Complements and Meat Demand in the U.S.

Christopher Davis[1], Stela Stefanova[2], William Hahn[3], and Steven Yen[4]

[1]Economist with the Markets and Trade Economics Division,
Economic Research Service, U.S. Department of Agriculture. 1800 M Street, NW, Washington D.C. 20036. Phone: (202) 694-5167. Email Address**:** chrisdavis@ers.usda.gov
[2]Graduate Assistant in the Department of Economics,
the University of Delaware, Newark, Delaware.
Phone: (302) 831-6424. Email address: stefstel@UDel.Edu
[3]Senior Economist with the Markets and Trade Economics Division,
Economic Research Service, U.S. Department of Agriculture. 1800 M Street, NW, Washington D.C. 20036. Phone: (202) 694-5175. Email Address: whahn@ers.usda.gov
[4]Associate Professor in the Department of Agricultural Economics,
the University of Tennessee, Knoxville, Tennessee.
Phone: (865) 974-7474. Email address: syen@utk.edu

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Abstract

In this study we estimated the price elasticities among meats, vegetables, grains, and potatoes and the impact that different levels of income have on the demand for these commodities. The 2005 Nielsen retail home scan data were used to construct a censored demand system of 14 equations. Results revealed that the uncompensated cross-price elasticities for both low and high-incomes suggest both substitution and complement relationships, while the compensated price elasticities are dominated primarily by substitution relationships. Our findings also revealed that expenditure elasticities among both low and high-income households differ for most commodities[1].

Key Words: censored dependent variables, meats, poultry, fish, vegetables, sample selection model, two-step estimation.

JEL Classifications: C25, D12, Q11

[1] **Disclaimer**: The opinions and analysis presented represent the authors' idea and do not necessarily reflect Economic Research Service or the U.S. Department of Agriculture position.

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Introduction

For decades consumer food demand studies have provided insightful information on who eats what, where, and how much (Yen, Lin and Davis, 2008; Davis and Lin, 2005a, 2005b; Lin et al., 2003). Many studies have addressed the substitutability of meats like beef, pork, poultry, and fish by types, by parts and/or cuts, as well as assessed complementary relationships among them (Thompson, 2004; Kinnucan et al., 1997; Eales and Unnevehr, 1993; Capps and Lambregts, 1991; Moschini and Meilke, 1989; Cheng and Capps, 1988; Purcell and Raunikar, 1971). Likewise, there have been several studies conducted that analyze fruit, vegetable, and grain demands in the United States through the estimation of price elasticities and income or expenditure elasticity (Just and Weninger, 1997). Separately these analyses have helped food companies improve their supply-chain management and enhanced distributors' marketing strategies to increase the flow of goods.

Several recent studies have emphasized the substitution and complementarity relationships between meats and other dishes (Thompson, 2004; Kinnucan et al., 1997; Park et al., 1996). For most non-vegetarian households, the demands for vegetables, grains, and potatoes are contingent upon the demands for beef, pork, poultry, or fish. Theoretically, complementary relationships between meats, vegetables, grains, and potatoes are essential components that help identify a consumer's food consumption basket.

Park et al. (1996) examined 12 food commodity groups (food away from home, beef, pork, chicken, fish, cheese, milk, fruits, vegetables, breakfast cereals, bread, and fats and oils) to determine whether commodity demand projections are based on individual income strata rather than on average estimates of price and income elasticities. Results from a 1987-88 Nationwide Food Consumption Survey reveal that own-price elasticities are similar between income groups for most commodities and income elasticities are consistently higher for the lower-income group.

Like Park et al. (1996), we analyzed the impact that different levels of income have on commodity demand, but also estimated the price elasticities among meats, vegetables, grains, and potatoes using the 2005 Nielsen retail home scan data. For this study special attention is given to cross-price relationship, particularly complementarities among the commodity groups. A censored demand system of 14 equations is employed to determine the price and income/expenditure relationships that exist among a selected group of commodities.

Methodology

We estimated a large censored demand system using a multivariate sample selection model developed by Yen and Lin (2006), which was estimated with a two step procedure proposed by Shonkwiler and Yen (1999). This approach accommodates zero purchases and simplifies the computational burden, while still producing consistent estimates. We followed closely the specification of Yen, Lin and Davis (2008).

We assumed that meat products and hypothesized complementary products are separable from all other goods. In the first step of the procedure, censoring of each commodity is governed by the following stochastic sample selection process.

$$w_i = d_i\left[\, f_i(x;\theta) + e_i\right], i = 1,...,n\,, \tag{1}$$

where $d_i = 1$ if $z'\gamma_i + u_i > 0$ and $d_i = 0$ if $z'\gamma_i + u_i \le 0$, w_i is the expenditure share of the *i*th commodity, *x* and *z* are vectors of explanatory variables, θ and γ_i are vectors of parameters, and e_i and u_i are random errors.

