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# Demand Elasticities of Selected Proteinous Food in Sri Lanka

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*ABSTRACT: The objective of this paper is to estimate price and expenditure elasticities of beef, mutton, chicken, fresh fish and dried fish. Data were collected from the Department of Census and Statistics and the Central Bank of Sri Lanka. Elasticities were estimated employing a finite version of the Rotterdam Model.*

*Partial expenditure elasticities of beef, mutton, chicken, fresh fish and dried fish are 0.037, 0.223, 0.556 and 0.980 respectively. This indicates fresh fish is a near luxury whereas others are normal food. Smaller changes of beef and mutton intake with respect to change in total expenditure result in lower expenditure elasticities. Compensated partial own price elasticities of the same commodities are −0.245, −0.962, −3.233, −0.189 and −0.368 respectively. This implies that chicken is price elastic while others are price inelastic. Compensated partial cross price elasticities of these food indicate that they are substitutes except beef and mutton compared with chicken.*

*Considering the relative magnitudes of protein food intake in the country implication of the finding such as substitutability, high price responsive of chicken and less variation of beef and mutton consumption with income have to be considered in policy formulation.*

## INTRODUCTION

An understanding of food consumption parameters is of vital importance in making price and income policies in the country. These parameters include own price, cross price, and income elasticities of demand. Changes in income and food prices affect food intake

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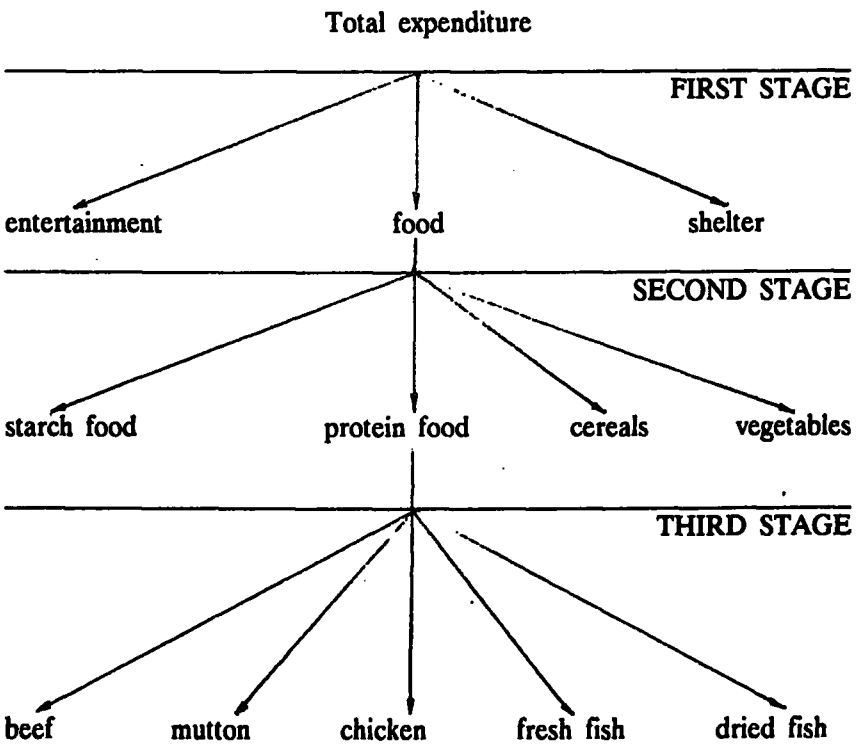
especially of the low income people which inturn affect their nutrition status. Therefore, price and income parameters of food demand have to be considered when altering food policies.

Only a few studies have been carried out on consumer behaviour in Sri Lanka (Jogaratnam and Poleman, (1966); De Mel and Jogaratnam, (1977); Edirisinghe and Poleman, (1977); Alderman and Timmer, (1980); and Sahn, (1988)). These studies have, however, ignored the endogenous nature of prices and total expenditure which leads to correlate across equations for the same observation. This implies that food demand function cannot be treated in isolation as a single equation model, but belongs to a system of equations which describes the joint dependence of variables. An application of ordinary least squares to a single equation in isolation from the system results in biased and inconsistent estimates. The objective of this paper is to estimate price and expenditure elasticities taking into account the endogenous nature of prices and total expenditure in respect of beef, mutton, chicken, fresh fish and dried fish.

