A Demand System Analysis with Emphasis on Container Size of Fluid Milk

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ABSTRACT

A Censor Corrected Almost Ideal Demand System (CCAIDS) is used to study the price quantity relationships between white milk, carbonated soft drinks, bottled water, and fruit juice for various container sizes of each.

By varying the units of measure on the right hand side (RHS) of the share equations the resulting matrix of own-price, cross-price, and expenditure elasticities provide information involving various container sizes of the four product groups. The data used is a cross-section constructed from 1999 household scanner data, HSD. We described price imputations and the handling of censored observations to develop the respective elasticities. These elasticities provided information about intra-product relationships (same product but different sizes), intra-size relationships (different products same container size), and inter-product relationships (different products and different sizes). This container size issue, as well as the methodology used, are unique in the extant literature associated with non-alcoholic beverage industry.

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Introduction

From a recent summary on trends in milk consumption, it is evident that changes in milk consumption are anything but static (Nyman and Capps). The trends in dairy food and beverage products were reflective of changes in demographics, population composition, income distribution, and other factors as well as taste and preferences. The past several decades have seen the proliferation of products that potentially compete with milk as a beverage. This contention is evident from the ever-increasing number of non-alcoholic beverages. These facts further support the need for a more rigorous and detailed examination of consumer behavior for non-alcoholic beverages.

In all of the literature on milk demand no research study yet has investigated the effect of container sizes on elasticity estimates for milk or non-alcoholic beverages. To date most studies on milk and other non-alcoholic beverages aggregate all of the products included in the demand system into a single container size measure, the gallon. An exception to note, which uses the half-gallon as the normalized measure, was the study by Glaser and Thompson. Interestingly Glaser and Thompson use the half-gallon measure by default, since the primary focus of their work was on organic milk, which was at the time almost exclusively sold in half-gallons.

Among the likely reasons applied economists have shown a preference for demand systems that have a single unit measure results from extensive application of the LA/AIDS model. Additionally until most recently data of a disaggregate nature has been unavailable. The LA/AIDS model is generally applied with the inclusion of the Stone index to linearize the system of equations. It has been shown that the Stone index creates a biased estimate of the parameters when the unit measures of the right-hand side variables in the demand equations are not in uniform unit measures. (Moschini).

The departure from the single unit measurement demand system is a step away from the traditional approach, and a step toward isolating the effect characteristics have on consumer behavior. Elasticity information by container size, which is hidden in any aggregated demand model, can be more clearly identified. Capps and Love recognized this in their 2002 *AJAE* article on demand analysis when they indicated, "scanner data from retailers enhances analysts' ability to understand consumer demand, particularly food products". Home Scan Data (HSD) can generally support the construction of these more sophisticated demand systems.

Package aggregation hides differences in the qualities or characteristics that makeup the aggregated commodity. For example in a data such as ACNielsen survey data, milk is bought in various container sizes, but ignoring that by aggregating all purchases as if they were only one quantity size, implies that the price relationships estimated from such an aggregation is the result of some kind of weighted relationship among those container sizes. The problem is not that the estimated coefficients and resulting elasticities are weighted, but rather there is no way to disentangle the value of the weights that makeup these estimates of the aggregated demand system. Therefore, there is no way to measure the effect that a single characteristic, such as container size, has on consumer price and quantity response. It is, however, the relationships of the disaggregated products that tell the more complete story. Price relationships, which take into account container size, would provide valuable decision-making information and a clearer vision of how the non-alcoholic beverage market functions for at-home consumption. This information could prove invaluable to stakeholders in the milk and non-alcoholic beverage arena.

In capturing the price effects by container size in a demand system, a much more detailed understanding of the interrelationships between milk and other non-alcoholic beverages are possible. Beverages included in this work are of the ready to serve type and are commonly found in the demand literature as well as on the supermarket shelf. Carbonated soft drinks (CSDs) are included in most studies about non-alcoholic beverages, which is no surprise since they have been on an increasing trend for the last couple of decades and are the most commonly bought non-alcoholic beverage.

According to Nyman and Capps the estimated per capita consumption of CSDs in 1998 was in excess of fifty gallons annually (Nyman and Capps). Bottled water, juices, and flavored milk also have been on the increase and compete for a place in the bundle the consumer purchases. In this study a demand system with these five beverages in varying containers sizes was considered. The inclusion of different container sizes makes this beverage research unique when compared to previously published research. Table 1 provides a complete list of the beverage products and the container size groupings applied in the demand system.

The demand system provides several types of price information, including own-price, cross-price and expenditure elasticities. When these common measures of price effects are considered in the context of container size, i.e., cross-price elasticities, they represent the substitutability or complementary nature of beverages of different types and sizes. For the first time, relationships among various container sizes as well as types of non-alcoholic beverages are definitively and empirically available.

Table 1. Beverages Estimated in the Demand System

Variable Number	Variable Description	Container Sizes
1	Fruit and Vegetable Juices	Quart
2	Fruit and Vegetable Juices	Half-Gallon
3	Fruit and Vegetable Juices	Gallon
4	Carbonated Soft Drinks	Pint
5	Carbonated Soft Drinks	Quart
6	Carbonated Soft Drinks	Half-Gallon
7	White Milk	Half-Gallon
8	White Milk	Gallon
9	Bottled Water	Half-Gallon
10	Bottled Water	Gallon

The estimation of the ten-product demand system in Table 1 provided the coefficients that allowed the calculation and statistical testing of two hundred and ten elasticity estimates, ninety each of compensated and uncompensated cross-price effects, ten each own-price effects, and ten expenditure elasticities.

Literature Review

As mentioned in the introduction, no published research study has ever considered the effect of container sizes on elasticity estimates for milk or non-alcoholic beverages. A single staff paper and related dissertation was found that addressed the brand-size relationship of spaghetti products (Changwon and Senauer). However, this demand system used a logit-type demand system, designed to estimate the probabilities associated with consumer choices. This logit model focused on the brand-size effect in relation to advertising. Therefore only elasticities associated with advertising were estimated, and not the typical own-price and cross-price elasticities.

Many studies have investigated milk demand but one of the first to estimate a demand structure for fluid milk products was Rojko. In his 1957 work Rojko used time series data to estimates single-equation demand models for fluid milk, cream, butter, and other manufactured dairy products.

Since this first study by Rojko, many different types of studies have been undertaken using different types of data, as can be seen in Capps' literature review done in 2003. A classic example of using disappearance data was that of the 1990 milk demand study by Gould, Cox, and Perali. Gould, Cox, and Perali applied the LA/AIDS model and investigated demographic changes over time and their effect on demand for whole and low-fat milk.

Much of the more current demand work applies a demand systems approach with some type of survey or scanner data. Of the many different papers published, two are representative of the issues that arise when estimating a demand system using these types of data.

Schmit, Chung, Dong, Kaiser, and Gould used a Heckman two-step procedure to perform single-equation estimates on household scanner data (HSD). One of the major purposes of using the Heckman procedure is to accommodate censoring. Glaser and

Thompson used a series of four LA/AIDS models on half-gallon sizes of three different milk types, organic, branded white milk, and private label white milk. Each one of the four models was reflective of a specific fat level. The fat levels used were whole milk, two percent fat milk, one percent fat milk, and non-fat milk. Although the reader is intrigued by their comments on the importance of different container sizes, they nonetheless use only the half-gallon size in their models.

The demand system used in this work includes many of the missing elements not included in previous research. First and foremost, this work uses a systems approach to address the price effects of the two most common container sizes of milk as well as the leading competing products in like sizes. Second, a methodology was used that accounts for censoring. The methodology proposed by Shonkwiler and Yen was applied. The Shonkwiler and Yen methodology uses a consistent two-step estimation procedure referred to as CTS. Much like the single-equation case and the method posed by Heien and Wessels (HW) the first stage requires a probit estimation. However, it is the second stage where the CTS diverge from the HW estimation procedure. There are several other methods of accounting for censoring in a demand system found in the literature, but many of these require the use of integrals, which may make the estimation of a model this size intractable (Yen et al. 2003). And thirdly several variations of the Almost Ideal Demand System (AIDS) from Deaton and Muelbauer, including the AIDS itself and the Linear Approximation to the AIDS model (LA/AIDS). The advantage to the more complex AIDS verses the LA/AIDS is that it accounts for unit measure differences between estimated commodities in the system (Moschini). The AIDS model also is more appropriate from an aggregation prospective.

Data Description

Scanner data have been available from grocery stores since the mid 1970's. The first published academic research to appear using store-collected scanner data appeared in 1987. Scanner data has many different forms. The two primary suppliers in U.S. for scanner data are, aside from proprietary sources, Information Resources Incorporated (IRI) and ACNielsen (Bucklin and Gupta). Scanner data have several different forms. Daily information, as used by Kinoshita et al., in their study of the Japanese milk market, is not often used. Weekly scanner data, the most commonly used frequency, is generally a time-series data set (Bucklin and Gupta). The home scan type of data, which is a survey of household purchases for a specified period, generally a year, is another type of scanner data, although found less frequently in the literature. The type of data used in this work is of the home scan type as collected by ACNielsen.

The 1999 ACNielsen home scan data (HSD) are unique in that this data set is similar to a survey. Each panelist was supplied with a scanner device that he/she used at home to record grocery items purchased at any grocery store, or other type of store throughout a given time period. Each panelist represents a unique household, with each household having eighteen known demographic characteristics. A complete list of the demographics variables can be reviewed in Table 2.

Table 2. Demographic Information Available on Households

	Demographic Information	Number of categories
	Panelist ID Number	
1	Household Size	9
2	Household Income	16
3	Age of Female Head	10
4	Age of Male Head	10
5	Age and Presence of Children	8
6	Male Head Employment	5
7	Female Head Employment	5
8	Male Head Education	7
9	Female Head Education	7
10	Martial Status	5
11	Male Head Occupation	12
12	Female Head Occupation	12
13	Household Composition	8
14	Race	4
15	Hispanic Origin	2
16	Region	4
17	Scantrack Market Identifier	53
18	Projection Factor	1

The households are representative of 52 different cities (84.34%) and unidentified rural areas (15.66%) spread over four regions of the lower 48 states of the U. S., northeast, southeast, central, and west. Table 3 shows the regions and Table 4 exhibits a list of the represented cities.

Table 3. Percent of Households by Region

Region	Percent
East	20.3
West	20.0
South	34.3
Central	25.3

The scanner information was collected by date of purchase and included only those panelist that purchased some kind of grocery product in ten out of the twelve-month periods, making a total of 7,195 participating households. The overall data set was divided into four product groupings,

(1) Dry grocery (4,111,719 records),

(2) Dairy (873,899 records),

(3) Frozen (1,002,851 records), and

(4) Random weights (507,306 records),

with each grouping having numerous product modules. Each product module was further subdivided into, brand, size, flavor, form, formula, container, style, type and variety with each one represented each by a unique UPC number.

Table 4. Locations of Households

	City	Percent of Households		City	Percent of Households
1	Rural	15.66	28	San Diego	0.61
2	Boston	1.3	29	St.	0.96
3	Chicago	10.46	30	Tampa	0.77
4	Houston	0.56	31	Baltimore	4.3
5	Indianapolis	1.27	32	Birmingham	0.25
6	Jacksonville	0.28	33	Buffalo - Rochester	1.04
7	Kansas City	0.76	34	Hartford- New Haven	1.17
8	Los Angeles	11.26	35	Little Rock	0.15
9	Suburban New York	5.47	36	Memphis	0.08
10	Urban New York	3.81	37	New Orleans - Mobile	0.18
11	Ex-Urban New York	2.79	38	Oklahoma City - Tulsa	0.13
12	Orlando	0.48	39	Phoenix	1.83
13	San Francisco	0.64	40	Raleigh - Durham	0.23
14	Seattle	0.71	41	Salt Lake City	1.57
15	Atlanta	13.79	42	Columbus	0.58
16	Cincinnati	0.94	43	Washington, D. C.	8.83
17	Cleveland	1.01	44	Albany	0.49
18	Dallas	0.4	45	Charlotte	0.56
19	Denver	0.86	46	Des Moines	0.49
20	Detroit	1.32	47	Grand Rapids	0.91
21	Miami	0.64	48	Louisville	0.18
22	Milwaukee	0.63	49	Omaha	0.56
23	Minneapolis	0.56	50	Richmond	0.28
24	Nashville	0.16	51	Sacramento	0.48
25	Philadelphia	1.8	52	San Antonio	7.51
26	Pittsburgh	1.43	53	Syracuse	1.45
27	Portland, Oregon	1.09			

For example, in a sub-group such as dairy a product module is Cheese – Natural – American Cheddar, module number 3550. An overall summary of the number of modules in each product grouping is given in Table 5.

Table 5. Modules Per Grouping

Product Grouping	Number of Modules
Dry Grocery	417
Dairy	43
Frozen	43
Random Weights	119

In addition to demographic information total expenditure and quantity information were also recorded for each transaction. This information enabled the imputation of price per unit by transaction, depending on the specified units.

