ESTIMATION OF POTATO DEMAND ELASTICITIES IN BANGLADESH

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ABSTRACT

The study estimated potato demand elasticities in Bangladesh by using AIDS model with corrected Stone price index. The income elasticity of demand for potato was 0.632. The compensated and uncompensated own price elasticities indicated that all food items were price inelastic. The estimated own price elasticity indicated that if the potato price fell by 10 per cent, demand for potato would increase by 8.82 percent. The estimates of cross price elasticities indicated that the substitution effects of price change were not quite strong. Therefore, government price interventions may not lead to considerable price repercussions in the economy.

I. INTRODUCTION

Potato is the leading vegetable crop in the world. People of at least 40 countries eat potato as their staple food (Islam, 1987 p.1). On a global basis it is already a major world food occupying fourth place in terms of importance, falling just after the three cereals - rice, wheat and corn (Swaminathan and Sawer, 1982 p.3). In Bangladesh it is one of the most important vegetables as well as cash crop and owing to promotional effort of government, it is being placed as a third crop next to rice and wheat (Afsar, 1997 p. 10).

In any planned economic development programme, exchange of goods assumes a very important role in maintaining equilibrium between production and consumption. The general consensus regarding markets in developing countries is that they are highly imperfect for the reasons that supply do not match with actual demand. This situation has led to serious bottlenecks in the process of marketing.

Ensuring a balance between the demand for and supply of food is one of the important tasks of the Government or the planning authority in a developing economy. With rise in incomes and population in the country, the demand for potato is expected to increase in the coming years. For these reasons, it is essential to frame policies and pursues programmes for

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larger production of potato. To formulate suitable production and distribution policy, a thorough knowledge on demand of potato is needed.

Empirical study dealing with potato demand in the context of Bangladesh is very few. Sabur (1983) did one study using both time series and cross-section data for estimating demand for potato. He used single commodity analysis in which a subset of prices and incomes were considered as explanatory variables. Talukder (1990a) also used single equation model for multiple commodity analysis to estimate demand elasticity of different food items. Demand theory, which is governed by a set of general as well as particular restrictions, is quite often inconsistent with real world data. Such inconsistency becomes more pronounced in the context of single commodity analysis. A household's consumption is influenced by its own price, price of related goods, income and other socio-demographic variables, depending on the nature of the commodity and particular aims of the investigation. All these factors were not considered in earlier studies.

In recent years, the Almost Ideal Demand System (AIDS) model formulated by Deaton and Muellbauer (1980) is being widely used by economists, owing to its properties which are consistent with the theory of demand. Ahmed and Shams (1994) applied AIDS model with Stone price index for estimating elasticities by using data collected from rural Bangladesh.

The present study is an attempt to estimate the demand elasticities of potato. For drawing meaningful implication of price change, substitution relationship between different food items is important which has also been looked into the present study.

II. METHODOLOGY

Data Sources

The demand analysis is based on data from the Household Expenditure Survey (HES) 1995-96, which was conducted by the Bangladesh Bureau of Statistics (BBS). Large sample size is needed to apply linear approximate Almost Ideal Demand System (LA/AIDS) which was chosen to estimate the parameters of the potato demand in Bangladesh. A total of 7,420 (5,020 rural and 2,400 urban) households were interviewed in the survey from which, by eliminating the abnormal data, the sample size stood at 7,072 (4,806 rural and 2,266 urban) households which are used for analysis in this study.

Theoretical Framework

The basic objective of the theory of consumer behaviour is to explain how a rational consumer chooses what to consume when confronted with various prices and limited income. Their choice for commodity bundles turns out to be formulated to utility maximising or cost minimising problem. The optimal solutions to these are Marshallian and Hicksian demand function perspective. Marshallian uncompensated demand functions, defined on prices and
Estimation of potato demand elasticities in Bangladesh

outlay, are contrasted with Hicksian compensated demand functions, defined on prices defined on prices and utility, and the central concept of the cost function is introduced. The simplest and single most important type of opportunity set is that which arises when the household has an exogenous budget, outlay or total expenditure \( x \), which is to be spent within a given period of time on some or all commodities. These can be bought in nonnegative quantities \( q_i \) at given fixed prices \( p_i \). The constraint can then be written as

\[
x \geq \sum_{i=1}^{k} p_i q_i
\]

