugar & other Sweets	-0.203%	0.009%	0.142%	-0.694%
Miscellaneous Goods	0.053%	0.012%	1.387%	0.858%

Table 2.6
Summary of significant estimates for estimated demand systems[a]

Estimates	Monthly CPI based SL prices	Quarterly CPI based SL prices	Unity CPI based SL prices
Parameters	51%	51%	23%
Elasticities	78%	79%	83%
Marginal effects	70%	70%	67%

[a]Significance is tested at a 5% level

Table 2.7
Estimated uncompensated and expenditure elasticities when employing monthly CPI based SL price index

Quantity Demanded	Prices								Expenditure
	Cereal & Bakery	**Meats & Eggs**	**Dairy**	**Fruit & Vegetables**	**Nonalcoholic Beverages**	**Fats & Oils**	**Sugar & other Sweets**	**Miscellaneous Goods**	
Cereal & Bakery	-0.7208**	-0.1818**	-0.0563**	-0.1049**	-0.0408**	-0.0066	0.0254**	-0.0382**	1.1241**
	(0.0131)	(0.0119)	(0.0093)	(0.0097)	(0.0100)	(0.0059)	(0.0065)	(0.0100)	(0.0222)
Meats & Eggs	-0.0879**	-0.5287**	-0.0949**	-0.0548**	-0.042**	-0.0019	-0.0170**	-0.1198**	0.9471**
	(0.0056)	(0.0105)	(0.0055)	(0.0062)	(0.0057)	(0.0033)	(0.0038)	(0.0074)	(0.0152)
Dairy	-0.0178*	-0.1485**	-0.5789**	-0.0354**	0.0144	-0.0156**	0.0199**	-0.0055	0.7675**
	(0.0099)	(0.0124)	(0.0157)	(0.0103)	(0.0103)	(0.0060)	(0.0069)	(0.0104)	(0.0234)
Fruit & Vegetables	-0.1041**	-0.1301**	-0.0712**	-0.5971**	-0.1021**	-0.0148**	-0.0052	-0.1276**	1.1524**
	(0.0085)	(0.0110)	(0.0081)	(0.0134)	(0.0089)	(0.0051)	(0.0057)	(0.0095)	(0.0180)
Nonalcoholic Beverages	-0.0182	-0.0718**	-0.0050	-0.0886**	-0.7502**	-0.0069	0.0192**	-0.0077	0.9293**
	(0.0115)	(0.0130)	(0.0109)	(0.0115)	(0.0187)	(0.0070)	(0.0089)	(0.0119)	(0.0235)
Fats & Oils	-0.0397**	-0.0662**	-0.0846**	-0.0667**	-0.0525**	-0.7928**	0.0303	-0.1342**	1.2066**
	(0.0199)	(0.0213)	(0.0173)	(0.0186)	(0.0202)	(0.0397)	(0.0263)	(0.0176)	(0.0350)
Sugar & other Sweets	0.0919**	-0.0679**	0.0312**	0.0120	0.0477**	0.0335*	-1.1087**	0.0259	0.9343**
	(0.0177)	(0.0210)	(0.0168)	(0.0170)	(0.0205)	(0.0217)	(0.0350)	(0.0177)	(0.0367)
Miscellaneous Goods	-0.0172**	-0.1810**	-0.0311**	-0.0962**	-0.0159*	-0.0268**	0.0046	-0.6456**	1.0092**
	(0.0070)	(0.0111)	(0.0068)	(0.0081)	(0.0079)	(0.0040)	(0.0047)	(0.0124)	(0.0187)

Note: Standard errors in parentheses.
* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

Table 2.8
Estimated uncompensated and expenditure elasticities when employing quarterly CPI based SL price index

Quantity Demanded	Prices: Cereal & Bakery	Meats & Eggs	Dairy	Fruit & Vegetables	Nonalcoholic Beverages	Fats & Oils	Sugar & other Sweets	Miscellaneous Goods	Expenditure
Cereal & Bakery	-0.7208**	-0.1813**	-0.0562**	-0.1054**	-0.0411**	-0.0064	0.0254**	-0.0381**	1.1238**
	(0.0132)	(0.0105)	(0.0088)	(0.0094)	(0.0101)	(0.0059)	(0.0065)	(0.0091)	(0.0122)
Meats & Eggs	-0.0876**	-0.5283**	-0.0950**	-0.0551**	-0.0422**	-0.0018	-0.0170**	-0.1199**	0.9471**
	(0.0055)	(0.0098)	(0.0052)	(0.0061)	(0.0057)	(0.0033)	(0.0038)	(0.0071)	(0.0083)
Dairy	-0.0176**	-0.1486**	-0.5790**	-0.0359**	0.0145	-0.0155**	0.0201**	-0.0052**	0.7673**
	(0.0099)	(0.0111)	(0.0152)	(0.0101)	(0.0107)	(0.0060)	(0.0069)	(0.0097)	(0.0138)
Fruit & Vegetables	-0.1047**	-0.1306**	-0.0717**	-0.5964**	-0.1012**	-0.0154**	-0.0049	-0.1279**	1.1527**
	(0.0085)	(0.0100)	(0.0078)	(0.0133)	(0.0090)	(0.0051)	(0.0057)	(0.0090)	(0.0100)
Nonalcoholic Beverages	-0.0186*	-0.0723**	-0.0049	-0.0875**	-0.7507**	-0.0068	0.0191**	-0.0081	0.9297**
	(0.0116)	(0.0123)	(0.0107)	(0.0114)	(0.0186)	(0.0070)	(0.0088)	(0.0154)	(0.0153)
Fats & Oils	-0.0392	-0.0657**	-0.0844**	-0.0686**	-0.0519*	-0.7941**	0.0317	-0.1340**	1.2061**
	(0.0197)	(0.0189)	(0.0164)	(0.0180)	(0.0203)	(0.0397)	(0.0265)	(0.0155)	(0.0185)
Sugar & other Sweets	0.0921**	-0.0681**	0.0316*	0.013	0.0476**	0.0346*	-1.1109**	0.0259	0.9343**
	(0.0175)	(0.0184)	(0.0159)	(0.0164)	(0.0205)	(0.0218)	(0.0352)	(0.0159)	(0.0193)
Miscellaneous Goods	-0.0171**	-0.1812**	-0.0309**	-0.0964**	-0.0161**	-0.0267**	0.0046**	-0.6453**	1.0091**
	(0.0088)	(0.0141)	(0.0078)	(0.0100)	(0.0099)	(0.0042)	(0.0139)	(0.0133)	(0.0363)

Note: Standard errors in parentheses.
* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

Table 2.9
Estimated uncompensated and expenditure elasticities when employing unity CPI based SL price index

Quantity Demanded	Prices								Expenditure
	Cereal & Bakery	**Meats & Eggs**	**Dairy**	**Fruit & Vegetables**	**Nonalcoholic Beverages**	**Fats & Oils**	**Sugar & other Sweets**	**Miscellaneous Goods**	
Cereal & Bakery	-0.7220**	-0.1768**	-0.0519**	-0.1062**	-0.0452**	-0.0039	0.0246**	-0.0385**	1.1200**
	(0.0118)	(0.0048)	(0.0092)	(0.0106)	(0.0090)	(0.0051)	(0.0054)	(0.0103)	(0.0246)
Meats & Eggs	-0.0857**	-0.5271**	-0.0958**	-0.0547	-0.0435	-0.0027**	-0.0180	-0.1216**	0.9490**
	(0.0047)	(0.0053)	(0.0041)	(0.0046)	(0.0042)	(0.0017)	(0.0019)	(0.0057)	(0.0231)
Dairy	-0.0127**	-0.1497**	-0.5814**	-0.0361**	0.0136*	-0.0173**	0.0198	-0.0032**	0.7669**
	(0.0096)	(0.0056)	(0.0151)	(0.0108)	(0.0089)	(0.0063)	(0.0060)	(0.0108)	(0.0254)
Fruit & Vegetables	-0.1064**	-0.1301**	-0.0721**	-0.5918**	-0.0982**	-0.0151**	-0.0067**	-0.1349**	1.1554**
	(0.0084)	(0.0061)	(0.0089)	(0.0138)	(0.0084)	(0.0049)	(0.0051)	(0.0114)	(0.0271)
Nonalcoholic Beverages	-0.0247**	-0.0755**	-0.0066**	-0.0845**	-0.7509**	-0.0049**	0.0211	-0.0099**	0.9360**
	(0.0106)	(0.0074)	(0.0106)	(0.0122)	(0.0140)	(0.0061)	(0.0060)	(0.0134)	(0.0343)
Fats & Oils	-0.0314**	-0.0700	-0.0890**	-0.0675**	-0.046**	-0.8094**	0.0364**	-0.1295**	1.2064**
	(0.0179)	(0.0073)	(0.0187)	(0.0183)	(0.018)	(0.0280)	(0.0129)	(0.0181)	(0.0374)
Sugar & other Sweets	0.0883**	-0.0733	0.0302	0.0070	0.0520	0.0383**	-1.1071**	0.0238**	0.9408**
	(0.0152)	(0.0072)	(0.0152)	(0.0160)	(0.0134)	(0.0108)	(0.0139)	(0.0167)	(0.0362)
Miscellaneous Goods	-0.0168**	-0.1812**	-0.0285**	-0.1011**	-0.0156**	-0.0253**	0.0046**	-0.6367**	1.0006**
	(0.0074)	(0.0053)	(0.0068)	(0.0087)	(0.0093)	(0.0039)	(0.0043)	(0.0125)	(0.0198)

Note: Standard errors in parentheses.
* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

Table 2.10
Estimated socio-demographic marginal effects when employing monthly CPI based SL price index

Quantities Demanded	Education		Region			Age of Household Head in years					Race			Family Size	Hispanic
	No college	Some college	Northeast	Midwest	South	<25	≥25 -30	≥30 -40	≥40 -50	≥50 -60	White	Black	Asian		
Cereal & Bakery	-1.480*	-0.920	4.140**	1.100	1.550*	-10.380**	-8.690**	-8.410**	-7.360**	-5.100**	1.840	-2.150	-2.970	2.780**	-2.970**
	(0.799)	(0.563)	(0.852)	(0.711)	(0.719)	(2.333)	(1.646)	(1.319)	(1.029)	(0.794)	(1.755)	(1.884)	(2.231)	(0.605)	(0.807)
Meats & Eggs	2.510**	1.940**	3.110**	0.990*	3.480**	-11.320**	-5.690**	-5.040**	-1.580**	0.300	-1.100	6.300**	1.150	3.220**	7.000**
	(0.724)	(0.485)	(0.681)	(0.618)	(0.583)	(1.831)	(1.216)	(0.969)	(0.754)	(0.670)	(1.677)	(1.837)	(2.110)	(0.427)	(0.922)
Dairy	-2.260**	-1.620**	0.940**	-0.370	-0.850**	-4.970**	-2.740**	-2.140**	-2.040**	-1.560**	2.580**	-4.680**	-5.690**	2.180**	-1.580**
	(0.539)	(0.362)	(0.472)	(0.409)	(0.379)	(1.281)	(0.844)	(0.664)	(0.565)	(0.466)	(1.081)	(1.194)	(1.448)	(0.343)	(0.523)
Fruit & Vegetables	-5.320**	-4.600**	-0.460	-1.710**	-1.990**	-13.380**	-10.330**	-9.440**	-8.050**	-4.560**	1.140	0.710	13.170**	1.000**	6.090**
	(0.587)	(0.410)	(0.491)	(0.436)	(0.425)	(1.255)	(0.913)	(0.754)	(0.610)	(0.501)	(1.273)	(1.326)	(1.669)	(0.260)	(0.580)
Nonalcoholic Beverages	1.370**	1.140**	0.990**	0.450	0.760**	6.110**	4.400**	5.320**	5.080**	4.170**	-1.460	-2.430**	-3.600**	0.680**	0.170
	(0.457)	(0.332)	(0.458)	(0.378)	(0.380)	(0.843)	(0.637)	(0.515)	(0.499)	(0.471)	(1.040)	(1.124)	(1.436)	(0.282)	(0.500)
Fats & Oils	0.950**	0.500**	-0.450**	-0.040	-0.160	0.920**	0.730**	0.610**	0.330	0.220	-0.250	0.650	-1.050**	-0.530**	-0.270*
	(0.168)	(0.121)	(0.170)	(0.157)	(0.159)	(0.369)	(0.287)	(0.209)	(0.162)	(0.149)	(0.361)	(0.384)	(0.479)	(0.087)	(0.196)
Sugar & other Sweets	0.570	0.580**	-1.440**	0.000	-0.480	-1.150**	-0.060	0.850*	1.310**	0.820**	0.310	0.230	-1.870*	0.040	-1.600**
	(0.337)	(0.237)	(0.324)	(0.293)	(0.295)	(0.557)	(0.457)	(0.369)	(0.341)	(0.337)	(0.754)	(0.818)	(0.968)	(0.158)	(0.385)
Miscellaneous Goods	-3.490**	-1.890**	-4.190**	-0.490	-1.230**	5.120**	4.590**	3.060**	2.960**	1.630**	0.300	-4.500**	-4.040**	0.550**	-4.020**
	(0.514)	(0.357)	(0.516)	(0.393)	(0.376)	(1.019)	(0.709)	(0.523)	(0.449)	(0.406)	(0.968)	(1.085)	(1.209)	(0.241)	(0.460)

Note: Standard errors in parentheses.
* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

Table 2.11
Estimated socio-demographic marginal effects when employing quarterly CPI based SL price index

Quantities Demanded	Education		Region			Age of Household Head in years					Race			Family Size	Hispanic
	No college	Some college	Northeast	Midwest	South	<25	≥25 -30	≥30 -40	≥40 -50	≥50 -60	White	Black	Asian		
Cereal & Bakery	-1.480*	-0.930	4.140**	1.100	1.550*	-10.380**	-8.690**	-8.420**	-7.360**	-5.090**	1.840	-2.150	-2.970	2.780**	-2.970**
	(0.800)	(0.564)	(0.853)	(0.712)	(0.720)	(2.339)	(1.650)	(1.322)	(1.031)	(0.795)	(1.757)	(1.886)	(2.234)	(0.606)	(0.808)
Meats & Eggs	2.510**	1.950**	3.100**	0.990*	3.480**	-11.330**	-5.690**	-5.040**	-1.580**	0.300	-1.100	6.300**	1.140	3.220**	7.000**
	(0.724)	(0.485)	(0.681)	(0.618)	(0.583)	(1.834)	(1.217)	(0.970)	(0.754)	(0.669)	(1.676)	(1.836)	(2.110)	(0.428)	(0.922)
Dairy	-2.260**	-1.620**	0.940**	-0.380	-0.850**	-4.970**	-2.740**	-2.140**	-2.040**	-1.550**	2.580**	-4.680**	-5.680**	2.180**	-1.580**
	(0.539)	(0.362)	(0.472)	(0.408)	(0.379)	(1.285)	(0.845)	(0.665)	(0.566)	(0.466)	(1.080)	(1.193)	(1.447)	(0.343)	(0.523)
Fruit & Vegetables	-5.320**	-4.600**	-0.460	-1.710**	-1.990**	-13.380**	-10.330**	-9.440**	-8.050**	-4.570**	1.150	0.720	13.180**	1.000**	6.090**
	(0.587)	(0.410)	(0.492)	(0.436)	(0.425)	(1.258)	(0.914)	(0.756)	(0.611)	(0.502)	(1.274)	(1.328)	(1.671)	(0.261)	(0.580)
Nonalcoholic Beverages	1.380**	1.150**	0.990**	0.450	0.770**	6.120**	4.410**	5.330**	5.080**	4.170**	-1.460	-2.440**	-3.600**	0.670**	0.170
	(0.461)	(0.335)	(0.458)	(0.379)	(0.380)	(0.859)	(0.642)	(0.517)	(0.499)	(0.471)	(1.041)	(1.127)	(1.435)	(0.287)	(0.501)
Fats & Oils	0.950**	0.500**	-0.450**	-0.040	-0.160	0.920**	0.730**	0.610**	0.330	0.220	-0.250	0.650	-1.050**	-0.530**	-0.270*
	(0.169)	(0.121)	(0.170)	(0.157)	(0.159)	(0.370)	(0.287)	(0.210)	(0.163)	(0.149)	(0.362)	(0.385)	(0.480)	(0.087)	(0.197)
Sugar & other Sweets	0.570	0.580**	-1.440**	0.000	-0.480	-1.150**	-0.060	0.850*	1.310**	0.820**	0.300	0.220	-1.870*	0.040	-1.600**
	(0.338)	(0.238)	(0.325)	(0.293)	(0.296)	(0.559)	(0.458)	(0.370)	(0.343)	(0.338)	(0.756)	(0.820)	(0.970)	(0.159)	(0.386)
Miscellaneous Goods	-3.490**	-1.890**	-4.190**	-0.490	-1.230**	5.120**	4.590**	3.050**	2.960**	1.630**	0.290	-4.510**	-4.040**	0.550**	-4.020**
	(0.582)	(0.404)	(0.577)	(0.454)	(0.430)	(1.097)	(0.819)	(0.611)	(0.530)	(0.475)	(1.125)	(1.243)	(1.394)	(0.260)	(0.530)

Note: Standard errors in parentheses.
* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

Table 2.12
Estimated socio-demographic marginal effects when employing unity CPI based SL price index

Quantities Demanded	Education		Region			Age of Household Head in years					Race			Family Size	Hispanic
	No college	Some college	Northeast	Midwest	South	<25	≥25 -30	≥30 -40	≥40 -50	≥50 -60	White	Black	Asian		
Cereal & Bakery	-1.502**	-0.938**	4.124**	1.086	1.535*	-10.370**	-8.693**	-8.411**	-7.361**	-5.100**	1.839	-2.165	-2.933	2.783**	-2.980**
	(0.803)	(0.564)	(0.815)	(0.678)	(0.679)	(2.330)	(1.630)	(1.272)	(0.946)	(0.752)	(1.574)	(1.804)	(2.050)	(0.569)	(0.720)
Meats & Eggs	2.497**	1.943**	3.110**	1.010*	3.490**	-11.222**	-5.613**	-4.985**	-1.552**	0.325	-1.134	6.222**	1.067	3.185**	7.002**
	(0.677)	(0.463)	(0.665)	(0.596)	(0.566)	(1.853)	(1.184)	(0.933)	(0.714)	(0.645)	(1.946)	(2.078)	(2.276)	(0.401)	(0.806)
Dairy	-2.275**	-1.635**	0.938*	-0.389	-0.858**	-5.055**	-2.781**	-2.164**	-2.065**	-1.569**	2.596**	-4.702**	-5.684**	2.196**	-1.57**
	(0.541)	(0.368)	(0.483)	(0.422)	(0.394)	(1.308)	(0.858)	(0.675)	(0.560)	(0.465)	(1.173)	(1.359)	(1.606)	(0.341)	(0.520)
Fruit & Vegetables	-5.354**	-4.621**	-0.438	-1.691**	-1.974**	-13.491**	-10.365**	-9.465**	-8.070**	-4.571**	1.157**	0.704*	13.180**	1.019**	6.101**
	(0.607)	(0.427)	(0.518)	(0.466)	(0.449)	(1.278)	(0.935)	(0.760)	(0.619)	(0.528)	(1.520)	(1.581)	(1.821)	(0.256)	(0.580)
Nonalcoholic Beverages	1.414**	1.170**	1.000	0.456	0.767	6.294**	4.465**	5.371**	5.102**	4.168**	-1.455**	-2.388**	-3.591**	0.650	0.164
	(0.448)	(0.331)	(0.464)	(0.387)	(0.387)	(0.896)	(0.656)	(0.523)	(0.488)	(0.463)	(1.41)	(1.463)	(1.796)	(0.285)	(0.479)
Fats & Oils	0.958**	0.505**	-0.455	-0.031	-0.155	0.935	0.748*	0.620	0.339	0.224	-0.253	0.651	-1.057**	-0.531**	-0.268
	(0.172)	(0.123)	(0.181)	(0.164)	(0.168)	(0.425)	(0.311)	(0.234)	(0.170)	(0.152)	(0.371)	(0.397)	(0.503)	(0.102)	(0.196)
Sugar & other Sweets	0.593*	0.597**	-1.456**	0.010	-0.472	-1.163*	-0.058	0.858**	1.323**	0.830**	0.296	0.237	-1.912**	0.042	-1.614**
	(0.354)	(0.246)	(0.351)	(0.309)	(0.320)	(0.619)	(0.484)	(0.396)	(0.365)	(0.358)	(0.801)	(0.876)	(1.013)	(0.172)	(0.387)
Miscellaneous Goods	-3.498**	-1.902**	-4.185**	-0.523	-1.256**	5.007**	4.495**	2.979**	2.915**	1.605**	0.305	-4.457**	-3.939**	0.588	-4.006**
	(0.508)	(0.356)	(0.505)	(0.396)	(0.376)	(1.051)	(0.722)	(0.531)	(0.450)	(0.409)	(0.929)	(1.060)	(1.213)	(0.240)	(0.446)