Data Selection Process

The data selection process includes all of the steps that are necessary to clean and organize the data in such away so that it was usable for the analytical and descriptive purpose of this study.

The first step in the process of obtaining a usable data set was to determine which modules were needed to construct the appropriate data set to be used in the analysis. Of the many hundreds of modules, modules from two of the groupings were selected and used in the modeling procedures. Nineteen modules from the dry grocery grouping, and one from the dairy grouping were included. A complete listing of each individual module and its grouping can be seen in Table 6. These raw data were extracted from the original groupings, along with all the appropriate demographic information using SAS.

It should be noted that there are other modules that contain juices, however these are not in the ready to serve form, i.e. frozen juice concentrates or powdered drink mixes.

Table 6. Modules Used To Create Data Sets

Sub-Group / Grouping	Module Number	Product Name
Dry Grocery	1030	Fruit Drinks/Cranberry
Dry Grocery	1031	Cider
Dry Grocery	1032	Grapefruit Juice
Dry Grocery	1033	Apple Juice
Dry Grocery	1034	Grape Juice
Dry Grocery	1035	Grapefruit Juice - Canned
Dry Grocery	1036	Orange Juice - Canned
Dry Grocery	1037	Lemon/Lime Juice
Dry Grocery	1038	Pineapple Juice
Dry Grocery	1039	Prune Juice
Dry Grocery	1040	Orange Juice
Dry Grocery	1041	Fruit Drinks - Canned
Dry Grocery	1042	Fruit Drinks
Dry Grocery	1044	Fruit Drinks Remaining
Dry Grocery	1045	Fruit Juice Nectars
Dry Grocery	1054	Vegetable Juice - Tomato
Dry Grocery	1484	Soft Drinks - Carbonated
Dry Grocery	1487	Water - Bottled
Dry Grocery	1553	Soft Drinks - Low Calorie
Dairy Food	3625	White Milk

To transform the data into the appropriate form required several steps. The first step required identifying the appropriate modules that contain the needed beverage information. The second step was to extract the appropriate container size, price and quantity information from the selected modules. The third and fourth steps included consolidating the data into an annual cross section of households and checking and removing any anomalies.

The raw data set has two sub-groupings that contain modules of ready to serve non-alcoholic beverages. The dry grocery sub-group contains modules for juices of all kinds, CSDs, and bottled water. The dairy sub-group had only the single module, white milk.

Each of the single modules contains many different types of information about its general product area. An example will help to clarify what is meant by module information. The module for white milk, #3625, has information on the characteristics of the various ways white milk was sold, such as container size and type, brand name, and fat type. The module also contains purchase information, such as household identification number, quantity of purchase, and expenditure and coupon or special purchase information.

For example, milk comes in gallon, half-gallon, quart, pint and half pint sizes, with a container that may be categorized as plastic, cardboard, pouch or glass. Additionally, the milk type is a designation of fat content and possibly origin such as soymilk, goat's milk, raw milk, as well as other types. The purchase information is based on transactions where homogeneous items purchased during a single trip to the store are recorded in number and total expenditure as a group.

Eighteen modules were combined to make the aggregated group called juice, while the CSD group was comprised of two modules. The bottled water, and white milk, modules are both single modules. A list of the modules used to create the four-aggregated beverage groups are summarized in Table 7. Once the aggregations were decided upon, the next phase was to decide on appropriate container size assignments within each aggregate grouping.

Two of the four aggregate groups, juice, and white milk are sold primarily in the container sizes of gallons, half-gallons, and quarts. CSDs and water follow a slightly different pattern that includes both the English and metric systems of volume measurement. However, for uniformity all four groups were measured in ounces and converted to the closest container size, such as pint, quart, half-gallon, or gallon.

Juices were divided into three container size groups, quart, half-gallon and gallon. Juice sold in containers holding between 16 ounces and 33.8 ounces were classed as quart size. Juice containers larger than 33.8 ounces and less than or equal to 67.6 ounces were classified as half-gallons. Any juice containers sold that were larger than 67.6 ounces were classified as gallons.

CSDs were grouped into the three sizes of pints, quarts and half-gallons. CSD containers 16 ounces or less are grouped as pints, while those containers holding more then 16 ounces and less than 57 ounces were grouped as quarts, and those greater than 57 ounces are classified as half-gallons.

Table 7. List of Used Modules and Assigned Aggregation Groups

Sub-Group	Module #	Description Title	Aggregate Group
Dry Grocery	1030	Fruit Drinks/Cranberry	Fruit Juice / FJ
Dry Grocery	1031	Cider	Fruit Juice / FJ
Dry Grocery	1032	Grapefruit Juice	Fruit Juice / FJ
Dry Grocery	1033	Apple Juice	Fruit Juice / FJ
Dry Grocery	1034	Grape Juice	Fruit Juice / FJ
Dry Grocery	1035	Grapefruit Juice - Canned	Fruit Juice / FJ
Dry Grocery	1036	Orange Juice - Canned	Fruit Juice / FJ
Dry Grocery	1037	Lemon/Lime Juice	Fruit Juice / FJ
Dry Grocery	1038	Pineapple Juice	Fruit Juice / FJ
Dry Grocery	1039	Prune Juice	Fruit Juice / FJ
Dry Grocery	1040	Orange Juice	Fruit Juice / FJ
Dry Grocery	1041	Fruit Drinks - Canned	Fruit Juice / FJ
Dry Grocery	1042	Fruit Drinks	Fruit Juice / FJ
Dry Grocery	1044	Fruit Drinks Remaining	Fruit Juice / FJ
Dry Grocery	1045	Fruit Juice Nectars	Fruit Juice / FJ
Dry Grocery	1054	Vegetable Juice - Tomato	Fruit Juice / FJ
Dry Grocery	1055	Vegetable Juice Remaining	Fruit Juice / FJ
Dry Grocery	1484	Soft Drinks - Carbonated	Carbonated Soft Drinks / CSD
Dry Grocery	1487	Water - Bottled	Bottled Water / BW
Dry Grocery	1553	Soft Drinks - Low Calorie	Carbonated Soft Drinks / CSD
Dairy Food	3625	White Milk	White Milk / WM

For bottled water, an appropriate grouping scheme was difficult to decide on since to there was no clear uniformity of container size when compared to the other aggregate groups. Additionally to divide the bottled water into more than two smaller groups would cause the budget shares to become very small and possibly create econometric difficulties. From the data it was evident that larger size containers, such as gallons, are really inexpensive, even less than that of the single liter size. However this larger container size is not convenient for carrying around, while the smaller containers are more expensive but are easily toted. Therefore two groupings were made, one of containers smaller than 67.6 ounces, and another of containers holding more than 67.6 ounces. The smaller container sizes were converted to half-gallon equivalents, while the larger sizes were converted to the gallon-size equivalents.

White milk was subdivided into two groups, with gallons being the most purchased size followed by half-gallons. The half-gallon size ranged from 33.9 to 101.4 ounces and the gallon size being any container greater than 101.4 ounces. Quarts were not used since there were some anomalies associated with the data.

Once the modules were extracted from the raw data, aggregated and subdivided into one of the ten products, several things needed to be done to create the appropriate cross-sectional data set. Demographic information was necessary to accommodate imputation of missing prices and for the estimation of the cumulative distribution function (cdf) and the probability density function (pdf) variables needed for the estimation of the censored model.

The HSD data is collected in the form of transactions. Each observation was date specific, with purchase and product characteristic information. The purchase information was shown as a total expenditure amount for the transaction. This expenditure was identified as "price paid deal" or "price paid non-deal" where the total actually spent by the household was the price paid non-deal if no promotion or coupon was present, or price paid deal minus coupon value in the event of a discount. The price paid for each item was the total expenditure for the transaction divided by the quantity bought in that transaction. Remember, a transaction is defined as the purchase of a single product type in a single time period. A transaction may be for only one item such as a single gallon of milk or for many items such as twenty-four, 12-ounce cans of a single type of CSD.

To create the annual cross-sectional data set to be used in this analysis an average price per household was calculated for each of the ten products. Tables 8 and 9 lists the descriptive price and quantity statistics from the final data set. The descriptive statistics are only for those households who purchased a positive quantity during the year of 1999. Included statistics are average price and quantity, standard deviations, minimum and maximum prices and quantities.

Table 8. Price Statistics for Households That Purchased the Ten Beverages

Beverage Type	Container Size	Number of Households That Purchased	Average Price	Standard Deviation	Minimum Price	Maximum Price
Fruit Juice	Quart	6,058	1.58	0.89	0.00	7.84
Fruit Juice	Half-Gallon	6,789	2.07	0.60	0.00	6.79
Fruit Juice	Gallon	3,952	3.36	1.41	0.00	9.72
Bottled Water	Half-Gallon	3,847	1.51	0.74	0.00	5.68
Bottled Water	Gallon	3,056	0.78	0.23	0.00	2.59
CSD's*	Pint	6,573	0.34	0.14	0.00	1.67
CSD's	Quart	4,807	0.93	0.37	0.00	3.87
CSD's	Half-Gallon	6,770	1.93	0.58	0.00	4.07
White Milk	Half-Gallon	5,428	1.66	0.41	0.00	3.95
White Milk	Gallon	5,404	2.52	0.38	0.00	5.73

* CSD's is an acronym for Carbonated Soft Drinks

The average price was calculated by dividing the total annual expenditure for each product by household, by the total annual quantity bought of that product by that household. This price and quantity information was retained for each of the ten products for each household. In the event that a household did not purchase any of a particular product the price was unrecorded. Some households purchased product for a zero price.

Table 9. Quantity Statistics for Households That Purchased the Ten Beverages

Beverage Type	Container Size	Number of Households That Purchased	Average Number of Units Purchased	Standard Deviation	Minimum Number of Units Purchased	Maximum Number of Units Purchased
Fruit Juice	Quart	6,058	22.16	33.44	0.08	558.30
Fruit Juice	Half-Gallon	6,789	25.99	29.85	0.69	324.70
Fruit Juice	Gallon	3,952	7.36	11.13	0.75	225.96
Bottled Water	Half-Gallon	3,847	10.02	21.98	0.13	452.05
Bottled Water	Gallon	3,056	16.75	36.76	1.00	430.00
CSD's*	Pint	6,573	273.99	408.70	0.75	17,613.00
CSD's	Quart	4,807	26.63	67.11	0.63	1,082.80
CSD's	Half-Gallon	6,770	31.70	35.93	0.93	455.92
White Milk	Half-Gallon	5,428	16.24	24.03	0.89	597.00
White Milk	Gallon	5,404	34.11	36.71	1.00	376.00

*CSD's an acronym for Carbonated Soft Drinks.

The annual expenditure sum for each product by household was retained so that gross expenditures could be calculated as well as budget shares for each product. The final average budget shares range from just over 23% for CSD pints to less than 2% for bottled water in the gallon size. Table 10 shows all of the budget shares.

Prior to calculating the average annual price and quantities, several things were done to reduce anomalies in the final data set. By using Chebychev's inequality, any transactional prices greater than five standard deviations from the mean price of that product were dropped from the data set. From Table 11 it can be seen that of the more than six hundred thousand transactions less than two tenths of a percent were dropped. The Chebychev's inequality was performed prior to aggregation across households.

Table 10. Average Budget Shares by Type and Container Size

Beverage Type	Container Size	Average Budget Share
Fruit Juice	Quart	6.9%
Fruit Juice	Half-Gallon	15.1%
Fruit Juice	Gallon	4.0%
Fruit Juices	All	26.0%
Bottled Water	Half-Gallon	2.0%
Bottled Water	Gallon	1.6%
Bottled Water	All	3.6%
CSD's*	Pint	23.8%
CSD's	Quart	3.9%
CSD's	Half-Gallon	17.1%
CSD's	All	44.9%
White Milk	Half-Gallon	6.2%
White Milk	Gallon	19.7%
White Milk	All	25.5%

*CSD's an acronym for Carbonated Soft Drinks

Table 11. Effect of Using Chebychev's Inequality with Five Standard Deviations

Product	# Of Observations Without Chebychev's	# Of Observations With Chebychev's	Number of lost Observations	Percent of Lost Observations
Fruit Juices Quarts	5,596	5,580	16	0.29%
Fruit Juices Half-Gallons	4,720	4,720	0	0.00%
Fruit Juices Gallons	147,388	147,388	0	0.00%
Bottled Water Half-Gallon	75,669	75,669	0	0.00%
Bottled Water Gallon	21,369	21,369	0	0.00%
Carbonated Soft Drinks Pints	142,904	142,258	646	0.45%
Carbonated Soft Drinks Quarts	48,887	48,873	14	0.03%
Carbonated Soft Drinks Half-Gallons	144,574	144,309	265	0.18%
White Milk Half-Gallons	18,719	18,655	64	0.34%
White Milk Gallons	25,832	25,832	0	0.00%
Totals	635,658	634,653	1,005	0.16%

The next step in obtaining the usable data set was to add demographic information. The HSD data set has a demographic sub file with 18 different demographic categories. The eighteen categories are described in further detail in figure 1. All of the demographic information was added for each of the 7,195 households. By aggregating the data across households a cross sectional data set was created. In 170 cases household consumed none of the ten products during the year. I these cases these 170 households were excluded from the study. Even among the reaming 7,025 households not all bought all ten products sometime during the year, and where no purchases were made, no observed price was recorded or budget share allotted to the purchase of that product. In order for the data set to be used appropriately in a demand system it was necessary to fill in these unobserved prices. This was accomplished through a first order imputation process. A full discussion of the methods and information used in these imputations is discussed in the methodology portion of this paper.