(Deaton and Muellbauer, 1988 pp. 1-25)

**The Implications of a Linear Budget Constraint**

To understand consumer behaviour, we must recognise that the budget constraint is the hurdle perceived by the decision maker. A great deal of consumer demand analysis is built on the assumption of a simple linear budget constraint. In equality form it is represented below

\[
x = \sum_{k} p_k q_k
\]

where total expenditure is \( x \) and prices are \( p_k \). The use of the equality, as opposed to the inequality of (1), will be justified if consumers always attain the upper boundary of the opportunity set. This will happen if the consumer cannot completely satisfy all his wants within the budget and as such there will be always some commodities which are more desirable. The use of (2) rules out the nonlinearities, indivisibilities, uncertainties, and interdependencies of (1). It also assumes that the total amount to be spent \( x \) is decided separately from the detail to be made up.

**General Restriction of Demand Functions**

To maximise utility function subject to a budget constraint implies a number of general restrictions on the parameters of the Hicksian and Marshallian demand functions. These are the aggregation or adding up restriction, homogeneity restriction, Slutsky’s symmetry restriction and negativity restriction. The first restriction is particularly applicable to complete demand systems.

The aggregation restriction which also arises from the budget constraint, implies that the total value of both Hicksian and Marshallian demands is equal to total expenditure, that is,

\[
\sum p_i h_i(u, p) = \sum p_i g_i(x, p) = x
\]

The homogeneity conditions states that the Hicksian demands are homogeneous of degree zero in prices, the Marshallian demands in total expenditure and prices together, this implies that consumer do not suffer from money illusion. This can be shown as,

\[
h_i(u, \theta p) = h_i(u, p) = g_i(\theta x, \theta p) = g_i(x, p)
\]
Slutsky’s symmetry restriction arises from the cross substitution effects. It states that the effect of a price change on the quantity consumed of a good can be decomposed into an income effect and substitution effect. The cross price derivatives of the Hicksian demands are symmetric, that is, for all \( i \neq j \)

\[
\frac{\partial h_i(u, p)}{\partial p_j} = \frac{\partial h_j(u, p)}{\partial p_i}
\]

Since \( h_i(u, p) = \partial c(u, p) / \partial p_i \), \( \partial h_i / \partial p_i \) is \( \partial^2 c / \partial p_i \partial p_j \). Similarly, \( \partial h_j / \partial p_i \) is \( \partial^2 c / \partial p_j \partial p_i \), so that the only difference between the two lies in the order of the double differentiation. Young’s theorem asserts that given that continuous derivatives exist, which does not matter and hence the two derivatives are identical.

The negativity restriction requires that the own price substitution effect is negative. The \( n \times n \) matrix formed by the elements \( \partial h_i / \partial p_j \) is negative semi definite, that is, for any \( n \) vector \( \xi \), the quadratic form is

\[
\sum_i \sum_j \xi_i \xi_j \frac{\partial h_i}{\partial p_j} \leq 0
\]

If \( \xi \) is proportional to \( p \), the inequality becomes an equality and the quadratic form is zero. This result also follows from the derivative property; \( (\partial h_i / \partial p_j) \) is the matrix of second derivatives of a concave function and so is negative semi definite. The fact that \( \sum_i \partial h_i / \partial p_i \) is zero follows from homogeneity.

For a normal good the total effect of a price change is negative. This is the basic law of demand which says that quantity demanded of good varies inversely with its price level. It is only a Giffen good that has a positively sloping demand curve. (Deaton and Muellbauer, 1988 pp.43-46 and Talukder, 1990a pp.83-86)

**The Empirical Model**

The linear approximate almost ideal demand system (LA/AIDS) was chosen to estimate the parameters of the potato demand in Bangladesh. Each equation in the AIDS is given as:

\[
W_i = \alpha_i + \sum_j \gamma_{ij} \ln P_j + \beta_i \ln \left( \frac{X}{P} \right) + \mu_i \quad \text{..................................(3)}
\]

where, \( W_i = \text{share of the } \text{ith } \text{good (i.e., } W_i = \frac{P_i Q_i}{X} \text{ )} \)

\( P_j = \text{price of the } j\text{th good} \)

\( X = \text{total expenditure on all goods in the system} \)

\( P = \text{a price index} \)

\( \mu_i = \text{the residuals and assumed to have zero mean and constant variance} \)