Note: Standard errors in parentheses.
* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

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Appendices

Appendix 2.1. Derivation of demand elasticities and marginal effects for the censored LA/EASI demand model

Hicksian demand elasticities

Define Hicksian demand share equations as

$$w_i = \hat{\Phi}_i(\sum_{r=0}^{5} b_{ri}u^r + \sum_{m=1}^{M}(C_{mi}z_m + D_{mi}z_m u) + \sum_{k=1}^{N} A_{ki}\log p_k + \sum_{k=1}^{N} B_{ki}\log p_k u) + \sigma_i\hat{\phi}_i + \varepsilon_i, \quad \text{(a)}$$

taking the derivative of equation (a) with respect to $\log p_j$ we obtain:

$$\frac{\partial w_i}{\partial \log p_j} = \hat{\Phi}_i\left(A_{ji} + B_{ji}u\right). \quad \text{(b)}$$

Since

$$\frac{\partial w_i}{\partial \log p_j} = w_i\frac{\partial \log w_i}{\partial \log p_j} = w_i\left(\frac{\partial \log q_i}{\partial \log p_j} + \frac{\partial \log p_i}{\partial \log p_j} - \frac{\partial \log x}{\partial \log p_j}\right), \quad \text{(c)}$$

we can substitute equation (c) into (b) and solve for $\frac{\partial \log q_i}{\partial \log p_j}$ to obtain:

$$\frac{\partial \log q_i}{\partial \log p_j} = \frac{\hat{\Phi}_i}{w_i}\left(A_{ji} + B_{ji}u\right) + w_j - \delta_{ji}, \quad \text{(d)}$$

where u can be approximated by real expenditures y ($y = \log x - \sum_{k=1}^{N} w_k \log p_k$):

$$e_{ij}^{*} = \frac{1}{w_i}\hat{\Phi}_i\left(A_{ji} + B_{ji}y\right) + w_j - \delta_{ji}. \quad \text{(e)}$$

Equation (e) is the compensated censored LA/EASI demand elasticity for commodity group i, as defined in equation (12). This can be written in matrix form as

$$\boldsymbol{E}^{*} = \boldsymbol{W}^{T}\boldsymbol{\Phi}(\boldsymbol{A} + \boldsymbol{B}) + \boldsymbol{G} - \boldsymbol{I} \quad \text{[A]}$$

where

$$\boldsymbol{E}^*{}_{nxn} = \begin{bmatrix} e_{11}^* & . & . & e_{1n}^* \\ \vdots & \vdots & \vdots & \vdots \\ e_{n1}^* & . & . & e_{nn}^* \end{bmatrix} ; \boldsymbol{W}_{nxn} = \begin{bmatrix} w_1 & 0 & . & 0 \\ 0 & w_2 & . & 0 \\ . & . & . & . \\ 0 & 0 & . & w_n \end{bmatrix} ; \boldsymbol{\Phi}_{nxn} = \begin{bmatrix} \widehat{\Phi}_1 & 0 & . & 0 \\ 0 & \widehat{\Phi}_2 & . & 0 \\ . & . & . & . \\ 0 & 0 & . & \widehat{\Phi}_n \end{bmatrix} ;$$

$$\boldsymbol{\beta}_{nxn} = \begin{bmatrix} \beta_{11}y & . & . & \beta_{n1}y \\ \vdots & \vdots & \vdots & \vdots \\ \beta_{1n}y & . & . & \beta_{nn}y \end{bmatrix} ; \boldsymbol{A}_{nxn} = \begin{bmatrix} A_{11} & . & . & A_{n1} \\ \vdots & \vdots & \vdots & \vdots \\ A_{1n} & . & . & A_{nn} \end{bmatrix} ; \boldsymbol{I}_{nxn} = \begin{bmatrix} 1 & 0 & . & 0 \\ 0 & 1 & \vdots & 0 \\ 0 & 0 & . & 1 \end{bmatrix} ;$$

$$\boldsymbol{G}_{nxn} = \begin{bmatrix} w_1 & . & . & w_n \\ \vdots & \vdots & \vdots & \vdots \\ w_1 & . & . & w_n \end{bmatrix}.$$

where $\widehat{\Phi}_1$ refers to the mean value for the cumulative density function for the choice probabilities of buying good 1.

<u>Implicit expenditure elasticities</u>

Define implicit Marshallian demand share equations as

$$w_i = \widehat{\Phi}_i \left(\sum_{r=0}^{5} b_{ri} y^r + \sum_{m=1}^{M} (C_{mi} z_{mt} + D_{mi} z_{mt} y) + \sum_{k=1}^{N} A_{ki} \log p_k + \sum_{k=1}^{N} B_{ki} \log p_k y\right) + \sigma_i \widehat{\phi}_i + \varepsilon_i, \quad \text{(f)}$$

taking the derivative of equation (f) with respect to $\log x$ we obtain:

$$\frac{\partial w_i}{\partial \log x} = \widehat{\Phi}_i (1 - \sum_{k=1}^{N} w_k \log p_k (\eta_{kx} - 1))(\sum_{r=1}^{5} r b_{ri} y^{r-1} + \sum_{m=1}^{M} D_{mi} z_m + \sum_{k=1}^{N} B_{ki} \log p_k). \quad \text{(g)}$$

Since

$$\frac{\partial w_i}{\partial \log x} = w_i \frac{\partial \log w_i}{\partial \log x} = w_i \left(\frac{\partial \log q_i}{\partial \log x} + \frac{\partial \log p_i}{\partial \log x} - \frac{\partial \log x}{\partial \log x}\right) = w_i (\eta_{ix} - 1), \quad \text{(h)}$$

where $\eta_{ix} = \frac{\partial \log w_i}{\partial \log x}$

We can now substitute equation (h) into (g) and solve for η_{ix}. Thus:

$$\eta_{ix} - 1 = \frac{1}{w_i}\widehat{\Phi}_i(1 - \sum_{k=1}^{N} w_k \log p_k(\eta_{kx} - 1))(\sum_{r=1}^{5} r b_{ri} y^{r-1} + \sum_{m=1}^{M} D_{mi} z_m + \sum_{k=1}^{N} B_{ki} \log p_k). \quad \text{(i)}$$

Equation (i) is the equation for censored expenditure elasticities as defined in (13). Notice that the equation is not explicitly solve for η_{ix}. Rewriting equation (i) in matrix notation we obtain:

$$\boldsymbol{M} = \left(\boldsymbol{W}^{-1}\boldsymbol{\Phi} - \boldsymbol{W}^{-1}\boldsymbol{\Phi}(\boldsymbol{P}^T\boldsymbol{W}\boldsymbol{M})\right)\left(\boldsymbol{b}\dot{\boldsymbol{Y}} + \boldsymbol{D}\boldsymbol{Z} + \boldsymbol{V}\boldsymbol{P}\right)$$

Where

$$\boldsymbol{M}_{nx1} = \begin{bmatrix} \eta_{1x} - 1 \\ \vdots \\ \eta_{nx} - 1 \end{bmatrix}; \boldsymbol{W}_{nxn} = \begin{bmatrix} w_1 & 0 & . & 0 \\ 0 & w_2 & . & 0 \\ . & . & . & . \\ 0 & 0 & . & w_n \end{bmatrix}; \boldsymbol{\Phi}_{nxn} = \begin{bmatrix} \widehat{\Phi}_1 & 0 & . & 0 \\ 0 & \widehat{\Phi}_2 & . & 0 \\ . & . & . & . \\ 0 & 0 & . & \widehat{\Phi}_n \end{bmatrix};$$

$$\boldsymbol{V}_{nxn} = \begin{bmatrix} \beta_{11} & . & . & \beta_{n1} \\ \vdots & \vdots & \vdots & \vdots \\ \beta_{1n} & . & . & \beta_{nn} \end{bmatrix}; \boldsymbol{P}_{nx1} = \begin{bmatrix} \log p_1 \\ \vdots \\ \log p_n \end{bmatrix}; \boldsymbol{D}_{nxm} = \begin{bmatrix} D_{11} & . & . & D_{m1} \\ \vdots & \vdots & \vdots & \vdots \\ D_{1n} & . & . & D_{mn} \end{bmatrix};$$

$$\boldsymbol{Z}_{mx1} = \begin{bmatrix} z_1 \\ \vdots \\ z_m \end{bmatrix}; \dot{\boldsymbol{Y}}_{rx1} = \begin{bmatrix} (1)y^0 \\ (2)y^1 \\ . \\ (r)y^{r-1} \end{bmatrix}; \boldsymbol{b}_{nxr} = \begin{bmatrix} b_{11} & . & . & b_{r1} \\ \vdots & \vdots & \vdots & \vdots \\ b_{1n} & . & . & b_{rn} \end{bmatrix}.$$

We can now use matrix algebra to solve for the vector of expenditure elasticities, it follows that:

$$\boldsymbol{M} = (\boldsymbol{W}^T\boldsymbol{\Phi} - \boldsymbol{W}^T\boldsymbol{\Phi}(\boldsymbol{P}^T\boldsymbol{W}\boldsymbol{M}))\left(\boldsymbol{b}\dot{\boldsymbol{Y}} + \boldsymbol{D}\boldsymbol{Z} + \boldsymbol{V}\boldsymbol{P}\right)$$

$$\boldsymbol{M} = \boldsymbol{W}^T\boldsymbol{\Phi}\left(\boldsymbol{b}\dot{\boldsymbol{Y}} + \boldsymbol{D}\boldsymbol{Z} + \boldsymbol{V}\boldsymbol{P}\right) - \boldsymbol{W}^T\boldsymbol{\Phi}(\boldsymbol{P}^T\boldsymbol{W}\boldsymbol{M})\left(\boldsymbol{b}\dot{\boldsymbol{Y}} + \boldsymbol{D}\boldsymbol{Z} + \boldsymbol{V}\boldsymbol{P}\right)$$

$$\boldsymbol{M} = \boldsymbol{W}^T\boldsymbol{\Phi}\left(\boldsymbol{b}\dot{\boldsymbol{Y}} + \boldsymbol{D}\boldsymbol{Z} + \boldsymbol{V}\boldsymbol{P}\right) - \boldsymbol{W}^T\boldsymbol{\Phi}\left(\boldsymbol{b}\dot{\boldsymbol{Y}} + \boldsymbol{D}\boldsymbol{Z} + \boldsymbol{V}\boldsymbol{P}\right)\boldsymbol{P}^T\boldsymbol{W}\boldsymbol{M}$$

$$\boldsymbol{M} + \boldsymbol{W}^T\boldsymbol{\Phi}\left(\boldsymbol{b}\dot{\boldsymbol{Y}} + \boldsymbol{D}\boldsymbol{Z} + \boldsymbol{V}\boldsymbol{P}\right)\boldsymbol{P}^T\boldsymbol{W}\boldsymbol{M} = \boldsymbol{W}^T\boldsymbol{\Phi}\left(\boldsymbol{b}\dot{\boldsymbol{Y}} + \boldsymbol{D}\boldsymbol{Z} + \boldsymbol{V}\boldsymbol{P}\right)$$

$$\left(\boldsymbol{I} + \boldsymbol{W}^T\boldsymbol{\Phi}\left(\boldsymbol{b}\dot{\boldsymbol{Y}} + \boldsymbol{D}\boldsymbol{Z} + \boldsymbol{V}\boldsymbol{P}\right)\boldsymbol{P}^T\boldsymbol{W}\right)\boldsymbol{M} = \boldsymbol{W}^T\boldsymbol{\Phi}\left(\boldsymbol{b}\dot{\boldsymbol{Y}} + \boldsymbol{D}\boldsymbol{Z} + \boldsymbol{V}\boldsymbol{P}\right)$$

$$\boldsymbol{M} = \left[\boldsymbol{I} + \boldsymbol{W}^T\boldsymbol{\Phi}\left(\boldsymbol{b}\dot{\boldsymbol{Y}} + \boldsymbol{DZ} + \boldsymbol{VP}\right)\boldsymbol{P}^T\boldsymbol{W}\right]^T \boldsymbol{W}^T\boldsymbol{\Phi}\left(\boldsymbol{b}\dot{\boldsymbol{Y}} + \boldsymbol{DZ} + \boldsymbol{VP}\right)$$

$$\boldsymbol{M} = \left[\boldsymbol{W} + \boldsymbol{\Phi}\left(\boldsymbol{b}\dot{\boldsymbol{Y}} + \boldsymbol{DZ} + \boldsymbol{VP}\right)\boldsymbol{P}^T\boldsymbol{W}\right]^T \boldsymbol{\Phi}\left(\boldsymbol{b}\dot{\boldsymbol{Y}} + \boldsymbol{DZ} + \boldsymbol{VP}\right)$$

$$\boldsymbol{N} = \boldsymbol{M} + \boldsymbol{1} = \boldsymbol{W}^T\left[\boldsymbol{I} + \boldsymbol{\Phi}\left(\boldsymbol{b}\dot{\boldsymbol{Y}} + \boldsymbol{DZ} + \boldsymbol{VP}\right)\boldsymbol{P}^T\right]^T \boldsymbol{\Phi}\left(\boldsymbol{b}\dot{\boldsymbol{Y}} + \boldsymbol{DZ} + \boldsymbol{VP}\right) + \boldsymbol{1} \qquad \text{[B]}$$

where

$$\boldsymbol{1}_{nx1} = \begin{bmatrix} 1 \\ : \\ 1 \end{bmatrix} ; \boldsymbol{I}_{nxn} = \begin{bmatrix} 1 & 0 & . & 0 \\ 0 & 1 & : & 0 \\ . & . & & . \\ 0 & 0 & . & 1 \end{bmatrix} ; \boldsymbol{N}_{nx1} = \begin{bmatrix} \eta_{1x} \\ : \\ \eta_{nx} \end{bmatrix} ;$$

Implicit Marshallian demand elasticities

From the Slutsky equation we know that:

$$e_{ij} = e^*_{ij} - \eta_{ix} w_j,$$

where e_{ij} and e^*_{ij} are the uncompensated and compensated demand elasticities for good *i* with respect to the price of good *j*, respectively. Using the results from equations [A] and [B] we can express LA/EASI Marshallian (uncompensated) censored demand elasticities in the following matrix form

$$\boldsymbol{E} = \boldsymbol{E}^* - \boldsymbol{NG}$$

where

$$\boldsymbol{E}_{nxn} = \begin{bmatrix} e_{11} & . & . & e_{1n} \\ : & : & : & : \\ e_{n1} & . & . & e_{nn} \end{bmatrix} ; \boldsymbol{N}_{nxn} = \begin{bmatrix} \eta_{1x} & 0 & . & 0 \\ 0 & \eta_{2x} & . & 0 \\ . & . & . & . \\ 0 & 0 & . & \eta_{nx} \end{bmatrix} ; \boldsymbol{G}_{nxn} = \begin{bmatrix} w_1 & . & . & w_n \\ : & : & : & : \\ w_1 & . & . & w_n \end{bmatrix}.$$

Marginal Effects

As stated in page 13, derivation of marginal effects is dependent upon the presence of the socio-demographic characteristic in the share equation or probit model only, or in both LA/EASI and probit equations. We proceed to derive marginal effects for those variables mutually present in the probit and LA/EASI equations. Thus, let's define $g_j$as a specific socio-demographic variable mutually present in both, LA/EASI and probit equations, such that z_j=s_j=g_j. Taking the derivative of equation (f) with respect to g_j.we obtain:

$$\frac{\partial w_i}{\partial g_j} = [\hat{\phi}_i * \rho_{ji} * (\sum_{r=0}^{5} b_{ri} y^r + \sum_{m=1}^{M} (C_{mi} z_m + D_{mi} z_m y) +$$

$$\sum_{k=1}^{N} A_{ki} \log p_k + \sum_{k=1}^{N} B_{ki} \log p_k y) + \left(C_{ji} + D_{ji} y\right) * \hat{\Phi}_i] + \sigma_i F_i(S) * \hat{\phi}_i * \rho_{ji}. \quad \text{(j)}$$

Assuming prices and total expenditures are independent of demographic characteristics, it must be true that

$$\frac{\partial w_i}{\partial \omega_j} = \frac{1}{x} \frac{\partial x_i}{\partial \omega_j}, \quad \text{(k)}$$

substituting equation (k) into (j) and solving for $\frac{\partial x_i}{\partial g_j}$ we obtain:

$$\frac{\partial x_i}{\partial g_j} = x([\hat{\phi}_i * \rho_{ji} * (\sum_{r=0}^{5} b_{ri} y^r + \sum_{m=1}^{M} (C_{mi} z_m + D_{mi} z_m y) +$$

$$\sum_{k=1}^{N} A_{ki} \log p_k + \sum_{k=1}^{N} B_{ki} \log p_k y) + \left(C_{ji} + D_{ji} y\right) * \hat{\Phi}_i] + \sigma_i F_i(S) * \hat{\phi}_i * \rho_{ji}). \quad \text{(l)}$$

The expression in (l) is our equation for marginal effects from the censored LA/EASI demand equations. Notice that the equation expresses the change in total expenditures for a unit change in the variable g_j.

Appendix 2.2. Parameter estimates for the estimated systems of equations.

