DEMAND FOR VEGETABLES IN MALAYSIA

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ABSTRACT

The Malaysian agro-food industry is increasingly market-driven. A closer look at consumer studies show that consumers are becoming more health-conscious and they are consuming more vegetables. This dynamism requires a scrutiny, particularly on the demand for vegetables at a disaggregated level. By using the Household Expenditure Survey 2004/05 data (one of the most comprehensive and well-designed surveys in Malaysia), demand elasticities for aggregated food, aggregated vegetables, and category-specific vegetables were estimated via a multi-stage demand system. The results suggest that while all of them are normal goods, consumer expenditure on fresh vegetables is poised to increase at a faster pace than processed vegetables, ceteris paribus. This, however, is uncertain because consumers are price elastic to changes in vegetable prices (except podded vegetables) since increasing demand will simply drive up prices if the inherent issues in vegetable production are not solved. Therefore, more investments in high-yielding, low-cost, and green technologies are ultimately needed.

Keywords: Vegetable, multi-stage demand system, demand elasticity.

INTRODUCTION

The health benefits of increased vegetable consumption are clearly documented in the literature. Block et al. (1992) briefly documented that the health benefits include reduction in the incidence of various forms of cancer as well as other ailments like stroke, heart disease, and obesity. Vegetables therefore are better known as healthy foods and hence vegetables have become increasingly important in the Malaysian food diet.

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According to FAMA (1993), the per capita consumption of vegetables (excluding flavouring category) in 1982 was 27.25kg. This increased to 40.58kg in 2001, according to the Ministry of Agriculture and Agro-based Industry (2006). Amongst the major vegetables, significant increases in per capita consumption between 1982 and 2001 were in brassica (*sawi hijau*), cucumber, cabbage, water spinach, and Chinese spinach which were respectively recorded as 3.76kg, 3.14kg, 2.7kg, 1.68kg, and 1.75kg in 1982 and 8.46kg, 6.83kg, 7.49kg, 4.47kg, and 3.64 kg in 2001.

The growth in vegetable consumption discussed above is a good indication of the promising future growth in the vegetable sector. This is confirmed by Fatimah and Amna (2007), who suggested that per capita consumption of vegetables in Malaysia is expected to rise in view on the improvement in the standard of living and the growing health concern among the consumers. This statement, however, is rather general and deserves scrutiny particularly regarding the demand for vegetables at a disaggregated level. Therefore, there is a gap in the body of knowledge in terms of the future consumer demand for the major categories of vegetables consumed in Malaysia.

It was pointed out by Dey et al. (2008) that demand analysis at disaggregated level is able to capture short-term response of specific markets to price and other non-price factors. Hence, this study focuses on the estimation of the price and income elasticities for the six major categories of vegetables that are commonly found and consumed in Malaysia. This study will provide valuable insights on the relationship between the responses of demand for vegetables to changes in prices and incomes. These are salient factors, indicators and references when formulating policies.

RELEVANT PAST STUDIES IN MALAYSIA

Previous studies in Malaysia included the use of the framework 'Almost Ideal Demand System' (AIDS) by Nik Mustapha et al. (2001), Alias et al. (2005), and Tey et al. (2008a, 2008b, 2008c, and 2008d) while another study by Ishida et al. (2003) used the 'Engel Curve' to analyse the Household Expenditure Surveys to estimate the demand elasticities for aggregated food groups. All the results are presented in Tables 1 and 2. The results show that the estimated demand elasticies for vegetables change over time. It should be noted that the latest observations in Tey et al. (2008a, 2008b, 2008c, and 2008d) suggested that Malaysian consumer demand for aggregated vegetables is generally expenditure and price-elastic.