Additionally, the coefficient estimates are found in Appendix A. One hundred and seventy households out of the 7,195 were found to have purchased none of the ten products; these households were excluded from the data set used in the final estimation of the demand system.

Methodology

Price Imputations

In order to estimate the demand system each of the households must have price information for each product. Since many of the households only purchased some of the products, prices for non-purchased products were not recoverable. By using the demographic variables a simple OLS regression was used to impute those missing prices.

An OLS regression was performed for each of the ten products using only those observations where price for the chosen product were observed. Figure 1 shows equation 5-1, the mathematical representation of the OLS regression equations and the explanation of the variables used for the price imputation. Appendix A has a summary of the outcome of the OLS coefficient estimates with standard errors, t-statistics and p-values.

$$
\begin{aligned}
(5\text{-}1)\quad P_{ih} = {} & \hat{\beta}_{0i} + \hat{\beta}_{1ih}{*}I_h + \hat{\beta}_{2ih}{*}H_{1h} + \hat{\beta}_{3ih}{*}H_{2h} + \hat{\beta}_{4ih}{*}H_{3h} + \hat{\beta}_{5ih}{*}A_{1h} \\
& + \hat{\beta}_{6ih}{*}A_{2h} + \hat{\beta}_{7ih}{*}A_{3h} + \hat{\beta}_{8ih}{*}C_h + \hat{\beta}_{9ih}{*}E_{1h} + \hat{\beta}_{10ih}{*}E_{2h} + \hat{\beta}_{11ih}{*}R_h \\
& + \hat{\beta}_{12ih}{*}J_{1h} + \hat{\beta}_{13ih}{*}J_{2h} + \hat{\beta}_{14ih}{*}S_h + \hat{\beta}_{15ih}{*}R_{1h} + \hat{\beta}_{16ih}{*}R_{2h} + \hat{\beta}_{17ih}{*}R_{3h} \\
& + \hat{\beta}_{18ih}{*}NM_h + \varepsilon_{ih}
\end{aligned}
$$

Equation 5-1. The OLS Regression equations used to impute missing prices.

Where $i = \{1,2,3,,,\ldots\ldots 10\}$ number of products, and $h = \{1,2,3,,, \ldots\ldots 7{,}025\}$ number of households, observations.

P_{ih} - Where P is the actual price of the i^{th} product and h^{th} household.
$\hat{\beta}_{0i}$ - The intercept term for the base profile for the i^{th} product.

$\hat{\beta}_{1ih}$ - The effect of household income on the i^{th} product of the h^{th} household.
I_h - The average income of the h^{th} household.

Figure 1. Mathematical representation of the OLS regression equations

$\hat{\beta}_{2ih}$ - The effect of having a one person household on the ith product of the hth household

H_{1h} – The indication of household size of one person, for the hth household.

$\hat{\beta}_{3ih}$ - The effect of having a two people household on the ith product of the hth household.

H_{2h} – The indication of household size two people, for the hth household.

$\hat{\beta}_{4ih}$ - The effect of having a two people household on the ith product of the hth household.

H_{3h} – The indication of household size of three people, for the hth household.

$\hat{\beta}_{5ih}$ - The effect of having a female household head less than 25 years old on the ith price of the hth household.

A_{1h} - The indication of a female household head less than 25 years old for the hth household.

$\hat{\beta}_{6ih}$ - The effect of having a female household head between than 40 and 64 years old on the ith price the hth household.

A_{2h} - The indication of a female household head between 40 and 64 years old for the hth household.

$\hat{\beta}_{7ih}$ - The effect of having a female household head 65 years old or older on the ith price of the hth household.

A_{3h} - The indication of a female household head 65 years old or older for the hth household.

$\hat{\beta}_{8ih}$ - The effect of having no children under 18 years old in the household on the ith price of the hth household.

C_h - The indication of having no children under 18 years old in the household for the hth household.

$\hat{\beta}_{9ih}$ - The effect of having female household head with a high school education or less on the ith price of the hth household

E_{1h} - The indication of having a female household head with a high school education or less for the hth household

$\hat{\beta}_{10ih}$ - The effect of having female household head with more than four years of college on the ith price of the hth household.

E_{2h} - The indication of having a female household head with more than four years of college for the hth household.

$\hat{\beta}_{11ih}$ - The effect of a household with a race other than white on the ith price of the hth household.

R_h - The indication of a household with a race other than white for the hth household.

$\hat{\beta}_{12ih}$ - The effect of the female household head having no employment on the ith price of the hth household.

J_{1h} - The indication of the female household head having no employment for the hth household.

$\hat{\beta}_{f13ih}$ - The effect of the female household head working less than 30 hours a week on the ith price of the hth household.

J_{2h} - The indication of the female household head working less than 30 hours a week for the hth household.

$\hat{\beta}_{14ih}$ - The effect of a non-Hispanic household on the ith price of the hth household.

Figure 1. Continued.

S_h - The indication of a non-Hispanic household for the hth household.

$\hat{\beta}_{15ih}$ - The effect of the household located in the eastern region of th U.S. for the Ith price of the hth household.

R_{1ih}- The indication that the hth household is located in the eastern region of the U.S..

$\hat{\beta}_{16ih}$ - The effect of the household located in the western region of th U.S. for the Ith price of the hth household.

R_{2ih} - The indication that the hth household is located in the western region of the U.S. .

$\hat{\beta}_{17ih}$ - The effect of the household living in the central region of th U.S. for the ith price of the hth household.

R_{3ih} - The indication that the hth household is located in the eastern region of the U.S. .

$\hat{\beta}_{18ih}$ - The effect of the household living outside a city for the Ith price of the hth household..

NM_h – The indication of the hth households living outside a city.

ε_{ih} – The unexplained error for the ith price of the hth household.

Figure 1. Continued.

All of the demographic variables in the regression model except household income were indicator variables. The estimated intercept term corresponds to the base demographic profile. In this case the base profile is that of a white Hispanic household with children under eighteen years of age, with a household size of more than four people, having a female head of house that has some college education, between the ages of twenty-five and forty, works more than 30 hours a week, and lives in the southern region of the U.S. in a city. Imputation for each price was made using the estimates from the regressions of only those households that purchased that brand of ice cream. The predicted prices were then imputed using the estimated coefficients. The predicted prices were used to fill in any missing values.

Model Selection

Two models were likely candidates to estimate the elasticities the Almost Ideal Demand System (AIDS) model and the Linear Approximation of the Almost Ideal

Demand System (LA/AIDS). The AIDS model is deemed to be the more appropriate model verses the LA/AIDS. Both models are well suited to cross-sectional data, however as mentioned previously the LA/AIDS model contains the Stone index which has been shown to result in biased estimates of the parameters (Moschini). However the AIDS model is a non-linear model and is more complex to apply then LA/AIDS. The AIDS model has the additional advantage of having desirable properties when aggregating, in this case over consumers. An additional complication is the fact that the data has missing information and therefore requires some method to account for censored observations. The Shonkwiler and Yen Consistent Two Step, CTS, procedure was applied.

Although the primary model estimated was the Censored AIDS (CAIDS), the linerized version the Censored LA/AIDS (CLA/AIDS), was estimated in order to establish starting values for the non-linear version. Additionally the results from the linerized version of the model help to determine the robustness of the resulting estimates and provide reference information. The CLA/AIDS results were used to gauge differences in the compensated and uncompensated own-price and cross-price elasticities as well as expenditure elasticities versus estimating the CAIDS. The difference between the system estimates can be attributed to approximation errors, errors due to linearizing, and/or the Stone index bias. The complete matrices of all elasticities and their associated p-values for the censored CLA/AIDS is found in appendix C and CAIDS models are in Table 13 and 14, page 37 and 38.

Estimation of the Models

The AIDS model as specified by Deaton and Muellbauer is of the PIGLOG class indicating that price is independent from expenditure in the log form.

$$(5\text{-}2) \quad \omega_{ih} = \alpha_i + \sum_{j=1}^{13} \gamma_{ij} \ln p_{jh} + \beta_i * \ln(x_h - P''_h) + \varepsilon_{ih}$$

Equation 5-2 General AIDS model specification.

$i = 1,2,3,\ldots,10$ number of products

$h = 1,2,3,\ldots\ldots 7025$ number of households, observations

where ω_{ih} = the budget share of the ith product of the hth household defined as

$$(5\text{-}3) \quad \omega_{ih} = \frac{p_{ih} * q_{ih}}{x_h}$$

Equation 5-3 Budget share equation.

where α_i is the constant coefficient in the share equation i, and γ_{ij} is the slope coefficient associated with good j in the i share equation .

Total expenditure for the hth household is defined as

$$(5\text{-}4) \quad x_h = \sum_{i=1}^{13} p_{ih} q_{ih}$$

Equation 5-4 Expenditure equation.

Where the LA/AIDS specification of lnP* is defined in equation 5-5a as

(5-5a) $$\ln P''_h = \sum_{k=1}^{10} \omega_{kh} \ln p_{kh}$$

Equation 5-5a The Stone approximation.

where p_{ih} is the price of good i for the h^{th} household. The lnP*, price index, for the AIDS specification is defined in equation 5-5b as

(5-5b) $$\ln P''_h = \alpha_0 + \sum_{k=1}^{10} \alpha_k + \frac{1}{2} \sum_{k=1}^{10} \sum_{j=1}^{10} \gamma_{kj} \ln p_k \ln p_j$$

Equation 5-5b The AIDS expenditure equation.

where k is a counter from 1,2,,,…..10.

The uncensored models automatically satisfy the adding-up restriction if the following conditions hold.

(5-6) $$\sum_{i=1}^{13} \alpha_i = 1 \text{ , } \sum_{i=1}^{13} \gamma_{ij} = 0 \text{, } \sum_{i=1}^{13} \beta_i = 0$$

Equation 5-6 Conditions to ensure the adding-up restriction hold.

The restrictions for maintaining homogeneity are satisfied if and only if, the sum of all gamma *ij's* for each i equal zero.

(5-7) $\sum_{j=1}^{13} \gamma_{ij} = 0$

Equation 5-7. Conditions necessary to ensure that the homogeneity restriction is maintained.

The symmetry condition is satisfied if and only if that all gamma *ij's* equal the gamma *ji's*

(5-8) $\gamma_{ij} = \gamma_{ji}$

Equation 5-8. Conditions to ensure that the symmetry restriction is maintained in the AIDS and LA/AIDS models.

However, the CTS censoring procedure add additional variables to be estimated and modifications in the three conditions must be made to impose these classical conditions.

Censored-Correction Conditions

The first stage of the CTS is known as the selection stage, which refers to the discrete choice where the dependent variable is a qualitative choice variable. In this case, the choice was to purchase or not to purchase the given product. This choice variable was assigned a value of (1) for having purchased the product during the year or (0) for not having purchased the product during the year. The choice variable was then modeled using a probit. The probit estimation process produces two important factors that households have already observed prices and made a choice about consumption. Therefore, something other than price was used to explain their decision to consume. This reasoning was consistent with the budgeting process concept. Only demographic variables were used in this phase of the probit modeling process.

The right hand side (RHS) variables used in the probit model were income, household size, age, education, employment status of the female head of house, presence of children under eighteen years of age, race, region, and urban or non-urban dweller. In cases where the household had no female head, the indicators for the male head of house were used.

All of the RHS variables were indicator variables except income, which though not technically continuous, was treated as such. The incomes for households were reported within a range, therefore any given household in a specific range were assigned the average for that range. Summing the lowest and the highest boundaries of the range and dividing by two provided the averaged range. It should be noted that incomes less than $5,000.00 were averaged to $2,500, and for incomes over the $100,000 measure were set at $100,000.

Household size was classified into four groups: group1, single individual households (hs1); group 2, households of two individuals (hs2); group3, households with 3 individuals (hs3); and group 4, households with four or more individuals (hs4). Age of the female head of house was divided into four ranges: range 1, female heads less than twenty-five years of age (age25); range 2, female heads twenty-four to thirty-nine years of age (age40); range 3, female heads forty to sixty-five years of age (age50); and range

4, female heads over sixty-five years of age (age65). Households with children present under the age of eighteen years of age were coded as (child), and those households without children present under the age of eighteen years of age were coded as (child0). Female heads of house education level had three groups: group1, female heads with a high school or less education (edufh); group2, female heads of house with some college (edufsc); and group3, female heads with at least one degree (edufcp). Employment of the female heads also was separated into three groups: group1, female head not employed for pay (unemp); group2, female head of house employed but less than thirty-five hours per week (ptemp); and group3, female heads of house employed thirty-five or more hours per week (ftemp).