Assuming the translog utility function, the translog demand system in expenditure form can be derived as:

$$w_i = \frac{\alpha_i + \sum_{j=1}^{n} \beta_{ij} \log v_j}{\sum_{j=1}^{n} \alpha_j + \sum_{k=1}^{n}\sum_{j=1}^{n} \beta_{kj} \log v_j}, i = 1,...,n\,, \tag{2}$$

where v_j are expenditure normalized prices for commodity *j*. Homogeneity is implied in the above equation by the use of the normalized prices for all commodities, and symmetry is imposed with the restrictions

$$\beta_{ij} = \beta_{ji} \quad \forall \quad i, j \tag{3}$$

We allowed the intercept α_i to vary with demographic variables h_ℓ such that

$$\alpha_i = \alpha_{i0} + \sum_{\ell=1}^{L} \alpha_{i\ell} h_\ell, i = 1,...n-1 \tag{4}$$

One issue with the censored system approach specified above is that the adding-up restriction cannot be imposed. Following the approach suggested by Yen and Lin (2006), we estimated the first $n-1$ equations and calculate elasticities for the nth equation using the adding-up property in demand theory. Even though the estimates are not invariant to the equation excluded, Yen and Lin (2006) showed that the elasticity estimates are stable regardless of which commodity is treated as the residual category.

The system of demand equations in share form can be written as:

$$w_i = E(w_i) + \xi_i = \Phi(z_i'\gamma_i)\, f_i(x;\theta) + \delta_i \phi(z_i'\gamma_i) + \xi_i, \quad (5)$$

where δ_i is the covariance between the error terms e_i and u_i, $\Phi(z_i'\gamma_i)$ and $\Phi(z_i'\gamma_i)$ are the normal cumulative distribution and probability density functions respectively, and $\xi_i = w_i - E(w_i)$ is a heteroskedastic error term, with $E(\xi_i) = 0$ (Shonkwiler and Yen, 1999). The system can be estimated using the two step procedure. First, we obtained maximum-likelihood (ML) estimates for γ_i based on binary probit for $w_i = 0$ and $w_i > 0$. Second, assuming that the disturbances (e_i, u_i) are distributed bivariate normal with $\text{cov}(e_i, u_i) = \delta_i$, we estimated the demand parameters θ and covariances δ_i in the system

$$w_i = \Phi(z_i'\hat{\gamma}_i)\, f_i(x;\theta) + \delta_i \phi(z_i'\hat{\gamma}_i) + \xi_i \quad (6)$$

using iterated seemingly unrelated regressions. Demand elasticities for the n–1 goods can be derived by differentiating Equation (6). Elasticities for the residual good are calculated using the adding up restriction. To derive compensated demand elasticites, we used Slutsky's equation.

Data

The ACNielsen 2005 Homescan data contain demographic and food purchases information for a nationwide panel of representative households. Each household in the panel is given a hand-held scanning device to scan at home all food items purchased at any retail outlet. Some households record only UPC coded foods while others scan both UPC coded as well as random weight items. In this study we used the smaller subset of 8,216 households that recorded both UPC-coded and random weight products. These households reported 7,597,426 purchases in 2005:

4,001,639 dry grocery products; 1,379,832 random weight items; 900,100 dairy products and 1,315,855 produce, meat and frozen food. Each purchase record contains data on product characteristics, quantity purchased, price paid with and without promotions, date of purchase, store and brand information and is matched to a household record. Information on size and composition of household, income, origin, age, race, gender, education and occupation of household members, as well as market location data is available for each household. Projection factors (sample weights) are provided by ACNielsen to be used at the household level to provide representative estimates for the U.S. population.

It is not feasible to simultaneously account for the joint consumption of all possible types of food, so we further limited the dataset to only foods that people are more likely to consume together with meat or fish. Using What We Eat in America (WWEIA)-NHANES data for years 1999-2000, 2001-2002, and 2003-2004, we compared the probabilities of consuming different types of food conditional on consuming different types of meat and fish with the marginal probabilities of consuming every food category. For our analysis, we aggregated these food categories by the first two digits of the NHANES food codes. Table 1 provides the first two digits of the food codes and the conditional and unconditional probabilities calculated from 2003-2004 data. The results are very similar for the other periods. We identified 9 food categories - cheese, bread, rice, pasta products, tomato products, orange vegetables, potatoes, salad and hamburger vegetables, and all other vegetables, that we expected to be complementary to meat and fish.