## METHOD

The concept of separability and multi stage budgeting is widely used in empirical demand analysis in order to limit the number of estimated parameters (Eales and Unnevehr, (1988)). This helps to find an explanation for the demand for a particular good through much smaller number of commodities. Further, the decision on how to allocate total current expenditure among sub-groups of commodities is independent of the individual goods. In addition, leaving out large number of commodities make analysis simpler and convenient. Furthermore, if there are rationed goods the expenditure needed to buy them can be simply deducted from the total expenditure and the remainder can be allocated on other goods independent of the amounts of ration.

Separability and multi stage budgeting lead to a hypothesis that the allocation of total expenditure on different commodities takes place in several stages. At the first stage, total expenditure is allocated to broad groups of goods such as entertainment, food, and shelter. The second stage sub-group expenditure is further allocated to the deeper sub-group of commodities within a broad group. The third stage sub-group




expenditure is allocated to the individual commodities within a deeper sub-group. This can be represented by the following sketch.

The Rotterdam Model described below was used to estimate price and expenditure elasticities since it has several advantages over the other commonly used models such as: linear demand model, double log demand model, indirect addilog system, linear expenditure system and almost ideal demand system. Linear demand model gives the price and income elasticities at a point corresponding to an average price and quantity for the entire period. The double log demand model gives the elasticities directly as coefficients which are constant over the entire period. With change in prices, income, taste and preferences over time the elasticities should also change. The linear expenditure system does not eliminate serial correlation, if any, of the data. Further, it is impossible to treat inferior goods in the system (Phlips, 1983). The indirect addilog system has no clear advantage over the linear expenditure system.

## Model

The model employed in this study is the Rotterdam Model which is the most frequently used one in estimating elasticities and to test the theory of consumption (Deaton and Muelbauer, 1980). This allows to specify demand function directly: quantities as dependent variable and prices and total expenditure on each food group as independent variables.

The Rotterdam Model can be represented as follows.

$$d(\log q_i) = e_i \, d(\log X) + \Sigma_j e_{ij} \, d(\log p_j) \quad (1)$$

Where: $q_i$ = quantity demanded of ith good,

$e_i$ = expenditure elasticity,

$X$ = group expenditure,

$e_{ij}$ = uncompensated price elasticity, and

$p_j$ = price of jth good.

The imposition of Slutsky's decomposition of price change, ($e_{ij} = e^*_{ij} - w_j e_i$) to equation (1) results in:

$$d \log q_i = e_i \, (d \log X - \Sigma_k w_k \, d \log p_k) + \Sigma_j e^*_{ij} \, d \log p_j \quad (2)$$

Where: $w_j$ = budget share of jth good,

$e_{ij}$ = compensated price elasticity, and others as defined earlier.

Deaton and Muelbauer (1980) shows that the imposition of symmetry restriction can be done by multiplying equation (2) by budget share, $w_i = p_i q_i / X$. This is because the classical demand results imply restriction on these parameters (Parks, 1969). Weighting equation (2) by $w_i$ and taking natural logarithmic from equation (2) can be written as:

$$w_i \, d \ln q_i = w_i e_i \, (d \ln X - \Sigma_k w_k \, d \ln p_k) + \Sigma_j w_i e^*_{ij} \, d \ln p_j \quad (3)$$

The equation (3) can be estimated provided finite changes of variables and the coefficients $w_i e_i$ and $w_i e^*_{ij}$ are constant over time. Then equation (3) can be represented as:

$$w_{it}\, Dq_{it} = w_i e_i\, (DX_t - \Sigma_k w_k Dp_k) + \Sigma_j w_i e^*_{ij} Dp_{tj} + U_{it} \quad (4)$$

$$(i = 1, 2, 3, ..., N; \qquad t = 1, 2, 3, ..., T)$$

The operator D represents the log difference of variables (first difference) such as:

$Dq_{it} = \ln q_i - \ln q_{i,t-1}$, and

$U_{it}$ is stochastic error term.