Table 2.13
Parameter estimates for the estimated LA/EASI demand systems

Parameter	Monthly CPI based SL prices		Quarterly CPI based SL prices		Unity based SL prices	
	Estimate	Std. dev.	Estimate	Std. dev.	Estimate	Std. dev.
B11	-0.0288*	0.0164	-0.0288*	0.0164	-0.1319	0.0132
B21	0.0068*	0.0030	0.0068*	0.0030	0.1011	0.0140
B31	0.0003	0.0023	0.0003	0.0023	-0.0369	0.0062
B41	-0.0017*	0.0008	-0.0017*	0.0008	0.0058*	0.0011
B51	-0.0003	0.0003	-0.0003	0.0003	-0.0003**	0.0001
B12	0.0387**	0.0110	0.0386**	0.0110	0.0592	0.0244
B22	-0.0358**	0.0025	-0.0358**	0.0025	-0.1782	0.0141
B32	0.0032**	0.0012	0.0032**	0.0012	0.0944	0.0088
B42	0.0075**	0.0006	0.0075**	0.0006	-0.0175	0.0018
B52	0.0011**	0.0002	0.0011**	0.0002	0.0011	0.0001
B13	-0.0293**	0.0138	-0.0293**	0.0138	0.0034	0.0110
B23	0.0138**	0.0027	0.0138**	0.0027	0.1406	0.0266
B33	0.0044**	0.0017	0.0045**	0.0017	-0.0658	0.0139
B43	-0.0032**	0.0006	-0.0032**	0.0006	0.0108	0.0025
B53	-0.0006**	0.0002	-0.0006**	0.0002	-0.0006	0.0001
B14	-0.0048	0.0125	-0.0050	0.0125	0.0320	0.0089
B24	-0.0061**	0.0023	-0.0061**	0.0023	-0.0176	0.0079
B34	-0.0008	0.0013	-0.0008	0.0013	0.0061	0.0044
B44	0.0002	0.0005	0.0002	0.0005	-0.001*	0.0009
B54	0.0000	0.0002	0.0000	0.0002	0.0001**	0.0001
B15	-0.0202	0.0165	-0.0200	0.0168	0.0023	0.0070
B25	0.0224**	0.0036	0.0224**	0.0036	-0.0477	0.0089
B35	-0.0045	0.0024	-0.0045	0.0023	0.0046	0.0048
B45	-0.0021**	0.0008	-0.0021**	0.0008	0.0011	0.0010
B55	-0.0001	0.0003	-0.0001	0.0003	-0.0001	0.0001
B16	0.0178**	0.0056	0.0178**	0.0055	0.0788	0.0386
B26	-0.0041**	0.0015	-0.0041**	0.0014	-0.0216	0.0255
B36	-0.0004	0.0010	-0.0004	0.0010	0.0051	0.0078
B46	0.0000	0.0003	0.0000	0.0003	-0.0007	0.0011
B56	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001
B17	-0.0002	0.0070	-0.0001	0.0070	-0.0118	0.0504
B27	0.009**	0.0019	0.009**	0.0019	-0.0223**	0.0337
B37	-0.0019	0.0012	-0.0019	0.0012	0.005**	0.0107
B47	-0.0006	0.0004	-0.0006*	0.0004	-0.0001**	0.0015
B57	0.0000	0.0001	0.0000	0.0001	0*	0.0001
B18	0.0268**	0.0097	0.0268**	0.0099	-0.0321	0.0371
B28	-0.0061**	0.0025	-0.0061**	0.0024	0.0457	0.0257
B38	-0.0004	0.0010	-0.0004	0.0010	-0.0124*	0.0085
B48	-0.0002	0.0005	-0.0002	0.0005	0.0015**	0.0013
B58	-0.0001	0.0001	-0.0001	0.0001	-0.0001**	0.0001

* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

Table 2.13
Continued

Parameter	Monthly CPI based SL prices		Quarterly CPI based SL prices		Unity based SL prices	
	Estimate	Std. dev.	Estimate	Std. dev.	Estimate	Std. dev.
C11	-0.0045	0.0052	-0.0045	0.0052	-0.0059	0.0246
C21	-0.0028	0.0037	-0.0028	0.0037	-0.0162	0.0181
C31	0.0237**	0.0054	0.0237**	0.0054	0.0488	0.0253
C41	0.0024	0.0047	0.0024	0.0047	-0.0270	0.0210
C51	0.0045	0.0048	0.0045	0.0048	-0.0076	0.0205
C61	-0.0381**	0.0121	-0.0381**	0.0122	-0.1034*	0.0388
C71	-0.0406**	0.0087	-0.0406**	0.0088	-0.095**	0.0331
C81	-0.0408**	0.0070	-0.0409**	0.0070	-0.1018**	0.0222
C91	-0.04**	0.0058	-0.0401**	0.0058	-0.1142**	0.0093
C101	-0.0276**	0.0046	-0.0276**	0.0046	-0.051**	0.0075
C111	-0.0002	0.0134	-0.0002	0.0134	-0.0873	0.0090
C121	-0.0140	0.0142	-0.0140	0.0142	-0.0748	0.0131
C131	-0.0276*	0.0161	-0.0276*	0.0161	-0.1768	0.0148
C141	0.0077**	0.0028	0.0077**	0.0028	0.0047	0.0088
C151	-0.0171**	0.0054	-0.0171**	0.0054	-0.006**	0.0055
C12	0.0226**	0.0042	0.0226**	0.0042	0.0095**	0.0061
C22	0.0149**	0.0029	0.0149**	0.0029	-0.0111	0.0148
C32	0.0195**	0.0040	0.0195**	0.0040	0.0390	0.0256
C42	0.0086**	0.0036	0.0086**	0.0036	0.048**	0.0235
C52	0.022**	0.0034	0.022**	0.0034	0.0464**	0.0238
C62	-0.0312**	0.0103	-0.0313**	0.0104	-0.0176	0.0342
C72	-0.0105*	0.0068	-0.0106*	0.0068	0.0037	0.0322
C82	-0.0113**	0.0051	-0.0113**	0.0051	-0.0021	0.0224
C92	0.0043	0.0042	0.0043	0.0042	0.0325*	0.0241
C102	0.0087**	0.0037	0.0087**	0.0037	0.0266	0.0184
C112	-0.0106	0.0095	-0.0107	0.0095	0.0065	0.0159
C122	0.0513**	0.0105	0.0513**	0.0105	0.136**	0.0184
C132	0.0107	0.0132	0.0106	0.0131	-0.0071	0.0211
C142	0.007**	0.0021	0.007**	0.0021	0.022*	0.0052
C152	0.0409**	0.0053	0.0409**	0.0053	0.0901**	0.0076
C13	-0.01**	0.0040	-0.01**	0.0040	-0.0196	0.0254
C23	-0.0074**	0.0028	-0.0074**	0.0028	-0.0069	0.0160
C33	0.0035	0.0037	0.0035	0.0037	0.0155	0.0237
C43	-0.0039	0.0034	-0.0039	0.0034	-0.0119	0.0216
C53	-0.0065**	0.0032	-0.0065**	0.0032	-0.0170	0.0208
C63	-0.019**	0.0074	-0.019**	0.0074	-0.0623**	0.0348
C73	-0.0106**	0.0052	-0.0106**	0.0052	-0.0389**	0.0279
C83	-0.0044	0.0042	-0.0043	0.0042	0.0020	0.0244
C93	-0.0055	0.0041	-0.0055	0.0041	-0.0030	0.0243
C103	-0.0064**	0.0034	-0.0064**	0.0034	-0.0132	0.0214

* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

Table 2.13
Continued

Parameter	Monthly CPI based SL prices		Quarterly CPI based SL prices		Unity based SL prices	
	Estimate	Std. dev.	Estimate	Std. dev.	Estimate	Std. dev.
C113	0.0148	0.0099	0.0149	0.0099	0.0412	0.0534
C123	-0.0267**	0.0105	-0.0266**	0.0105	-0.0376	0.0604
C133	-0.036**	0.0118	-0.0359**	0.0118	-0.0996**	0.0636
C143	0.0114**	0.0019	0.0114**	0.0019	0.0311**	0.0069
C153	-0.0114**	0.0042	-0.0114**	0.0042	-0.0427	0.0244
C14	-0.0288**	0.0039	-0.0288**	0.0039	-0.0639**	0.0192
C24	-0.0241**	0.0029	-0.0241**	0.0029	-0.0250	0.0149
C34	-0.0053	0.0036	-0.0053	0.0036	-0.0532*	0.0192
C44	-0.008**	0.0032	-0.008**	0.0032	-0.0029	0.0189
C54	-0.0128**	0.0031	-0.0128**	0.0031	-0.0400	0.0181
C64	-0.0785**	0.0075	-0.0785**	0.0075	-0.2813**	0.0302
C74	-0.0641**	0.0054	-0.064**	0.0054	-0.2081**	0.0236
C84	-0.0609**	0.0047	-0.0609**	0.0047	-0.2085**	0.0214
C94	-0.0561**	0.0039	-0.0561**	0.0039	-0.1924**	0.0197
C104	-0.0335**	0.0036	-0.0335**	0.0036	-0.1202**	0.0187
C114	0.0028	0.0095	0.0028	0.0095	-0.0101	0.0352
C124	0.0091	0.0101	0.0091	0.0101	0.0250	0.0384
C134	0.0955**	0.0128	0.0954**	0.0128	0.2214**	0.0472
C144	-0.0024*	0.0015	-0.0025*	0.0015	-0.0016	0.0076
C154	0.0377**	0.0041	0.0377**	0.0041	0.07**	0.0193
C15	0.0172**	0.0046	0.0172**	0.0046	0.0535*	0.0286
C25	0.0133**	0.0035	0.0133**	0.0035	0.0386*	0.0212
C35	0.0026	0.0045	0.0026	0.0044	0.0136	0.0271
C45	0.0034	0.0041	0.0034	0.0041	0.0127	0.0267
C55	0.0084**	0.0040	0.0085**	0.0040	0.065**	0.0262
C65	0.072**	0.0070	0.072**	0.0072	0.2368**	0.0426
C75	0.0525**	0.0060	0.0525**	0.0061	0.2159**	0.0453
C85	0.0567**	0.0050	0.0567**	0.0050	0.2218**	0.0323
C95	0.0462**	0.0045	0.0462**	0.0045	0.1678**	0.0288
C105	0.0331**	0.0041	0.0331**	0.0041	0.1107**	0.0253
C115	-0.0061	0.0106	-0.0060	0.0106	0.0027	0.0504
C125	-0.0132	0.0112	-0.0132	0.0112	-0.0512	0.0550
C135	-0.0035	0.0143	-0.0034	0.0142	0.0973	0.0712
C145	-0.0063**	0.0020	-0.0064**	0.0021	-0.0414**	0.0086
C155	-0.0049	0.0052	-0.0049	0.0052	-0.0298	0.0312
C16	0.0121**	0.0027	0.0121**	0.0027	0.0181	0.0159
C26	0.0048**	0.0018	0.0048**	0.0018	-0.0031	0.0089
C36	-0.0053*	0.0025	-0.0053*	0.0025	0.0027	0.0125
C46	-0.0009	0.0023	-0.0009	0.0023	0.0084	0.0113
C56	-0.0020	0.0023	-0.0020	0.0023	0.0069	0.0114

* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

Table 2.13
Continued

Parameter	Monthly CPI based SL prices		Quarterly CPI based SL prices		Unity based SL prices	
	Estimate	Std. dev.	Estimate	Std. dev.	Estimate	Std. dev.
C66	0.0183**	0.0049	0.0183**	0.0049	-0.0509**	0.0217
C76	0.0155**	0.0040	0.0154**	0.0040	-0.0032	0.0205
C86	0.0121**	0.0029	0.0121**	0.0029	-0.0023	0.0139
C96	0.0055**	0.0022	0.0055**	0.0022	-0.0079	0.0114
C106	0.0018	0.0023	0.0018	0.0023	-0.0040	0.0129
C116	-0.0053	0.0047	-0.0053	0.0047	-0.0227	0.0197
C126	0.0080	0.0053	0.0080	0.0053	-0.0032	0.0263
C136	-0.0061	0.0065	-0.0060	0.0065	-0.066**	0.0270
C146	-0.0109**	0.0013	-0.0109**	0.0013	-0.0088**	0.0042
C156	-0.0006	0.0030	-0.0006	0.0030	0.0031	0.0142
C17	0.007*	0.0042	0.007*	0.0042	0.0082	0.0180
C27	0.0071**	0.0029	0.007**	0.0029	0.0099	0.0117
C37	-0.0154**	0.0042	-0.0154**	0.0042	-0.0275	0.0179
C47	-0.0027	0.0037	-0.0026	0.0037	-0.025*	0.0163
C57	-0.0073*	0.0038	-0.0073*	0.0038	-0.0247*	0.0163
C67	0.0072	0.0067	0.0072	0.0068	0.137**	0.0318
C77	0.0077	0.0055	0.0077	0.0055	0.0475	0.0250
C87	0.0148**	0.0046	0.0148**	0.0046	0.0549*	0.0179
C97	0.0181**	0.0041	0.0181**	0.0042	0.0609**	0.0156
C107	0.0107**	0.0039	0.0107**	0.0039	0.0298	0.0137
C117	0.0018	0.0081	0.0018	0.0081	0.0107	0.0235
C127	0.0022	0.0090	0.0022	0.0090	-0.0267	0.0285
C137	-0.0159	0.0115	-0.0159	0.0115	-0.0376	0.0389
C147	-0.0031	0.0021	-0.0031	0.0021	0.0031	0.0059
C157	-0.0163**	0.0047	-0.0163**	0.0047	-0.0465*	0.0170
C18	-0.0156**	0.0035	-0.0156**	0.0035	0.0002	0.0192
C28	-0.0058**	0.0026	-0.0058**	0.0027	0.0138	0.0142
C38	-0.0234**	0.0038	-0.0233**	0.0038	-0.0389*	0.0195
C48	0.0010	0.0031	0.0010	0.0031	-0.0024	0.0191
C58	-0.0064**	0.0030	-0.0064**	0.0030	-0.029*	0.0177
C68	0.0694**	0.0069	0.0694**	0.0069	0.1417**	0.0331
C78	0.0502**	0.0049	0.0502**	0.0049	0.078**	0.0285
C88	0.0337**	0.0035	0.0337**	0.0035	0.0360	0.0188
C98	0.0276**	0.0030	0.0276**	0.0030	0.0563**	0.0167
C108	0.0133**	0.0026	0.0133**	0.0026	0.0212	0.0155
C118	0.0027	0.0068	0.0026	0.0067	0.0589	0.0371
C128	-0.0168**	0.0075	-0.0168**	0.0075	0.0324	0.0415
C138	-0.0171*	0.0091	-0.0171*	0.0091	0.0685	0.0537
C148	-0.0034**	0.0016	-0.0034**	0.0016	-0.0090	0.0065
C158	-0.0282**	0.0033	-0.0282**	0.0033	-0.0382	0.0190

* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

Table 2.13
Continued

Parameter	Monthly CPI based SL prices		Quarterly CPI based SL prices		Unity based SL prices	
	Estimate	Std. dev.	Estimate	Std. dev.	Estimate	Std. dev.
D11	0.0002	0.0053	0.0003	0.0053	0.0003	0.0046
D21	0.0029	0.0035	0.0029	0.0036	0.0029	0.0033
D31	-0.0054	0.0049	-0.0054	0.0049	-0.0055	0.0048
D41	0.0064	0.0044	0.0064	0.0044	0.0064*	0.0040
D51	0.0026	0.0043	0.0026	0.0043	0.0026	0.0039
D61	0.014*	0.0077	0.0141*	0.0077	0.0142	0.0069
D71	0.0117	0.0070	0.0117*	0.0070	0.0118	0.0061
D81	0.0132**	0.0053	0.0132**	0.0053	0.0132**	0.0041
D91	0.016**	0.0048	0.0161**	0.0048	0.0161**	0.0019
D101	0.0050	0.0045	0.0050	0.0045	0.0051	0.0016
D111	0.0191	0.0148	0.0190	0.0148	0.0189	0.0022
D121	0.0136	0.0155	0.0135	0.0156	0.0132	0.0030
D131	0.0325**	0.0161	0.0324**	0.0161	0.0325*	0.0034
D141	0.0006	0.0014	0.0006	0.0014	0.0007	0.0016
D151	-0.0024	0.0053	-0.0024	0.0053	-0.0025**	0.0011
D12	0.0029	0.0043	0.0029	0.0043	0.0028**	0.0014
D22	0.0056*	0.0027	0.0056*	0.0027	0.0056**	0.0029
D32	-0.0045	0.0036	-0.0045	0.0036	-0.0043	0.0049
D42	-0.0087**	0.0035	-0.0087**	0.0035	-0.0085**	0.0045
D52	-0.0055*	0.0033	-0.0055*	0.0033	-0.0053	0.0046
D62	-0.0025	0.0056	-0.0025	0.0056	-0.0028	0.0063
D72	-0.0032	0.0063	-0.0032	0.0063	-0.0030	0.0063
D82	-0.0019	0.0044	-0.0019	0.0043	-0.0019*	0.0044
D92	-0.0064	0.0043	-0.0064	0.0043	-0.0061**	0.0048
D102	-0.0042	0.0040	-0.0042	0.0040	-0.0039	0.0037
D112	-0.0030	0.0090	-0.0029	0.0090	-0.0037	0.0042
D122	-0.0172*	0.0099	-0.0172*	0.0099	-0.0184	0.0050
D132	0.0046	0.0119	0.0047	0.0119	0.0038	0.0047
D142	-0.0031**	0.0012	-0.0032**	0.0012	-0.0033	0.0011
D152	-0.0107**	0.0049	-0.0108**	0.0049	-0.0107**	0.0016
D13	0.0020	0.0050	0.0020	0.0050	0.0021	0.0049
D23	-0.0001	0.0031	-0.0002	0.0031	-0.0001	0.0030
D33	-0.0027	0.0042	-0.0027	0.0042	-0.0026	0.0045
D43	0.0016	0.0038	0.0016	0.0038	0.0017	0.0041
D53	0.0022	0.0036	0.0022	0.0036	0.0023	0.0039
D63	0.0094	0.0065	0.0093	0.0065	0.0093**	0.0067
D73	0.0059	0.0052	0.0059	0.0052	0.0061**	0.0053
D83	-0.0013	0.0046	-0.0014	0.0046	-0.0014	0.0047
D93	-0.0008	0.0048	-0.0008	0.0048	-0.0006	0.0047
D103	0.0013	0.0043	0.0013	0.0042	0.0015	0.0041

* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

Table 2.13
Continued

Parameter	Monthly CPI based SL prices		Quarterly CPI based SL prices		Unity based SL prices	
	Estimate	Std. dev.	Estimate	Std. dev.	Estimate	Std. dev.
D113	-0.0060	0.0125	-0.0061	0.0125	-0.0058	0.0099
D123	0.0022	0.0135	0.0022	0.0134	0.0023	0.0112
D133	0.0136	0.0133	0.0135	0.0133	0.0138*	0.0116
D143	-0.0043**	0.0011	-0.0043**	0.0011	-0.0043**	0.0012
D153	0.0068	0.0046	0.0068	0.0046	0.0068	0.0046
D14	0.0077*	0.0041	0.0077*	0.0041	0.0076	0.0037
D24	0.0002	0.0028	0.0002	0.0028	0.0002	0.0028
D34	0.0104**	0.0038	0.0104**	0.0038	0.0104*	0.0036
D44	-0.0012	0.0036	-0.0012	0.0036	-0.0011	0.0036
D54	0.0058*	0.0035	0.0058*	0.0035	0.0059	0.0034
D64	0.0438**	0.0062	0.0438**	0.0062	0.0439**	0.0058
D74	0.031**	0.0052	0.031**	0.0052	0.0313**	0.0045
D84	0.0318**	0.0046	0.0318**	0.0046	0.032**	0.0040
D94	0.0293**	0.0044	0.0293**	0.0044	0.0296**	0.0038
D104	0.0187**	0.0045	0.0187**	0.0045	0.0188**	0.0036
D114	0.0025	0.0110	0.0027	0.0110	0.0028	0.0065
D124	-0.0041	0.0119	-0.0039	0.0119	-0.0035	0.0074
D134	-0.0277**	0.0137	-0.0275**	0.0137	-0.0274	0.0089
D144	-0.0001	0.0010	-0.0001	0.0010	-0.0002	0.0014
D154	-0.0071	0.0045	-0.0071	0.0045	-0.0070	0.0037
D15	-0.0078	0.0059	-0.0077	0.0059	-0.0078	0.0055
D25	-0.0054	0.0041	-0.0054	0.0041	-0.0054	0.0040
D35	-0.0023	0.0052	-0.0023	0.0051	-0.0024	0.0051
D45	-0.0019	0.0051	-0.0019	0.0050	-0.0020	0.0051
D55	-0.0121**	0.0050	-0.0121**	0.0049	-0.0123**	0.0050
D65	-0.0357**	0.0084	-0.0356**	0.0084	-0.0355**	0.0084
D75	-0.0352**	0.0087	-0.0352**	0.0087	-0.0354**	0.0089
D85	-0.0357**	0.0064	-0.0357**	0.0064	-0.0358**	0.0062
D95	-0.026**	0.0059	-0.026**	0.0059	-0.0264**	0.0056
D105	-0.0165**	0.0054	-0.0165**	0.0054	-0.0169**	0.0049
D115	-0.0020	0.0142	-0.0021	0.0142	-0.0019	0.0092
D125	0.0082	0.0148	0.0082	0.0148	0.0083	0.0101
D135	-0.0215	0.0167	-0.0217	0.0167	-0.0218	0.0129
D145	0.0075**	0.0015	0.0075**	0.0015	0.0075**	0.0016
D155	0.0058	0.0064	0.0058	0.0064	0.0054	0.0060
D16	-0.0015	0.0032	-0.0014	0.0032	-0.0013	0.0031
D26	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017
D36	-0.0019	0.0024	-0.0019	0.0024	-0.0018	0.0023
D46	-0.0020	0.0022	-0.0020	0.0022	-0.0020	0.0021
D56	-0.0019	0.0022	-0.0019	0.0022	-0.0019	0.0021

* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

Table 2.13
Continued

Parameter	Monthly CPI based SL prices		Quarterly CPI based SL prices		Unity based SL prices	
	Estimate	Std. dev.	Estimate	Std. dev.	Estimate	Std. dev.
D66	0.0149**	0.0040	0.0149**	0.0040	0.0151**	0.0041
D76	0.0040	0.0041	0.0040	0.0041	0.0041	0.0040
D86	0.0032	0.0027	0.0032	0.0027	0.0032*	0.0026
D96	0.0029	0.0023	0.0029	0.0023	0.0029	0.0022
D106	0.0011	0.0026	0.0011	0.0026	0.0012	0.0025
D116	0.0041	0.0043	0.0040	0.0042	0.0038	0.0037
D126	0.0027	0.0057	0.0026	0.0057	0.0025	0.0051
D136	0.0131**	0.0056	0.0131**	0.0056	0.013**	0.0050
D146	-0.0005	0.0007	-0.0005	0.0007	-0.0005	0.0007
D156	-0.0008	0.0028	-0.0007	0.0028	-0.0008	0.0027
D17	-0.0003	0.0036	-0.0003	0.0036	-0.0002	0.0034
D27	-0.0007	0.0023	-0.0007	0.0023	-0.0006	0.0022
D37	0.0027	0.0035	0.0027	0.0034	0.0026	0.0033
D47	0.0050	0.0031	0.0049	0.0031	0.0049**	0.0031
D57	0.0039	0.0032	0.0039	0.0032	0.0038	0.0030
D67	-0.0282**	0.0063	-0.0281**	0.0063	-0.0282**	0.0062
D77	-0.0086*	0.0050	-0.0086*	0.0050	-0.0086	0.0048
D87	-0.0089**	0.0035	-0.0088**	0.0035	-0.0087	0.0033
D97	-0.0093**	0.0031	-0.0092**	0.0031	-0.0093*	0.0029
D107	-0.0041	0.0027	-0.0041	0.0027	-0.0041	0.0026
D117	-0.0017	0.0050	-0.0017	0.0050	-0.0019	0.0044
D127	0.0061	0.0058	0.0061	0.0058	0.0063	0.0053
D137	0.0046	0.0076	0.0046	0.0076	0.0046	0.0070
D147	-0.0012	0.0010	-0.0012	0.0010	-0.0013**	0.0010
D157	0.0062*	0.0033	0.0061*	0.0033	0.0065	0.0032
D18	-0.0034	0.0040	-0.0034	0.0040	-0.0035**	0.0038
D28	-0.0042	0.0028	-0.0042	0.0028	-0.0043	0.0027
D38	0.0037	0.0038	0.0037	0.0038	0.0034	0.0037
D48	0.0008	0.0038	0.0009	0.0038	0.0007	0.0037
D58	0.0051	0.0034	0.0051	0.0034	0.0049	0.0034
D68	-0.0158**	0.0065	-0.0158**	0.0065	-0.0159**	0.0066
D78	-0.0055	0.0061	-0.0056	0.0061	-0.0062	0.0057
D88	-0.0004	0.0039	-0.0004	0.0039	-0.0006	0.0037
D98	-0.0059*	0.0035	-0.0059*	0.0035	-0.0063	0.0033
D108	-0.0013	0.0032	-0.0013	0.0032	-0.0017	0.0031
D118	-0.0129	0.0080	-0.0129	0.0080	-0.0123	0.0076
D128	-0.0115	0.0089	-0.0115	0.0089	-0.0107	0.0085
D138	-0.0192*	0.0103	-0.019*	0.0103	-0.0185	0.0105
D148	0.0012	0.0011	0.0012	0.0011	0.0013	0.0012
D158	0.0023	0.0040	0.0023	0.0040	0.0022	0.0038

* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

Table 2.13
Continued

Parameter	Monthly CPI based SL prices		Quarterly CPI based SL prices		Unity based SL prices	
	Estimate	Std. dev.	Estimate	Std. dev.	Estimate	Std. dev.
A011	0.0239**	0.0041	0.0238**	0.0041	-0.2217	0.0181
A021	-0.0223**	0.0020	-0.0222**	0.0020	-0.0002	0.0031
A031	-0.0052**	0.0022	-0.0053**	0.0022	0.0124	0.0061
A041	-0.0095**	0.0022	-0.0095**	0.0022	0.0380	0.0097
A051	0.0075**	0.0029	0.0075**	0.0029	0.1272	0.0182
A061	-0.0007	0.0015	-0.0007	0.0015	-0.0037	0.0043
A071	0.0074**	0.0017	0.0074**	0.0017	0.0328	0.0033
A081	-0.0011	0.0019	-0.0011	0.0019	0.0152	0.0020
A012	-0.0223**	0.0020	-0.0222**	0.0020	-0.0002	0.0031
A022	0.0963**	0.0029	0.0963**	0.0029	-0.1121	0.0185
A032	-0.0233**	0.0019	-0.0232**	0.0019	-0.0019	0.0095
A042	-0.0142**	0.0019	-0.0143**	0.0019	0.0025	0.0048
A052	-0.0102**	0.0022	-0.0103**	0.0022	0.0134	0.0120
A062	-0.0023*	0.0013	-0.0022*	0.0013	-0.0169	0.0024
A072	-0.0019	0.0013	-0.0019	0.0013	0.0285	0.0041
A082	-0.0221**	0.0019	-0.0222**	0.0019	0.0867	0.0016
A013	-0.0052**	0.0022	-0.0053**	0.0022	0.0124	0.0061
A023	-0.0233**	0.0019	-0.0232**	0.0019	-0.0019	0.0095
A033	0.0177**	0.0036	0.0175**	0.0036	-0.3294	0.0335
A043	-0.0021	0.0019	-0.0021	0.0019	0.0724	0.0096
A053	0.0047**	0.0025	0.0047**	0.0025	0.0771	0.0220
A063	-0.0017	0.0012	-0.0017	0.0012	0.0073	0.0129
A073	0.0039**	0.0015	0.0039**	0.0015	0.0318	0.0030
A083	0.0061**	0.0018	0.0062**	0.0018	0.1301	0.0054
A014	-0.0095**	0.0022	-0.0095**	0.0022	0.0380	0.0097
A024	-0.0142**	0.0019	-0.0143**	0.0019	0.0025	0.0048
A034	-0.0021	0.0019	-0.0021	0.0019	0.0724	0.0096
A044	0.0435**	0.0038	0.0435**	0.0038	-0.2476	0.0194
A054	-0.0086**	0.0025	-0.0084**	0.0025	0.0431	0.0066
A064	0.0009	0.0013	0.0009	0.0013	0.0326	0.0051
A074	0.0019	0.0015	0.0019	0.0015	0.0189	0.0022
A084	-0.012**	0.0019	-0.0121**	0.0019	0.0401	0.0031
A015	0.0075**	0.0029	0.0075**	0.0029	0.1272	0.0182
A025	-0.0102**	0.0022	-0.0103**	0.0022	0.0134	0.0120
A035	0.0047**	0.0025	0.0047**	0.0025	0.0771	0.0220
A045	-0.0086**	0.0025	-0.0084**	0.0025	0.0431	0.0066
A055	0.0056	0.0052	0.0055	0.0051	-0.2910	0.0300
A065	0.0018	0.0016	0.0018	0.0016	0.0365	0.0071
A075	0.0057**	0.0022	0.0057**	0.0022	0.0409	0.0035
A085	-0.0065**	0.0023	-0.0066	0.0025	-0.0473	0.0012

* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

Table 2.13
Continued

Parameter	Monthly CPI based SL prices		Quarterly CPI based SL prices		Unity based SL prices	
	Estimate	Std. dev.	Estimate	Std. dev.	Estimate	Std. dev.
A016	-0.0007	0.0015	-0.0007	0.0015	-0.0037	0.0043
A026	-0.0023*	0.0013	-0.0022*	0.0013	-0.0169	0.0024
A036	-0.0017	0.0012	-0.0017	0.0012	0.0073	0.0129
A046	0.0009	0.0013	0.0009	0.0013	0.0326	0.0051
A056	0.0018	0.0016	0.0018	0.0016	0.0365	0.0071
A066	-0.0077**	0.0035	-0.0078**	0.0035	-0.2019	0.0174
A076	0.0133**	0.0023	0.0134**	0.0023	0.1381	0.0027
A086	-0.0037**	0.0011	-0.0037**	0.0010	0.0079	0.0017
A017	0.0074**	0.0017	0.0074**	0.0017	0.0328	0.0033
A027	-0.0019	0.0013	-0.0019	0.0013	0.0285	0.0041
A037	0.0039**	0.0015	0.0039**	0.0015	0.0318	0.0030
A047	0.0019	0.0015	0.0019	0.0015	0.0189	0.0022
A057	0.0057**	0.0022	0.0057**	0.0022	0.0409	0.0035
A067	0.0133**	0.0023	0.0134**	0.0023	0.1381	0.0027
A077	-0.0323**	0.0041	-0.0325**	0.0041	-0.3047	0.0014
A087	0.002*	0.0013	0.002*	0.0012	0.0137	0.0000
A018	-0.0011	0.0019	-0.0011	0.0019	0.0152	0.0020
A028	-0.0221**	0.0019	-0.0222**	0.0019	0.0867	0.0016
A038	0.0061**	0.0018	0.0062**	0.0018	0.1301	0.0054
A048	-0.012**	0.0019	-0.0121**	0.0019	0.0401	0.0031
A058	-0.0065**	0.0023	-0.0066**	0.0010	-0.0473	0.0017
A068	-0.0037**	0.0011	-0.0037**	0.0010	0.0079	0.0017
A078	0.002*	0.0013	0.002*	0.0012	0.0137	0.0000
A088	0.0374**	0.0031	0.0374**	0.0031	-0.2464	0.0065
G11	0.0528**	0.0063	0.0529**	0.0063	0.0532**	0.0037
G21	-0.0043	0.0025	-0.0045*	0.0025	-0.0046**	0.0007
G31	-0.0031	0.0031	-0.0031	0.0031	-0.0036*	0.0013
G41	-0.0095**	0.0032	-0.0095**	0.0032	-0.0103*	0.0020
G51	-0.0265**	0.0039	-0.0265**	0.0039	-0.0262	0.0036
G61	0.0006	0.0017	0.0007	0.0017	0.0007	0.0008
G71	-0.006**	0.0022	-0.0061**	0.0022	-0.0056	0.0007
G81	-0.0041	0.0025	-0.0040	0.0025	-0.0036**	0.0005
G12	-0.0043	0.0025	-0.0045*	0.0025	-0.0046**	0.0007
G22	0.0449**	0.0039	0.045**	0.0039	0.0453	0.0038
G32	-0.0051**	0.0024	-0.0053**	0.0024	-0.0047	0.0019
G42	-0.0037	0.0024	-0.0037	0.0024	-0.0036	0.0010
G52	-0.0048**	0.0028	-0.0046**	0.0028	-0.0051	0.0025
G62	0.0031*	0.0017	0.003*	0.0017	0.0031	0.0005
G72	-0.0066**	0.0016	-0.0067**	0.0016	-0.0067	0.0009
G82	-0.0234**	0.0023	-0.0234**	0.0023	-0.0237	0.0004

* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

Table 2.13
Continued

Parameter	Monthly CPI based SL prices		Quarterly CPI based SL prices		Unity based SL prices	
	Estimate	Std. dev.	Estimate	Std. dev.	Estimate	Std. dev.
G13	-0.0031	0.0031	-0.0031	0.0031	-0.0036*	0.0013
G23	-0.0051**	0.0024	-0.0053**	0.0024	-0.0047	0.0019
G33	0.0737**	0.0052	0.074**	0.0052	0.0752*	0.0067
G43	-0.0157**	0.0026	-0.0159**	0.0026	-0.0162	0.0019
G53	-0.0149**	0.0032	-0.0149**	0.0032	-0.0157	0.0044
G63	-0.0026*	0.0013	-0.0026*	0.0013	-0.0021	0.0025
G73	-0.0059**	0.0018	-0.0059**	0.0018	-0.0060	0.0006
G83	-0.0264**	0.0024	-0.0265**	0.0024	-0.0268*	0.0011
G14	-0.0095**	0.0032	-0.0095**	0.0032	-0.0103*	0.0020
G24	-0.0037	0.0024	-0.0037	0.0024	-0.0036	0.0010
G34	-0.0157**	0.0026	-0.0159**	0.0026	-0.0162	0.0019
G44	0.0628**	0.0060	0.0631**	0.0060	0.0634**	0.0040
G54	-0.0121**	0.0034	-0.0122**	0.0033	-0.0112	0.0014
G64	-0.006**	0.0016	-0.006**	0.0016	-0.0068	0.0010
G74	-0.004**	0.0019	-0.004**	0.0019	-0.0038	0.0005
G84	-0.0118**	0.0025	-0.0118**	0.0025	-0.0116**	0.0007
G15	-0.0265**	0.0039	-0.0265**	0.0039	-0.0262	0.0036
G25	-0.0048**	0.0028	-0.0046**	0.0028	-0.0051	0.0025
G35	-0.0149**	0.0032	-0.0149**	0.0032	-0.0157	0.0044
G45	-0.0121**	0.0034	-0.0122**	0.0033	-0.0112	0.0014
G55	0.0641**	0.0068	0.0642**	0.0067	0.0644*	0.0060
G65	-0.007**	0.0017	-0.007**	0.0017	-0.0074	0.0014
G75	-0.0077**	0.0027	-0.0079**	0.0027	-0.0076	0.0007
G85	0.0089**	0.0030	0.0088**	0.0025	0.0088**	0.0003
G16	0.0006	0.0017	0.0007	0.0017	0.0007	0.0008
G26	0.0031*	0.0017	0.003*	0.0017	0.0031	0.0005
G36	-0.0026*	0.0013	-0.0026*	0.0013	-0.0021	0.0025
G46	-0.006**	0.0016	-0.006**	0.0016	-0.0068	0.0010
G56	-0.007**	0.0017	-0.007**	0.0017	-0.0074	0.0014
G66	0.0408**	0.0040	0.0409**	0.0039	0.0419	0.0033
G76	-0.0264**	0.0026	-0.0264**	0.0026	-0.027**	0.0005
G86	-0.0026*	0.0014	-0.0025	0.0013	-0.0025**	0.0004
G17	-0.006**	0.0022	-0.0061**	0.0022	-0.0056	0.0007
G27	-0.0066**	0.0016	-0.0067**	0.0016	-0.0067	0.0009
G37	-0.0059**	0.0018	-0.0059**	0.0018	-0.0060	0.0006
G47	-0.004**	0.0019	-0.004**	0.0019	-0.0038	0.0005
G57	-0.0077**	0.0027	-0.0079**	0.0027	-0.0076	0.0007
G67	-0.0264**	0.0026	-0.0264**	0.0026	-0.027**	0.0005
G77	0.0592**	0.0050	0.0594**	0.0050	0.0592**	0.0003
G87	-0.0025	0.0016	-0.0026*	0.0016	-0.0026**	0.0002
G18	-0.0041	0.0025	-0.0040	0.0025	-0.0036**	0.0005
G28	-0.0234**	0.0023	-0.0234**	0.0023	-0.0237	0.0004
G38	-0.0264**	0.0024	-0.0265**	0.0024	-0.0268*	0.0011
G48	-0.0118**	0.0025	-0.0118**	0.0025	-0.0116**	0.0007
G58	0.0089**	0.0030	0.0088**	0.0025	0.0088**	0.0003
G68	-0.0026*	0.0014	-0.0025	0.0013	-0.0025**	0.0004
G78	-0.0025	0.0016	-0.0026**	0.0050	-0.0026**	0.0002
G88	0.0619**	0.0047	0.0619**	0.0047	0.0619**	0.0014

* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

CHAPTER THREE

Estimating Food Demand in Ecuador from Household-Level Data

3.1. Introduction

Demand elasticities are the main output from the estimation of demand systems. For instance, these estimates can be used to analyze consumption patterns (Gao *et al.*, 1996), international trade movements (Boonsaeng *et al.*, 2008), and to formulate policy recommendations (Nzuma and Sarker, 2010). Most demand systems allow for the indirect utility and cost functions to be recovered, thereby making possible the conduction of welfare analyses (West and Williams, 2004).

Estimation of demand systems from cross-sectional data has been rather common in countries such as the United Kingdom and the United States where national household-level surveys have been collected annually since 1957 and 1980, respectively. Nevertheless, the conduction of these surveys in developing countries is a recent phenomenon. For instance, the *Encuesta de las Condiciones de Vida* (ECV) for Ecuador, a national household survey that collects information on major items of expenses and demographic characteristics, was carried out for the first time in 1994. Availability of similar surveys for other developing countries has allowed, in recent years, demand systems to be estimated for these countries. Examples include the study conducted by Jensen and Manrique (1998) for Indonesia, and by Alfonzo and Peterson (2006) for Paraguay. Demand elasticities and indirect utility or cost functions obtained from estimated demand models can be used to analyze consumption patterns (Gao *et al.*, 1996) and to analyze policies (Nzuma and Sarker, 2010; West and Williams, 2004).

According to the 2010 food security indicators published by the FAO (Food and Agriculture Organization), the share of food for Ecuador in total 2005 expenditures was of 30.6%. This share is relatively high when compared with countries such as the United States or Chile, where the share is of 13.9% and 22.5%, respectively. The high food share expenditure level by Ecuadorian households makes relevant the identification of factors affecting food consumption to better evaluate and formulate governmental food policies.

To date, the only estimates of food demand elasticities for Ecuador is a 1994 study of urban households conducted by the Ecuadorian Department of Agriculture (see Criollo, 1994). The study computed own-price, cross-price and expenditure elasticities for 52 food disaggregated commodities and 11 food commodity groups, employing a procedure introduced by Frisch (1959). The procedure is computationally simple and suitable for situations where data availability is limited, since it allows cross-price and own-price elasticities of a group of goods to be estimated from their expenditure elasticities. The Frisch procedure is valid under a set of very restrictive assumptions. For instance, the procedure restricts all goods to be Hicks-Allen substitutes, rules out inferior goods and imposes a proportionality rule between expenditure and price elasticities (see Deaton and Muellbauer, 1980:138). This procedure can be used when applied to broad categories of goods (Deaton, 1974), but this is not the case for the 1994 Ecuadorian elasticity estimates.