The final dataset used in this study is compiled from ACNielsen Homescan data and includes all purchase records of beef, pork, poultry, fish, cheese, bread, rice, pasta products, tomato products, and vegetables made by consumers reporting random weight items. Prices are measured for all products in dollars per pound after any coupons or promotion information is taken into account. Meat products, mostly fresh meats, which could not be readily identified as specific meat types, are assigned into groups using the descriptions of the UPC and designated codes for the random weight items. Meat is categorized into five groups: beef, pork, poultry, fish, and processed meats. The Processed meats include sausages, corn dogs, hotdogs, salami, mixed meats, lunch meats, bratwursts, refrigerated bacon, sandwich steak, canned meat and deviled ham. Beef, pork, poultry, and fish are broad categories including products in all forms -- fresh, canned and frozen -- that could be identified in the respective categories.

Similar to Yen, Lin, and Davis (2008), we split the sample in low and high income groups using a cutoff of 350% poverty income ratio (PIR). The PIR is calculated by dividing the mid-point of the range of self reported income to the Federal poverty thresholds, i.e. it expresses income as a percent of the Federal poverty thresholds for households of different size. The 350% cutoff is used to generate similar number of observations in the two groups. The sample sizes of the low income and the high income groups are 4,129 and 4,087 respectively.

We focused on 14 types of food products. To organize the food categories, we first identified the product modules that fall within each category. We converted the quantities purchased to pounds and prices to dollars. Purchased quantities and expenditures on each product category are aggregated to the annual level for each household. The price for each product category is

calculated by dividing the expenditures by the purchase quantity, thereby representing unit values. Missing prices for non-consuming households are assigned mean unit values calculated by region.

Descriptive statistics for the 14 chosen food categories are provided in Table 2 and Table 3. Almost all of the sample households consume some type of bread. Cheese, processed meats and vegetables are the next most popular food categories with over 95% of the households consuming. This is followed by the potato category, which is consumed by 93% of the households. Beef, fish, poultry, noodles and orange vegetables are consumed by about 90% of the households. About 87% purchase pork and some type of a tomato product. Rice is purchased by the least number of households – about 75%. The consumption patterns are not dramatically different between the low and the high income households. However, quantities consumed are somewhat different between the two income samples. Notable differences are that the high income households consuming more fish, orange and salad vegetables and less beef, pork, processed meats, bread and potatoes when compared to the low income households.

The prices paid by the high income households are higher than those paid by the low income households for all product categories. Among the 14 food products, fish and cheese are the most expensive and tomato products the least expensive per pound. Poultry meat is the least expensive meat product.

Table 4 presents descriptive statistics for certain demographic variables. Following Yen, Lin, and Davis (2008), household size, dummy variables for age groups, race and regional dummies,

presence of children, and dummy variables for marital status correspond to a set of explanatory variables used in the second stage regressions. All these demographic variables plus female head of household employment, male head of household employment, dummy variables for levels of education, and the poverty income ratio are included in the first step probit regressions. The average household size for the low income sample is 2.50 and is 2.22 for the high income sample. More than 50% of the households in both income categories are headed by individuals between 40 and 60 years of age. Geographic characteristics of the respondents are represented by regional variables. The low and high income distributions are similar with slightly more low income households located in the central and south regions of the U.S. The racial and ethnic characteristics are also similar across income groups with 77% White, 14% Black, 2% Asian, 9% Hispanic, and 7% other race for the low income sample. The low income sample includes higher percent ages of male and female head of household employed – 60% and 56% respectively, compared to the high income group - 40% and 38%. Individuals in the high income group are more educated with 55% of the sample having college education and above, compared with only 27% of the low income sample in the same category.

Demand Elasticities

High-Income Households

Results of the uncompensated price and expenditure elasticities for high-income households are found in table 5. All uncompensated own-price elasticities are negative and statistically significant at the 1 percent level. Own-price elasticities for meat products ranged from –1.22 for beef to –1.47 for poultry, while own-price elasticities for side dishes ranged from –1.19 for tomatoes to –2.23 for salad vegetables.

Seventy-three percent (133 out of 182) of the uncompensated cross-price elasticities are significant at the 10 percent level or lower, which suggest a mixture of gross complements and substitutes among the meat product categories. With an exception of processed meats and beef, and poultry and pork relationships, all other meats (including poultry and fish) combinations are gross substitutes for each other. In identifying meat products that serve as complements to side dishes, our results reveal that beef & noodles are negatively related, which means a 1 percent increase in the price of beef will result in a .05 percent decrease in the demand for noodles. Other complementary relations include pork & tomatoes, pork & salads, fish & orange vegetables, and processed meat & other vegetables.