Parks (1969) notes that the system of equation (4) ia s set of seemingly unrelated regression equations in the sense of Zellner. That is $\Sigma E\ (U_{it}) = 0$ for all i and t, and the stochastic error terms are uncorrelated across observations but correlated across equations for the same observations. Therefore, the system of equations (4) was estimated using Zellner's Iterative Seemingly Unrelated Regression method. The respective coefficients were obtained with imposing homogeneity, symmetry, and adding-up conditions for the set of equations in the system.

## Data

Data used in this study were gathered from the reports published by the Department of Census and Statistics and the Central Bank of Ceylon, Sri Lanka. Per capita availabilities of the above food items were collected from the food balance sheets (FBS) from 1960 to 1986 prepared by the Department of Census and Statistics. The prices of the same commodities and the consumer price index for the same period were obtained from the statistical abstracts of the Department of Census and Statistics. The "actual" intake of these foods for different years were collected from the 1973, 1978/79 and 1981/82 reports on Consumer Finance Survey (CFS) conducted by the Central Bank of Sri Lanka. Following conversion factor was used to convert per capita availabilities of foods to actual consumption.

$$\text{Conversion factor} = \frac{\text{amount of } i^{th} \text{ commodity indicated in CFS in year t}}{\text{amount of ith commodity indicated in FBS in year t}}$$

Since there were no detailed consumer finance survey reports for each year under consideration, the conversion factor for 1973 had to be used for the period 1960 to 1975 (Annex 1). Further, conversion factor for 1978/79 was used for the period 1976 to 1980 and the conversion factor for 1981/82 was used for the period 1981 to 1986.

## RESULTS

The estimated coefficients matrix with the average budget shares for beef, mutton, chicken, fresh fish and dried fish in 1986 is presented in Table 1. Since the price coefficients matrix is symmetric only the lower triangle is presented to avoid over crowding of the table. Table 2 presents the partial expenditure and partial uncompensated price elasticities of beef, mutton, chicken, fresh fish and dried fish. It shows that compensated partial own price elasticities of beef, mutton, chicken, fresh fish and dried fish are $-0.24$, $-0.96$, $-3.33$, $-0.80$ and $-0.72$ respectively. The signs of own price elasticities are negative as expected and consistent with the theory of consumption. This implies that increase in own prices of these commodities will result in decreasing quantity demanded.

Among these beef, mutton, fresh fish and dried fish are price inelastic ($e_{ii} < 1$) while chicken is price elastic. In other words, consumers respond highly for changes in chicken price compared to the changes in prices of other commodities. This could be attributed to its higher price which leads to substantial change in quantity demanded to changes in price.

The signs on the cross price elasticities are positive except for beef and mutton in the demand equation of chicken. It is reasonable to expect positive cross price elasticities with these foods since they are generally regarded as substitutes among Sri Lankan consumers. The introduction of frozen chicken, which increased the availability of chicken, could be the reason for the unexpected results with beef, and mutton in the chicken demand equation.

Table 1. Coefficients of the restricted rotterdam model for proteneous food.

| Commodity | Expenditure | Beef | Mutton | Chicken | Fresh Fish | Dried Fish |
|---|---|---|---|---|---|---|
| Beef | 0.0045 | -0.0297 | | | | |
| Mutton | 0.0066 | 0.0047 | -0.0284 | | | |
| Chicken | 0.0153 | -0.0211 | -0.0185 | -0.0914 | | |
| Fresh Fish | 0.6147 | 0.0072 | 0.0195 | 0.0584 | -0.0864 | |
| Dried Fish | 0.3588 | 0.0390 | 0.0227 | 0.0810 | 0.0014 | -0.1350 |
| Average budget share in 1986 | | 0.1210 | 0.0295 | 0.0275 | 0.4560 | 0.3660 |