Advancements in consumer demand theory now allow for the estimation of demand systems from household level data that are consistent with theoretical conditions and are not subject to the strong separability assumption imbedded in Frisch's (1959) method. Examples include Deaton and Muellbauer's (1980) AIDS model and Lewbel and Pendakur's (2009) EASI demand system.

Using data from the 2005-2006 Ecuadorian ECV survey, we estimate a system of demand equations for nine food commodity groups using Deaton and Muellbauer's (1980) AIDS model. The assumption of weak separability allows us to analyze the food demand system problem independently of non-food demands. The estimated demand system controls for two major limitations when using household survey data: 1) lack of information on commodity's prices, and 2) presence of households reporting zero expenditure for several commodity groups.

Given likely differences between elasticity estimates for rural and urban areas (Alfonzo and Peterson, 2006) we estimate three different demand systems: one for the entire population, one for households in rural areas, and one for households in urban locations. Demand elasticities and marginal effects are derived for each system.

The remainder of this article is organized as follows. In the next section we discuss model specification, followed by a brief description of the Ecuadorian data set used. Next, we comment on the estimation procedures and then discuss and present the estimated results. Concluding remarks and an appendix are provided at the end of the document.

3.2. Conceptual framework

3.2.1. AIDS (Almost Ideal Demand System)

The parametric demand system, selected for estimation is Deaton and Muellbauer's (1980) Almost Ideal Demand System (AIDS). The estimated system is derived by assuming preferences are of the PIGLOG class (see Muellbauer, 1976), which allows for exact aggregation of market demands across consumers. In the AIDS model, the uncompensated (Marshallian) demand in budget-share equation is specified as (Deaton and Muellbauer, 1980):

$$w_{it} = \alpha_i + \sum_k \gamma_{ik} \log p_k + \beta_i \log\left\{{}^{x_t}/_{P}\right\} + \varepsilon_{it}, \qquad (1)$$

where $\log P = \alpha_o + \sum_k \alpha_k \log p_k + \frac{1}{2}\sum_j \sum_k \gamma_{kj} \log p_k \log p_j$,

where for the i^{th} equation and the t^{th} observation, w_{it} is the demand budget share, x_t is total nominal expenditures, p_k is the price estimate for commodity group k, $\log P$ is a price index, and the $\alpha_k's$, $\beta_i's$, $\gamma'_{kj}s$, and α_o are parameters to be estimated.

The theoretical parameter restrictions for equation (1) are:

a) Adding-up which requires

$\sum_i \alpha_i = 1,\ \sum_i \beta_i = 0,\ \sum_k \gamma_{ik} = 0\ \forall\ i;$

b) Homogeneity is satisfied if

$\sum_k \gamma_{ik} = 0\ \forall\ k$; and

c) Symmetry requires

$\gamma_{ik} = \gamma_{ki}\ \forall\ i\ and\ k.$

The equations used to derive own and cross-price elasticities for the AIDS model are given by

$$\varepsilon_{ik} = \frac{\gamma_{ik} - \beta_i[w_i - \beta_i \log(x/P)]}{w_i} - \delta_{ik}, \qquad (2)$$

where ε_{ik} is the uncompensated (Marshallian) demand elasticity for good *i* with respect to the price of good *k*, and δ_{ik} is the kronecker delta. The equation for expenditure elasticity of the i^{th} good (η_i) is given by

$$\eta_i = \frac{\beta_i}{w_i} + 1. \tag{3}$$

To incorporate demographic characteristics into our system of equations, the $\alpha_i{}'$s terms in equation (1) can be written as a linear function of demographic variables, such that $\alpha_i = \alpha_i^{\circ} + \sum_{l=1}^{M} \sigma_{il} z_{lt}$, where z_{lt} is a demographic characteristic *l* for observation *t*, and the $\sigma_{il}{}'s$ are parameters to be estimated (Pollak and Wales, 1981). Thus, the demand equations to be estimated have the following form:

$$w_{it} = \alpha_i^{\circ} + \sum_{l=1}^{M} \sigma_{il} z_{lt} + \sum_k \gamma_{ik} \log p_k + \beta_i \log\left\{ {x_t}/{P_t} \right\} + \varepsilon_{it}, \tag{4}$$

where $\log P_t = \alpha_o + \sum_k \left(\alpha_k^{\circ} + \sum_{l=1}^{M} \sigma_{kl} z_{lt} \right) \log p_k + \frac{1}{2} \sum_j \sum_k \gamma_{kl} \log p_k \log p_j.$

In equation (4), the incorporation of socio-demographic characteristics only affects the theoretical adding-up condition which requires that the $\sum_i \alpha_i^{\circ}$ rather than $\sum_i \alpha_i$ be set equal to one. The additional condition of $\sum_i \sigma_{il} = 0$ is also needed[12].

Marginal effects of socio-demographic characteristics on good expenditures are given by

$$\theta_{ji} = \sigma_{ji} - \beta_j \sum_{k=1}^{N} \sigma_{ki} \log p_k , \tag{5}$$

where θ_{ij} represents the change in total expenditures for the j^{th} good given a one unit change in the i^{th} demographic characteristic. We use marginal effects on total good

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[12] Alston *et al*. (2001) showed that a system of equations of the form in (4) is not Close Under Units of Scaling (CUUS). To test the sensibility of our model to this limitation, we estimated a demand system while rescaling all prices by its mean. We found our results to be robust to this transformation.

expenditures instead of marginal effects on the share or quantities since they are easier to interpret.

3.2.2. Quality corrected prices

The majority of national household surveys, such as the one used in this study, only collect data on quantities and expenditures for goods purchased but not on good prices. A first approximation to a price estimate for the groups is given by the quotient of total expenditures and quantities (unit value). However, as Deaton (1988) note, this price estimate is only valid for homogeneous goods. Thus, if the aggregate good is composed by several heterogeneous commodities (e.g., total beef consumption is composed by different types of cuts) the variation in the estimated unit price reflect quality differences due to heterogeneous households preferences.

As shown by Deaton (1988) and Cox and Wohlgenant (1986) the variation in unit values can be decomposed in two components: a price index capturing variation in prices from the supply side, and a quality component capturing variation in prices due to household purchasing decisions. This relationship is expressed in equation (6), where the natural log of the unit value for some commodity *i* at a cluster *C* (V_c^i) is given by

$$\log V_c^i = \log \pi_c^i + \log \lambda_c^i, \qquad (6)$$

where π_c^i is a measure of the price level of the goods within commodity group *i* at cluster *C*, and λ_c^i is a measure of quality, defined as the average cost per unit of commodity *i* at location *C* once price-level differences across clusters have been taken into account.

Thus, if the unit value V_c^i where to be used as estimate for the price index of the i^{th} commodity group, additional variation would be incorporated due to quality choices (λ_c^i).

Consequently, π_c^i and not V_c^i is to be preferred as an approximation for commodity group price indices.

3.3. Data

3.3.1. Description

Data used in this study comes from the fifth Ecuadorian National Household Survey (*Encuesta de las Condiciones de Vida,* (ECV)) collected by the Ecuadorian National Institute of Censuses and Statistics (INEC) during September 2005 to September 2006.

The survey collected information on expenditures and quantities of 100 food commodities during a two-week period. The survey also collected information on socio-demographic characteristics of household participants. A total of 13,535 households participated in the survey.

To simplify the analysis, the 100 individual food commodities were aggregated into nine commodity groups using as criteria the nutritional composition of the food commodities. The nine groups used include: 1) Cereal and Bakery products, 2) Meats and Eggs, 3) Vegetables, 4) Fruit, 5) Dairy, 6) Fats and Oils, 7) Pulses, 8) Meal complements, and 9) Nonalcoholic Beverages.

Observations with missing socio-demographic variables and households reporting zero total food expenditures were deleted from the dataset. Households including more than one family were also were also dropped. The final dataset used in the analysis contained information on 8,258 households (68% urban areas and 32% in rural areas).

3.3.2. Summary Statistics

Summary statistics of the budget shares of the nine commodity groups used in the study are reported in Table 3.1. The censoring level was especially high for the groups of Pulses, Non alcoholic Beverages, and Sugars. We believe the high level of censoring in these groups is due to the short surveying period and the non-perishable nature of the commodities, that is, the observation period is very short to fully observe consumption purchases for these commodity groups.

The groups of Cereals and Meats collectively represent about 50% of total food expenditures. The expenditure share for these groups is about equal for rural households, whereas; urban households' expenditure share for meats nearly doubles the cereal share.

Socio-demographic variables used in the analyses and their summary statistics are shown in Table 3.2. The summary statistics reveal prominent differences between rural and urban households. Whereas agriculture is the main economic activity for the majority of rural household heads (56%), only 6% of household heads in urban areas work in agriculture. Rural household heads are also less educated than urban household heads. Rural households have more members and are more likely to have children. The food expenditure share of total income is higher for rural households.

<u>3.4. Estimation Procedures</u>

3.4.1 Quality-corrected unit values

Quality-corrected unit value prices were estimated using the approach suggested by Alfonzo and Peterson (2006). The procedure specifies the natural log of the unit value

($\log V_c^i$) for some commodity group i in cluster C, to be a function of annual income (y), demographic characteristics $(z_l{}'s)$, and cluster dummies (D), such that

$$\log V_c^i = \alpha_i + \beta_i \log y + \sum_{l=1}^{L} k_{il}\, z_l + \sum_{c=1}^{C-1} \varphi_{ic}\, D_c + v_i, \quad (7)$$

where v_i is the stochastic component and the cluster dummies control for the city the household resides (441 cities in this study). The part of the variation captured by y and $z_l{}'s$ accounts for the variation of preferences across households ($\log \lambda_c^i$ in equation 6) and the variation captured by the D_c's accounts for regional price variation due to supply side factors ($\log \pi_c^i$ in equation 4). Once the Ordinary Least Squares (OLS) parameter estimates of the parameters in (7) are obtained, estimates of $\log \pi_c^i$ (i.e., quality corrected unit values) are calculated by

$$\log \pi_c^i = \hat{\alpha}_i + \sum_{c=1}^{C-1} \hat{\varphi}_{ic}\, D_c. \quad (8)$$

Summary statistics for log unit values and log quality-corrected unit values for the uncensored observations are presented in Table 3.3. Notice that the correction for quality does not change the mean of the estimates but reduces their variation.

3.4.2 Censored AIDS model

The fact that several households reported zero consumption of one or more commodity groups hampers the estimation of a demand system of the form in (4). Several procedures have been proposed to address this problem, most of them departing from Tobin's (1958) censored regression model. In this study we use Shonkwiler and Yen's (1999) two-step procedure (henceforth SY procedure) to control for reported zero consumption.

The SY procedure is formalized as follows. Consider the following system of equations:

$$w_{it}^* = f(\boldsymbol{p}, \boldsymbol{z}_t, x_t;\ \boldsymbol{\theta}_i) + \varepsilon_{it} \qquad d_{it}^* = \boldsymbol{s}_t'\boldsymbol{\rho}_i + \mu_{it} \tag{9}$$

$$d_{it} = \begin{cases} 1\ if\ d_{it}^* > 0 \\ 0\ if\ d_{it}^* \leq 0 \end{cases} \qquad w_{it} = d_{it} w_{it}^* \tag{10}$$

$$(i = 1, 2, \ldots, N; t = 1, 2, \ldots, T),$$

where, for the i^{th} commodity and the t^{th} observation, w_{it}^* and d_{it}^* are latent dependent variables for the demand budget share and the sample decision process, respectively; d_{it} and w_{it} are the observed dependent variables; $f(\boldsymbol{p}, \boldsymbol{z}_t, x_t;\ \boldsymbol{\theta}_i)$ represents a demand equation of the form in (4), where $\boldsymbol{p}$ is a vector of prices, $\boldsymbol{z}_t$ is a vector of socio-demographic characteristics, x_t is total nominal expenditures, and $\boldsymbol{\theta}_i$ is a vector of parameter estimates; $\boldsymbol{s}_t$is a vector of socio-demographic characteristics explaining the sample selection process, and $\boldsymbol{\rho}_i$ is the vector of parameters for the sample selection equation.

The estimation procedure consists of the following steps: 1) Maximum likelihood probit estimates are obtained for $\boldsymbol{\rho}_i$; 2) the parameter estimates for the sample selection equation are used to estimate $\widehat{\Phi}_{it}$ and $\hat{\phi}_{it}$, which represent estimates for the cdf and pdf of μ_{it}; and 3) estimates for the parameters in $\boldsymbol{\theta}_i$ are obtained using equations of the form:

$$w_j = \widehat{\Phi}_{it}\left(\alpha_i^{\circ} + \textstyle\sum_{l=1}^{M} \sigma_{il}\, z_{lt} + \sum_k \gamma_{ik} \log p_k + \beta_i \log\left\{{}^{x_t}/_{P_t}\right\}\right) + \delta_i \hat{\phi}_{it} + \varepsilon_{it}, \tag{11}$$

we will refer to equation (11) as the censored AIDS demand equation for commodity group *i*.

Formulas for uncompensated demand and expenditure elasticities, and marginal effects presented in (2), (3) and (5) need to be modified to account for the censoring problem (Yen *et al.*, 2002; Yen and Lin, 2006). The price and expenditure elasticities are given by:

$$\varepsilon_{ik}^{c} = \frac{\hat{\Phi}_i}{w_i}\left(\gamma_{ij} - \beta_i\left(\alpha_j^{\circ} + \sum_{l=1}^{M}\sigma_{jl}z_l + \sum_{k=1}^{N}\gamma_{jk}\log\pi_k\right)\right) + w_j - \delta_{ij}, \quad (12)$$

$$\eta_i^c = \frac{\hat{\Phi}_i}{w_i}\beta_i + 1. \quad (13)$$

Marginal effects of socio-demographic characteristics on good expenditures in the censored AIDS are calculated as:

$$\theta_i^c = x\left(\left[\hat{\phi}_i * \rho_{ij} * \left(\alpha_j^{\circ} + \sum_{l=1}^{M}\sigma_{il}z_l + \sum_{k=1}^{N}\gamma_{ik}\log\pi_k + \beta_i\log\left(\frac{x}{P}\right)\right) + \left(\sigma_{ij} - \beta_i\sum_{k=1}^{N}\sigma_{kj}\log\pi_k\right) * \hat{\Phi}_i\right] + \delta_i * (\boldsymbol{s}_i'\hat{\boldsymbol{\rho}}_i) * \hat{\phi}_i * \rho_{ij}\right), \quad (14)$$

where the superscript *c* denotes censored, δ_{ij} is the kronecker delta, and marginal effects θ_i^c are derived for some socio-demographic variable that appears both, in the AIDS and probit equation[13].

The SAS MODEL procedure was used to estimate parameters in (11) using Iterated Seemingly Unrelated Regression (ITSUR) procedures. Three demand systems were estimated, one for the entire population, one for the urban households and a third for rural households. All demand systems are estimated using all *N* equations. The simultaneous estimation of all *N* equations is possible provided that a system of equations of the form in (11) does not have a singular variance-covariance matrix of residuals (Yen *et al*., 2002; Drichoutis *et al*., 2008).

To account for the endogeneity of nominal expenditures (log x) (La France, 1991), the procedure suggested by Blundell and Robin (2000) is used to augment

[13] A detailed derivation of the censored demand elasticities and marginal effects is provided in appendix 3.1.

equation (11) with the error term ϵ from a reduced specification of *x*. The error term ε_i in equation (11) is rewritten as the orthogonal decomposition $\varepsilon_i = \varphi_i \epsilon + u_i$ such that $E(u_i | lnx, z_1, \dots, z_m, \log p_1, \dots, \log p_n) = 0$.

The reduced form of *x* follows Blundell and Robin's (2000) specification, and is defined as

$$\log x = \log y + \log y^2 + \sum_{k=1}^{N} \gamma_k \log p_k + \sum_{h=1}^{H} \tau_h m_h + \epsilon, \tag{15}$$

where y is household annual income, m_h is some socio-demographic characteristic h, and ϵ is a random error. The hypothesis that the $\varphi_j{}'s$ parameters are different from zero is used to test the endogeneity of x (Blundell and Robin, 2000; Boonsaeng et al., 2008).

3.4.3 Standard Errors in the Censored AIDS model

Standard errors for the parameters, elasticities, and marginal effect were estimated using bootstrapping procedures with 900 replications (see Alfonzo and Peterson, 2006; and Wooldridge, 2002:379).The bootstrapping procedure accounts for the fact that quality-corrected unit values ($\log \pi_c^i$) and the cumulative and probability density functions (Φ and ϕ) in (11) are predicted values obtained from auxiliary regressions. The procedure also accounts for the fact that the errors in equation (11) are heteroskedastic (Shonkwiler and Yen, 1999; Murphy and Topel, 1985).

<u>3.5. Results</u>

The null hypothesis that nominal expenditure is exogenous is rejected (5% level) in eight of the nine demand equations in the systems for the full and urban samples, and in six of the nine demand equations in the system for the rural sample.

The symmetry and adding-up restrictions were tested and imposed in our censored AIDS demand systems. Homogeneity is not tested nor imposed, as it is automatically satisfied if the symmetry and adding-up conditions hold. Results for tests of these conditions are summarized in Table 3.4. Wald tests rejected the null hypotheses that symmetry and adding-up conditions were satisfied in the three demand systems. Thus, parameter estimates from the restricted demand systems were used for estimation of elasticities and marginal effects.

3.5.1 Full sample's elasticity estimates

Own-price, cross-price, and expenditure elasticities for the estimated demand system using the full sample is detailed in Table 3.5. Elasticities are reported for the average household. Consistent with theory, all own-price elasticities are found to be negative and significant at a 5% level. None of the own-price elasticities is larger than one, indicating that the average consumer's response to a change in the own price is inelastic for all food groups. This result might be due to the high level of aggregation; broad commodity groups have fewer substitutes than individual commodities. In particular, the own-price elasticity for the groups of Meats, Cereals, Vegetables, and Fats are the most inelastic.

Expenditure elasticities are all positive, ruling out the possibility of inferior goods. This result is expected, given the broad level of aggregation. Most expenditure elasticities are close to one, however, those for the groups of Vegetables, Fruits, and Nonalcoholic beverages are larger than one; indicating these groups are luxuries.

Out of our 72 cross-price elasticities, 62 were significant at a 5% level. In most cases, the cross-commodity relationships indicate substitutability between groups. Specifically, we observe substitutability between the groups of Cereals and Meats, Dairy and Meats, Pulses and Meats, Pulses and Cereals, and Vegetables and Fruits. All of these relations are consistent with nutritional expectations.

In Table 3.6 we compare our elasticity estimates with those provided by Criollo (1994) for Ecuador, for the nine food groups: 1) Cereals & by-products, 2) Meats & by-products, 3) Fresh Vegetables, 4) Fresh Fruits, 5) Dairy & Eggs, 6) Fats & Oils, 7) Pulses & by-products, 8) Sugar & Seasonings, and 9) Coffee & Drinks. Own-price elasticities for the groups of Cereals, Meats, Vegetables, Fruit, Dairy, and Nonalcoholic beverages from our study are much more inelastic than the values reported by Criollo (1994). Our estimates of expenditure elasticities for the groups of Meats, Nonalcoholic beverages, Pulses, and Dairy are close to the ones presented by Criollo (1994). All cross-price elasticities from Criollo (1994) indicate a complementary relation across groups. Because Criollo's (1994) approach restricted all goods to be Hicks-Allen substitutes; this implies that for all cross-effects the income effect must have outweighed the substitution effect. Thus; major differences exist between our elasticity estimates and those presented by Criollo's (1994) less flexible approach.