Table 1: Estimated Expenditure Elasticity of Vegetables in Previous Studies

Previous Studies	1973	1980	1993/94	1990	2004/05
Ishida et al. (2003) [a]	0.86 [a]	0.68 [a]	0.74 [a]	-	-
Nik Mustapha et al. (2001)	-	-	-	0.46	-
Alias et al. (2005)	-	-	-	0.05	-
Tey et al. (2008a)	-	-	-	-	1.34
Tey et al. (2008b)	-	-	-	-	1.17
Tey et al. (2008c)	-	-	-	-	1.12
Tey et al. (2008d)	-	-	-	-	1.12

Note: [a] vegetables and fruits

Table 2: Estimated Own Price Elasticity of Vegetables in Previous Studies

Previous Studies	1973	1980	1993/94	1990	2004/05
Nik Mustapha et al. (2001)	-	-	-	-0.65	-
Alias et al. (2005)	-	-	-	-0.42	-
Tey et al. (2008a)	-	-	-	-	- 0.85
Tey et al. (2008b)	-	-	-	-	- 1.15
Tey et al. (2008c)	-	-	-	-	- 1.06
Tey et al. (2008d)	-	-	-	-	- 1.13

The mentioned previous studies, however, did not recognise vegetables as heterogeneous products. These analyses did not capture the demand responses of specific or categorised vegetables, a feature that can be obtained easily from the comprehensive Household Expenditure Surveys. Recognising this need, Tey et al. (2009) attempted a dissgregated demand analysis for vegetables. The study suggested that Malaysian consumers tend to increase their demand for quality vegetables (except root and tuberous vegetables) in response to income growth. The insights are valuable but they are incomplete without the estimation for price elasticities.

ESTIMATION PROCEDURE

The recent development in food demand studies like those by Dey (2000), Garcia et al. (2005), and Dey et al. (2008) have made full use of a 'multi-stage demand system' that combined the framework used by Deaton and Muellbauer (1980), Heien and Wessells (1990), and Blundell et al. (1993). One special feature of the multi-stage demand system is its ability to estimate demand elasticities at various stages which track down to specific food items. Therefore, a similar method was applied in this study.

In the first stage, it is assumed that a household makes decisions on how much of their total income (expenditure) is to be allocated for food consumption, conditional on household characteristics and the consumption of non-food goods. The functional form of Working-Leser in the first stage can be written as:

$$\ln(M^h) = \alpha + \beta_1 \ln(SP^h) + \beta_2 \ln(NF^h) + \beta_3 \ln(Y^h) + \beta_4 (\ln Y^h)^2 + \sum_{i \notin Z_1} \beta_i Z \qquad (1)$$

where M^h is food expenditure, SP^h is price index for food, NP^h is non-food expenditure as proxy for price index for non-food, Y^h is per capita total expenditure (incomes), and Z is a vector of demographic variables that include household size and urban dummy.

As equation (1) is an outcome of utility maximization problem, it must observe homogeneity of degree zero in prices and income which can be stated as:

$$\beta_1 + \beta_2 + \beta_3 + 2\beta_4 \ln y^h = 0 \qquad (2)$$

In the second stage, the household allocates a portion of food expenditure for vegetables and other commodity groups. The Tobit regression for stage 2 is expressed as:

$$\ln EG_i^h = \theta_o + \theta_1 \ln PG_i^h + \theta_2 \ln \hat{M}^h + \theta_3 (\ln \hat{M}^h)^2 + \theta_4 S_i^h + \sum_{i \in Z_2} \theta_i' Z \qquad (3)$$

where EG_i^h is aggregate expenditure on vegetables, PG_i^h is price index of aggregate vegetable group, $\hat{M}^h$ is the predicted value of M^h from stage 1, S_i^h is the price index for *i*th food group, and Z is a vector of demographic variables that include household size and urban dummy.

Then, a probity regression is computed in order to estimate the probability that a given household consumes the individual vegetable in question. This regression is used to yield the inverse Mills ratio for each household, in order to correct the possible bias created by the presence of zero consumption (Heien and Wessels, 1990).

In the third stage, the household allocates the aggregate vegetable group expenditure between different vegetable categories. Denote the set of food items on the demand side as DF. For, $\notin DF$ the quadratic version of Almost Ideal Demand System (AIDS) is:

$$s_i^h = \gamma_0 + \sum_{j \notin DF} \gamma_{ij} \ln P_j^h + \gamma 1_i * \ln\left[\frac{\hat{EG}^h}{ST^h}\right] + \gamma 2_i \left[\ln\left[\frac{\hat{EG}^h}{ST^h}\right]\right]^2 + \gamma 3_i * IMR_i^h + \sum_{k \notin Z_5} \gamma_i' Z \qquad (4)$$