Households across the United States were classed in four general locations: area1, east; area2, west; area3, central; and area4, south. Households were identified as within an urban area (metro) or not (nonmetro). The dependent variable was a binary choice value of the i^{th} product, where a one (1) represents households that bought some of the i^{th} product, and zero (0) represents households where none of the i^{th} product was bought, where $i = 1,2,3,\ldots 10$. All of these conditions were imposed on all of the models. Only nine equations were estimated with the thirteenth being imputed because of the restrictions imposed on the model. A complete summary of the probit results is found in the Appendix B.

The implementation censoring process of the CLA/AIDS and CAIDS are parallel. The same two-step process was used for both models. The probit for the all four models was the same estimation of the same variables resulting in one set of cdf's and pdf's for all of the censored models. The cdf and pdf from the probit analysis, stage-one were saved and used in the next phase. The cdf was multiplied by the specific product *i*'s demand equation (equation (5-9)) and the pdf was weighted by a new parameter (φ). Once the effect of censoring has been accounted for in the estimation process, providing the conditions of symmetry hold, the standard elasticity formulae for each of the demand systems may be applied.

Elasticity Estimates for the CLA/AIDS , LA/AIDS

The uncompensated elasticity equations for the CLA/AIDS model are the same as the standard LA/AIDS as taken from Green and Alston version number iii. The ε_{ij}*'s* are the uncompensated own-price and cross-price elasticities.

(5-11) $\varepsilon_{ij} = -\delta_{ij} + (\gamma_{ij} - \beta_i / \omega_i) / \omega_i$

Equation 5-11. The LA/AIDS model uncompensated elasticities formula.

where the Kronecker delta (δ) equal one when $i = j$.

The compensated elasticity, E_{ij}', incorporates the Slutsky relationship where the share weighted income effect was added to the compensated elasticity.

(5-12) $E_{ij}' = \varepsilon_{ij} + \omega_j \cdot \eta_i$

Equation 5-12. The LA/AIDS model compensated elasticities formula.

η_i was the expenditure elasticity of the i^{th} product where

(5-13) $\eta_i = (1 + \beta_i / \omega_i)$

Equation 5-13 The LA/AIDS model expenditure elasticities formula.

Elasticity Estimates for the CAIDS and AIDS

Since the AIDS was a non-linear model and the elasticities are defined using differentiation of the share equations, the AIDS elasticities are different for those of the LA/AIDS model for both uncompensated and compensated elasticities. However, the expenditure elasticities for the two models are identical, since the expenditure portions of the two equations are identical. The uncompensated own-price and cross-price elasticity equations for the CAIDS and AIDS are defined as:

(5-14) $\xi_{ij} = -\delta_{ij} + (\gamma_{ij} - \beta_i \cdot \alpha_j - \beta_i \cdot \sum_{k=1}^{13} \gamma_{kj}) / \omega_{ii}$

Equation 5-14. Non-Linear AIDS model uncompensated elasticity formula.

Where the Kronecker delta (δ) equals one when $i = j$.

The compensated elasticity, ξ_{ij}', incorporates the Slutsky relationship where the share weighted income effect was added to the compensated elasticity.

(5-15) $\xi'_{ij} = \xi_{ij} + \omega_{ji} * N_i$

Equation 5-15. Non-Linear AIDS model uncompensated elasticity formula.

where N_i was the expenditure elasticity of the ith product, where

(5-16) $N_i = (1 + \beta_i / \omega_i)$

Equation 5-16. Non-Linear AIDS model formula for the expenditure elasticity.

All four models were estimated, CLA/AIDS, LA/AIDS, CAIDS and AIDS. The only elasticities reported in the main body of this paper are from the CAIDS model the remaining tables of elasticites are in the appendix C. Three different kinds of elasticities are reported, own-price, cross-price and expenditure elasticities. Own-price and cross-price elasticities included both compensated and uncompensated. The parameter estimates with the standard errors and t-statistics for the CAIDS model are in Appendix D. The matrices of uncompensated, compensated, and expenditure elasticities for the CAIDS model are in Tables 34, and 35.

Results: CAIDS Estimates

Because of the size of the model and the number of elasticities involved, only the censored corrected non-linear AIDS compensated elasticities are discussed in the remaining results. To further facilitate the task of assembling the results in a comprehensible manner, a series of comparisons were made. The first sets of comparisons were based on individual product verses all other products which could be considered an inter-product comparison. The comparisons rank the products and place them in order of effect, ranging from the largest substitutes to smallest complement. The effects are either net substitutes or net complements since they are compensated elasticities. The second sets of comparisons were done by product type, and are referred to as intra-product comparisons. The third set of comparisons were done by container size, this grouping was referred to as an intra-size grouping. The Final set of comparisons were done by comparing categories, such as all white milk with all fruit juices, this comparison was referred to as an intra-category comparison. In this last comparison the evaluation was based on significance and sign.

To help facilitate a more concise reporting of the results all references to the beverages henceforth will be in the form of acronyms. Acronyms for the ten beverage products will be fruit juices denoted as FJ with sizes of quart, Q, half-gallon, H, and gallon, G. Bottled water as BW with sizes of half-gallon or less, H, and G, more than a half-gallon. CSDs are in sizes of pint, P, quart, Q, and half-gallon, H. White milk denoted as WM with sizes of quart, Q, half-gallon, H, and gallon, G. A reference table is provided that shows all of the beverages and their appropriate acronyms, Table 12. Table 13 shows the matrix of uncompensated elasticities from the estimation of the CAIDS model, with the last column being the expenditure elasticities. Table 14 shows the matrix of compensated elasticities from the same CAIDS model.

Table 12. Acronyms for Beverages Included in the Demand System

Container Size	Pint	Quart	Half-Gallon	Gallon
Beverage Type				
White Milk	-	-	WMH	WMG
Carbonated Soft Drinks	CSDP	CSDQ	CSDH	-
Bottled Water	-	-	BWH	BWG
Fruit Juice	-	FJQ	FJH	FMG

Table 13. Uncompensated Elasticities of the CAIDS Model

Products	FJQ	FJH	FJG	CSDP	CSDQ	CSDH	WMH	WMG	BWH	BWG	N_i
FJQ	-1.5199	-0.0052	0.0471	0.2491	0.0581	-0.0210	0.1415	0.1421	0.0596	0.0042	0.0042
p-value	0.00	0.89	0.08	0.00	0.10	0.51	0.01	0.04	0.03	0.89	0.89
FJH	-0.0150	-0.5817	0.0214	-0.0273	-0.0834	-0.0874	-0.0954	-0.1760	0.0344	-0.0197	-0.0197
p-value	0.40	0.00	0.14	0.27	0.00	0.00	0.00	0.00	0.01	0.20	0.20
FJG	0.0322	0.0181	-0.6580	-0.0206	0.0769	-0.4347	-0.3256	-0.0096	0.1216	-0.2767	-0.2767
p-value	0.48	0.74	0.00	0.81	0.24	0.00	0.00	0.94	0.03	0.00	0.00
CSDP	0.0590	-0.0204	0.0111	-1.1392	0.1270	0.0032	0.0342	-0.1548	0.0585	-0.0278	-0.0278
p-value	0.00	0.19	0.45	0.00	0.00	0.81	0.10	0.00	0.00	0.04	0.04
CSDQ	0.1181	-0.2965	0.0811	0.8015	-2.4924	-0.3251	-0.3663	1.0429	0.2543	0.3533	0.3533
p-value	0.05	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CSDH	-0.0299	-0.0920	-0.0883	-0.0119	-0.0807	-0.6640	-0.0896	-0.1161	0.0200	0.0190	0.0190
p-value	0.02	0.00	0.00	0.52	0.00	0.00	0.00	0.00	0.03	0.23	0.23
WMH	0.2163	-0.1166	-0.1643	0.3059	-0.2442	-0.0993	-0.1753	0.0531	-0.0379	0.0602	0.0602
p-value	0.00	0.04	0.01	0.00	0.00	0.04	0.22	0.66	0.48	0.35	0.35
WMG	0.0334	-0.1414	0.0172	-0.1906	0.2053	-0.0868	-0.0422	-0.7027	-0.0900	-0.0654	-0.0654
p-value	0.18	0.00	0.50	0.00	0.00	0.00	0.27	0.00	0.00	0.02	0.02
BWH	0.2311	0.3275	0.2827	0.8055	0.4980	0.2660	-0.1554	-0.7787	-2.7807	0.7143	0.7143
p-value	0.02	0.00	0.01	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.00
BWG	-0.0603	-0.2007	-0.5928	-0.4076	0.8250	0.2676	-0.0338	-0.7797	0.8196	-1.1234	-1.1234
p-value	0.63	0.16	0.00	0.04	0.00	0.11	0.89	0.02	0.00	0.01	0.01

* See Table 12 for a complete explanation of the acronyms (Page 37)

Table 14. Compensated Elasticities of the CAIDS Model

Products	FJQ	FJH	FJG	CSDP	CSDQ	CSDH	WMH	WMG	BWH	BWG
FJQ	-1.4613	0.1225	0.0807	0.4505	0.0914	0.1232	0.1936	0.3054	0.0762	0.0179
p-value	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.55
FJH	0.0564	-0.4260	0.0624	0.2183	-0.0428	0.0884	-0.0318	0.0232	0.0547	-0.0029
p-value	0.00	0.00	0.00	0.00	0.01	0.00	0.18	0.43	0.00	0.85
FJG	0.1346	0.2414	-0.5993	0.3314	0.1351	-0.1827	-0.2344	0.2759	0.1507	-0.2527
p-value	0.00	0.00	0.00	0.00	0.04	0.01	0.02	0.03	0.01	0.00
CSDP	0.1318	0.1383	0.0529	-0.8891	0.1684	0.1823	0.0990	0.0481	0.0792	-0.0107
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.43
CSDQ	0.1756	-0.1711	0.1141	0.9992	-2.4597	-0.1835	-0.3151	1.2033	0.2706	0.3668
p-value	0.00	0.00	0.08	0.00	0.00	0.01	0.01	0.00	0.00	0.00
CSDH	0.0487	0.0794	-0.0432	0.2584	-0.0360	-0.4705	-0.0196	0.1031	0.0423	0.0374
p-value	0.00	0.00	0.00	0.00	0.02	0.00	0.26	0.00	0.00	0.02
WMH	0.2303	-0.0860	-0.1563	0.3541	-0.2362	-0.0648	-0.1628	0.0922	-0.0340	0.0635
p-value	0.00	0.14	0.01	0.00	0.00	0.18	0.26	0.45	0.53	0.32
WMG	0.1071	0.0194	0.0595	0.0629	0.2472	0.0946	0.0234	-0.4970	-0.0691	-0.0481
p-value	0.00	0.40	0.02	0.05	0.00	0.00	0.54	0.00	0.00	0.08
BWH	0.2720	0.4167	0.3062	0.9461	0.5212	0.3667	-0.1190	-0.6646	-2.7691	0.7239
p-value	0.01	0.00	0.01	0.00	0.00	0.00	0.48	0.00	0.00	0.00
BWG	0.0289	-0.0062	-0.5416	-0.1010	0.8757	0.4871	0.0457	-0.5310	0.8449	-1.1025
p-value	0.82	0.97	0.00	0.61	0.00	0.00	0.85	0.10	0.00	0.01

* See Table 12 for a complete explanation of the acronyms (Page 37).

Inter-product Comparisons

FJQ has an own-price elasticity of -1.4613 with statistically significant substitutes of CSDP with an cross-price elasticity of .4505, WMG at .3054, WMH at .1936, CSDH at .1232, FJH at .1225, CSDQ at .0914, FJG at .0807 and BWH at .0762. The remaining product, BWG was statistically insignificant.

FJH has an own-price elasticity of -.4260 with statistically significant substitutes of CSDP with a cross-price elasticity of .2183, CSDH at .0884, FJG at .0624, FJQ at .0564, BWH at .0547, and one complement CSDQ at -.0428. All other products were statistically insignificant.

FJG has an own-price elasticity of -.5993 with statistically significant substitutes of CSDP with a cross-price elasticity of .3314, WMG at .2759, FJH at .2414, BWH at .1507, CSDQ at .1351, FJQ at .1346, and three complements CSDH at -.1827, WMH at -.2344, BWG at -.2527. With no products being statistically insignificant.

CSDP has an own-price elasticity of -.8891 with statistically significant substitutes of CSDH with a cross-price elasticity of .1823, CSDQ at .1684, FJH at .1383, FJQ at .1318, WMH at .0990, BWH at .0792, FJG at .0529 and no complements. All other products were statistically insignificant.

CSDQ has an own-price elasticity of -2.4597 with statistically significant substitutes of WMG with a cross-price elasticity of 1.2033, CSDP at .9992, BWG at .3668, BWH at .2706, FJQ at .1756, and three complements, FJG at -.1711, CSDH at -.1835, WMH at -.3151. The remaining product FJG was statistically insignificant.