A direct comparison of our results with other published results is difficult given notable differences in the commodity groups included in the demand systems, so we limit our comparison to those studies that analyzed commodities similar to those included in this study. Alfonzo and Peterson (2006) in a Paraguay food demand study estimate own-price elasticities for the groups of Cereals, Nonalcoholic beverages, and Fruits which are similar to those estimated in this study. However, own–price elasticities for the Vegetables and Fats & Oils groups found by these authors are more inelastic than ours. Comparison of elasticities for the Meats group is more difficult since their Meat group had more disaggregated categories. Though, their cross-price effects generally indicated a complementary relationships between the groups of food (contrary to our findings), most of their estimated elasticities were not significantly different from zero.

Dong *et al*. (2004) report uncompensated demand elasticities for food commodities in Mexico. Again, conspicuous differences exist in the chosen commodity groups and aggregation level that hamper a direct comparison across studies. Nevertheless, their own-price elasticity for Grains, as ours, is one of the most inelastic relative to the other commodity groups. Their own-price elasticities for the groups of Vegetables and Fruits are relatively close to our estimates for these two groups.

We also compared our elasticities with those reported by Lemma *et al*. (2007) for food commodities in Argentina, Paraguay and Bolivia. Of the eleven commodities considered in their analysis, only three groups were similar to our commodity groups. For these three groups in common in the two studies the estimated elasticities differed. Own-price elasticity estimates for Sugar, Milk, and Oil reported for Argentina and Paraguay are more inelastic than our estimates for the groups of Meal Complements, Dairy, and Fats & Oils, respectively. On the other hand, own-price elasticity estimates of the same groups for Bolivia are much more elastic than ours.

In short, even though we found some similar elasticities of demand for certain commodity groups between Ecuador and other neighboring countries, we also found strong differences for particular commodity groups. In most cases, we could not fully compare elasticity estimates between studies given the differences in the commodities considered from one study to another.

3.5.2 Rural and urban samples' elasticity estimates

Separate elasticity estimates for urban and rural areas are provided in Tables 3.7 and 3.8, respectively. In both areas all own-price elasticities are negative and significant at a 5% level. However, rural household demand is more elastic than for urban households, for the groups of Cereals, Meats, Vegetables, and Fruits.

None of the commodity is income inferior. Vegetables are considered a luxury good for both rural and urban households. The Fruit and Dairy groups are luxuries for urban households and necessities for rural households. On the other hand, Pulses, Meal complements, and Nonalcoholic beverages are luxuries for the rural households and necessities for the urban households.

For the 72 cross-price elasticity estimates, 39 were statistically significant (at a 5% level) for urban households, and 63 proved to be significant for rural households. For both, the estimated rural and urban systems, a greater number of complementary relations exist between commodities than exist when only an aggregated demand system is stated. For instance, while all groups were substitutes in the aggregated demand system, the groups of Meats and Cereal are complements for the urban households. The same is true for the groups of Fruits and Vegetables. Moreover, while rural households consider the groups of Cereals and Vegetables to be complements, urban households see them as substitutes.

Differences between elasticities for the urban and rural households highlight the relevance of estimating different demand systems for each sample.

3.5.3 Marginal effects

Estimates for marginal effects for the full, urban, and rural samples are provided in Tables 3.9, 3.10, and 3.11, respectively. The marginal effects of the dummy variables are measured, *ceteris paribus,* relative to those of the base (omitted) category (Amazon region, college graduate, interviewed between Oct. and Dec.). For instance, from Table 8 we see that a household located in the Andean region spends $3.39 less in Cereals and bakery products than a household located in the Amazon region, *ceteris paribus*.

Of the 90 marginal effects estimated for each demand system only a few were significant. This result seems to imply that after controlling for prices and expenditures, socio-demographic characteristics do not explain much of the variability in the demand for food products.

We now discuss the statistically significant marginal effect estimates (5% level) which are economically relevant (how big is the change in group expenditures relative to the mean expenditures in the group). From Table 8, we observe that less educated households spend less on Dairy products than more educated households. In particular, families with a head of household who is a college graduate spend $1.82 more in the Dairy category than those with a head of household who has, at most, elementary education. Regional differences across the population are also observable. Households in the Coast region spend more on Meat and Dairy than households in the Andean and Amazon regions. Households in the Amazon region consume the most cereals. Moreover, the proportion of children is observed to be the strongest determinant in consumption choices. An increase in the proportion of children is associated with an increase in expenditures on the Meats, Vegetables, Fruit, and Dairy groups.

3.6. Summary and Conclusions

This study examined food demand behavior of Ecuadorian households, via the estimation of food demand elasticities and marginal effects for the general population. A national demand system was estimated, as well as, separate sub-national systems for urban and rural areas. The AIDS model was used to estimate all three demand systems. Two-step estimation procedures are employed to isolate quality effects from unit values and to account for the potential endogeneity of nominal expenditures. The two-step estimation procedure from Shonkwiler and Yen (1999) is used to control for limited response variables.

Our results showed negative own-price and positive expenditure elasticities for all commodity groups. Most estimates are significant at the 5% level and present magnitudes with reasonable ranges. Results from the urban and rural systems presented similar expenditure elasticity estimates; although, substantial differences in own-, and cross-price elasticity estimates were found at the sub-national level. These differences might be explained by: 1) differences in tastes and cultural preferences, and 2) differences in the food distribution system (rural households might obtain food from non-market sources). Commodity specific policies, should account for such differences.

For instance, the fact that most expenditure elasticities between urban and rural households presented similar values suggests that food policy interventions that affect income need not to be different between urban and rural populations. On the other hand, differences found for own-price elasticities for major groups of consumption indicate the necessity to differentiate policy interventions that differentially affect commodity prices between urban and rural populations.

Potential research questions can be drawn from our marginal effect estimates. For instance, households in the Amazon region spend less on the groups of Meats, Vegetables, and Fruits than households in the Andean and Coast region, *ceteris paribus*. Thus, a study could be conducted to examine the existence of nutritional deficiencies in these groups for households located in the Amazon region.

The Ecuadorian national household survey provides enough information to estimate demand elasticities for more disaggregated groups than those considered in this study. For example, future research could focus on the estimation of demand elasticities for subsistence commodities produced in Ecuador's rural areas. Knowledge of cross-price elasticities for these commodities would allow the conduction of welfare analyses for the rural population (e.g., Tefera *et al*., 2012). Similarly, demand studies considering a higher level of aggregation could be conducted to establish relationships between food commodities and other major groups of expenses such as clothing, education, housing, etc. (e.g., Regmi and Seale, 2010).

Table 3.1
Commodity groups' composition and summary statistics

Commodity groups	Individual Food Commodities in Original Survey	All population			Urban			Rural		
		Mean Total Expenditures	Mean budget share	Level of censoring	Mean Total Expenditures	Mean budget share	Level of censoring	Mean Total Expenditures	Mean budget share	Level of censoring
Cereals & Bakery	rice, barley rice, oat, noodles, crackers, broad bean flour, corn flour, plantain flour, wheat flour, machica, mote, bread, quinoa, breakfast cereal, ripe plantain, green plantain, potatoes, cassava	6.06	20%	6%	5.54	18%	8%	7.19	26%	2%
Meats & Eggs	lamb, pork, beef, beef entrails, chicken, chicken breasts, chicken giblets, sausage, ham, bologna sausage, sausage, fresh fish, tuna, shrimp, shell, eggs	9.66	31%	4%	10.43	34%	5%	7.99	27%	3%
Vegetables	ulluco, beet, carrot, chard, garlic, peas, celery, broccoli, white onion, red onion, yellow corn, cabbage, cauliflower, parsley, green bean, green broad bean, lettuce, pickles, bell pepper, radish, tomato, green bean shelf	2.55	8%	20%	2.43	7%	24%	2.82	9%	11%
Fruits	bananas, lemon, small green orange, papaya, pineapple, watermelon, tree tomato, grape, tangerine, apple, passion fruit, honeydew, blackberry, orange	3.55	12%	10%	3.79	12%	10%	3.02	10%	10%
Dairy	powdered milk, milk, cheese, yogurt	3.72	12%	13%	4.07	13%	11%	2.95	10%	19%
Fats & Oils	vegetable oil, pork fat, vegetable fat, margarine, butter, avocado	1.32	5%	13%	1.21	4%	15%	1.56	6%	9%
Pulses	dry peas, pearl lupin, dry bean, dry chickpea, dry broad bean, lentil	0.63	2%	48%	0.56	2%	52%	0.78	3%	39%
Meal complements	sugar, cocoa, chocolate, panela, seasoning, salt	1.12	4%	22%	1.02	3%	26%	1.34	5%	13%
Nonalcoholic beverages	coffee, water, mineral water, powdered juice, juice, soft drink	1.54	6%	26%	1.79	7%	22%	1.01	4%	35%

Table 3.2
Descriptive statistics of socio-demographic characteristics

Category	Variable	All pop.		Urban[*†]		Rural	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Continuous Variables							
Household composition	Family Size[*†•]	4.17	1.91	3.97	1.74	4.60	2.17
	Proportion of males in the hh[*†]	0.50	0.22	0.50	0.23	0.52	0.20
	Age of the head of the hh[*†•]	41.64	12.64	42.13	12.54	40.58	12.79
Age composition of the household	Proportion of members age <12[*†•]	0.26	0.22	0.24	0.21	0.31	0.23
	Proportion of members age ≥12-20[*†]	0.16	0.20	0.16	0.20	0.17	0.20
	Proportion of members age ≥21-40[*†]	0.33	0.25	0.34	0.26	0.30	0.23
	Proportion of members age ≥41-60[*†]	0.19	0.26	0.20	0.27	0.16	0.24
	Proportion of members age >60	0.06	0.18	0.06	0.18	0.06	0.19
	Annual Income[*]	7052.91	9624.78	8378.96	10681.02	4163.93	5809.79
	Total food expenditures (two-week period)	30.15	19.88	30.83	20.86	28.66	17.47
Dummy Variables (yes=1, no=0)							
Education level of the reference person	At most elementary[*†•]	0.61	0.49	0.50	0.50	0.83	0.38
	At most high school[*†•]	0.25	0.44	0.31	0.46	0.13	0.34
	College graduate	0.14	0.35	0.19	0.39	0.04	0.19
Region of Residence	Sierra[†•]	0.52	0.50	0.48	0.50	0.62	0.49
	Coast[†•]	0.39	0.49	0.45	0.50	0.26	0.44
	Amazon	0.09	0.28	0.07	0.25	0.12	0.33
Quarter in which the survey was collected	Jan. to Mar.[†•]	0.25	0.43	0.22	0.42	0.29	0.45
	Apr. to June[†•]	0.25	0.43	0.25	0.43	0.24	0.43
	July to Sept.[†•]	0.26	0.44	0.28	0.45	0.22	0.42
	Oct. to Dec.	0.25	0.43	0.25	0.43	0.24	0.43
	Head of the household is male[*†]	0.85	0.36	0.82	0.38	0.89	0.31
	Head of the hh works in an agric. activity[*†]	0.21	0.41	0.06	0.23	0.56	0.50

Note: There were 5,654 observations (68%) from urban areas and 2,604 (32%) observations from rural areas
*Refers to demographic variables used to obtained quality-corrected unit values.
† Refers to demographic variables used in the PROBIT model.
• Refers to demographic variables used in the AIDS model.

Table 3.3
Summary statistics for log unit values and log quality-corrected unit values for uncensored observations

Commodity Groups	Log Unit Values				Log Quality-Corrected Unit Values			
	Mean	**Std. Dev.**	**Min**	**Max**	**Mean**	**Std. Dev.**	**Min**	**Max**
Cereal & Bakery	-0.467	1.266	-6.694	8.006	-0.467	0.545	-3.161	2.238
Meats & Eggs	0.952	0.587	-1.292	7.601	0.952	0.198	-0.026	4.554
Vegetables	-0.232	1.028	-7.435	6.908	-0.232	0.543	-2.161	3.681
Fruits	0.849	2.416	-5.324	7.601	0.849	1.766	-2.615	6.908
Dairy	-0.150	1.215	-6.271	9.105	-0.150	0.587	-1.998	7.244
Fats & Oils	0.407	0.805	-2.299	9.393	0.407	0.249	-0.664	2.349
Pulses	0.108	0.592	-5.076	8.006	0.108	0.291	-3.434	1.574
Meal complements	-0.360	1.087	-5.815	8.006	-0.360	0.368	-2.237	1.514
Nonalcoholic beverages	-0.372	1.816	-5.425	8.294	-0.372	0.622	-2.470	4.314

Table 3.4
Test of the demand restrictions

Estimated demand system	**Restriction Tested**	**Test type**	**Value of the Statistic**	**Probability of rejecting the null hypothesis**
Full sample	Adding-up	Wald	694.74	<.0001
	Symmetry	Wald	400.31	<.0001
Urban population	Adding-up	Wald	1091.00	<.0001
	Symmetry	Wald	369.47	<.0001
Rural Populations	Adding-up	Wald	809.79	<.0001
	Symmetry	Wald	103.35	<.0001

Table 3.5
Uncompensated price and expenditure elasticities, full sample

Quantity Demanded	Prices									Expenditure
	Cereal & Bakery	Meats & Eggs	Vegetables	Fruit	Dairy	Fats & Oils	Pulses	Meal complements	Nonalcoholic beverages	
Cereal & Bakery	-0.7804**	0.3603**	0.0852**	0.0931**	0.1564**	0.0237**	0.0269**	0.0197*	0.0671**	0.948**
	(0.0326)	(0.036)	(0.0124)	(0.0107)	(0.0156)	(0.009)	(0.0069)	(0.0091)	(0.0068)	(0.0315)
Meats & Eggs	0.2229**	-0.6888**	0.0367**	0.1301**	0.1204**	0.0548**	0.0244**	0.041**	0.0594**	0.999**
	(0.0239)	(0.03)	(0.0105)	(0.0072)	(0.0122)	(0.0101)	(0.0079)	(0.0081)	(0.0055)	(0.0291)
Vegetables	0.1841**	0.1113**	-0.7342**	0.1027**	0.0579**	0.0025	0.0114	0.042**	0.0644**	1.1581**
	(0.0353)	(0.0488)	(0.0296)	(0.0126)	(0.0239)	(0.0162)	(0.0123)	(0.0143)	(0.0115)	(0.0741)
Fruit	0.1468**	0.3395**	0.0725**	-0.8827**	0.1181**	0.0561**	-0.0001	0.04**	0.0658**	1.044**
	(0.0263)	(0.0296)	(0.0119)	(0.0133)	(0.0157)	(0.0075)	(0.0065)	(0.0084)	(0.0054)	(0.0677)
Dairy	0.2476**	0.3109**	0.0484**	0.1172**	-0.8647**	0.0293**	0.0323**	0.0404**	0.0516**	0.9871**
	(0.0244)	(0.029)	(0.0128)	(0.0093)	(0.0209)	(0.0119)	(0.0108)	(0.0106)	(0.008)	(0.0323)
Fats & Oils	0.1073**	0.3643**	0.0189	0.1415**	0.0788**	-0.7198**	-0.0669	-0.0185	0.0985**	0.9959**
	(0.0368)	(0.0588)	(0.0238)	(0.0114)	(0.0306)	(0.0654)	(0.0371)	(0.0303)	(0.0155)	(0.0649)
Pulses	0.2812**	0.4218**	0.0771*	0.0425**	0.2071**	-0.132	-0.9498**	0.0869	0.0609**	0.9044**
	(0.0586)	(0.0994)	(0.0383)	(0.0226)	(0.0578)	(0.0826)	(0.0526)	(0.0476)	(0.029)	(0.1161)
Meal complements	0.1166**	0.3523**	0.1017**	0.1317**	0.135**	-0.0216	0.0459	-0.8191**	0.0489**	0.9086**
	(0.0458)	(0.0621)	(0.028)	(0.0168)	(0.0333)	(0.0381)	(0.0271)	(0.0479)	(0.0176)	(0.0894)
Nonalcoholic beverages	0.2053**	0.2978**	0.0864**	0.1247**	0.1014**	0.072**	0.0155*	0.028**	-0.9487**	1.0176**
	(0.0198)	(0.0231)	(0.0119)	(0.0071)	(0.015)	(0.0118)	(0.0101)	(0.0111)	(0.0101)	(0.0289)

Note: Standard errors in parentheses.
* Denotes significance at the 10% level.
** Denotes significance at the 5% level

Table 3.6
Uncompensated price and expenditure elasticities from Criollo (1994)

Quantity Demanded	Prices									Expenditure
	Cereals & by-products	Meats & by-products	Fresh Vegetables	Fresh Fruits	Dairy & Eggs	Fats & Oils	Pulses & by-products	Sugar & Seasonings	Coffee & Drinks	
Cereals & by-products	-1.32	-1.55	-0.50	-0.61	-1.05	-0.30	-0.08	-0.31	-0.50	0.32
Meats & by-products	-1.77	-3.00	-0.78	-0.96	-1.64	-0.57	-0.13	-0.49	-0.78	0.95
Fresh Vegetables	-1.55	-2.13	-1.00	-0.84	-1.44	-0.50	-0.11	-0.43	-0.69	0.52
Fresh Fruits	-1.75	-2.41	-0.78	-1.37	-1.63	-0.57	-0.13	-0.49	-0.78	0.69
Dairy & Eggs	-1.79	-2.47	-0.79	-0.97	-2.21	-0.58	-0.13	-0.50	-0.79	0.90
Fats & Oils	-1.80	-2.48	-0.80	-0.98	-1.67	-0.58	-0.64	-0.50	-0.80	0.25
Pulses & by-products	-0.91	-1.25	-0.40	-0.49	-0.84	-0.44	-0.07	-0.25	-0.40	0.85
Sugar & Seasonings	-0.84	-1.15	-0.37	-0.45	-0.78	-0.27	-0.06	-0.37	-0.37	0.22
Coffee & Drinks	-1.72	-2.37	-0.76	-0.93	-1.60	-0.56	-0.12	-0.48	-1.37	1.01

Table 3.7
Uncompensated price and expenditure elasticities, urban sample

Quantity Demanded	Prices									
	Cereal & Bakery	Meats & Eggs	Vegetables	Fruit	Dairy	Fats & Oils	Pulses	Meal complements	Nonalcoholic beverages	Expenditure
Cereal & Bakery	-0.7597**	-0.1967**	0.0798**	-0.0798**	-0.0195**	-0.0366	0.0211**	0.0074	0.0175**	0.9664**
	(0.0611)	(0.0726)	(0.0214)	(0.0235)	(0.0373)	(0.0172)	(0.0111)	(0.0155)	(0.0204)	(0.0416)
Meats & Eggs	-0.1044**	-0.9374**	-0.0655	0.0623**	0.0418**	0.0242**	-0.0201	-0.0083**	0.0171**	0.9904**
	(0.038)	(0.0755)	(0.017)	(0.0146)	(0.0334)	(0.0186)	(0.012)	(0.0159)	(0.0194)	(0.0317)
Vegetables	0.1811**	-0.3317	-0.6793**	-0.1138*	-0.0555*	-0.1008	-0.0179	0.0732**	0**	1.0446**
	(0.0567)	(0.0852)	(0.0417)	(0.0232)	(0.0496)	(0.025)	(0.0185)	(0.0212)	(0.026)	(0.0835)
Fruit	-0.1337*	0.138**	-0.0695	-0.9942**	-0.0091**	0.0028**	-0.0025	-0.0159**	-0.0092**	1.0935**
	(0.0396)	(0.0517)	(0.0163)	(0.0246)	(0.0287)	(0.0106)	(0.0071)	(0.0105)	(0.0146)	(0.0758)
Dairy	-0.0332**	0.0952**	-0.0264**	0.0021**	-0.9902**	-0.024*	0.0133*	-0.0156	-0.0357	1.0145**
	(0.0486)	(0.0849)	(0.0243)	(0.0228)	(0.0581)	(0.0207)	(0.0148)	(0.0194)	(0.0246)	(0.0465)
Fats & Oils	-0.1373*	0.1734**	-0.1475	0.0171**	-0.067**	-0.8227**	0.0649	-0.1066	0.0336**	0.9921**
	(0.0653)	(0.1349)	(0.0367)	(0.0225)	(0.0593)	(0.1041)	(0.0698)	(0.0453)	(0.0383)	(0.0902)
Pulses	0.19**	-0.325	-0.0557	0.0019**	0.1026**	0.1562	-1.0065**	0.0766	-0.0762	0.9363**
	(0.0987)	(0.2064)	(0.063)	(0.0346)	(0.0977)	(0.1674)	(0.1269)	(0.0867)	(0.0549)	(0.1456)
Meal complements	0.0541*	-0.0354**	0.1563**	-0.0245**	-0.0358	-0.1329	0.0427	-0.8931**	0.0124*	0.8562**
	(0.0749)	(0.1514)	(0.0414)	(0.0289)	(0.0719)	(0.0587)	(0.0472)	(0.0772)	(0.0479)	(0.1084)
Nonalcoholic beverages	0.0337**	0.0712**	0.0037**	-0.0023**	-0.0574	0.0196**	-0.0198	0.0011	-1.0409**	0.9911**
	(0.0464)	(0.0832)	(0.0228)	(0.022)	(0.0427)	(0.0239)	(0.0142)	(0.0227)	(0.0358)	(0.0417)