The expenditure elasticities vary slightly, ranging from 0.92 for cheese, to 1.03 for pork, rice, and potatoes (table 6). Expenditure elasticities for meats, particularly beef, pork, and poultry are above unity, which are similar to the aggregate meat expenditure elaticities derived by Kesavan et al. (1993). For side dishes such as rice, potatoes, and other vegetables, expenditure elasticities also exceeded one which differs from Parks et al. (1996) findings for aggregated vegetables for poverty and non-poverty status households. All expenditure elasticities are estimated with relatively high precision (with small standard errors), relative to the cross-price elasticities.

Table 7 presents the compensated price elasticities for high-income households. Similar to their Marshallian counterparts, all of the compensated own-price elasticities are significant, with the appropriate signs put forward by economic theory. All compensated own-price elasticities are greater than unity, ranging from –1.16 for beef to –1.37 for poultry, and from –1.13 for tomatoes

to –2.17 for rice. The own-price elasticity of pork (–1.20), beef (–1.16), fish (–1.23), and poultry (–1.37) are all elastic and more price responsive than the Park et al. (1996) own-price elasticity estimates for the same commodities for non-poverty status households. Contrary to uncompensated elasticities, which suggest gross substitutes and complements among meat products and side dishes, the compensated elaticities suggest predominantly gross substitutes, minus a couple exceptions. A strong substitution relationship between beef and potatoes, pork and rice, poultry and orange vegetables, and fish and salad vegetables indicates that vegetarian diets can be easily exchanged for diets that include meat for some high-income households.

Low-Income Households

The uncompensated price and total expenditure elasticities for low-income households are presented in table 8. All uncompensated own-price elasticities are significant at the 1 percent level with negative signs similar to elasticities for the high-income households. Of the 14 commodities analyzed, all are greater than unity, ranging from –1.32 for fish to –1.74 for processed meat, to –2.43 for rice. Unlike Park et al. (1996), our own-price elasticities for beef, pork, fish, vegetables, and bread are elastic for low-income households or poverty households but more responsive to changes in price.

Of the 184 possible cross-price elasticities, 121 (60%) are positive and statistically significant. This is similar to Nayga and Caps' (1994) study in which a majority of the cross-price elasiticities had positive signs implying a substitution relationship. The total expenditure elasticities for the 14 commodities are precisely estimated as in the low-income sample (table 9). All expenditure elasticities are statistically significant at the 1 percent level with positive signs

implying a direct relationship between commodity consumption and increases in expenditures. Commodities such as beef, pork, fish, poultry, rice, tomatoes orange vegetables, and potatoes are all above unity, which differs from Park et al. (1996), indicating a greater level of sensitivity to changes in consumers' expenditures. In contrast, the expenditure elasticity for bread is considerably less than unity and is similar to what Park et al. (1996) found for poverty households. Along with bread, there are other commodities (processed meats, cheese, noodles, other vegetables and salad vegetables) with expenditure elasticities less than unity.

Table 10 presents the compensated price elasticities for low-income households. All compensated own-price elaticities are significant, negative and greater than unity, ranging from –1.28 for fish to –1.70 for processed meat, to –2.40 for rice. The large own-price elasticity for rice implies that it is highly sensitive to changes in price. Like results from the high-income household sample, the low-income household sample cross-price elasticities suggest s net substitution relationships in most cases, 174 of which are significant and positive. The one significant complementary relationship is among fish and salad vegetables, where a 1 percent increase in the price of fish will only reduce the demand for salad vegetable marginally (.04 percent).

Conclusion and Recommendations

In this study we analyzed at-home consumption of different types for meat products and side dishes such as rice, vegetables, bread, and cheese by estimating a 14 equation demand system using a multivariate sample selection model. Nielsen household Homescan data highlighted zero purchases of many commodities due to some disaggregate commodities and commodities that

were not purchased during specific time periods. We estimated this large censored demand system using the Heckman two-step procedure. The two-step procedure produces statistically consistent estimates although it is less efficient than the ML alternative of Yen and Lin (2006).

This study presented information on the demand for beef, pork, fish, poultry, vegetables, cheese, bread, and rice separately for low-income and high-income households. Findings indicated notable differences in the elasticity estimates between the two groups of households, particularly with compensated and uncompensated price elasticities. Our chief objective for this study was based on a perceived logic guiding consumers' purchase behaviors. That logic is that non-vegetarians seek to purchase a desired meat (beef, pork, fish, or poultry) first and then choose a side dish to accompany their choice of meat or vice versa. Results revealed that the uncompensated cross-price elasticities for both low and high incomes suggest both substitution and complement relationships, while the compensated price elasticities are dominated primarily by substitution relationships. These findings are surprising and unexpected given hypothesized logic consumers often use when planning meals or shopping for food for family members. This perceived logic is rejected by the results found for compensated price elasticities, but not rejected based on the results rendered from the uncompensated price elasticities.