\( \alpha_i, \beta_i \text{ and } \gamma_{ij} \text{ are parameters} \)
The price index (P) is a translog index:

\[ \ln P = \alpha_0 + \sum_j \alpha_j \ln P_j + \frac{1}{2} \sum_{i,j} \gamma_{ij} \ln P_i \ln P_j \quad \text{(4)} \]

The price index from equation (4) makes equation (3) a non-linear estimation, raising estimation difficulties. To avoid non-linear estimation, many empirical studies used Stone (1953) price index \((P^*)\) instead of \(P\), as suggested by Deaton and Muellbauer (1980 p.16):

\[ \ln P^* = \sum_j w_j \ln P_j \]

The model that uses Stone geometric price index is called the “Linear Approximate AIDS” (LA/AIDS). It can be shown that if prices are highly collinear, then the LA/AIDS model can be used to estimate the parameters of the AIDS model because the factor of proportionally of \(P\) to \(P^*\) is incorporated in the intercept term (Green and Alston, 1990 pp.442-445).

The use of the Stone price index has been shown to be inappropriate as it makes the estimated parameters inconsistent (Prasharap, 1993 pp.908-915; Buse, 1994 pp.781-793; Moschini, 1995 pp.63-68). Moschini attributes this problem to the fact that the Stone price index does not satisfy what Dievert (1987) calls the commensurability property and suggests that the problem may be solved by using a price index that satisfies this property. Moschini suggests several other price indices that satisfy this property which may be used to keep the specification of the almost ideal demand system linear. He also shows that these indices perform like the translog index in a Monte Carlo experiment. To keep the specification of the demand system linear, the price index that Moschini calls the corrected Stone index has been used which may be written as:

\[ \ln P = \sum w_i \ln \left( \frac{P_i}{P^i} \right) \quad \text{(5)} \]

The AIDS model automatically satisfies the adding-up condition, and is capable of satisfying the three other restrictions but does not necessarily do so. In terms of the parameters in equation (3) the adding-up condition implies

\[ \sum_i \alpha_i = 1, \sum_i \beta_i = 0, \sum_j \gamma_{ij} = 0 \quad \text{(6)} \]

Homogeneity is satisfied if

\[ \sum_j \gamma_{ij} = 0 \quad \text{(7)} \]

while symmetry is satisfied provided

\[ \gamma_{ij} = \gamma_{ji} \quad \text{(8)} \]
The negativity conditions have no obvious parametric representation in the AIDS model. Except for the adding-up condition, the AIDS does not have the restrictive implications. Thus, the AIDS offers the opportunity of testing homogeneity and symmetry restrictions.

The adding up restriction is given by equation (6). Equation (7) implies that the demands are homogeneous of degree zero in prices and income, and equation (8) shows the Slutsky Symmetry. The derivations of elasticity formulas for the AIDS model are found in Green and Alston (1990 pp.443-444), and Buse (1994 pp.783-786). The expenditure elasticity $\eta_i$ and uncompensated (Marshallian) own and cross price elasticity $\epsilon_{ij}$ can take the following form:

$$\eta_i = 1 + \beta_i / w_i$$  \hspace{1cm} (9)

$$\epsilon_{ij} = -\delta_{ij} + (\gamma_{ij} - \beta_j w_j) / w_i$$  \hspace{1cm} (10)

where $\delta_{ij}$ is Kronecker delta, which takes the value of one for own price elasticity and zero for cross price elasticity, $w_i$ is the share of the ith good and $w_j$ is the share of the jth good. Once the expenditure and uncompensated price elasticities are estimated, compensated (Hicksian) own and cross price elasticities can be computed using the Slutsky equation in elasticity form:

$$\epsilon_{ij} = \epsilon_{ij}^H - w_j \eta_i$$  \hspace{1cm} (11)

or $$\epsilon_{ij}^H = -\delta_{ij} + \left(\frac{\gamma_{ij}'}{w_i}\right) + w_j$$

where $\epsilon_{ij}^H$ is the compensated (Hicksian) price elasticity. (Deaton and Muellbauer, 1980 pp.312-326; Baharumshah, 1993 pp.23-37; Ahmed and Shams, 1994 pp.1-21; Moschini, 1995 pp.63-68; and Asche et al., 1998 pp.69-81)