CSDH has an own-price elasticity of -.4705 with statistically significant substitutes of CSDP with a cross-price elasticity of .2585, WMG at .1031, FJH at .0794, FJQ at .0487, BWH at .0423, BWG at .0374, and two complements CSDQ at -.0360, FJG at -.0432. The remaining product WMH was statistically insignificant.

WMH has an own-price elasticity of -.1628, that was not statistically significant, with statistically significant substitutes of CSDP with a cross-price elasticity of .3541, FJQ at .2303, and two complements FJG at .-1563, CSDQ at -.2362. All other products were statistically insignificant.

WMG has an own-price elasticity of -.4970, with statistically significant substitutes of CSDQ with a cross-price elasticity of .2472, FJQ at .1071, CSDH at .0946, CSDP at .0629, and one complement, BWH at -.0691. All other products were statistically insignificant.

BWH has an own-price elasticity of -2.769 with statistically significant substitutes of CSDP with a cross-price elasticity of .9461, BWG at .7239, CSDQ at .5212, FGH at .4167, CSDH at .3667, FJQ at .3062, CSDQ at .2878, and one complement WMG at -.6646. The remaining product WMH was statistically insignificant.

BWG has an own-price elasticity of –1.025 with statistically significant substitutes of CSDQ with a cross price elasticity of .8757, BWH at .8449, CSDH at .4871, and one complement, FJG at -.5416. All other products were statistically insignificant.

Inter-Product Comparison Summary

FJG had the most net substitutes and complements with 6 net substitutes and 3 net complements. FJQ, CSDQ, CSDH, and BWH each have a total of eight net substitutes and net complements. Of the four products CSDQ has the most complements, 3, followed by CSDH with 2, BWH with one and FJQ with no net complements. CSDP has 7 net substitutes and no net complements. WMG has 5 net substitutes and one net complement. BWG has 3 net substitutes and one net complement. The product WMH has the least number of net substitutes with 2, and a single net complement.

The CSD group had the largest valued net substitutes for 9 of the 10 products. The only product with the higher valued net substitute was CSDQ with the product WMG. Of the other 9 largest net substitutes 6 were of the product CSDP, with 2 of CSDQ and 1 of CSDH. Of the ten products CSDP was the only product that was never a net complement, while FJQ was a net complement is had no net complements. CSDQ was complementary most frequently, and complementary three times. FJG, CSDQ and WMH were complements twice each. BWG, BWH, FJQ, and WMG were all complementary once. All gallon measures were net complements for at least one product.

Intra-product Comparison

In the fruit juices group FJH was least affected by price with the smallest own-price elasticity of -.4260. FHQ was the most affected with an elasticity of -1.4613 while FJG was closer to FJH with an elasticity of -.5993. In the intermediate size, FJH was a substitute for either FJG or FJQ with cross-price elasticities of .0564 and .0624, respectively. FJQ had a statistically significant price relationship with FJG and FJH with positive cross-price elasticity of .0807 for FJG and .1225 for FJH. Similarly FJG had statistically significant price relationships with FJQ and FJH and was a substitute for each with a cross-price elasticities of .2414 for FJH and .1346 for FJQ respectively (see Table 15).

Table 15. Intra-Product Compensated Elasticity Comparison of Fruit Juices for the CAIDS Model

Products	FJQ	FJH	FJG
FJQ	-1.4613	0.1225	0.0807
p-value	0.000	0.002	0.002
FJH	0.0564	-0.4260	0.0624
p-value	0.001	0.000	0.000
FJG	0.1346	0.2414	-0.5993
p-value	0.003	0.000	0.000

* See Table 12 for a complete explanation of the acronyms (Page 37).

In the bottled water group BWG was least affected by price with the smallest own-price elasticity of –1.103. BWH was most affected being elastic with an elasticity of -2.769. Both BWG and BWH have a statistically significant cross-price relationship. BWG is a net substitute for BWH with a cross price elasticity of .7239, and BWH is a net substitute for BWG with a cross-price elasticity of .8449 (see Table 16).

Table 16. Intra-Product Compensated Elasticity Comparison of Bottled Water for the CAIDS Model

Products	BWH	BWG
BWH	-2.769	0.7239
p-value	0.000	0.000
BWG	0.8449	-1.1025
p-value	0.000	0.007

* See Table 12 for a complete explanation of the acronyms (Page 37).

In the CSD group, CSDH was least affected by price with the smallest own-price elasticity of -4705. CSDQ was the most affected being very elastic with an elasticity of -2.4597 while CSDP was close to unit elastic with an elasticity of -.8891. While CSDP was a net substitute for CSDQ, and CSDH as both CSDQ and CSDH being net substitutes for CSDP, CSDQ and CSDH were net complements. This seems plausible when you consider that cans of soda close to this size are sold by the six-pack, a seventy-two ounce size. CSDP substituted for either CSDQ or CSDH with cross-price elasticities of .9992 and .2584, respectively. CSDP was substituted by CSDQ with a cross-price elasticity of .1684 and for CSDH with a cross-price elasticity of .1823. CSDQ and CSDH were statistically significant net complements, with CSDH as a net complement for CSDQ with an elasticity of -.1835, and CSDQ as a net complement for CSDH with an elasticity of -.0360 (see Table 17).

Table 17. Intra-Product Compensated Elasticity Comparison of Carbonated Soft Drinks for the CNLAIDS Model

Products	CSDP	CSDQ	CSDH
CSDP	-0.8891	0.1684	0.1823
p-value	0.000	0.000	0.000
CSDQ	0.9992	-2.4597	-0.1835
p-value	0.000	0.000	0.007
CSDH	0.2584	-0.0360	-0.4705
p-value	0.000	0.021	0.000

* See Table 12 for a complete explanation of the acronyms (Page 37).

In the white milk group WMH was least affected by price with the smallest own-price elasticity of -.1628, which was not statistically significant. WMG was the most affected having an own price elasticity of -.4970. WMH was not a statistically significant substitute for WMG and WMG was not a statistically significant substitute for WMH (see Table 18).

Table 18. Intra-Product Compensated Elasticity Comparison of White Milk for the CAIDS Model

Products	WMH	WMG
WMH	-0.1628	0.0922
p-value	0.256	0.446
WMG	0.0234	-0.497
p-value	0.542	0.000

* See Table 12 for a complete explanation of the acronyms (Page 37).

Intra-product Comparison Summary

The WM and FJ groups both had cross-price elasticities between the quart and gallon sizes, which were not statistically significant. However, the half-gallon or adjacent sized cross-price elasticities were positive and statistically significant with both quarts and gallons, making them substitutes.

The FJ group was the only group that had a statistically significant intra-group complement. FJH was complementary with FJG, however, it was very small in value. The CSD group had all sizes as statistically significant substitutes, except between quarts and half-gallon sizes, and half-gallons and quarts sizes. The BW and FM groups had no statistically significant intra-group substitutes or complements.

Intra-size Results

In the quart size group, FJQ and CSDQ both had own-price elasticities greater than one, indicating a high degree of price sensitivity. CSDQ and FJQ were substitutes for each other. CSDQ was substituted for FJQ with a cross-price elasticity of .0914, and substituted by FHQ with a cross-price elasticity of .1756. The FJQ cross price elasticity is about half as large as the CSDQ cross price elasticity, indicating that a price rise in FJQ has half the effect as a price rise in CSDQ. Table 19 shows a summary of all the elasticities in this group.

Table 19. Intra-size Compensated Elasticity Comparison for the Quart Size for the CNLAIDS Model

Products	FJQ	CSDQ
FJQ	-1.4613	0.0914
p-value	0.000	0.010
CSDQ	0.1756	-2.4597
p-value	0.001	0.007

* See Table 12 for a complete explanation of the acronyms (Page 37).

The half-gallon intra-size was the only size group that contained all four product groups. BWH had the largest significant own-price elasticity of – 2.7691 followed by CSDH and FJH, which were both fairly inelastic, with own-price elasticities of -.4705 and -.4260 respectively. WMH had no statistically significant own-price or cross-price elasticities in the intra-size group, indicating a lack of price sensitivity with beverage of comparable size. None of the half gallons sizes were complementry to each other. BWH was most sensitive to price changes, with the largest cross-price elasticities being for FJH at .4167 followed by CSDH at .3667. CSDH was a stronger substitute for FJH then was BWH with a cross price elasticity of .0884 verses .0547. FJH was also a stronger substitute for CSDH than was BWH. FJH had a cross-price elasticity of .0794 for CSDH, while BWH had only a .0423 cross price elasticity. Table 20 exhibits a complete summary of the elasticities.

Table 20. Intra-size Compensated Elasticity Comparison for the Half-Gallon Size for the CAIDS Model

Products	FJH	CSDH	WMH	BWH
FJH	-0.4260	0.0884	-0.0318	0.0547
p-value	0.000	0.000	0.178	0.000
CSDH	0.0794	-0.4705	-0.0196	0.0423
p-value	0.000	0.000	0.264	0.000
WMH	-0.0860	-0.0648	-.1628	-.0.0340
p-value	0.136	0.184	0.256	0.530
BWH	0.4167	0.3667	-0.1190	-2.7691
p-value	0.000	0.000	0.478	0.000

* See Table 12 for a complete explanation of the acronyms (Page 37).

The gallon size intra-size group had three types of products, BWG with an own-price elasticity of –1.1025, FJG with an own-price elasticity of -.5993, and WMG with the smallest intra-group size own-price elasticity of -.4970, all three were statistically significant. BWG was relatively elastic and FJG and WMG were relatively inelastic. WMG did not have a statistically significant relationship with BWG, however, WMG was a net substitute for and by FJG. FJG was a weaker substitute for WMG, with a cross price elasticity of .0595, then WMG was for FJG with a cross price elasticity of .2759. BWG and FJG have a complementary relationship. An increase in BWG price would reduce FJH quantity, with a cross-price elasticity of -.5416, and a price increase in FJG causes a smaller reduction in BWG quantity, with a cross-price elasticity of -.2537. All of these relationships are summarized in Table 21.

Table 21. Intra-Size Compensated Elasticity Comparison of the Gallon Size for the CNLAIDS Model

Products	FJG	WMG	BWG
FJG	-0.5993	0.2751	-0.2527
p-value	0.000	0.025	0.001
WMG	0.0595	-0.4970	-0.0481
p-value	0.020	0.000	0.075
BWG	-0.5416	-0.5310	-1.1025
p-value	0.004	0.099	0.007

* See Table 12 for a complete explanation of the acronyms (Page 37).

Intra-size Results Summary

The intra-size cross-price relationships show that different sizes among the same beverage types have different effects. The quart size CSD was more sensitive to a price change then was the FJQ beverage. The half-gallon size for the FJ and CSD groups had smaller own price and the cross price effects. Additionally these two beverage types were reversed in magnitude relative to the quart size. FJH was more sensitive to a price change then was the CSDH. BWH had the largest own-price elasticity for the half-gallon size, and was the beverage type in that intra-size group that was most sensitive to price changes. All of the beverages in the half-gallon intra-size group were substitutes for others in the group, except WMH, which had no statistically significant substitutes or complements or own-price elasticity. The gallon size intra-size group WMG was unresponsive to BWG but was responsive as a substitute to and for FJG. WMG was a much stronger substitute for FJG then was FJG for WMG. BWG and

FJG had a complementary relationship, with FJG being a twice a strong a complement for BWG as BWG was for FJG.

Intra-category Results

The product category for FJ as a substitute for other products had a total of 16 of the 21 possible cross-price elasticities for other categories as being statistically significant. Of the16 elasticities 12 of the cross-price elasticities were positive, indicating a substitutive relationship with the remaining 4 elasticities being negative indicating that they were complementary in effect.

The product category CSD as a substitute for other products had a total of 19 of the 21 possible cross-price elasticities as being statistically significant, making it the beverage type with the highest percentage of statistically significant price effects omn other prodct out of it own category. Of the 19 significant elasticities 16 were positive, indicating a substitutive relationship with the remaining 3 elasticities being negative indicating they were complementary in effect.

The product category for WM as a substitute for other products had a total of 9 of the 16 possible cross-price elasticities as being statistically significant, making it the beverage with least percentage of statistically significant price effects. Of the 9 elasticities 6 were positive, indicating a substitutive relationship with the remaining 3 elasticities being negative, indicating they were complementary in effect.

The product category for BW as a substitute for other products had a total of 8 of the 16 possible cross-price elasticities for other categories as being statistically significant. Of the 8 elasticities 6 were positive, indicating a substitutive relationship with the remaining 2 elasticities being negative, indicating they were complementary in effect. See Table 22 and 23 for a summary of the percentage of elasticities by type.