Elasticities derived from a massive database like the Nielsen retail homescan data can prove to be quite useful. Agricultural industries or food retailers may use information from studies such as this to boost sales through advertisement of specific food combinations, especially among frozen meals. Elasticities from this study can be used to determine the impact increased demand for corn and soybeans used in other agricultural production will have on consumer demand for

specific meats primarily pork, poultry, and fish. We anticipate that as input or feed prices rise in response to increasing demand for corn and/or soybeans for other agricultural production, demand elasticities derived from this study for meats can serve as a useful tool in addressing changes in consumer demand for food commodities and making policy recommendations.

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Table1: Conditional vs. Unconditional Probabilities of Consumption

		Unconditional Probability	Conditional probability			
Food Type	2-digit code	P(Type)	P(Type/ Fish)	P(Type/ Beef)	P(Type/ Poultry)	P(Type/ Pork)
Cheese	14	3.19	10.74	39.91	11.70	15.22
Breads	51	5.86	24.91	52.89	23.71	35.08
Biscuits	52	1.80	10.17	20.98	14.50	14.77
Pasta products and rice	56	1.35	15.09	7.15	10.32	10.27
Potatoes	71	3.65	27.89	35.86	32.90	21.96
Raw green vegetables	72	0.59	12.00	4.99	7.73	6.00
Orange vegetables	73	0.70	7.89	6.94	8.47	5.47
Tomato products	74	4.13	49.83	66.93	37.61	28.34
Hamburger vegetables	75	6.38	75.66	95.27	58.49	51.87

Table2: Average Annual Household Purchases: Prices, Expenditures and Quantity by Income

	Low Income		High Income	
Variable	Mean	Std.Dev.	Mean	Std.Dev.
Prices				
Beef	3.06	1.09	3.69	1.47
Pork	3.40	2.55	3.88	2.89
Fish	3.81	1.95	4.74	2.33
Poultry	2.05	0.93	2.32	1.06
Processed Meat	3.57	1.35	4.27	1.64
Cheese	3.92	1.18	4.56	1.50
Bread	1.54	0.76	1.83	0.99
Rice	1.92	0.95	2.12	1.07
Noodles	1.23	0.80	1.43	0.83
Tomato Products	0.79	0.32	0.88	0.61
Orange	1.02	0.39	1.13	0.49
Potatoes	1.06	0.71	1.20	0.78
Other Vegetables	1.89	1.90	2.36	1.98
Salad Vegetables	1.28	0.51	1.48	0.60
Expenditures				
Beef	119.79	133.40	134.67	156.52
Pork	68.74	76.53	70.56	77.67
Fish	48.96	70.22	68.30	101.47
Poultry	66.03	72.89	71.15	77.29
Processed Meat	103.36	101.71	105.46	109.06
Cheese	88.62	80.86	105.21	96.74
Bread	90.79	70.37	94.34	75.31
Rice	8.05	12.62	8.21	11.39
Noodles	15.00	18.96	15.77	20.10
Tomato Products	11.63	14.50	11.12	13.02
Orange	13.85	17.02	16.69	22.46
Potatoes	27.72	27.84	25.08	26.30
Other Vegetables	59.79	52.79	73.71	67.05
Salad Vegetables	50.64	53.50	63.26	65.35
Quantities				
Beef	44.32	48.63	40.40	44.94
Pork	30.56	38.40	27.29	33.82
Fish	13.78	18.22	15.48	21.05
Poultry	45.26	51.98	42.42	49.37
Processed Meat	35.03	33.63	29.69	29.12
Cheese	25.59	23.51	26.81	24.21
Bread	83.20	92.47	74.99	76.18
Rice	8.03	19.69	6.93	14.94
Noodles	15.26	20.07	13.60	21.05
Tomato Products	17.08	22.23	15.01	18.59

Orange	15.94	19.83	17.49	26.23
Potatoes	49.91	51.89	37.83	40.51
Other Vegetables	55.03	49.36	54.61	47.74
Salad Vegetables	49.86	52.97	53.67	53.86

Table 3: Consuming Households

Food Type	Number Households Consuming	Total % consuming	Low Income % consuming	High Income % Consuming
Beef	7450	90.68	90.87	90.48
Pork	7164	87.2	87.82	86.44
Fish	7451	90.69	90.82	90.36
Poultry	7420	90.31	90.14	90.41
Processed Meat	7947	96.73	97.00	96.43
Cheese	8048	97.96	97.80	98.12
Bread	8145	99.14	99.25	99.00
Rice	6198	75.44	75.15	75.43
Noodles	7344	89.39	89.25	89.33
Tomato Products	7178	87.37	88.21	86.35
Orange Vegetables	7383	89.86	89.42	90.26
Potatoes	7679	93.46	94.14	92.76
Other Vegetables	8061	98.11	98.06	98.14
Salad Vegetables	7950	96.76	96.83	96.70