**III. RESULTS AND DISCUSSION**

**Estimation of Price Elasticity of Demand, Cross Price Elasticities and Income Elasticity**

The almost ideal demand system provided in Eq. 3 was estimated by eliminating oil and spices. Without a proper dynamic specification of the estimated equations, the homogeneity and symmetry restrictions implied by economic theory cannot be rejected. These restrictions are tested with the help of Wald test where the estimated value of Chi-squared (28) was 1847.6 as against the tabular value at 1 per cent level of significance which is 48.3. As such no evidence against the homogeneity and symmetry restrictions implied by consumer theory was found which implies that estimated results were consistent.
Estimated potato demand elasticities in Bangladesh

Estimated coefficients of LA/AIDS model are presented in Table 1 where 69 coefficients out of 80 were statistically significant.

Table 1. Estimated Coefficients of AIDS Model

<table>
<thead>
<tr>
<th>Food item</th>
<th>Potato</th>
<th>Brinjal</th>
<th>Leafy vegetable</th>
<th>Other vegetable</th>
<th>Pulse</th>
<th>Rice</th>
<th>Fish and Meat</th>
<th>Oil and Spices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.1604*</td>
<td>0.1290*</td>
<td>0.1721</td>
<td>0.0902*</td>
<td>0.2245**</td>
<td>0.7287**</td>
<td>-0.7324**</td>
<td>0.2342**</td>
</tr>
<tr>
<td>Potato</td>
<td>0.0037*</td>
<td>-0.0012*</td>
<td>-0.0003*</td>
<td>-0.0009*</td>
<td>-0.0021*</td>
<td>-0.0010*</td>
<td>-0.0007*</td>
<td>-0.0007</td>
</tr>
<tr>
<td></td>
<td>(48.24)</td>
<td>(3.52)</td>
<td>(0.93)</td>
<td>(15.34)</td>
<td>(4.57)</td>
<td>(4.45)</td>
<td>(5.47)</td>
<td>(4.48)</td>
</tr>
<tr>
<td>Brinjal</td>
<td>-0.0001</td>
<td>0.0031*</td>
<td>-0.0002</td>
<td>-0.0004*</td>
<td>-0.0003*</td>
<td>-0.0010*</td>
<td>0.0000*</td>
<td>0.0001*</td>
</tr>
<tr>
<td></td>
<td>(70.50)</td>
<td>(3.52)</td>
<td>(0.93)</td>
<td>(15.34)</td>
<td>(4.57)</td>
<td>(4.45)</td>
<td>(5.47)</td>
<td>(4.48)</td>
</tr>
<tr>
<td>Leafy vegetable</td>
<td>-0.0003*</td>
<td>-0.00002</td>
<td>0.0021*</td>
<td>-0.0004*</td>
<td>0.0000*</td>
<td>-0.0007*</td>
<td>-0.0002*</td>
<td>-0.0001*</td>
</tr>
<tr>
<td></td>
<td>(-15.56)</td>
<td>(-4.93)</td>
<td>(52.40)</td>
<td>(-15.4)</td>
<td>(52.40)</td>
<td>(52.40)</td>
<td>(52.40)</td>
<td>(52.40)</td>
</tr>
<tr>
<td>Other vegetable</td>
<td>-0.0003*</td>
<td>-0.0001*</td>
<td>-0.0004*</td>
<td>0.0003*</td>
<td>-0.0002*</td>
<td>-0.0007*</td>
<td>-0.0002*</td>
<td>-0.0001*</td>
</tr>
<tr>
<td></td>
<td>(-10.93)</td>
<td>(-2.61)</td>
<td>(7.34)</td>
<td>(33.93)</td>
<td>(33.93)</td>
<td>(33.93)</td>
<td>(33.93)</td>
<td>(33.93)</td>
</tr>
<tr>
<td>Pulse</td>
<td>-0.0002*</td>
<td>-0.0002*</td>
<td>0.00002</td>
<td>-0.0002*</td>
<td>0.0005*</td>
<td>-0.0049*</td>
<td>0.00006*</td>
<td>0.0001*</td>
</tr>
<tr>
<td></td>
<td>(-4.57)</td>
<td>(-4.57)</td>
<td>(7.37)</td>
<td>(3.82)</td>
<td>(6.91)</td>
<td>(22.67)</td>
<td>(6.91)</td>
<td>(4.57)</td>
</tr>
<tr>
<td>Rice</td>
<td>-0.0010*</td>
<td>-0.0010*</td>
<td>-0.0007*</td>
<td>-0.0004*</td>
<td>0.0054*</td>
<td>-0.0197*</td>
<td>-0.0264*</td>
<td>-0.024*</td>
</tr>
<tr>
<td></td>
<td>(-4.85)</td>
<td>(-4.85)</td>
<td>(12.43)</td>
<td>(4.38)</td>
<td>(6.41)</td>
<td>(6.41)</td>
<td>(6.41)</td>
<td>(6.41)</td>
</tr>
<tr>
<td>Fish and Meat</td>
<td>-0.0001</td>
<td>-0.0001*</td>
<td>-0.0002*</td>
<td>-0.0003*</td>
<td>0.0159*</td>
<td>-0.0972*</td>
<td>-0.0197*</td>
<td>0.0119*</td>
</tr>
<tr>
<td></td>
<td>(5.47)</td>
<td>(0.1)</td>
<td>(2.64)</td>
<td>(1.10)</td>
<td>(0.9)</td>
<td>(2.9)</td>
<td>(5.9)</td>
<td>(4.12)</td>
</tr>
<tr>
<td>Oil and Spices</td>
<td>-0.0001</td>
<td>0.0001*</td>
<td>-0.0007</td>
<td>0.00017</td>
<td>0.00017*</td>
<td>0.0001*</td>
<td>0.0218*</td>
<td>0.0011*</td>
</tr>
<tr>
<td></td>
<td>(-4.48)</td>
<td>(1.7)</td>
<td>(1.57)</td>
<td>(4.7)</td>
<td>(4.73)</td>
<td>(4.73)</td>
<td>(4.73)</td>
<td>(4.73)</td>
</tr>
<tr>
<td>Smoke price</td>
<td>-0.0128*</td>
<td>-0.0166*</td>
<td>-0.0149*</td>
<td>-0.00158*</td>
<td>-0.00158*</td>
<td>-0.0290*</td>
<td>0.0038*</td>
<td>-0.0062*</td>
</tr>
<tr>
<td>index</td>
<td>(-16.86)</td>
<td>(-24.13)</td>
<td>(-28.33)</td>
<td>(-3.24)</td>
<td>(-21.07)</td>
<td>(-21.07)</td>
<td>(28.45)</td>
<td>(-5.96)</td>
</tr>
</tbody>
</table>