where s^h is the expenditure share of *i*th vegetable item in the aggregate vegetable group expenditure, P_j^h is price of the *i*th vegetable item, IMR_i^h is the estimated value of inverse Mills ratio, and ST^h is an approximation of the AIDS price index, which is computed as:

$$\ln ST^h = \sum_{i \notin DF} s_i^h \ln P_i^h \qquad (5)$$

Utility maximisation requires that parameters of equation (5) comply with homogeneity of degree zero in prices, symmetry of the Slutsky matrix, and the adding up restriction (budget shares sum to 1). These restrictions are expressed as follows:

$$\sum_j \gamma_{ij} = 0, i, j \notin DF \quad \text{(Homogeneity)} \quad (6)$$

$$\gamma_{ij} = \gamma_{ji}; \frac{\gamma 1_i}{\gamma 2_i} = \frac{\gamma 1_j}{\gamma 2_j}; i, j \notin DF \quad \text{(Symmetry)} \quad (7)$$

$$\sum \tilde{\gamma} 0_i = 1, \sum_i \gamma 1 = \sum_{i=1} \gamma 2 = 0; i \notin DF \quad \text{(Adding up)} \quad (8)$$

From the estimations of Equations (1), (3), and (4), the demand elasticities that can be yielded are as follows:
Food expenditure to income:

$$\eta_y^h = \beta_3 + 2\beta_4 \ln y^h \quad (9)$$

Aggregate vegetable group expenditure to total food expenditure:

$$\eta_{fd}^h = (\theta_2 + 2\theta_3 \ln \hat{M}^h) * PFD_i^h \quad (10)$$

The *i*th vegetable item to aggregate vegetable expenditure:

$$\eta_{if}^h = \left[\gamma 1_i \frac{2 * \gamma 2_i \ln(\hat{E}\hat{G}^h / P^h)}{s_i^h} + 1 \right] \quad (11)$$

Expenditure elasticity of aggregate vegetables:

$$\eta_{iy}^h = \eta_{if}^h * \eta_{fd}^h \quad (12)$$

Expenditure elasticity of the *i*th food item:

$$\eta_{iy}^h = \eta_{if}^h * \eta_{fd}^h * \eta_y^h \quad (13)$$

The Marshallian measures of price elasticity:

$$\varepsilon_{ij}^h = \frac{\gamma_{ij}}{S_i^h} - \left[\gamma 1_i + 2 * \gamma 2_i \ln(\hat{E}\hat{G}^h / P^h) \right] \frac{s_j^h}{s_i^h} - k_{ij} \quad (14)$$

where PFD_i^h is the probability aggregate vegetable group that is consumed, which may be estimated from simple proportion; k_{ij} is the Kronecker delta, which is unity for $i=j$, and is zero otherwise.

DATA

This study utilised the Household Expenditure Survey (HES) 2004/2005 data which was collected by the Department of Statistics, Malaysia. The data consisted of a wide range of information on expenditure and consumption of specific food items by 14,084 respondents. Initially, there were 160, 18, and 6 vegetable items listed under three major vegetable groups: fresh vegetables, dried vegetables, and tuberous vegetables, respectively. These vegetable items were then re-categorised into 6 major categories, namely (1) leafy and salad vegetables, (2) bulb and stem vegetables, (3) fruiting and flowering vegetables, (4) root and tuberous vegetables, (5) podded vegetables, and (6) processed vegetables, for the ease of computation and analysis.

RESULTS

Equation (1) is useful in validating the appropriateness of quadratic function form in the study. Appendix I presents the resultant parameter estimates of Equation (1). Noteworthy is the square term variable in the estimated equation which is significantly different from zero. This indicates that the relationship between food expenditure and income is non-linear. Arising from such result, a quadratic term was empirically grounded to be appropriate for the remaining analyses. Then Equations (3) and (4) were estimated. Their estimated parameters are presented in Appendices II and III respectively.

The estimated parameters were utilised to yield the demand elasticities (see Appendix IV) as formulated in Equations (9), (10), and (11). These initial expenditure elasticities, however, were difficult for direct interpretation. Therefore, Table 3 was constructed to present a better structured income elasticity at the sample mean of the 6 categorised vegetables.