Table 4: Sample Statistics for Demographic Variables

Variable	Low	High income
Household Size	2.50 (1.50)*	2.22 (1.11)*
Presence of children	0.29	0.18
Age of household head < 40	0.15	0.15
Age of household head 40-60	0.57	0.70
Age of household head > 60	0.28	0.14
Married	0.53	0.61
Widowed	0.13	0.06
Divorced	0.18	0.13
Single	0.17	0.20
East	0.22	0.23
Central	0.18	0.15
South	0.40	0.37
West	0.20	0.25
Education < high school	0.05	0.01
High School	0.31	0.15
Some College	0.36	0.29
College and above	0.27	0.55
White	0.77	0.76
Black	0.14	0.13
Asian	0.02	0.05
Hispanic	0.09	0.07
Other race	0.07	0.06
Male head employed	0.60	0.40
Female head employed	0.56	0.38
Poverty income ratio	212 (81)*	623 (266)*
Sample size	4129	4087

* Standard errors in parentheses

Table 5: Uncompensated Price Elasticites: High Income Households

Variable	Beef	Pork	Fish	Poultry	Processed	Cheese	Bread	Rice	Noodles	Tomatoes	OrangeV	Potatoes	OtherV	SaladV
Beef	-1.22***	-0.01	0.03***	0.03**	-0.01**	0.00	-0.01	0.05***	-0.02***	0.05***	0.01	0.04***	-0.01	0.03***
Pork	-0.02	-1.29***	0.00	-0.06***	0.04***	0.04***	0.11***	0.07***	0.00	-0.05**	0.03**	0.07***	0.03**	-0.01
Fish	0.08***	0.00	-1.27***	0.04*	0.04***	0.00	0.00	0.05***	0.02	-0.03	-0.03*	0.04***	0.05***	0.01
Poultry	0.03**	-0.03***	0.02*	-1.47***	0.02***	0.01*	0.07***	0.05***	0.02**	0.07***	0.04***	0.06***	0.04***	0.02*
Processed	-0.05*	0.08***	0.06***	0.08***	-1.40***	-0.04	0.06**	0.13***	0.00	0.06**	0.04*	0.05***	-0.03**	0.00
Cheese	0.01	0.08***	0.01	0.06**	-0.03	-1.57***	0.13***	0.16***	0.03	-0.02	0.02	0.10***	-0.04***	0.16***
Bread	-0.01*	0.10***	0.01	0.13***	0.03***	0.06***	-1.52***	0.08***	0.05***	-0.01	0.06***	0.03**	0.07***	-0.01
Rice	0.14***	0.09***	0.06***	0.14***	0.09***	0.11***	0.12***	-2.24***	0.12***	0.12***	0.09***	0.12***	0.05**	-0.05**
Noodles	-0.05**	0.00	0.02	0.06***	0.00	0.02	0.06***	0.11***	-1.27***	0.00	-0.02	0.10***	-0.05***	0.05**
Tomatoes	0.05***	-0.02**	-0.01	0.07***	0.02**	-0.01	-0.01***	0.04***	0.00	-1.19***	0.00	0.00	0.03***	0.03**
OrangeV	0.03	0.04***	-0.03*	0.11***	0.02***	0.01	0.08***	0.09***	-0.02	0.00	-1.33***	0.04***	0.04***	-0.07***
Potatoes	0.05***	0.03***	0.02**	0.07***	0.01**	0.03***	0.02***	0.05***	0.04***	0.00	0.01**	-1.41***	0.02***	0.04***
OtherV	-0.01	0.02**	0.04***	0.07***	-0.02**	-0.02***	0.07**	0.03**	-0.04***	0.04**	0.03***	0.03***	-1.32***	0.08***
SaladV	-0.15*	0.03	-0.01	0.53***	0.12**	0.34***	-0.34***	0.56***	0.02	-0.24**	-0.03	0.44***	0.05	-2.23***

Note: Level of Statistical Significance - *** = 1%, ** = 5%, * = 10%

Table 6: Total Meat Expenditure Elasticities: High Income Households

Variable	Total Expenditure
Beef	1.02***
Pork	1.03***
Fish	0.98***
Poultry	1.02***
Processed	0.97***
Cheese	0.92***
Bread	0.93***
Rice	1.03***
Noodles	0.99***
Tomatoes	0.99***
OrangeV	0.99***
Potatoes	1.03***
OtherV	1.01***
SaladV	0.92***