Note: Standard errors in parentheses.
* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

Table 3.8
Uncompensated price and expenditure elasticities, rural sample

Quantity Demanded	Prices									Expenditure
	Cereal & Bakery	Meats & Eggs	Vegetables	Fruit	Dairy	Fats & Oils	Pulses	Meal complements	Nonalcoholic beverages	
Cereal & Bakery	-1.0371**	0.1261**	-0.0018**	-0.0005**	-0.0042**	-0.0246**	0.0038**	-0.0212**	0.0132**	0.9462**
	(0.0309)	(0.0367)	(0.014)	(0.0098)	(0.0111)	(0.0109)	(0.0071)	(0.0119)	(0.0075)	(0.0639)
Meats & Eggs	0.1102**	-1.0741**	-0.0273**	-0.0098**	0.0111**	-0.0163**	0.0186**	0.0089**	-0.0101**	0.9889**
	(0.0283)	(0.0434)	(0.0159)	(0.009)	(0.0126)	(0.0142)	(0.0085)	(0.0131)	(0.0079)	(0.0621)
Vegetables	-0.0633**	-0.127**	-0.9561**	0.0273**	-0.0219**	0.0065**	-0.0053*	-0.0164	-0.0105**	1.1667**
	(0.0422)	(0.0506)	(0.0336)	(0.0143)	(0.0168)	(0.0196)	(0.0109)	(0.0198)	(0.0101)	(0.0947)
Fruit	-0.01**	-0.0239**	0.0407**	-1.0153**	0.0046**	0.0018**	-0.0057**	0.0192**	0.0043**	0.9844**
	(0.0342)	(0.0389)	(0.0202)	(0.014)	(0.0129)	(0.0115)	(0.0088)	(0.0111)	(0.0079)	(0.0914)
Dairy	-0.0192**	0.0247**	-0.0066**	0.0032**	-0.9908**	-0.0108**	0.0107**	0.0003**	-0.0097**	0.998**
	(0.0255)	(0.0274)	(0.0136)	(0.0084)	(0.0152)	(0.0122)	(0.011)	(0.0132)	(0.0085)	(0.0342)
Fats & Oils	-0.1066**	-0.0636**	0.0287**	0.0051**	-0.0168**	-0.6738**	-0.0928	-0.055	0.0125**	0.9623**
	(0.0373)	(0.0606)	(0.0288)	(0.0124)	(0.0218)	(0.082)	(0.0243)	(0.0396)	(0.0146)	(0.0977)
Pulses	0.0135**	0.1418**	-0.0018**	-0.0199**	0.0346**	-0.1715	-0.9919**	-0.0145	-0.0016*	1.0114**
	(0.0552)	(0.0757)	(0.0303)	(0.0199)	(0.0365)	(0.0475)	(0.0342)	(0.0341)	(0.0211)	(0.1165)
Meal complements	-0.1385**	0.0205**	-0.0183**	0.0281**	-0.0058**	-0.0708	-0.0111	-0.8706**	-0.0091**	1.0756**
	(0.0458)	(0.0707)	(0.0336)	(0.016)	(0.0288)	(0.0473)	(0.0214)	(0.068)	(0.0155)	(0.1396)
Nonalcoholic beverages	0.0513**	-0.0607**	-0.0101**	0.0056**	-0.0232**	0.0122**	-0.0014**	-0.0078**	-0.9863**	1.0203**
	(0.0351)	(0.0455)	(0.0193)	(0.0134)	(0.0185)	(0.0186)	(0.0138)	(0.017)	(0.0148)	(0.057)

Note: Standard errors in parentheses.
* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

Table 3.9
Estimated marginal effects, full sample

Quantities Demanded	Age of head of the hh	Family size	Education head of hh: At most elementary	Education head of hh: At most high school	Region: Sierra	Region: Coast	Quarter: Jan. to Mar.	Quarter: Apr. to June	Quarter: July to Sept.	Proportion members <12
Cereal & Bakery	0.21	-0.06**	1.07**	0.01	-3.39**	-5.40**	0.16	0.33	0.96	-4.33**
	(0.24)	(0.02)	(0.42)	(0.36)	(0.81)	(0.75)	(0.44)	(0.40)	(0.43)	(1.17)
Meats & Eggs	0.60**	0.07**	-0.97	0.39	1.53*	2.80**	-1.03**	-0.48	-1.09*	3.99**
	(0.23)	(0.03)	(0.57)	(0.62)	(1.08)	(1.05)	(0.51)	(0.48)	(0.52)	(1.38)
Vegetables	-0.02	0.02**	0.57**	0.13	0.81**	0.83**	0.08	0.01	-0.44	0.94**
	(0.09)	(0.01)	(0.22)	(0.20)	(0.40)	(0.35)	(0.20)	(0.18)	(0.20)	(0.62)
Fruit	0.13	0.05**	-0.82**	-0.23	1.40	0.76	-0.76**	-0.02	0.83**	2.68**
	(0.10)	(0.02)	(0.32)	(0.31)	(0.63)	(0.63)	(0.24)	(0.24)	(0.26)	(0.90)
Dairy	-0.04	0.02**	-1.82**	-0.80**	1.33**	1.85**	0.45*	0.35	0.00	1.63**
	(0.07)	(0.01)	(0.32)	(0.3)	(0.43)	(0.45)	(0.18)	(0.19)	(0.19)	(0.66)
Fats & Oils	0.06	0.00	0.82**	0.30	0.45	0.64	0.06	-0.06	-0.20	0.61
	(0.07)	(0.01)	(0.19)	(0.12)	(0.23)	(0.28)	(0.09)	(0.08)	(0.09)	(0.47)
Pulses	-0.06	0.00	0.42**	0.13	0.11	-0.02	0.13	-0.08	-0.17	-0.25
	(0.05)	(0.01)	(0.13)	(0.13)	(0.20)	(0.23)	(0.14)	(0.13)	(0.13)	(0.54)
Meal complements	-0.12	-0.01	0.35**	0.07	-0.31	-0.47	0.08	0.02	0.12	-0.30
	(0.06)	(0.01)	(0.19)	(0.10)	(0.18)	(0.25)	(0.10)	(0.09)	(0.08)	(0.36)
Nonalcoholic beverages	0.08	0.00	-0.04	0.05	0.15	1.10**	0.12	0.06	-0.13	-0.46
	(0.04)	(0.01)	(0.18)	(0.15)	(0.26)	(0.34)	(0.12)	(0.12)	(0.12)	(0.36)

Note: Standard errors in parentheses.
* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

Table 3.10
Estimated marginal effects, urban sample

Quantities Demanded	Age of head of the hh	Family size	Education head of hh: At most elementary	Education head of hh: At most high school	Region: Sierra	Region: Coast	Quarter: Jan. to Mar.	Quarter: Apr. to June	Quarter: July to Sept.	Proportion members <12
Cereal & Bakery	0.08	-0.06**	2.07**	0.03	0.85	-1.27*	0.73	1.60	1.73	-4.69**
	(0.50)	(0.02)	(0.54)	(0.41)	(1.05)	(1.00)	(0.58)	(0.56)	(0.59)	(1.43)
Meats & Eggs	1.10*	0.05	-1.59	-0.30	1.57	2.52*	-0.85	-0.45	-1.05	1.63
	(0.81)	(0.04)	(0.77)	(0.75)	(1.31)	(1.14)	(0.75)	(0.72)	(0.84)	(2.18)
Vegetables	0.04	0.02*	0.06	0.17	-1.03	-0.80	-0.03	-0.34	-0.44	0.54
	(0.47)	(0.01)	(0.35)	(0.25)	(0.43)	(0.33)	(0.25)	(0.23)	(0.27)	(0.64)
Fruit	0.67	0.06**	-0.97**	-0.37	1.38	0.10	-0.65*	-0.04	0.44	2.64
	(0.38)	(0.02)	(0.41)	(0.41)	(0.75)	(0.62)	(0.33)	(0.33)	(0.36)	(1.13)
Dairy	-0.49	0.02	-1.76**	-0.23	-0.24	0.13	0.28	-0.19	-0.12	3.28
	(0.22)	(0.04)	(0.73)	(0.37)	(0.59)	(0.49)	(0.31)	(0.32)	(0.29)	(2.60)
Fats & Oils	0.19	0.00	0.66	0.24	-0.16	-0.04	-0.10	-0.26	-0.35	0.38
	(0.24)	(0.01)	(0.39)	(0.23)	(0.25)	(0.20)	(0.14)	(0.13)	(0.14)	(0.71)
Pulses	0.03	0.00	0.34*	0.17	-0.49*	-0.28	-0.05	-0.25	-0.28	0.13
	(0.18)	(0.02)	(0.14)	(0.14)	(0.19)	(0.24)	(0.18)	(0.16)	(0.14)	(0.92)
Meal complements	-0.22	-0.02	0.21	0.06	-0.30	-0.36	0.22	0.21	0.16	-0.67
	(0.44)	(0.02)	(0.97)	(0.20)	(0.28)	(0.67)	(0.58)	(0.49)	(0.36)	(1.50)
Nonalcoholic beverages	0.10	0.00	0.39	0.16	-0.26	0.57	0.01	-0.10	-0.19	-0.73**
	(0.13)	(0.01)	(0.28)	(0.23)	(0.44)	(0.52)	(0.26)	(0.23)	(0.21)	(0.58)

Note: Standard errors in parentheses.
* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

Table 3.11
Estimated marginal effects, rural sample

Quantities Demanded	Age of head of the hh	Family size	Education head of hh: At most elementary	Education head of hh: At most high school	Region: Sierra	Region: Coast	Quarter: Jan. to Mar.	Quarter: Apr. to June	Quarter: July to Sept.	Proportion members <12
Cereal & Bakery	0.26	0.00	1.25	0.29	-1.02	-3.18	-0.45	-0.51	-0.96	-0.98
	(2.83)	(0.13)	(13.84)	(13.72)	(4.84)	(3.28)	(7.57)	(6.99)	(8.21)	(14.95)
Meats & Eggs	-0.08	0.01	-0.98	-0.01	-1.50	-1.10	-0.23	-0.45	0.32	0.48
	(1.00)	(0.28)	(56.64)	(54.11)	(6.70)	(7.06)	(3.49)	(3.35)	(1.80)	(19.89)
Vegetables	0.04	0.04	-0.37	-1.04	3.83	4.32	-0.18	0.15	-0.23	2.27
	(1.54)	(0.49)	(123.82)	(126.66)	(29.73)	(26.78)	(8.93)	(5.10)	(4.44)	(16.32)
Fruit	-0.08	-0.01	-0.46	0.36	-0.21	-0.64	-0.53	-0.06	0.85	-0.93
	(0.56)	(0.18)	(60.26)	(56.99)	(5.89)	(10.23)	(6.03)	(2.14)	(3.93)	(9.62)
Dairy	-0.06	0.04	-1.99	-1.27	1.42	2.43	0.41	0.48	0.39	1.52
	(0.42)	(0.21)	(51.09)	(49.70)	(7.47)	(16.60)	(2.13)	(3.26)	(2.70)	(6.10)
Fats & Oils	0.02	0.00	0.36	0.07	0.24	0.23	0.01	-0.08	-0.25	0.58
	(0.59)	(0.11)	(8.81)	(8.95)	(8.06)	(12.86)	(0.88)	(4.19)	(1.44)	(8.12)
Pulses	0.03	0.01	0.40	0.25	0.16	0.83	0.07	0.17	0.11	0.34
	(0.24)	(0.67)	(1.20)	(8.07)	(13.88)	(42.24)	(2.72)	(7.04)	(13.72)	(27.25)
Meal complements	-0.03	0.00	0.86	0.45	-0.22	-0.19	0.02	0.02	-0.07	0.55
	(1.39)	(0.24)	(9.30)	(9.23)	(13.53)	(20.34)	(3.22)	(3.28)	(4.04)	(7.49)
Nonalcoholic beverages	-0.02	-0.01	-0.13	-0.07	0.27	1.47	0.25	0.46	0.05	-0.25
	(0.27)	(0.06)	(4.52)	(3.82)	(4.84)	(12.31)	(0.55)	(2.46)	(0.88)	(2.85)

Note: Standard errors in parentheses.
* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

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Appendices

Appendix 3.1. Derivation of demand elasticities and marginal effects for the censored AIDS demand model

<u>Marshallian demand elasticities</u>

The uncompensated censored AIDS demand equation as defined in (17) is given by

$$w_j = \widehat{\Phi}_i\left(\alpha_i^{\circ} + \sum_{l=1}^{M} \sigma_{il}\, z_l \; + \sum_k \gamma_{ik} \log p_k + \beta_i \log\{{}^{x}/_{P}\}\right) + \delta_i \hat{\phi}_i + \varepsilon_i, \qquad \text{(a)}$$

where $\quad \log P = \alpha_o + \sum_k\left(\alpha_k^{\circ} + \sum_{l=1}^{M} \sigma_{kl}\, z_l\right) \log p_k + \frac{1}{2}\sum_j \sum_k \gamma_{kl} \log p_k \log p_j.$

Taking the derivative of the preceding equation with respect to $\log p_j$, we obtain:

$$\frac{\partial w_i}{\partial \log p_j} = \widehat{\Phi}_i\left(\gamma_{ij} - \beta_i \frac{\partial \log P^*}{\partial \log p_j}\right), \qquad \text{(b)}$$

where

$$\frac{\partial \log P^*}{\partial \log p_j} = \alpha_j^{\circ} + \sum_{l=1}^{M} \sigma_{jl} z_l + \sum_{k=1}^{N} \gamma_{jk} \log p_k. \qquad \text{(c)}$$

Thus, substituting (b) into (c) we get

$$\frac{\partial w_i}{\partial \log p_j} = \widehat{\Phi}_i\left(\gamma_{ij} - \beta_i\left(\alpha_j^{\circ} + \sum_{l=1}^{M} \sigma_{jl} z_l + \sum_{k=1}^{N} \gamma_{jk} \log p_k\right)\right), \qquad \text{(d)}$$

moreover, since

$$\frac{\partial w_i}{\partial \log p_j} = w_i \frac{\partial \log w_i}{\partial \log p_j} = w_i\left(\frac{\partial \log Q_i}{\partial \log p_j} - w_j + \delta_{ij}\right), \qquad \text{(e)}$$

we can substitute (e) into (d) and solve for $\frac{\partial \log Q_i}{\partial \log p_j}$ to get:

$$\frac{\partial \log Q_i}{\partial \log p_j} = \frac{\widehat{\Phi}_i}{w_i}\left(\gamma_{ij} - \beta_i\left(\alpha_j^{\circ} + \sum_{l=1}^{M} \sigma_{jl} z_l + \sum_{k=1}^{N} \gamma_{jk} \log p_k\right)\right) + w_j - \delta_{ij}.$$

which is our estimated equation for uncompensated own-price and cross-price elasticities as specified in (18).

Expenditure demand elasticities

Taking the derivative of equation (a) with respect to $\log x$ gives us:

$$\frac{\partial w_i}{\partial \log x} = \widehat{\Phi}_i \, \beta_i, \tag{f}$$

moreover, since

$$\frac{\partial w_i}{\partial \log x} = w_i \frac{\partial \log w_i}{\partial \log x} = w_i \left(\frac{\partial \log Q_i}{\partial \log x} - 1\right), \tag{g}$$

we can introduce (g) into (f) and solve for $\frac{\partial \log Q_i}{\partial \log x}$ such as:

$$\frac{\partial \log Q_i}{\partial \log x} = \frac{\widehat{\Phi}_i}{w_i} \beta_i + 1$$

which is our expression for expenditure demand elasticity as defined in (19).

Marginal effects

As stated earlier, the derivation for marginal effects is dependent on whether the socio demographic variable appears only in the probit equation or in both, probit and AIDS equations. Thus, for a given socio-demographic variable g_j that is mutually present in the probit and AIDS equation, the derivative of equation (a) with respect to g_j is given by:

$$\frac{\partial w_i}{\partial g_j} = \Big[\hat{\phi}_i * \rho_{ij} * \left(\alpha_j^{\circ} + \sum_{l=1}^{M} \sigma_{il} z_l + \sum_{k=1}^{N} \gamma_{ik} \log p_k + \beta_i \log\left(\frac{x}{P}\right)\right) + \Big(\sigma_{ij} - \beta_i \sum_{k=1}^{N} \sigma_{kj} \log p_k\Big) * \widehat{\Phi}_i\Big] + \delta_i * \left(\boldsymbol{s}_i' \widehat{\boldsymbol{\rho}}_i\right) * \hat{\phi}_i * \rho_{ij}\,, \tag{h}$$

since prices and total expenditures are independent of demographic characteristics, then

$$\frac{\partial w_i}{\partial g_j} = \frac{1}{x} \frac{\partial x_i}{\partial g_j}, \tag{i}$$

substituting equation (i) into (h) and solving for $\frac{\partial x_i}{\partial \omega_j}$ we get:

$$\frac{\partial x_i}{\partial g_j} = x\left(\left[\hat{\phi}_i * \rho_{ij} * \left(\alpha_j^{\circ} + \sum_{l=1}^{M} \sigma_{il} z_l + \sum_{k=1}^{N} \gamma_{ik} \log \pi_k + \beta_i \log\left(\frac{x}{P}\right)\right) + \left(\sigma_{ij} - \beta_i \sum_{k=1}^{N} \sigma_{kj} \log \pi_k\right) * \hat{\Phi}_i\right] + \delta_i * \left(\boldsymbol{s}_i^{'} \hat{\boldsymbol{\rho}}_i\right) * \hat{\phi}_i * \rho_{ij}\right)$$

which corresponds to our estimated equation for marginal effects described in (20).

Appendix 3.2. Parameter estimates for the estimated systems of equations.