Table 3: Expenditure Elasticity of Food, Vegetables, and Various Vegetable Categories

Food Item		Expenditure Elasticity
Food		0.4661
Vegetables		0.3557
	Leafy and salad vegetables	0.3615
	Bulb and stem vegetables	0.3557
	Fruiting and flowering vegetables	0.3619
	Root and tuberous vegetables	0.3617
	Podded vegetables	0.3583
	Processed vegetables	0.3191

Note: All the expenditure elasticity were estimated at the sample mean.

It is apparent that the estimated income elasticity for food, vegetables, and various vegetable categories are positive, indicating that they in general are normal goods. The expenditure elasticity of food suggests that Malaysian consumers are likely to increase

the expenditure on aggregated food by 4.7 percent, which corresponds to 10 percent in income growth. Similar income growth is expected to generate a 3.6 percent increase in expenditure on aggregated vegetables. Though this estimate is not as low as that found by Alias et al. (2005), it still shows a declining trend over the years. This can be attributed largely to higher demand for higher value products such as meat and fish (Tey et al., 2008a and 2008b).

It can also be seen that the estimates of expenditure elasticities for the vegetable categories are consistently in the range between 0.3 and 0.4. A comparison among the categories reveals that there is no distinct preference for any specific vegetable category. However, the expenditure on fresh vegetables will increase at a faster pace than processed vegetables in tandem with income growth.

The findings of this study are similar to those found by Ali (2000). In his observations, consumers prefer fresh vegetables while the contribution of processed vegetables remain small. Similar observations were also made in other Asian countries such as Bangladesh (Elias and Hussain, 2000), China (Ma et al., 2000), Indonesia (Darmawan and Pasandaran, 2000), and Taiwan (Wann et al., 2000). Thus, there is only a small role for processed vegetables in the diet.

The preference for fresh vegetables can also be statistically seen in the Household Expenditure Survey 2004/05. In the Household Expenditure Survey 2004/05, Malaysian households devoted 89 percent of vegetable expenditure to fresh vegetables which consisted of 37 percent for leafy and salad vegetables, 15 percent for bulb and stem vegetables, 20 percent for fruiting and flowering vegetables, 9 percent for root and tuberous vegetables, and 9 percent for podded vegetables. Only 11 percent of vegetable expenditure was spent on processed vegetables. From many perspectives, processed vegetables are generally more expensive than fresh vegetables. Hence, it is deemed important to include the price factor in the consumer demand studies.

As discussed earlier, price factor is important in determining demand for vegetables. Table 4 presents the Marshallian own-price elasticities of various vegetable categories, evaluated at the sample mean. Most of the own-price elasticities of demand for vegetables are elastic $(|\varepsilon_{ii}| > 1)$, , except podded vegetables (-0.7364). The estimates of own-price elasticity reveal that Malaysian consumers are generally sensitive to vegetable prices which include leafy and salad vegetables, bulb and stem vegetables, fruiting and flowering vegetables, root and tuberous vegetables, as well as processed vegetables. This general sensitivity is likely to have a relative bigger impact on the adjustment in the quantity demanded for these vegetables in line with changes in vegetable prices.

Table 4: Marshallian Own-Price Elasticity of Various Categories of Vegetable

Category of Vegetables	Own-price Elasticity
Leafy and salad vegetables	-1.1340
Bulb and stem vegetables	-1.1741
Fruiting and flowering vegetables	-1.0323
Root and tuberous vegetables	-1.0801
Podded vegetables	-0.7364
Processed vegetables	-1.3183

Note: All the own-price elasticity were estimated at the sample mean.

ADDITIONAL DISCUSSION

While previous discussion focuses on demand elasticity, this section is dedicated to discuss the impact of urbanization on the demand for vegetables, which was found to be empirically significant in the previous and current studies. Appendix II reports a positive parameter estimate of urban dummy (as 1 if a respondent resides in urban area). Though this is at an aggregated level, it indicates that urban consumers allocated more budget for vegetables compared to rural consumers. Similarly, same indication refers to bigger quantity of vegetables consumed by the urban consumers.