Table 2. Partial expenditure and uncompensated partial price elasticities of the restricted rotterdam model for proteneous food.

| Commodity | Expenditure | Beef | Mutton | Chicken | Fresh Fish | Dried Fish |
|---|---|---|---|---|---|---|
| Beef | 0.0371 | -0.2498 | | | | |
| Mutton | 0.2237 | 0.0372 | -0.9692 | | | |
| Chicken | 0.5563 | -0.1853 | -0.6332 | -3.3388 | | |
| Fresh Fish | 1.3480 | 0.0423 | 0.5589 | 1.8699 | -0.8040 | |
| Dried Fish | 0.9803 | 0.3078 | 0.6875 | 0.0230 | 0.4903 | -0.7275 |

The partial expenditure elasticities of beef, mutton, chicken, fresh fish and dried fish are 0.03, 0.22, 0.55, 1.34 and 0.98 respectively. Among these, expenditure elasticity of fresh fish is well above one which is a definition for luxury good. The positive signs of these elasticities correspond to expectations and consistent with the theory of consumption. That is increases in expenditure (or income) will result in increases in intake of these food.

Table 3 gives the expenditure elasticities of the previous studies of Jogaratnam and Poleman (1966), and Sahn (1988) along with the results of the present study. For the purpose of comparison elasticity of meat was calculated using the elasticities of beef, mutton and chicken by weighting per capita consumption of respective commodities. Similarly, elasticity of fish was calculated using the elasticity of fresh fish and dried fish. The calculated elasticities for meat and fish were lower than the results of the above two studies. It is interesting to note that according to Jogaratnam and Poleman (1966) meat was luxury while fish was normal food. According to Sahn (1988) fish was luxury while meat was normal food. The present study shows that fresh fish is near luxury while others are normal food in Sri Lankan consumers. Since consumers preferences can change over time due to technological changes and social factors, it is possible to have one commodity with luxury at one time to be normal commodity at another time.

According to the results of the study meat especially beef, is a normal commodity. This is quite different from the results of the Jogaratnam and Poleman, (1966). As mentioned earlier in the previous studies, meat was considered as one commodity and hence relatively large budget share was allocated. Therefore, adjustments of quantity demanded to change in budget share (or expenditure) was higher. Therefore, one can expect higher expenditure elasticity for meat as a whole.

Table 4 shows the own price elasticities of selected protein food items of the present study along with the results of Sahn (1988). Elasticities for meat and fish in the present study were calculated as same as in Table 3. Calculated price elasticity of meat is little higher than that of Sahn (1988) but it is elastic ($e_{11} > 1$) in nature. However, calculated elasticity of fish is different from the results of Sahn (1988). The lower weighted average elasticity of fish could be attributed to the lower elasticities of its individual commodities.

Table 3. Expenditure elasticities of selected protein food items.

| Commodity | Jogaratnam & Poleman (1) | Sahn (2) | Present study |
|---|---|---|---|
| Meat | 2.18 | 0.73 | 0.30* |
| Fish | 0.64 | 1.55 | 1.25** |
| Beef | - | - | 0.03 |
| Mutton | - | - | 0.22 |
| Chicken | - | - | 0.55 |
| Fresh Fish | - | - | 1.34 |
| Dried Fish | - | - | 0.98 |

(1) Jogaratnam, T. and T.T. Poleman, (1966).
(2) Sahn,.D.E., (1988).

* Weighted average of the elasticities of beef, mutton and chicken.
** Weighted average of the fresh fish and dried fish.