\( R^2 = 0.44 \quad 0.36 \quad 0.15 \quad 0.36 \quad 0.18 \quad 0.21 \quad 0.03 \)

Note: Figure in parentheses indicate t-values.

HS = Highly significant at 1 per cent level
S = Significant at 5 per cent level
CS = Critically significant at 10 per cent level

Expenditure (Income) Elasticity

Household expenditure survey (HES) conducted by the Bureau of Statistics provided data on household income. Despite of it availability household consumption expenditure was selected for analysis as this data was considered more reliable than income data.

As for income elasticity, the model chosen for the study enabled us to identify the nature of the food items by tracing through the evolution of their elasticity values. A commodity can be identified as superior, inferior, necessity or luxury depending on the degree of fluctuation of demand with the change in income. Using this scheme, some idea can be generated about the status of the various food items of Bangladesh.

Since elasticities of demand are independent of the units in which demand is measured, elasticities are more meaningful measures of the responsiveness of demand to change in income or prices. For example, estimated at the mean level of potato expenditures for the entire sample, the income elasticities of demand for potato was 0.632, suggesting that a 10 per cent increase in household income would increase the demand for potato by 6.32 per cent. All estimates of income elasticity for different commodities were statistically significant.
On an average, almost all food items had a positive income elasticity of demand which implies that they were normal goods. However, only fish-meat was expenditure (income) elastic and hence could be considered as a luxury, while all other food items were income inelastic meaning that those were necessity. The value of the expenditure elasticity of leafy vegetables and brinjal was close to zero indicating these to be near inferior goods.

Expenditure elasticities obtained for different food item indicated that if the household income increased, demand for different food items also increased. Given that the supply of potato is fixed; the upward shift of demand curves will imply that the equilibrium market prices will increase. Since the own-price elasticity of potato are less than unity, it is anticipated that the increase in price due to the shift of demand curves for potato will result in a decrease in demand by less than the proportionate price.