This indication is contra to common perception that demand for vegetables in rural areas is higher than urban areas. Though not econometrically verified, an earlier study by Nik Fuad et al. (2000) suggested that more vegetables are consumed in urban areas than in rural areas. However, this was from a perspective of statistics that shows changes in vegetable consumption in both areas over time. Likewise, Elias and Hussain (2000), Ma et al. (2000), Darmawan and Pasandaran (2000), and Sootsukon et al. (2000) also observed a similar difference in vegetable consumption in urban and rural areas in Bangladesh, China, Indonesia, and Thailand, respectively. Ma et al. (2000) pointed out that urbanisation creates a substantial demand for vegetables to be transported from diverse rural areas. In further effort, Ali (2000) noted that production in rural areas provides a platform to maintain regular supply of vegetables to meet the increasing demand for vegetables in urban areas.

From Appendix III, it can be seen that there are mixed results of preference for vegetable categories in urban areas. Barring a few exceptions, urban consumers were found to spend more on leafy and salad vegetables, root and tuberous vegetables, and processed vegetables. In greater details, Nik Fuad et al. (2000) also elaborated that urban consumers prefer higher value vegetables (like cabbage and *pakchoi*) while rural consumers consume lower value vegetables (like cucumber and *kangkong*). Tey et al. (2009) also suggested that urban consumers are increasingly demanding high quality vegetables in terms of cleanliness, appearance, nutrition, fragrance, and pesticide-free (Ma et al., 2000).

CONCLUSION

This study provides vital information on the demand for vegetables in general as well as specific categorised vegetables, namely leafy and salad vegetables, bulb and stem vegetables, fruiting and flowering vegetables, root and tuberous vegetables, podded vegetables, and processed vegetables. The estimates of expenditure elasticity that yielded from 'multi-stage demand system' suggest that Malaysian consumers are likely to increase their expenditure on aggregated vegetables and the various vegetable categories in line with income growth.

This, however, may not be so certain if there are positive adjustments in vegetable prices as suggested by the estimated own-price elasticities. Indeed, Malaysian consumers are price elastic to the changes in vegetables prices. The moderate supply response to increasing demand will simply drive up vegetable prices (Ali, 2000), unless constraints to expand vegetable cultivation or to increase yield is overcome.

In relation to this, more investments in high-yielding, low-cost, and green technologies are needed. These investments, perhaps, are more urgently needed in such turbulent times where the vegetable production is constantly affected by climate change. In order to specify the investment needs in the industry, more detailed and disaggregated demand analyses are needed in future studies. The main reasons being: (1) vegetables generally come from different production environments; (2) vegetable preferences vary according to income distribution and rural and urban areas; (3) domestic vegetable trade is often differentiated according to rural and urban markets. Detailed and disaggregated demand information will be useful in assessing the market development as well as in shaping plausible policies.

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Appendix I

Estimated Food Expenditure Function, Malaysia, 2004/05

Variable	Dependant Variable: Food Expenditure (Per capita)	
	Coefficient	**Std. Error**
Intercept	-0.4996***	0.0980
Ln (per capita total income)	1.3987***	0.0736
Ln (per capita total income) x Ln (per capita total income)	-0.1787***	0.0137
Ln (stone price index for food)	0.0436**	0.0198
Ln (per capita non-food expenditure)	-0.0478***	0.0047
Ln (household size)	0.0371***	0.0089
Urban dummy	-0.0557***	0.0045
Adjusted R-squared	0.5396	

*** 1% level of significance; ** 5% level of significance

Appendix II

Vegetable Expenditure Function, Malaysia, 2004/05

Variable	Dependant Variable: Vegetable Expenditure (Per capita)	
	Coefficient	**Std. Error**
Intercept	-1.3894***	0.4018
Ln (price of cereal)	-0.0869***	0.0160
Ln (price of meat)	0.0606**	0.0237
Ln (price of fish)	0.0083***	0.0012
Ln (price of milk, egg & fat)	-0.0467***	0.0105
Ln (price of fruit)	-0.0308**	0.0149
Ln (price of vegetable)	-0.0414	0.0281
Ln (price of sugar & beverage)	0.0679***	0.0105
Ln (price of other foods)	-0.0949***	0.0095
[a]Ln (per capita food expenditure)	1.9280***	0.4226
[a]Ln (per capita food expenditure) x Ln (per capita food expenditure)	-0.2922***	0.1113
Ln (household size)	-0.3976***	0.0135
Urban dummy	0.0229***	0.0057
Adjusted R-squared	0.2687	