Note: Level of Statistical Significance - *** = 1%, ** = 5%, * = 10%

Table 7: Compensated Price Elasticities: High Income Households

Variable	Beef	Pork	Fish	Poultry	Processed	Cheese	Bread	Rice	Noodles	Tomatoes	OrangeV	Potatoes	OtherV	SaladV
Beef	-1.16***	0.07***	0.08***	0.14***	0.03***	0.04***	0.04***	0.11***	0.02***	0.11***	0.08***	0.15***	0.03***	0.26***
Pork	0.04**	-1.20***	0.04***	0.05**	0.09***	0.08***	0.16***	0.13***	0.05***	0.01	0.10***	0.18***	0.07***	0.21***
Fish	0.13***	0.08***	-1.23***	0.14***	0.08***	0.04***	0.05**	0.11***	0.07***	0.02	0.04**	0.15***	0.09***	0.23***
Poultry	0.09***	0.06***	0.06***	-1.37***	0.07***	0.05***	0.12***	0.11***	0.07***	0.13***	0.11***	0.17***	0.09***	0.25***
Processed	0.01	0.16***	0.10***	0.18***	-1.35***	0.00	0.10***	0.18***	0.04**	0.11***	0.10***	0.15***	0.01	0.22***
Cheese	0.06**	0.16***	0.05**	0.15***	0.01*	-1.54***	0.17***	0.21***	0.08***	0.02	0.08***	0.20***	-0.01*	0.37***
Bread	0.04*	0.18***	0.05***	0.23***	0.07***	0.09***	-1.47***	0.13***	0.09***	0.04	0.12***	0.13***	0.11***	0.19***
Rice	0.20***	0.17***	0.11***	0.24***	0.14***	0.15***	0.17***	-2.17***	0.17***	0.17***	0.16***	0.23***	0.09***	0.18***
Noodles	0.00	0.08***	0.06***	0.15***	0.04***	0.05***	0.11***	0.16***	-1.22***	0.05*	0.05***	0.20***	-0.01	0.27***
Tomatoes	0.11***	0.06***	0.03***	0.17***	0.06***	0.03***	0.04***	0.10***	0.05***	-1.13***	0.06***	0.10***	0.07***	0.25***
OrangeV	0.09***	0.12***	0.01**	0.21***	0.07***	0.05***	0.13***	0.15***	0.03	0.05**	-1.26***	0.14***	0.08***	0.15***
Potatoes	0.10***	0.12***	0.06***	0.17***	0.06***	0.06***	0.07***	0.11***	0.09***	0.05***	0.08***	-1.30***	0.06***	0.27***
OtherV	0.04***	0.10***	0.08***	0.17***	0.03***	0.02**	0.12***	0.09***	0.01	0.09***	0.09***	0.14***	-1.27***	0.30***
SaladV	-0.10	0.11*	0.03	0.62***	0.16***	0.37***	-0.30***	0.61***	0.06	-0.19*	0.03	0.54***	0.08	-2.03***

Note: Level of Statistical Significance - *** = 1%, ** = 5%, * = 10%

Table 8: Uncompensated Price Elasticites: Low Income Households

Variable	Beef	Pork	Fish	Poultry	Processed	Cheese	Bread	Rice	Noodles	Tomatoes	OrangeV	Potatoes	OtherV	SaladV
Beef	-1.56***	0.04***	0.06***	0.10***	0.00	0.02**	0.07***	0.09***	0.02*	0.03	0.03*	0.07***	-0.01	-0.01
Pork	0.04***	-1.53***	0.00	0.01	0.04***	0.01	0.02	0.08***	0.02*	-0.01	0.05***	0.12***	0.04***	0.04***
Fish	0.11***	0.01	-1.32***	0.02	0.09***	0.00	0.07***	0.04**	-0.01	0.00	-0.03*	0.07***	0.05***	-0.10***
Poultry	0.06***	0.01	0.00	-1.61***	0.05***	0.02***	0.05***	0.09***	0.02**	0.06***	0.04***	0.07***	0.03***	0.05***
Processed	0.00	0.09***	0.10***	0.15***	-1.74***	-0.04*	0.04**	0.08***	0.00	0.07***	0.08***	0.13***	0.05***	0.03
Cheese	0.08***	0.05***	0.02	0.11***	-0.04	-1.53***	-0.02	0.08***	0.03	0.12***	0.07***	0.09***	0.02	0.11***
Bread	0.11***	0.05***	0.06***	0.14***	0.04***	-0.01	-1.48***	0.05***	0.02	0.11***	0.11***	0.07***	0.05***	-0.02
Rice	0.10***	0.08***	0.01	0.15***	0.04***	0.03***	0.03	-2.43***	0.06***	0.12***	0.02	0.17***	0.02	0.28***
Noodles	0.05**	0.05**	-0.01	0.07***	0.00	0.02	0.02	0.09***	-1.40***	0.01	0.06***	0.10***	0.01	0.04**
Tomatoes	0.03	-0.01	0.00	0.09***	0.04**	0.05***	0.08***	0.11***	0.00	-1.58***	0.02	0.10***	0.00	0.02
OrangeV	0.04**	0.06***	-0.03**	0.08***	0.05***	0.03**	0.09***	0.03**	0.04**	0.03	-1.58***	0.08***	0.03**	0.01
Potatoes	0.04***	0.08***	0.02***	0.07***	0.04***	0.02***	0.01	0.10***	0.03***	0.06***	0.04***	-1.56***	0.02***	-0.01
OtherV	-0.01	0.06***	0.04***	0.08***	0.04***	0.01	0.04**	0.04***	0.00	0.01	0.04***	0.07***	-1.39***	0.01
SaladV	0.02	0.05***	-0.09***	0.13***	0.07***	0.10***	0.00	0.07***	0.04***	0.03	0.01	0.10***	0.05***	-1.47***