Table 22. Percentage of All Elasticities Including Intra-product and Own-price Elasticities

Product Group	Complements	Substitutes	Own-Price	Total
FJ	13%	60%	10%	83%
CSD	17%	67%	10%	93%
WM	15%	30%	5%	50%
BW	10%	50%	10%	70%

Table 23. Percentage of All Other Elasticities Excluding Intra-product and Own-price Elasticities

Product Group	Complements	Substitutes	Total
FJ	19%	57%	76%
CSD	14%	76%	90%
WM	19%	38%	56%
BW	13%	50%	63%

The relationship between the product categories FJ and CSD had a total of 17 out of the 18 possible cross-price elasticities in either direction of substitution. Of the 17 elasticities, 13 were positive indicating a substitutive relationship with the remaining 4 elasticities being negative, indicating a complementary relationship.

The relationship between the product categories FJ and WM had a total of 8 out of the 12 possible cross-price elasticities in either direction. Of the 8 elasticities, 6 were positive indicating a substitutive relationship with the remaining 2 elasticities being negative, indicating a complementary relationship.

The relationship between the product categories FJ and BW had a total of 8 out of the 12 possible cross-price elasticities in either direction. Of the 8 elasticities, 6 were positive indicating a substitutive relationship with the remaining 2 elasticities being negative, indicating a complementary relationship.

The relationship between the product categories CSD and WM had a total of 9 of the 12 possible cross-price elasticities. Of the 9 elasticities, 7 were positive indicating a substitutive relationship with the remaining 2 elasticities being negative, indicating a complementary relationship.

The relationship between the product categories CSD and BW had a total of 9 of the 12 possible cross-price elasticities in either direction. Of the 9 elasticities, 10 were positive indicating a substitutive relationship with no elasticity being negative, indicating no complementary relationships.

The relationship between the product categories WM and BW had a total of 1 of the 8 possible cross-price elasticities in either direction. Of the single elasticity, none were positive indicating a substitutive relationship with the remaining 1 elasticity being negative, indicating a complementary relationship.

Conclusions

Non-alcoholic beverages sold in different sized containers had very different elasticities, as can be seen by these results. Elasticities representing intra-product price quantity relationships provide insight into the difference that container size has on a single product. Generally products within the group type were found to be substitiutes, except in the case between CSDQ and CSDH .

Inter-product elasticities also were enlightening, since a comparison of elasticities of different sizes of one product with respect to a single size and type of another product were compared, and found to be different. Products, which are normally considered to be substitutes for one another, were found to be complementary for some sizes and substitutes for others. For example a 1% increase in the price of WMH would increase FJQ quantity by .23%, decrease FJG quantity by .16%, increase CSDP by .35% and CSDQ would decrease by .24%. Given the average price of WMH as $1.66, it would increase to $1.6766, the total quantity of FJQ consumed by our sample of consumers would increase by 309.17 quarts, FJQ would decrease by 45.46 gallons, CSDP would increase by 6377.12 pints, and CSDQ would decrease by 302.36 quarts. Where as if aggregate elasticities had been estimated and we assume the sum of the intra-product elasticities approximate the aggregate elasticity for each product group, the same 1% price increase in WMH would result in a 31.38 gallon increase in FJ, and a 721.55 gallon increase in CSD's. While this number is important the detail is more useful for policy analysis when it might come to nutrition, or establishing price schemes for the different products.

The intra-size elasticity comparison was interesting especially for WMH since it was not statistically significant for any other half-gallon beverage. Additionally if we ignore the statistical test all of the cross-price elasticities for WMH all are negative indicating any increase in price would create a negative effect on quantity bought of all the other half-gallon beverages, CSD, FJ and BW.

SUMMARY AND DISCUSSION

Summary

Container sizes generally have been an interesting question for manufacture's, retailers and consumers. Until now this issue has been neglected in demand system analysis. By estimating a system that included various container sizes, much different and unique elasticity were estimated.

Elasticities representing intra-product price quantity relationships provide insight into the difference that package size has on a single product. Inter-product elasticities also were enlightening, since a comparison of elasticities of different sizes of one product with respect to a single size and type of another product were compared, and found to be different. Products, which are normally considered to be substitutes for one another, were found to be complementary for some sizes and substitutes for others.

The model estimated was a censored corrected non-linear AIDS model. The presence of small budget shares, and/or a high degree of censoring radically affected elasticity estimates. Since the estimates were derived using a non-linear estimation method, typical non-linear estimation issues are a concern, such as stability of the parameter estimates with respect it different starting values.

To help to fortify the robustness of the result several things should be pursued. A series of models using other censoring methods and other demand system specifications could be implemented. Other demand systems could include the Translog model and the quadratic AIDS model. Additionally the same study could be repeated using similar data from other years. It also may be informative to compare these elasticity results of those obtained using weekly scan data.

Discussion

It has been shown that HSD data are quite useful in addressing economic problems. HSD data provides information not available in other data sets, such as demographic profiles and individual transaction information. The characteristics of the data make it possible to apply economic theory in a disaggregate way. Carefully designed models as a demand system other detailed economic model can be estimated using this data, which can provide detailed information either in product space, or geographic space.

These carefully constructed models can be tailored to answer very specific questions. The questions addressed in this paper are a very small sample of limitless possibilities. Although the number of possibilities and applications are limitless the realm in which those applications are correctly applied is finite. The goal of the applied economist is to use theory and empirical information to solve a problem or answer a specific question.

Since the HSD is an innovation in data, it is yet unclear how to completely capitalize on that innovation to answer economic questions. The contribution of this work is in recognition of this fact and the recognition that this work itself needs work. The HSD data are well suited to gaining detailed information about economic agents and markets. The unfortunate thing about these data is the censoring that occurs in the demand system analysis. Although a method is used to adjust for censored observations, problems related to the appropriateness the adjustment still remain. As with any good research, the questions raised by the work provide the fuel for further investigations.

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APPENDIX A

PRICE IMPUTATION COEFFICIENTS

Table A1. Price Imputation Equation Coefficient Estimates for Fruit Juice in the Quart Size

Coefficient	Coefficient Estimate	Standard Error	t-statistic	p-value
β_1	0.00	0.00	4.15	0.00
β_2	0.35	0.05	7.25	0.00
β_3	0.23	0.04	5.60	0.00
β_4	0.06	0.04	1.67	0.10
β_5	0.04	0.03	1.33	0.19
β_6	0.07	0.03	2.41	0.02
β_7	0.23	0.04	5.23	0.00
β_8	0.27	0.04	7.04	0.00
β_9	-0.09	0.03	-3.00	0.00
β_{10}	0.03	0.03	1.13	0.26
β_{11}	-0.10	0.03	-3.25	0.00
β_{12}	0.01	0.03	0.37	0.71
β_{13}	-0.05	0.03	-1.72	0.09
β_{14}	-0.07	0.05	-1.63	0.10
β_{15}	0.00	0.03	-0.12	0.90
β_{16}	-0.04	0.03	-1.36	0.18
β_{17}	0.00	0.03	0.13	0.90
β_{18}	0.04	0.03	1.32	0.19
β_0	1.18	0.07	17.85	0.00

See Figure 1 for an explanation of the coefficients.

Table A2. Price Imputation Equation Coefficient Estimates for Fruit Juice in the Half-Gallon Size

Coefficient	Coefficient Estimate	Standard Error	t-statistic	p-value
β_1	0.00	0.00	10.77	0.00
β_2	0.16	0.03	5.23	0.00
β_3	0.11	0.03	4.07	0.00
β_4	0.05	0.02	2.10	0.04
β_5	0.04	0.02	2.04	0.04
β_6	0.03	0.02	1.69	0.09
β_7	0.08	0.03	3.05	0.00
β_8	0.09	0.02	3.46	0.00
β_9	-0.04	0.02	-2.33	0.02
β_{10}	0.03	0.02	1.70	0.09
β_{11}	-0.05	0.02	-2.70	0.01
β_{12}	-0.04	0.02	-2.39	0.02
β_{13}	-0.06	0.02	-2.76	0.01
β_{14}	-0.04	0.03	-1.49	0.14
β_{15}	-0.01	0.02	-0.55	0.58
β_{16}	-0.05	0.02	-2.79	0.01
β_{17}	0.20	0.02	9.67	0.00
β_{18}	-0.04	0.02	-1.99	0.05
β_0	1.77	0.04	41.10	0.00

See Figure 1 for an explanation of the coefficients.

Table A3. Price Imputation Equation Coefficient Estimates for Fruit Juice in the Gallon Size

Coefficient	Coefficient Estimate	Standard Error	t-statistic	p-value
β_1	0.00	0.00	12.63	0.00
β_2	0.58	0.10	5.97	0.00
β_3	0.22	0.08	2.90	0.00
β_4	0.14	0.07	2.06	0.04
β_5	0.08	0.06	1.45	0.15
β_6	0.17	0.06	2.87	0.00
β_7	0.30	0.09	3.40	0.00
β_8	0.06	0.07	0.89	0.37
β_9	-0.09	0.06	-1.51	0.13
β_{10}	0.09	0.05	1.81	0.07
β_{11}	-0.38	0.06	-6.77	0.00
β_{12}	-0.03	0.06	-0.50	0.62
β_{13}	0.02	0.06	0.41	0.68
β_{14}	-0.07	0.08	-0.83	0.41
β_{15}	0.02	0.06	0.38	0.70
β_{16}	-0.04	0.06	-0.61	0.54
β_{17}	0.26	0.06	4.26	0.00
β_{18}	-0.17	0.07	-2.66	0.01
β_0	2.49	0.12	20.22	0.00

See Figure 1 for an explanation of the coefficients.

Table A4. Price Imputation Equation Coefficient Estimates for Bottled Water in the Half-Gallon Size

Coefficient	Coefficient Estimate	Standard Error	t-statistic	p-value
β_1	0.00	0.00	-1.34	0.18
β_2	0.14	0.05	2.63	0.01
β_3	0.10	0.04	2.26	0.02
β_4	0.03	0.04	0.84	0.40
β_5	0.04	0.03	1.29	0.20
β_6	-0.03	0.03	-0.80	0.43
β_7	0.04	0.05	0.74	0.46
β_8	-0.04	0.04	-1.07	0.29
β_9	0.00	0.03	-0.11	0.91
β_{10}	0.02	0.03	0.60	0.55
β_{11}	0.04	0.03	1.12	0.26
β_{12}	-0.03	0.03	-0.84	0.40
β_{13}	-0.04	0.03	-1.06	0.29
β_{14}	-0.04	0.05	-0.77	0.44
β_{15}	0.00	0.03	-0.12	0.91
β_{16}	0.03	0.03	0.91	0.36
β_{17}	-0.14	0.03	-4.03	0.00
β_{18}	0.05	0.04	1.30	0.19
β_0	1.56	0.07	22.40	0.00

See Figure 1 for an explanation of the coefficients.

Table A5. Price Imputation Equation Coefficient Estimates for Bottled Water in the Gallon Size

Coefficient	Coefficient Estimate	Standard Error	t-statistic	p-value
β_1	0.00	0.00	4.16	0.00
β_2	0.03	0.02	1.74	0.08
β_3	0.00	0.02	0.12	0.91
β_4	0.00	0.01	0.27	0.78
β_5	0.00	0.01	-0.04	0.97
β_6	-0.02	0.01	-1.71	0.09
β_7	-0.02	0.02	-1.15	0.25
β_8	0.01	0.01	0.95	0.34
β_9	0.01	0.01	1.17	0.24
β_{10}	0.01	0.01	1.45	0.15
β_{11}	0.04	0.01	3.64	0.00
β_{12}	-0.01	0.01	-0.93	0.35
β_{13}	-0.01	0.01	-0.72	0.47
β_{14}	0.01	0.02	0.33	0.74
β_{15}	0.02	0.01	1.90	0.06
β_{16}	0.03	0.01	2.81	0.01
β_{17}	0.01	0.01	1.10	0.27
β_{18}	-0.04	0.01	-3.39	0.00
β_0	0.70	0.02	28.52	0.00

See Figure 1 for an explanation of the coefficients.

Table A6. Price Imputation Equation Coefficient Estimates for Carbonated Soft Drinks in the Pint Size

Coefficient	Coefficient Estimate	Standard Error	t-statistic	p-value
β_1	0.00	0.00	2.43	0.02
β_2	0.05	0.01	6.65	0.00
β_3	0.02	0.01	3.19	0.00
β_4	0.00	0.01	0.08	0.93
β_5	0.01	0.00	1.74	0.08
β_6	0.00	0.00	-1.00	0.32
β_7	-0.01	0.01	-1.22	0.22
β_8	0.01	0.01	1.48	0.14
β_9	-0.01	0.00	-1.54	0.12
β_{10}	0.01	0.00	2.16	0.03
β_{11}	0.02	0.00	4.99	0.00
β_{12}	-0.01	0.00	-2.31	0.02
β_{13}	0.00	0.00	-0.63	0.53
β_{14}	0.00	0.01	0.32	0.75
β_{15}	0.02	0.00	4.26	0.00
β_{16}	-0.04	0.00	-8.54	0.00
β_{17}	-0.02	0.00	-3.14	0.00
β_{18}	0.00	0.01	-0.27	0.79
β_0	0.31	0.01	29.86	0.00

See Figure 1 for an explanation of the coefficients.