[a] Predicted value of Ln (per capita food expenditure), obtained from stage 1.
*** 1% level of significance; ** 5% level of significance

Appendix III

Estimated Parameters of the QUAIDS Vegetable Demand System, Malaysia, 2004/05

	Vegetables					
	Leafy & salad	**Bulb & stem**	**Fruiting & flowering**	**Root & tuberous**	**Podded**	**Processed**
	Coefficient (Std. Error)	**Coefficient (Std. Error)**	**Coefficient (Std. Error)**	**Coefficient (Std. Error)**	**Coefficient (Std. Error)**	**Coefficient (Std. Error)**
Intercept	0.2734	0.1187	0.1360	0.0566	0.0528	0.3625[c]
	(0.0061)***	(0.0041)***	(0.0043)***	(0.0027)***	(0.0027)***	-
Ln (price of leafy & salad vegetable)	-0.0449	-0.0381	-0.0289	0.0006	-0.0413	0.1526[c]
	(0.0068)***	(0.0046)***	(0.0047)***	(0.0028)	(0.0029)***	-
Ln (price of bulb & stem vegetable)	-0.0242	-0.0242[c]	-0.0022	-0.0103	0.0058	0.0550[c]
	(0.0021)***	-	(0.0027)	(0.0018)***	(0.0018)***	-
Ln (price of fruiting & flowering vegetable)	0.0524	-0.0055	-0.0055[c]	-0.0047	0.0090	-0.0458[c]
	(0.0033)***	(0.0015)***	-	(0.0014)***	(0.0014)***	-
Ln (price of root & tuberous vegetable)	0.0194	0.0163	-0.0066	-0.0066[c]	0.0085	-0.0310[c]
	(0.0043)***	(0.0029)***	(0.0016)***	-	(0.0019)***	-
Ln (price of podded vegetable)	-0.0155	0.0326	0.0427	0.0226	0.0226[c]	-0.1051[c]
	(0.0065)**	(0.0043)***	(0.0043)***	(0.0020)***	-	-
Ln (price of processed vegetable)	0.0128[c]	0.0188[c]	0.0004[c]	-0.0016[c]	0.0047[c]	-0.0350[c]
	-	-	-	-	-	-
Ln (household size)	0.0962	0.0290	0.0659	0.0353	0.0349	-0.2614[c]
	(0.0064)***	(0.0043)***	(0.0043)***	(0.0028)***	(0.0028)***	-
Urban dummy	0.0037	-0.0172	-0.0160	0.0050	-0.0133	0.0377[c]
	(0.0035)	(0.0024)***	(0.0024)***	(0.0016)***	(0.0015)***	-
[b]Ln (per capita vegetable expenditure)	0.0057	0.0000	0.0032	0.0014	0.0006	-0.0110[c]
	(0.0005)***	(0.0004)	(0.0004)***	(0.0002)***	(0.0002)***	-
[b]Ln (per capita vegetable expenditure) x Ln (per capita vegetable expenditure)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000[c]
	(0.0000)***	(0.0000)	(0.0000)	(0.0000)***	(0.0000)	-
IMR	0.2544	0.1279	0.1899	0.1133	0.1197	-0.8052[c]
	(0.0150)***	(0.0045)***	(0.0051)***	(0.0020)***	(0.0020)***	-
Adjusted R-squared	0.0616	0.1080	0.1446	0.2198	0.2395	-

[b]Predicted value of Ln (per capita vegetable expenditure), obtained from stage 2.

[c]Significance cannot be assessed as there coefficients are estimated by imposing restrictions.

*** 1% level of significance; ** 5% level of significance

Appendix IV

Estimated Expenditure Elasticity at Each Stage of the Multi-Stage Budgeting System for Vegetable Consumption, Malaysia.

		Elasticity
Stage 1: Food expenditure elasticity with respect to total income		0.4661
Stage 2: Vegetable expenditure elasticity with respect to food expenditure		0.7632
Stage 3: Vegetable expenditure elasticity for individual type of vegetable		
	Leafy and salad vegetables	1.0163
	Bulb and stem vegetables	0.9998
	Fruiting and flowering vegetables	1.0172
	Root and tuberous vegetables	1.0166
	Podded vegetables	1.0072
	Processed vegetables	0.8972

Note: All the expenditure elasticity are estimated at the sample mean.