Economists use the famous example of salt to explain the concept of importance of being unimportant. Salt is a necessity in our diets yet is a very little amount of the total budget. Therefore, consumer response to any price change is minimal. When one considers the average Sri Lankan's diet, beef can also be considered similar to salt. Per capita beef consumption is about 0.87 kg/yr in the country and budget share for it is around 0.06%. Further, due to cultural and other social norms most people buy beef only for special occasions. Therefore, price response may not be important on day to day consumption decisions. Hence, it may be reasonable to conclude that meat specially beef plays a similar role in Sri Lankan's diets, importance of being unimportant. On the other hand, chicken is an important part of middle and high income people's diet in recent years. With the availability of frozen chicken almost every where one can expect an increase in demand for chicken. Hence, any change in price of chicken may result in larger change in quantity demanded. Therefore, it is reasonable to have higher price elasticities for chicken.

It is worthy to note that studies done by Jogaratnam and Poleman (1966), and Sahn (1988) did not use some commodities separately. For example, they used all meat as one commodity and all fish as one commodity. The present study used these commodities separately. Therefore, it is incorrect to compare the results of the present study with the results of the above two studies. Further, the above two studies were based on cross section data while the present study was based on time series data. This also limits the comparison of the present results with the results of the above two studies.

The other limiting factor of comparing these results with the results of the previous studies can be attributed to the methods adopted to estimate elasticities. In the present study, effect of commodities in other sub-group kept at a fixed or constant level and assumed that they have been determined before the consumer enters the market. This is called conditional demand analysis. But the two studies mentioned above do not follow such methodology, hence it called unconditional demand analysis. Therefore comparison is not proper.

Table 4. Own price elasticities of selected protein food items.

| Commodity | Sahn (1) | Present study |
|---|---|---|
| Meat | - 1.13 | - 1.82* |
| Fish | - 1.68 | - 0.78** |
| Beef | - | - 0.24 |
| Mutton | - | - 0.96 |
| Chicken | - | - 3.33 |
| Fresh Fish | - | - 0.80 |
| Dried Fish | - | - 0.72 |

(1) Sahn, D.E., (1988).

* Weighted average of the elasticities of beef, mutton and chicken.
** Weighted average of the fresh fish and dried fish.

## POLICY IMPLICATION

Estimated high expenditure (or income) elasticities indicate that income increases will place additional pressure on aggregate demand of chicken, fresh fish and dried fish in the country. The present welfare scheme of 'Janasaviya' for poors and other employment generation schemes which are currently underway or planned will contribute to increase income and hence to additional pressure on aggregate demand. This pressure then translate into higher food prices if there is no corresponding increase in supply. On the other hand, higher own price elasticities of mutton, chicken, fresh fish, dried fish imply that rise in prices result in decrease in demand of them. This eventually lead to low intake of animal proteins which will cause malnutrition and undernutrition. Therefore, with income rises, it is essential to increase the supply of these commodities either through higher domestic production and or imports depending on availability of resources and macroeconomic policies of the country.

According to the results and as hypothesized in the study most commodities (beef, mutton, fresh fish and dried fish) considered in this analysis are substitutes. Hence, quantity demanded of a particular commodity is depend not only on its own price and consumers income but also on prices of other commodities. Therefore, it is important to consider all the commodities as one set or one branch of the utility tree instead of individual commodities. However, when there exist more substitutes for a particular commodity, price increases of that commodity will result in shifting demand away from it to relatively cheaper substitutes. Therefore, price decreases of a particular commodity which can be easily produced in the country result in higher quantity demanded. This in turn lead to promote local infant industries and to reduce imports which otherwise require more foreign exchange. Therefore, it is important to design food policies on the basis of food groups instead of individual commodities.

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## ANNEX 1

**Conversion factors for the commodities for different periods.**

| Commodity | 1960 – 1975 | 1976 – 1980 | 1981 – 1986 |
|---|---|---|---|
| Beef | 1.100 | 1.363 | 1.660 |
| Mutton | 1.150 | 1.200 | 1.540 |
| Chicken | 2.920 | 0.760 | 0.808 |
| Fresh Fish | 1.240 | 1.020 | 1.020 |
| Dried Fish | 0.789 | 2.960 | 2.120 |

Note: Conversion factors are prepared by using the data of consumer finances survey reports of the Central Bank of Sri Lanka and the food balance sheets of the Department of Census and Statistics, Sri Lanka.