Table A7. Price Imputation Equation Coefficient Estimates for Carbonated Soft Drinks in the Quart Size

Coefficient	Coefficient Estimate	Standard Error	t-statistic	p-value
β_1	0.00	0.00	-3.94	0.00
β_2	-0.01	0.02	-0.57	0.57
β_3	-0.01	0.02	-0.48	0.63
β_4	-0.01	0.02	-0.56	0.58
β_5	0.08	0.01	5.52	0.00
β_6	-0.03	0.01	-1.89	0.06
β_7	-0.05	0.02	-2.24	0.03
β_8	-0.01	0.02	-0.38	0.71
β_9	0.03	0.01	2.29	0.02
β_{10}	0.01	0.01	0.51	0.61
β_{11}	0.04	0.01	2.89	0.00
β_{12}	-0.04	0.01	-2.98	0.00
β_{13}	-0.02	0.01	-1.60	0.11
β_{14}	0.00	0.02	-0.21	0.83
β_{15}	-0.10	0.01	-7.19	0.00
β_{16}	-0.02	0.01	-1.56	0.12
β_{17}	0.14	0.02	9.08	0.00
β_{18}	0.05	0.02	3.16	0.00
β_0	0.98	0.03	31.38	0.00

See Figure 1 for an explanation of the coefficients.

Table A8. Price Imputation Equation Coefficient Estimates for Carbonated Soft Drinks in the Half-Gallon Size

Coefficient	Coefficient Estimate	Standard Error	t-statistic	p-value
β_1	0.00	0.00	13.93	0.00
β_2	0.27	0.03	9.12	0.00
β_3	0.16	0.03	6.39	0.00
β_4	0.09	0.02	3.94	0.00
β_5	0.02	0.02	1.28	0.20
β_6	0.04	0.02	1.91	0.06
β_7	0.08	0.03	2.90	0.00
β_8	0.08	0.02	3.34	0.00
β_9	-0.04	0.02	-2.47	0.01
β_{10}	0.06	0.02	3.76	0.00
β_{11}	-0.12	0.02	-6.34	0.00
β_{12}	-0.04	0.02	-2.01	0.04
β_{13}	-0.02	0.02	-1.26	0.21
β_{14}	-0.03	0.03	-1.11	0.27
β_{15}	0.02	0.02	1.03	0.30
β_{16}	-0.04	0.02	-1.95	0.05
β_{17}	0.14	0.02	7.10	0.00
β_{18}	-0.03	0.02	-1.66	0.10
β_0	1.53	0.04	36.89	0.00

See Figure 1 for an explanation of the coefficients.

Table E9. Price Imputation Equation Coefficient Estimates for White Milk in the Half-Gallon Size

Coefficient	Coefficient Estimate	Standard Error	t-statistic	p-value
β_1	0.00	0.00	4.63	0.00
β_2	0.06	0.02	2.40	0.02
β_3	0.01	0.02	0.29	0.77
β_4	0.00	0.02	0.24	0.81
β_5	0.02	0.02	1.52	0.13
β_6	-0.01	0.01	-0.86	0.39
β_7	-0.01	0.02	-0.39	0.70
β_8	0.03	0.02	1.58	0.12
β_9	0.01	0.01	0.41	0.68
β_{10}	0.01	0.01	0.93	0.35
β_{11}	0.09	0.02	6.02	0.00
β_{12}	-0.01	0.01	-0.51	0.61
β_{13}	-0.01	0.02	-0.71	0.48
β_{14}	-0.02	0.02	-0.85	0.40
β_{15}	-0.06	0.01	-4.13	0.00
β_{16}	-0.07	0.02	-4.47	0.00
β_{17}	0.18	0.02	11.80	0.00
β_{18}	-0.09	0.02	-5.62	0.00
β_0	1.57	0.03	47.34	0.00

See Figure 1 for an explanation of the coefficients.

Table A10. Price Imputation Equation Coefficient Estimates for White Milk in the Gallon Size

Coefficient	Coefficient Estimate	Standard Error	t-statistic	p-value
β_1	0.00	0.00	3.40	0.00
β_2	0.00	0.02	0.01	0.99
β_3	0.00	0.02	-0.12	0.91
β_4	0.01	0.02	0.47	0.64
β_5	0.06	0.01	4.17	0.00
β_6	0.00	0.01	-0.09	0.93
β_7	0.00	0.02	0.03	0.97
β_8	-0.01	0.02	-0.49	0.63
β_9	0.03	0.01	2.42	0.02
β_{10}	-0.01	0.01	-0.66	0.51
β_{11}	0.03	0.02	1.78	0.08
β_{12}	-0.03	0.01	-2.61	0.01
β_{13}	-0.03	0.01	-2.40	0.02
β_{14}	0.00	0.02	-0.17	0.87
β_{15}	0.00	0.01	0.04	0.97
β_{16}	-0.14	0.01	-10.43	0.00
β_{17}	0.04	0.01	2.97	0.00
β_{18}	-0.03	0.01	-2.17	0.03
β_0	2.52	0.03	81.95	0.00

See Figure 1 for an explanation of the coefficients.

Table E14. Goodness-of-Fit for the Price Imputation Models

Model	R-square
Fruit Juice Quarts	0.10
Fruit Juice Half-Gallons	0.07
Fruit Juice Gallons	0.09
Bottled Water Half-Gallons	0.01
Bottled Water Gallons	0.03
Carbonated Soft Drink Pints	0.05
Carbonated Soft Drink Quarts	0.07
Carbonated Soft Drink Half-Gallons	0.10
White Milk Half-Gallons	0.08
White Milk Gallons	0.05

APPENDIX B

PROBIT COEFFICIENT ESTIMATES

Table B1. Probit Coefficient Estimates for the Presence of Fruit Juice in the Quart Size

Coefficient	Coefficient Estimate	Standard Error	t-statistic
AVGINC	0.000	0.000	2.75
HS1	-0.806	0.092	-8.77
HS2	-0.438	0.084	-5.19
HS3	-0.219	0.084	-2.61
AGEF25	0.042	0.059	0.71
AGEF50	-0.074	0.051	-1.43
AGEF65	-0.080	0.069	-1.16
CHILD0	-0.487	0.079	-6.13
EDUFH	-0.003	0.051	-0.51
EDUFCP	-0.045	0.046	-0.98
OTHER	0.325	0.060	5.38
UNEMP	0.004	0.051	0.79
PTEMP	0.136	0.058	2.33
HISPN	0.047	0.094	0.50
EAST	0.029	0.054	0.54
CENTRAL	-0.064	0.052	-1.24
WEST	-0.002	0.054	-0.29
NONMETRO	-0.070	0.053	-1.32
CONSTANT	1.679	0.132	12.75

See sub-section, Estimation of the Probit Model (Selection Stage), Page 31-33 for an explanation of the coefficients.

Table B2. Probit Coefficient Estimates for the Presence of Fruit Juice in the Half-Gallon Size

Coefficient	Coefficient Estimate	Standard Error	t-statistic
AVGINC	0.000	0.000	3.39
HS1	-0.480	0.121	-3.96
HS2	-0.056	0.112	-0.50
HS3	0.217	0.113	1.91
AGEF25	-0.013	0.075	-0.17
AGEF50	0.042	0.070	0.61
AGEF65	0.049	0.092	0.54
CHILD0	-0.223	0.108	-2.07
EDUFH	0.028	0.067	0.42
EDUFCP	0.075	0.062	1.22
OTHER	0.230	0.081	2.85
UNEMP	0.019	0.069	0.28
PTEMP	-0.027	0.074	-0.37
HISPN	-0.069	0.124	-0.55
EAST	0.251	0.082	3.06
CENTRAL	0.052	0.071	0.74
WEST	-0.340	0.066	-5.13
NONMETRO	-0.132	0.067	-1.96
CONSTANT	1.741	0.169	10.31

See sub-section, Estimation of the Probit Model (Selection Stage), page 31-33 for an explanation of the coefficients.

Table B3. Probit Coefficient Estimates for the Presence of Fruit Juice in the Gallon Size

Coefficient	Coefficient Estimate	Standard Error	t-statistic
AVGINC	0.000	0.000	1.65
HS1	-0.884	0.068	-12.93
HS2	-0.380	0.059	-6.45
HS3	-0.211	0.053	-3.98
AGEF25	0.046	0.043	1.06
AGEF50	0.048	0.042	1.15
AGEF65	-0.058	0.059	-0.99
CHILD0	-0.186	0.055	-3.36
EDUFH	-0.059	0.041	-1.44
EDUFCP	-0.060	0.037	-1.61
OTHER	0.358	0.045	7.99
UNEMP	-0.056	0.041	-1.38
PTEMP	-0.015	0.044	-0.33
HISPN	-0.012	0.068	-0.18
EAST	-0.153	0.043	-3.59
CENTRAL	0.077	0.042	1.82
WEST	0.130	0.044	2.94
NONMETRO	-0.128	0.045	-2.87
CONSTANT	0.575	0.096	5.99

See sub-section, Estimation of the Probit Model (Selection Stage), page 31-33 for an explanation of the coefficients.

Table B4. Probit Coefficient Estimates for the Presence of Bottled Water in the Half-Gallon Size

Coefficient	Coefficient Estimate	Standard Error	t-statistic
AVGINC	0.000	0.000	7.40
HS1	-0.197	0.067	-2.95
HS2	-0.127	0.058	-2.20
HS3	-0.056	0.052	-1.07
AGEF25	0.064	0.043	1.50
AGEF50	-0.120	0.041	-2.91
AGEF65	-0.402	0.059	-6.85
CHILD0	-0.117	0.054	-2.16
EDUFH	0.005	0.040	0.12
EDUFCP	-0.063	0.037	-1.71
OTHER	0.271	0.044	6.21
UNEMP	-0.088	0.040	-2.20
PTEMP	-0.012	0.043	-0.27
HISPN	-0.134	0.067	-2.00
EAST	0.060	0.042	1.41
CENTRAL	-0.048	0.041	-1.15
WEST	0.138	0.044	3.16
NONMETRO	-0.085	0.044	-1.91
CONSTANT	0.215	0.094	2.28

See sub-section, Estimation of the Probit Model (Selection Stage), page 31-33 for an explanation of the coefficients.

Table B5. Probit Coefficient Estimates for the Presence of Bottled Water in the Gallon Size

Coefficient	Coefficient Estimate	Standard Error	t-statistic
AVGINC	0.000	0.000	3.28
HS1	-0.087	0.066	-1.32
HS2	0.060	0.057	1.05
HS3	-0.045	0.051	-0.88
AGEF25	0.013	0.042	0.32
AGEF50	-0.002	0.041	-0.58
AGEF65	-0.109	0.058	-1.88
CHILD0	-0.104	0.054	-1.95
EDUFH	-0.030	0.040	-0.75
EDUFCP	-0.079	0.036	-2.16
OTHER	0.242	0.042	5.70
UNEMP	0.022	0.040	0.55
PTEMP	0.031	0.043	0.73
HISPN	-0.012	0.064	-0.19
EAST	-0.087	0.042	-2.06
CENTRAL	-0.099	0.041	-2.41
WEST	0.038	0.043	0.89
NONMETRO	-0.093	0.044	-2.09
CONSTANT	-0.168	0.092	-1.83

See sub-section, Estimation of the Probit Model (Selection Stage), page 31-33 for an explanation of the coefficients.

Table B6. Probit Coefficient Estimates for the Presence of Carbonated Soft Drinks in the Pint Size

Coefficient	Coefficient Estimate	Standard Error	t-statistic
AVGINC	0.000	0.000	4.42
HS1	-0.692	0.106	-6.52
HS2	-0.248	0.098	-2.53
HS3	-0.072	0.092	-0.79
AGEF25	-0.032	0.066	-0.48
AGEF50	-0.057	0.062	-0.92
AGEF65	-0.235	0.081	-2.89
CHILD0	-0.064	0.091	-0.70
EDUFH	0.164	0.062	2.66
EDUFCP	-0.059	0.053	-1.10
OTHER	-0.010	0.063	-0.15
UNEMP	-0.007	0.060	-0.11
PTEMP	0.073	0.067	1.09
HISPN	-0.041	0.110	-0.38
EAST	-0.435	0.058	-7.56
CENTRAL	0.016	0.063	0.25
WEST	0.166	0.070	2.38
NONMETRO	0.041	0.066	0.62
CONSTANT	1.662	0.151	11.03

See sub-section, Estimation of the Probit Model (Selection Stage), page 31-33 for an explanation of the coefficients.