Ahmed and Shams (1994, p.10) estimated expenditure elasticity for potato and rice at 1.15 and 0.68 respectively by applying AIDS model. Ali (2002, p.25) found expenditure elasticity for cereals and vegetables at 0.78 and 0.70 respectively. Chowdhury (1982, p.95) obtained expenditure elasticity for potato as 1.30. Talukder (1990b, p.50) found income elasticity of potato as 1.23 while Sabur's (1983, p.66-67) income elasticity of potato ranged from 0.24 for inverse function to 1.51 for semi log function. He mentioned that income elasticity of 0.89 obtained from logarithmic function was more consistent to the real world situation because potato was not considered as a luxury commodity in Bangladesh. The present study also found potato as a necessity commodity.

Price Elasticity

Estimation of price elasticities from a cross section data encounters a host of limitations. Cross section data are usually collected during brief periods, which do not allow for adequate price variation. Moreover, the observed price differences are often interpreted as the result of difference in tastes of different households. Thus it is argued that it is difficult to attribute the price effects of the estimates to actual price variations, either spatial or temporal, if any (Talukder, 1990a p.149). The data used in the present study are from the nationwide consumption survey covering the whole of Bangladesh. Thus it is likely to have reasonably captured spatial price variations. Moreover, the survey was designed to collect data from different geographical locations covering the entire 12 months period and some price variability arose from the time taken to conduct the survey.

Own Price Elasticity

Table 2 provides the estimated uncompensated and compensated own price elasticities, and income (expenditure) elasticities for different items. Own price elasticity of all of the food items were of appropriate sign. The estimates suggest that households were quite responsive to change in prices while adjusting their consumption of corresponding commodities. The compensated and uncompensated own price elasticities indicated that all food items were price inelastic.
The estimated own price elasticity indicated that if the potato price fell by 10 per cent then demand for potato would increase by 8.82 percent. Of this increase in demand, 8.60 per cent was purely due to price effect (i.e., the substitution effect) as the compensated elasticity suggested. The income effect due to decline in price accounted for the remaining 0.22 percent (i.e., 8.82 - 8.60) rise in potato demand due to the increase in real income, although the absolute amount of money income remains unchanged. The income effect was relatively small in potato demand because potato had a small share in household budget. If per capita income increased by 10 per cent accompanied by a 10 per cent fall in potato price, then demand for potato would increase by 15.14 per cent (i.e., 8.82 + 6.32). However, the increase in per capita income represents a shift in the potato demand curve that normally leads to an increase in potato price. The estimation of resulting equilibrium level of potato consumption will require the information on the supply elasticity of potato.

**Table 2. Own Price and Expenditure Elasticities of All Commodities**

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Own price elasticities</th>
<th>Expenditure elasticities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Uncompensated</td>
<td>Compensated</td>
</tr>
<tr>
<td>Potato</td>
<td>-0.88198&quot;**s&quot;</td>
<td>-0.85995</td>
</tr>
<tr>
<td>Brinjal</td>
<td>-0.83666 &quot;**s&quot;</td>
<td>-0.83324</td>
</tr>
<tr>
<td>Leafy vegetable</td>
<td>-0.86498 &quot;**s&quot;</td>
<td>-0.86223</td>
</tr>
<tr>
<td>Other vegetable</td>
<td>-0.87572 HS</td>
<td>-0.82520</td>
</tr>
<tr>
<td>Pulses</td>
<td>-0.88064 &quot;**s&quot;</td>
<td>-0.86227</td>
</tr>
<tr>
<td>Rice</td>
<td>-0.87154 &quot;**s&quot;</td>
<td>-0.37122</td>
</tr>
<tr>
<td>Fish and Meat</td>
<td>-0.99697 &quot;**s&quot;</td>
<td>-0.70686</td>
</tr>
<tr>
<td>Oil and spices</td>
<td>-0.83788 &quot;**s&quot;</td>
<td>-0.72440</td>
</tr>
</tbody>
</table>

Note: HS = Highly significant at 1 percent level

The estimates of uncompensated and compensated own price elasticities in Table 2 reveal that the income effect of change in prices was very little for different food items except rice. This is so because most food items have very small shares in household income, hence their price changes have only minimal effects on real income. In case of rice, income effect due to change in price is very high owing to its large share in the household expenditure.