Table 3.12
Parameter estimates for the estimated AIDS demand systems

Parameter	Full Sample		Urban Sample		Rural Sample	
	Estimate	Std. dev.	Estimate	Std. dev.	Estimate	Std. dev.
a1	0.4943**	0.0780	0.422**	0.0849	0.3027**	0.1255
a2	0.1464	0.0900	0.1101	0.0937	0.4477**	0.1199
a3	0.0209	0.0302	0.0942	0.0438	-0.0897	0.0503
a4	0.0218	0.0536	-0.0537	0.0583	0.2005**	0.0696
a5	0.1274**	0.0329	0.2013**	0.0473	0.0379	0.0366
a6	0.0127	0.0264	0.0119	0.0326	0.0280	0.0307
a7	0.0409	0.0246	0.0300	0.0266	-0.0093	0.0276
a8	0.0876**	0.0234	0.1133**	0.0262	0.0399*	0.0342
a9	0.048**	0.0272	0.071**	0.0420	0.0423	0.0289
b1	-0.0107	0.0065	-0.0060	0.0074	-0.0143	0.0170
b2	-0.0003	0.0095	-0.0034	0.0111	-0.0031	0.0171
b3	0.0127**	0.0059	0.0033	0.0061	0.0160	0.0091
b4	0.0053	0.0082	0.0119	0.0097	-0.0017	0.0097
b5	-0.0017	0.0043	0.0021	0.0066	-0.0002	0.0040
b6	-0.0002	0.0035	-0.0004	0.0044	-0.0024	0.0062
b7	-0.0024	0.0029	-0.0013	0.0030	0.0004	0.0041
b8	-0.0040	0.0039	-0.0054	0.0041	0.0041	0.0077
b9	0.0013	0.0022	-0.0008	0.0035	0.0011	0.0030
g11	0.0006	0.0064	0.0417**	0.0106	-0.0144	0.0078
g12	0.0062	0.0071	-0.0371**	0.0128	0.0294*	0.0078
g13	0.0016	0.0025	0.0139*	0.0037	-0.0010	0.0034
g14	-0.0056**	0.0024	-0.0146**	0.0043	-0.0016	0.0027
g15	0.0054	0.0030	-0.0043	0.0066	-0.0023	0.0027
g16	-0.0052**	0.0018	-0.0068	0.0030	-0.0075*	0.0026
g17	0.0013	0.0014	0.0036**	0.0019	0.0006	0.0019
g18	-0.0048**	0.0019	0.0009	0.0027	-0.0063**	0.0028
g19	0.0004	0.0013	0.0027	0.0037	0.0030	0.0019
g21	0.0062	0.0071	-0.0371**	0.0128	0.0294*	0.0078
g22	-0.0013	0.0098	0.0207	0.0258	-0.0213	0.0101
g23	-0.0125**	0.0034	-0.0231**	0.0059	-0.0076	0.0041
g24	0.0046*	0.0025	0.0215**	0.0055	-0.0030	0.0030
g25	-0.0010	0.0036	0.0141	0.0117	0.0028	0.0031
g26	0.0026	0.0031	0.0083	0.0064	-0.0047	0.0036
g27	0.0020	0.0025	-0.0071	0.0042	0.0050	0.0023
g28	0.0004	0.0025	-0.0031	0.0055	0.0023	0.0032
g29	-0.0009	0.0017	0.0057	0.0068	-0.0029	0.0021
g31	0.0016	0.0025	0.0139*	0.0037	-0.0010	0.0034
g32	-0.0125**	0.0034	-0.0231**	0.0059	-0.0076	0.0041
g33	0.0159**	0.0024	0.0236**	0.0030	0.0048	0.0033
g34	-0.0001	0.0013	-0.0081**	0.0019	0.0043*	0.0020
g35	-0.0037**	0.0017	-0.0036	0.0035	-0.0008	0.0015

* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

Table 2.13
Continued

Parameter	Full Sample		Urban Sample		Rural Sample	
	Estimate	Std. dev.	Estimate	Std. dev.	Estimate	Std. dev.
g36	-0.003*	0.0013	-0.0072**	0.0018	0.0017	0.0017
g37	-0.0001	0.0009	-0.0012	0.0013	-0.0001	0.0010
g38	0.0010	0.0012	0.0055**	0.0015	-0.0009	0.0018
g39	0.0009	0.0009	0.0003	0.0019	-0.0005	0.0010
g41	-0.0056**	0.0024	-0.0146**	0.0043	-0.0016	0.0027
g42	0.0046*	0.0025	0.0215**	0.0055	-0.0030	0.0030
g43	-0.0001	0.0013	-0.0081**	0.0019	0.0043*	0.0020
g44	0.0006	0.0020	0.0015	0.0035	-0.0018	0.0021
g45	0.0000	0.0013	0.0004	0.0033	0.0004	0.0011
g46	0.0014	0.0007	0.0008	0.0012	0.0001	0.0010
g47	-0.002**	0.0007	0.0000	0.0008	-0.0007	0.0009
g48	0.0004	0.0009	-0.0013	0.0012	0.0020	0.0013
g49	0.0008	0.0006	-0.0002	0.0019	0.0004	0.0008
g51	0.0054	0.0030	-0.0043	0.0066	-0.0023	0.0027
g52	-0.0010	0.0036	0.0141	0.0117	0.0028	0.0031
g53	-0.0037**	0.0017	-0.0036	0.0035	-0.0008	0.0015
g54	0.0000	0.0013	0.0004	0.0033	0.0004	0.0011
g55	0.0014	0.0027	0.0017	0.0082	0.0010	0.0017
g56	-0.0024	0.0015	-0.0033	0.0029	-0.0013	0.0014
g57	0.0018	0.0014	0.0019	0.0021	0.0012	0.0013
g58	0.0000	0.0014	-0.0021	0.0028	0.0000	0.0015
g59	-0.0015*	0.0011	-0.0049*	0.0036	-0.0011	0.0009
g61	-0.0052**	0.0018	-0.0068	0.0030	-0.0075*	0.0026
g62	0.0026	0.0031	0.0083	0.0064	-0.0047	0.0036
g63	-0.003*	0.0013	-0.0072**	0.0018	0.0017	0.0017
g64	0.0014	0.0007	0.0008	0.0012	0.0001	0.0010
g65	-0.0024	0.0015	-0.0033	0.0029	-0.0013	0.0014
g66	0.0125**	0.0034	0.0086	0.0050	0.0205**	0.0050
g67	-0.0046**	0.0020	0.0032	0.0034	-0.0059**	0.0016
g68	-0.0031**	0.0016	-0.0052	0.0022	-0.0036	0.0024
g69	0.0019	0.0008	0.0016	0.0020	0.0007	0.0009
g71	0.0013	0.0014	0.0036**	0.0019	0.0006	0.0019
g72	0.0020	0.0025	-0.0071	0.0042	0.0050	0.0023
g73	-0.0001	0.0009	-0.0012	0.0013	-0.0001	0.0010
g74	-0.002**	0.0007	0.0000	0.0008	-0.0007	0.0009
g75	0.0018	0.0014	0.0019	0.0021	0.0012	0.0013
g76	-0.0046**	0.0020	0.0032	0.0034	-0.0059**	0.0016
g77	0.0007	0.0013	-0.0002	0.0026	0.0003	0.0012
g78	0.0010	0.0011	0.0015	0.0018	-0.0005	0.0012
g79	-0.0002	0.0007	-0.0017	0.0012	0.0000	0.0007
g81	-0.0048**	0.0019	0.0009	0.0027	-0.0063**	0.0028

* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

Table 2.13
Continued

Parameter	Full Sample		Urban Sample		Rural Sample	
	Estimate	Std. dev.	Estimate	Std. dev.	Estimate	Std. dev.
g82	0.0004	0.0025	-0.0031	0.0055	0.0023	0.0032
g83	0.0010	0.0012	0.0055**	0.0015	-0.0009	0.0018
g84	0.0004	0.0009	-0.0013	0.0012	0.0020	0.0013
g85	0.0000	0.0014	-0.0021	0.0028	0.0000	0.0015
g86	-0.0031**	0.0016	-0.0052	0.0022	-0.0036	0.0024
g87	0.0010	0.0011	0.0015	0.0018	-0.0005	0.0012
g88	0.0059**	0.0020	0.0037	0.0029	0.0073**	0.0034
g89	-0.0008	0.0008	0.0000	0.0019	-0.0004	0.0009
g91	0.0004	0.0013	0.0027	0.0037	0.0030	0.0019
g92	-0.0009	0.0017	0.0057	0.0068	-0.0029	0.0021
g93	0.0009	0.0009	0.0003	0.0019	-0.0005	0.0010
g94	0.0008	0.0006	-0.0002	0.0019	0.0004	0.0008
g95	-0.0015*	0.0011	-0.0049*	0.0036	-0.0011	0.0009
g96	0.0019	0.0008	0.0016	0.0020	0.0007	0.0009
g97	-0.0002	0.0007	-0.0017	0.0012	0.0000	0.0007
g98	-0.0008	0.0008	0.0000	0.0019	-0.0004	0.0009
g99	-0.0007	0.0008	-0.0035	0.0031	0.0008	0.0008
z11	-0.0014	0.0073	-0.0122	0.0154	0.0064	0.0055
z12	-0.0023**	0.0007	-0.0027**	0.0007	-0.0002	0.0010
z13	0.0323**	0.0143	0.0626**	0.0173	0.0420	0.0323
z14	-0.0023	0.0125	-0.0037	0.0132	0.0086	0.0393
z15	-0.1271**	0.0265	0.0121	0.0304	-0.0401	0.0549
z16	-0.1846**	0.0252	-0.0392**	0.0293	-0.114*	0.0575
z17	0.0090	0.0143	0.0315	0.0179	-0.0161	0.0200
Z18	0.0127	0.0133	0.0545	0.0173	-0.0170	0.0223
Z19	0.0348	0.0142	0.0609	0.0185	-0.0330	0.0259
Z110	-0.1542**	0.0395	-0.1745**	0.0445	-0.0315	0.0558
z21	0.0085*	0.0066	0.0217**	0.0119	-0.0042	0.0043
z22	0.0016*	0.0007	0.0011	0.0009	-0.0003	0.0008
z23	-0.0348	0.0160	-0.0549	0.0204	-0.0364	0.0296
z24	0.0097	0.0170	-0.0129	0.0190	-0.0009	0.0358
z25	0.0396	0.0336	0.0449	0.0332	-0.0609	0.0547
z26	0.0919**	0.0327	0.0867**	0.0323	-0.0491	0.0552
z27	-0.0259*	0.0139	-0.0209	0.0187	-0.0020	0.0155
Z28	-0.0115	0.0123	-0.0107	0.0171	-0.0116	0.0173
Z29	-0.0280	0.0139	-0.0256*	0.0166	0.0136	0.0194
Z210	0.0971*	0.0400	0.0438	0.0442	-0.0270	0.0507
z31	-0.0027	0.0026	0.0043	0.0049	0.0017	0.0018
z32	0.0005**	0.0002	0.0007**	0.0003	0.0007	0.0004
z33	0.0168*	0.0069	0.0032	0.0079	-0.0090	0.0113
z34	0.0033	0.0063	0.0067	0.0073	-0.0253	0.0136

* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

Table 2.13
Continued

Parameter	Full Sample		Urban Sample		Rural Sample	
	Estimate	Std. dev.	Estimate	Std. dev.	Estimate	Std. dev.
z35	0.0211**	0.0103	-0.0343	0.0121	0.0893**	0.0193
z36	0.0257**	0.0109	-0.0281	0.0111	0.1134**	0.0208
z37	0.0042	0.0061	-0.0019	0.0080	0.0074	0.0068
Z38	0.0001	0.0057	-0.0123	0.0077	0.0088	0.0082
Z39	-0.0143	0.0060	-0.0165	0.0080	-0.0024	0.0077
Z310	0.0266*	0.0152	0.0180	0.0217	0.0509	0.0252
z41	0.0000	0.0029	0.0027	0.0055	-0.0025	0.0022
z42	0.0008	0.0004	0.0014*	0.0006	-0.0009	0.0005
z43	-0.0223**	0.0087	-0.026**	0.0109	-0.0127	0.0157
z44	-0.0044	0.0078	-0.0046	0.0097	0.0124	0.0225
z45	0.0306	0.0193	0.0362	0.0166	-0.0161	0.0287
z46	0.0044	0.0194	-0.0059	0.0147	-0.0398	0.0339
z47	-0.0152**	0.0059	-0.0154	0.0089	-0.0114*	0.0090
Z48	-0.0028	0.0063	-0.0039	0.0082	-0.0027	0.0107
Z49	0.0232**	0.0073	0.0110	0.0090	0.0250	0.0128
Z410	0.0410	0.0230	0.0744*	0.0275	-0.0540	0.0306
z51	-0.0011	0.0025	-0.0192**	0.0057	-0.0009	0.0014
z52	0.0000	0.0003	0.0001	0.0004	0.0009**	0.0003
z53	-0.0525**	0.0098	-0.0494**	0.0119	-0.0462**	0.0211
z54	-0.0247**	0.0092	-0.0061	0.0102	-0.0227	0.0230
z55	0.0316**	0.0114	-0.0123	0.0182	0.0322**	0.0131
z56	0.0472**	0.0120	0.0044	0.0154	0.0459**	0.0181
z57	0.0143	0.0058	0.0107	0.0101	0.0073*	0.0070
Z58	0.0092	0.0058	-0.0059	0.0095	0.0063	0.0074
Z59	-0.0030	0.0061	-0.0051	0.0092	0.0071	0.0071
Z510	0.0205	0.0149	0.0758*	0.0247	0.0364*	0.0172
z61	-0.0001	0.0014	0.0033	0.0026	0.0007	0.0011
z62	-0.0003*	0.0001	-0.0002	0.0002	0.0001	0.0002
z63	0.0245**	0.0048	0.0191**	0.0055	0.014**	0.0081
z64	0.0082*	0.0040	0.0065	0.0052	0.0026	0.0091
z65	0.0118	0.0069	-0.0035	0.0083	0.0095	0.0112
z66	0.0151	0.0066	-0.0018	0.0073	0.0094	0.0120
z67	0.0026	0.0032	-0.0035	0.0048	0.0003	0.0043
Z68	-0.0034	0.0031	-0.0097	0.0045	-0.0030	0.0041
Z69	-0.0065	0.0031	-0.0124	0.0044	-0.0097	0.0048
Z610	0.0045	0.0082	0.0026	0.0104	0.0228	0.0117
z71	-0.0024	0.0016	0.0013	0.0020	0.0014	0.0012
z72	-0.0001	0.0002	0.0001	0.0002	0.0000	0.0002
z73	0.0191**	0.0058	0.0154*	0.0060	0.0179*	0.0120
z74	0.0063	0.0056	0.0077	0.0059	0.0073	0.0122
z75	0.0053	0.0085	-0.0219	0.0080	0.0038	0.0117

* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

Table 2.13
Continued

Parameter	Full Sample		Urban Sample		Rural Sample	
	Estimate	Std. dev.	Estimate	Std. dev.	Estimate	Std. dev.
z76	0.0006	0.0082	-0.0127	0.0081	0.0239	0.0137
z77	0.0057	0.0063	-0.0023	0.0068	0.0035	0.0052
Z78	-0.0035	0.0060	-0.0113	0.0062	0.0051	0.0054
Z79	-0.0074	0.0056	-0.0123	0.0060	0.0015	0.0051
Z710	-0.0048	0.0130	0.0060	0.0150	0.0032	0.0127
z81	-0.0035**	0.0012	-0.0043	0.0023	-0.0021	0.0011
z82	-0.0003	0.0001	-0.0004	0.0002	0.0000	0.0002
z83	0.0153**	0.0039	0.0134**	0.0042	0.025**	0.0111
z84	0.0029	0.0034	0.0024	0.0038	0.0128	0.0124
z85	-0.0105*	0.0061	-0.0134*	0.0076	-0.0144	0.0111
z86	-0.0151**	0.0063	-0.0113	0.0073	-0.0170	0.0122
z87	0.0019	0.0025	0.0032	0.0034	-0.0004	0.0044
Z88	-0.0004	0.0023	0.0027	0.0030	-0.0002	0.0043
Z89	0.0037	0.0024	0.0032	0.0030	-0.0033	0.0044
Z810	-0.0068	0.0070	-0.0153	0.0087	0.0150	0.0121
z91	0.0027	0.0017	0.0024	0.0045	-0.0005	0.0013
z92	-0.0001	0.0002	-0.0002	0.0004	-0.0004	0.0002
z93	0.0016	0.0065	0.0166	0.0104	0.0053	0.0126
z94	0.0009	0.0050	0.0039	0.0080	0.0053	0.0136
z95	-0.0024	0.0092	-0.0079	0.0158	-0.0033	0.0134
z96	0.0147	0.0102	0.0079	0.0168	0.0273*	0.0165
z97	0.0034	0.0041	-0.0013	0.0091	0.0113	0.0056
Z98	-0.0006	0.0039	-0.0036	0.0083	0.0143*	0.0060
Z99	-0.0025	0.0037	-0.0032	0.0066	0.0012	0.0059
Z910	-0.0241**	0.0119	-0.0309**	0.0188	-0.0157	0.0134
d1	0.313**	0.0530	0.4752**	0.0827	0.1768**	0.0313
d2	0.2354**	0.0559	0.144**	0.0954	0.2285**	0.0353
d3	-0.1022	0.0373	-0.0983	0.0448	0.0447**	0.0247
d4	0.2894**	0.0442	0.3169**	0.0651	0.1262**	0.0286
d5	0.0704**	0.0212	0.0449**	0.0360	0.0722**	0.0173
d6	0.0529	0.0269	0.0403	0.0287	0.0003	0.0271
d7	-0.0142	0.0122	0.0015	0.0145	-0.0020	0.0122
d8	-0.0239	0.0325	-0.0462	0.0319	-0.0153	0.0226
d9	0.0468**	0.0110	0.0568**	0.0138	0.027**	0.0103

* Denotes significance at the 10% level.
** Denotes significance at the 5% level.

CHAPTER FOUR

Conclusion

The findings in the two essays contained in this thesis add to the understanding of empirical estimation of demand systems from cross-sectional data. In particular, our results support the reliability of publicly available data sets for the conduction of demand analyses. In the case of Ecuador, we provide the first know estimates of a food demand system using household-level data.

The objective of the first essay was to test the sensitivity of demand model results to changes in the construction of Stone-Lewbel (SL). Specifically, to the use of different CPIs in the computation of SL prices. Our findings suggest that SL prices, for the United States, provide robust demand system estimates, regardless of the CPI used in its construction. Implications of this result are the complete estimation of a food demand system in the absence of price information. Future research should evaluate the performance of SL prices with other datasets and observed price variation.

Our second essay, focused on the estimation of demand elasticities and marginal effects for Ecuador. In particular, we found differences between own-price elasticity estimates for urban and rural populations. A potential policy implication of our results is the necessity to differentiate price related policies for food commodities between urban and rural sectors. Finally, comparison of our results with previous elasticity estimates from 1994, confirm the necessity of current elasticity estimates that account for the demographic and economic changes experienced in Ecuador during the last decade.

Finally, elasticity estimates for Ecuador can be compared with those found for the United States. Own price elasticities for the groups of Cereals, Meats, Dairy and Nonalcoholic beverages are more elastic for Ecuador than the United States. Also, own-price elasticities for the groups of Vegetables and Fruits for Ecuador are more elastic than the own-price elasticity for the group of Fruit & Vegetables for the United States. These results can potentially be explained by differences in wealth between both countries. Given the higher real *per capita* income in the United States relative to Ecuador, we expect households in the U.S. to be less responsive to changes in food prices than in Ecuador. Nevertheless, the fact that elasticity estimates for both countries are conditional on allocated expenditures for food commodities hampers the direct comparison of these estimates. Departing from our results, unconditional demand elasticities could be obtain for both countries to better relate the responsiveness of consumers to food prices as a consequence of differences in wealth across countries.