Table B7. Probit Coefficient Estimates for the Presence of Carbonated Soft Drinks in the Quart Size

Coefficient	Coefficient Estimate	Standard Error	t-statistic
AVGINC	0.000	0.000	-1.03
HS1	-0.441	0.070	-6.31
HS2	-0.244	0.061	-4.00
HS3	0.011	0.056	0.19
AGEF25	-0.065	0.045	-1.45
AGEF50	-0.256	0.043	-5.93
AGEF65	-0.436	0.060	-7.33
CHILD0	0.034	0.058	0.60
EDUFH	0.007	0.042	0.16
EDUFCP	-0.143	0.038	-3.76
OTHER	0.034	0.045	0.76
UNEMP	-0.131	0.041	-3.18
PTEMP	0.012	0.045	0.26
HISPN	-0.080	0.069	-1.15
EAST	0.037	0.044	0.83
CENTRAL	-0.084	0.043	-1.96
WEST	-0.297	0.044	-6.74
NONMETRO	0.070	0.046	1.52
CONSTANT	1.045	0.099	10.58

See sub-section, Estimation of the Probit Model (Selection Stage), page 31-33 for an explanation of the coefficients.

Table B8. Probit Coefficient Estimates for the Presence of Carbonated Soft Drinks in the Half-Gallon Size

Coefficient	Coefficient Estimate	Standard Error	t-statistic
AVGINC	0.000	0.000	3.72
HS1	-0.794	0.127	-6.23
HS2	-0.353	0.118	-2.99
HS3	-0.021	0.114	-0.18
AGEF25	0.068	0.077	0.89
AGEF50	-0.016	0.069	-0.23
AGEF65	0.077	0.091	0.85
CHILD0	-0.047	0.110	-0.42
EDUFH	0.005	0.066	0.78
EDUFCP	0.005	0.061	0.84
OTHER	0.303	0.084	3.63
UNEMP	-0.057	0.067	-0.85
PTEMP	-0.059	0.074	-0.79
HISPN	-0.104	0.134	-0.78
EAST	0.180	0.078	2.32
CENTRAL	0.029	0.069	0.43
WEST	-0.227	0.067	-3.37
NONMETRO	-0.131	0.067	-1.96
CONSTANT	1.885	0.177	10.63

See sub-section, Estimation of the Probit Model (Selection Stage), page 31-33 for an explanation of the coefficients.

Table B9. Probit Coefficient Estimates for the Presence of White Milk in the Half-Gallon Size

Coefficient	Coefficient Estimate	Standard Error	t-statistic
AVGINC	0.000	0.000	2.74
HS1	0.139	0.071	1.94
HS2	0.300	0.062	4.83
HS3	0.197	0.055	3.57
AGEF25	-0.012	0.045	-0.27
AGEF50	0.068	0.045	1.52
AGEF65	0.086	0.063	1.36
CHILD0	0.043	0.058	0.74
EDUFH	0.039	0.044	0.88
EDUFCP	-0.026	0.040	-0.65
OTHER	0.055	0.047	1.18
UNEMP	0.047	0.043	1.09
PTEMP	0.073	0.047	1.57
HISPN	0.032	0.070	0.46
EAST	0.094	0.048	1.97
CENTRAL	-0.314	0.044	-7.13
WEST	-0.249	0.046	-5.38
NONMETRO	0.121	0.048	2.55
CONSTANT	0.387	0.100	3.88

See sub-section, Estimation of the Probit Model (Selection Stage), page 31-33 for an explanation of the coefficients.

Table B10. Probit Coefficient Estimates for the Presence of White Milk in the Gallon Size

Coefficient	Coefficient Estimate	Standard Error	t-statistic
AVGINC	0.000	0.000	-2.26
HS1	-1.282	0.082	-15.59
HS2	-0.604	0.074	-8.18
HS3	-0.295	0.071	-4.15
AGEF25	0.071	0.053	1.35
AGEF50	-0.097	0.047	-2.04
AGEF65	-0.104	0.065	-1.60
CHILD0	-0.364	0.068	-5.32
EDUFH	0.084	0.048	1.74
EDUFCP	-0.054	0.042	-1.27
OTHER	-0.455	0.048	-9.41
UNEMP	0.017	0.047	0.36
PTEMP	0.058	0.052	1.11
HISPN	-0.167	0.080	-2.07
EAST	-0.452	0.047	-9.54
CENTRAL	0.289	0.051	5.67
WEST	-0.174	0.049	-3.53
NONMETRO	-0.024	0.052	-0.46
CONSTANT	2.024	0.117	17.27

See sub-section, Estimation of the Probit Model (Selection Stage), page 31-33 for an explanation of the coefficients.

APPENDIX C

ELASTICITY ESTIMATES

Table C1. Uncompensated Elasticities CLA/AIDS Model

	FJQ	FJH	FJG	CSDP	CSDQ	CSDH	WMH	WMG	BWH	BWG	N
FJQ	-1.5061	0.0514	-0.1022	0.4604	0.1094	-0.0287	0.2374	-0.0634	0.0955	-0.0087	0.7550
	0.00	0.08	0.00	0.00	0.00	0.29	0.00	0.33	0.00	0.84	
FJH	0.0216	-0.5130	-0.0366	-0.0080	-0.1024	0.0033	-0.1069	-0.1528	0.0163	0.0957	0.7827
	0.11	0.00	0.03	0.71	0.00	0.86	0.00	0.00	0.27	0.00	
FJG	-0.1997	-0.1822	-0.4721	0.1944	0.1379	-0.1197	0.2302	-0.2546	0.1157	-0.5173	1.0673
	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
CSDP	0.0803	-0.1176	0.0142	-1.1105	0.1362	-0.1025	-0.0633	-0.4218	0.0210	0.0370	1.5270
	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.08	0.04	
CSDQ	0.1638	-0.4509	0.1352	0.9094	-2.4560	-0.2309	-0.0953	0.3549	0.1518	0.3502	1.1679
	0.01	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00	
CSDH	-0.0201	-0.0112	-0.0203	0.0120	-0.0418	-0.6509	-0.0481	-0.1495	0.0004	0.0532	0.8763
	0.06	0.50	0.00	0.44	0.00	0.00	0.00	0.00	0.97	0.00	
WMH	0.3102	-0.1622	0.1858	0.0900	-0.0197	-0.0045	-0.0438	-0.1805	0.0306	-0.3302	0.1243
	0.00	0.00	0.00	0.22	0.69	0.92	0.72	0.06	0.52	0.00	
WMG	-0.0320	-0.1355	-0.0453	-0.3678	0.0834	-0.1341	-0.1049	-0.0681	0.0694	-0.1538	0.8886
	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.00	
BWH	0.3142	0.0825	0.2336	0.3642	0.3074	-0.0292	0.0376	0.6468	-3.1882	0.1655	1.0655
	0.00	0.47	0.00	0.01	0.00	0.77	0.80	0.00	0.00	0.33	
BWG	-0.0985	0.7611	-1.2896	0.5159	0.8311	0.4290	-1.3488	-1.9762	0.1896	0.3474	1.6392
	0.60	0.00	0.00	0.05	0.00	0.01	0.00	0.00	0.36	0.41	

Table C2. Compensated Elasticities CLA/AIDS Model

	FJQ	FJH	FJG	CSDP	CSDQ	CSDH	WMH	WMG	BWH	BWG
FJQ	-1.4537	0.1656	-0.0721	0.6403	0.1392	0.1002	0.2841	0.0826	0.1104	0.0035
	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.20	0.00	0.94
FJH	0.0759	-0.3946	-0.0055	0.1786	-0.0715	0.1369	-0.0586	-0.0014	0.0318	0.1084
	0.00	0.00	0.75	0.00	0.00	0.00	0.01	0.96	0.03	0.00
FJG	-0.1257	-0.0208	-0.4296	0.4488	0.1800	0.0625	0.2961	-0.0481	0.1368	-0.5000
	0.01	0.75	0.00	0.00	0.00	0.01	0.00	0.48	0.00	0.00
CSDP	0.1862	0.1133	0.0749	-0.7465	0.1964	0.1582	0.0310	-0.1265	0.0511	0.0618
	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00
CSDQ	0.2448	-0.2743	0.1817	1.1878	-2.4100	-0.0315	-0.0232	0.5808	0.1748	0.3692
	0.00	0.00	0.00	0.00	0.00	0.45	0.77	0.00	0.00	0.00
CSDH	0.0407	0.1213	0.0146	0.2209	-0.0073	-0.5013	0.0061	0.0200	0.0176	0.0675
	0.00	0.00	0.01	0.00	0.45	0.00	0.72	0.40	0.12	0.00
WMH	0.3188	-0.1434	0.1907	0.1197	-0.0148	0.0167	-0.0361	-0.1565	0.0330	-0.3281
	0.00	0.01	0.00	0.10	0.77	0.72	0.77	0.10	0.49	0.00
WMG	0.0296	-0.0011	-0.0099	-0.1559	0.1184	0.0176	-0.0500	0.1038	0.0870	-0.1394
	0.20	0.96	0.48	0.00	0.00	0.40	0.10	0.10	0.00	0.00
BWH	0.3880	0.2437	0.2760	0.6182	0.3494	0.1527	0.1035	0.8528	-3.1672	0.1829
	0.00	0.03	0.00	0.00	0.00	0.12	0.49	0.00	0.00	0.28
BWG	0.0151	1.0089	-1.2244	0.9066	0.8957	0.7088	-1.2475	-1.6591	0.2219	0.3740
	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.37

APPENDIX D

AIDS MODELS COEFFICIENTS

Table D1. AIDS Models Coefficients

CLA/AIDS Coefficients			**CAIDS Coefficients**	
A1	0.0000		A1	-0.3418
G1C1	-0.0363		G1C1	-0.0321
G1C2	0.0010		G1C2	-0.0039
G1C3	-0.0078		G1C3	-0.0056
G1C4	0.0279		G1C4	0.0098
G1C5	0.0069		G1C5	0.0071
G1C6	-0.0049		G1C6	-0.0134
G1C7	0.0154		G1C7	0.0312
G1C8	-0.0077		G1C8	0.0020
G1C9	0.0063		G1C9	0.0075
B1	-0.0170		B1	-0.0108
A0	0.0000		A0	46.7030
B2	-0.0329		A2	0.3117
B3	0.0027		A3	0.8075
B4	0.1256		A4	0.6695
B5	0.0066		A5	-0.2738
B6	-0.0211		A6	1.1109
B7	-0.0541		A7	-1.9560
B8	-0.0215		A8	0.6604
B9	0.0013		A9	-0.2723
ADJ1	-0.2598		G2C2	0.0647
A2	0.0000		G3C3	0.0292
G2C2	0.0687		G4C4	-0.0251
G2C3	-0.0068		G5C5	-0.0569
G2C4	-0.0090		G6C6	0.0825
G2C5	-0.0168		G7C7	0.1490
G2C6	-0.0051		G8C8	0.0664
G2C7	-0.0182		G9C9	-0.0326
G2C8	-0.0295		G2C3	0.0070
G2C9	0.0018		G2C4	-0.0010
ADJ2	-0.0887		G2C5	-0.0139
A3	0.0000		G2C6	-0.0082
G3C3	0.0211		G2C7	-0.0235
G3C4	0.0084		G2C8	-0.0233
G3C5	0.0056		G2C9	0.0038
G3C6	-0.0043		G3C4	0.0123
G3C7	0.0093		G3C5	-0.0023
G3C8	-0.0096		G3C6	0.0037
G3C9	0.0047		G3C7	-0.0507
ADJ3	-0.0049		G3C8	0.0134
A4	0.0000		G3C9	-0.0011
G4C4	0.0036		G4C5	0.0269

Table D1. Coefficients for the AIDS Models (Continued)

CLA/AIDS Coefficients			**CAIDS Coefficients**	
G4C5	0.0374		G4C6	0.0137
G4C6	-0.0030		G4C7	-0.0152
G4C7	-0.0073		G4C8	-0.0284
G4C8	-0.0763		G4C9	0.0103
G4C9	0.0075		G5C6	-0.0203
ADJ4	0.6144		G5C7	-0.0010
A5	0.0000		G5C8	0.0362
G5C5	-0.0571		G5C9	0.0121
G5C6	-0.0080		G6C7	-0.0606
G5C7	-0.0033		G6C8	-0.0033
G5C8	0.0153		G6C9	-0.0037
G5C9	0.0061		G7C8	-0.0325
ADJ5	0.0970		G7C9	0.0130
A6	0.0000		G8C9	-0.0212
G6C6	0.0560		ADJ1	-0.0095
G6C7	-0.0095		B2	0.0045
G6C8	-0.0296		ADJ2	0.1742
G6C9	-0.0004		B3	0.0190
ADJ6	-0.0778		ADJ3	0.0372
A7	0.0000		B4	0.0117
G7C7	0.0557		ADJ4	0.3644
G7C8	-0.0216		B5	-0.0067
G7C9	0.0008		ADJ5	0.1522
ADJ7	-0.6371		B6	0.0228
A8	0.0000		ADJ6	0.1262
G8C8	0.1761		B7	-0.0493
G8C9	0.0130		ADJ7	0.1077
ADJ8	-0.1363		B8	0.0122
A9	0.0000		ADJ8	0.0991
G9C9	-0.0431		B9	-0.0081
ADJ9	-0.0022		ADJ9	0.0352