Ahmed and Shams (1994, p.12) estimated uncompensated and compensated elasticities of potato as -1.27 and -1.26 respectively and found potato as a luxury commodity. Talukder (1990b, p.50) also found potato as a luxury commodity as the own price elasticity was -1.27. But in reality potato is not a luxury commodity in Bangladesh and its own price elasticity seems to be very high. Sabur (1982, pp.64-69) estimated price elasticity of potato -0.96 using time series data and -1.05 using pooling of the time series and cross-section data. Chowdhury (1982, pp. 98-99) estimated direct demand elasticity with respect to price as -0.52 for potato.
Cross-Price Elasticity

Table 3 and 4 provide respectively the entire uncompensated and compensated price elasticity matrices. The uncompensated cross-price elasticity provides the "gross" cross effects that include both the substitution effect and the income effect. The compensated cross-price elasticities represent the pure price effects (that is, only the substitution effect) or the net effects of price change on demand.

The results of the t-test suggested that 52 out of 64 (81 per cent) cross-price elasticities had statistically significant relationships. The estimates indicated that the change in potato price had statistically significant effect on rice as the cross price elasticity was 0.16, but rice price had very little or negligible effect (-0.001) on potato demand. The potato-to-rice cross price elasticity was positive because the price of potato and demand for rice moved in the same direction. The pure price effect of this fall in potato price resulted in a 4.9 percent decrease in rice demand. The increase in real income due to the fall in potato price (the income effect) induced the consumers to increase their rice demand by 0.33 per cent (i.e., 0.49 - 0.16). Thus the relationship between potato and rice are substitute. For brinjal, pulse, fish-meat and oil & spices cross price elasticities were also positive which means they are substitute for potato, although the cross price elasticity magnitudes were smaller.

Some cross-price elasticities changed the `+` or `-` signs between their uncompensated and compensated forms. For example, the total effect of a change in potato price on demand for vegetables suggested that potato and vegetables were "gross" complements (Table 3). However, the compensated cross-price elasticity was positive, indicating potato and vegetables were "net" substitutes (Table 4).

<table>
<thead>
<tr>
<th>Food item</th>
<th>Potato</th>
<th>Brinjal</th>
<th>Leafy vegetable</th>
<th>Other vegetable</th>
<th>Pulse</th>
<th>Rice</th>
<th>Fish and Meat</th>
<th>Oil and Spices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potato</td>
<td>-0.882</td>
<td>0.001</td>
<td>-0.009</td>
<td>-0.007</td>
<td>0.007</td>
<td>0.161</td>
<td>0.052</td>
<td>0.043</td>
</tr>
<tr>
<td>Brinjal</td>
<td>0.020</td>
<td>-0.836</td>
<td>0.013</td>
<td>0.034</td>
<td>0.014</td>
<td>0.297</td>
<td>0.161</td>
<td>0.112</td>
</tr>
<tr>
<td>Leafy vegetable</td>
<td>-0.001</td>
<td>0.010</td>
<td>-0.865</td>
<td>0.020</td>
<td>0.032</td>
<td>0.402</td>
<td>0.153</td>
<td>0.094</td>
</tr>
<tr>
<td>Other vegetable</td>
<td>-0.015</td>
<td>-0.002</td>
<td>-0.007</td>
<td>-0.876</td>
<td>-0.003</td>
<td>-0.070</td>
<td>0.009</td>
<td>-0.051</td>
</tr>
<tr>
<td>Pulse</td>
<td>0.011</td>
<td>0.001</td>
<td>0.009</td>
<td>0.019</td>
<td>4881</td>
<td>0.138</td>
<td>0.121</td>
<td>0.074</td>
</tr>
<tr>
<td>Rice</td>
<td>-0.001</td>
<td>-0.003</td>
<td>-0.001</td>
<td>-0.009</td>
<td>-0.007</td>
<td>-0.872</td>
<td>-0.029</td>
<td>-0.035</td>
</tr>
<tr>
<td>Fish and Meat</td>
<td>-0.020</td>
<td>-0.006</td>
<td>-0.010</td>
<td>-0.020</td>
<td>-0.013</td>
<td>-0.346</td>
<td>-0.997</td>
<td>-0.052</td>
</tr>
<tr>
<td>Oil and Spices</td>
<td>0.002</td>
<td>0.002</td>
<td>-0.000</td>
<td>0.014</td>
<td>0.007</td>
<td>-0.138</td>
<td>0.023</td>
<td>-0.838</td>
</tr>
</tbody>
</table>
Table 4. Compensated Own and Cross Price Elasticities of All Commodity Groups