Note: Level of Statistical Significance - *** = 1%, ** = 5%, * = 10%

Table 9: Total Meat Expenditure Elasticities: Low Income Households

Variable	Total Expenditure
Beef	1.04***
Pork	1.06***
Fish	1.00***
Poultry	1.07***
Processed	0.96***
Cheese	0.81***
Bread	0.69***
Rice	1.32***
Noodles	0.90***
Tomatoes	1.07***
OrangeV	1.03***
Potatoes	1.05***
OtherV	0.96***
SaladV	0.88***

Note: Level of Statistical Significance - *** = 1%, ** = 5%, * = 10%

Table 10: Compensated Price Elasticities: Low Income Households

Variable	Beef	Pork	Fish	Poultry	Processed	Cheese	Bread	Rice	Noodles	Tomatoes	OrangeV	Potatoes	OtherV	SaladV
Beef	-1.47***	0.12***	0.11***	0.23***	0.04***	0.07***	0.14***	0.12***	0.07***	0.10***	0.10***	0.21***	0.05***	0.11***
Pork	0.13***	-1.45***	0.05***	0.14***	0.09***	0.06***	0.10***	0.10***	0.07***	0.06***	0.12***	0.27***	0.10***	0.15***
Fish	0.20***	0.09***	-1.28***	0.14***	0.14***	0.04***	0.14***	0.06***	0.03*	0.07***	0.03	0.21***	0.11***	0.01
Poultry	0.16***	0.09***	0.05***	-1.48***	0.10***	0.06***	0.13***	0.11***	0.07***	0.13***	0.11***	0.22***	0.10***	0.16***
Processed	0.08***	0.16***	0.15***	0.26***	-1.70***	0.00	0.11***	0.10***	0.04**	0.14***	0.14***	0.26***	0.11***	0.14***
Cheese	0.15***	0.11***	0.05***	0.21	0.00	-1.50***	0.04	0.10***	0.07***	0.18***	0.12***	0.21***	0.07***	0.20***
Bread	0.17***	0.11***	0.10***	0.22***	0.07***	0.02	-1.43***	0.07***	0.05***	0.16***	0.15***	0.17***	0.09***	0.06***
Rice	0.21***	0.18***	0.07***	0.31***	0.11***	0.09***	0.12***	-2.40***	0.12***	0.21***	0.10***	0.35***	0.10***	0.43***
Noodles	0.13***	0.12***	0.04**	0.18***	0.04***	0.06***	0.08***	0.11***	-1.36***	0.07***	0.11***	0.22***	0.06***	0.14***
Tomatoes	0.12***	0.07***	0.05***	0.22***	0.09***	0.09***	0.15***	0.13***	0.05***	-1.51***	0.09***	0.25***	0.06***	0.14***
OrangeV	0.13***	0.14***	0.02	0.20***	0.10***	0.07***	0.17***	0.06***	0.08***	0.10***	-1.51***	0.23***	0.09***	0.12***
Potatoes	0.13***	0.16***	0.07***	0.20***	0.09***	0.06***	0.09***	0.12***	0.08***	0.13***	0.11***	-1.42***	0.09***	0.11***
OtherV	0.07***	0.14***	0.09***	0.20***	0.08***	0.05***	0.11***	0.06***	0.04***	0.07***	0.10***	0.20***	-1.33***	0.12***
SaladV	0.10***	0.12***	-0.04***	0.24***	0.11***	0.13***	0.07***	0.09***	0.08***	0.09***	0.06***	0.22***	0.10***	-1.37***

Note: Level of Statistical Significance - *** = 1%, ** = 5%, * = 10%