<table>
<thead>
<tr>
<th>Food item</th>
<th>Potato</th>
<th>Brinjal</th>
<th>Leafy vegetable</th>
<th>Other vegetable</th>
<th>Pulse</th>
<th>Rice</th>
<th>Fish and Meat</th>
<th>Oil and Spices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potato</td>
<td>-0.860</td>
<td>0.010</td>
<td>0.002</td>
<td>0.027</td>
<td>0.036</td>
<td>0.493</td>
<td>0.177</td>
<td>0.120</td>
</tr>
<tr>
<td>Brinjal</td>
<td>0.026</td>
<td>-0.833</td>
<td>0.016</td>
<td>0.044</td>
<td>0.021</td>
<td>0.394</td>
<td>.</td>
<td>0.134</td>
</tr>
<tr>
<td>Leafy vegetable</td>
<td>0.005</td>
<td>0.012</td>
<td>-0.862</td>
<td>0.028</td>
<td>0.037</td>
<td>0.484</td>
<td>0.184</td>
<td>0.113</td>
</tr>
<tr>
<td>Other vegetable</td>
<td>0.018</td>
<td>0.011</td>
<td>0.009</td>
<td>-0.825</td>
<td>0.031</td>
<td>0.419</td>
<td>0.193</td>
<td>0.144</td>
</tr>
<tr>
<td>Pulse</td>
<td>0.029</td>
<td>0.008</td>
<td>0.018</td>
<td>0.047</td>
<td>-0.862</td>
<td>0.403</td>
<td>0.221</td>
<td>0.136</td>
</tr>
<tr>
<td>Rice</td>
<td>0.033</td>
<td>0.010</td>
<td>0.006</td>
<td>0.043</td>
<td>0.028</td>
<td>-0.371</td>
<td>0.160</td>
<td>0.081</td>
</tr>
<tr>
<td>Fish and Meat</td>
<td>0.031</td>
<td>0.013</td>
<td>0.016</td>
<td>0.053</td>
<td>0.041</td>
<td>0.424</td>
<td>-0.707</td>
<td>0.128</td>
</tr>
<tr>
<td>Oil and Spices</td>
<td>0.034</td>
<td>0.014</td>
<td>0.016</td>
<td>0.064</td>
<td>0.040</td>
<td>0.349</td>
<td>0.207</td>
<td>-0.724</td>
</tr>
</tbody>
</table>

The uncompensated cross price elasticities were more ambiguous. However, the strong expenditure effects clearly play a role. The compensated cross price elasticities are the most appropriate when one wants information about substitution possibilities.

IV. CONCLUSION

In the present study, fish-meat was found to be strongly expenditure elastic, while other food items were inelastic. Potato, which was the major concern of present study, emerged as a necessity commodity. Any increase in household's total expenditure (income) would be accompanied by an increase in expenditure on potato with less than proportionate increase in total expenditure. This would mean that increase in average total household expenditure (income) would lead to an increase in demand for potato by lower extent. The crop sector production policy should therefore be based on the demand-supply balance in the market.

The compensated and uncompensated own price elasticities indicated that all food items were price inelastic. As in the case of potato, the cross price effects had no clear direction and a relatively low degree of complementarity and substitutability existed with the other food commodities considered in the model. Policies can, therefore, be undertaken only on the basis of the market condition of the potato. Cross price elasticities of other food item also indicated that the substitution effects of price were not quite strong. Therefore, government price interventions may not lead to considerable price repercussions in the economy.

Per capita annual consumption of potato in Bangladesh is as low as 14.55 kg compared to 174 kg in Germany, 146 kg in Belgium and 132 kg in Denmark (Sangwan, 1991 pp. 4 and5). Adequate steps have to be taken to increase demand for potato in domestic and foreign market. Domestic demand can be increased by strengthening publicity through popular mass media like television, radio etc. Involvement of political leader, nutrition specialists and renowned artists/personnel will be helpful in this aspect. For foreign demand, cultivation of variety like 'granola' which is preferred in foreign market should be expanded.
REFERENCES


