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Demand Elasticities for Different Food Items in Bangladesh

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Abstract: To identify the magnitude of food demand which would be helpful for demand projection and to assist government planning authority and researcher present study was under taken. The study estimated demand elasticities for different food items in the context of Bangladesh by using Almost Ideal Demand System (AIDS) model with corrected Stone Price Index. The income elasticity of demand for cereal, pulse, edible oil, vegetable, fish, meat, fruit, milk and spices were 0.51, 0.72, 1.77, 0.50, 1.30, 2.46, 1.96, 1.86 and 1.60, respectively. The compensated and uncompensated own price elasticity indicated that all food items (except edible oil and spices) were price inelastic. The estimated uncompensated own-price elasticity of demand for cereal, pulse, edible oil, vegetable, fish, meat, fruit, milk and spices indicated that if the price fell by 10% then the demand for cereal, pulse, edible oil, vegetable, fish, meat, fruit, milk and spices would increase by 2.73, 7.25, 13.92, 3.14, 4.32, 6.70, 6.11, 3.45 and 14.47%, respectively. The estimates of cross price elasticity indicate that substitution effects of price change were not quite strong. Consequently government price interventions may not lead to considerable price repercussions in the economy. Simultaneously no systematic differences in the absolute magnitudes of the expenditure elasticity and own price elasticity were found. This implies that a combination of income and price policies may be more effective in influencing consumption pattern than those based solely on an individuality basis without taking into consideration the other factor.

Key words: Food demand, price elasticities, income elasticities

INTRODUCTION

One of the basic needs of mankind-food, plays a crucial role in an agro-based economy like Bangladesh since a major portion of the population's income is spent on such item. Therefore, the first and foremost responsibility of the Government of Bangladesh is to ensure uninterrupted supply of food at reasonable price, round the year, for meeting the demand of all. The country's food security depends on development of the agriculture sector which supplies 96% of our yearly requirement and as such its improvement would contribute towards the economic growth of the nation (Hossain, 2007).

In this context, agricultural development is very vital for ensuring food to the enormously large and expanding population base so that they can maintain a minimum living standard. The basic challenge of food security is to ensure availability, access and utilization of food for all people throughout the year (Hossain, 2007).

Food security is defined as access by all people at all times to enough food needed for an active and healthy life. Its essential elements are the availability of food and the ability to acquire it (Reutlinger, 1985). At the national angles food security means the availability in the country of sufficient stocks of food to meet domestic demand and at individual angles, it means that all members of the society have access to the food they need, either from their own production, from market and/or from the government's transfer mechanism (Hossain *et al*., 2005).

Among all the agricultural commodities, rice is at the forefront of food security, since it is the main staple food, occupies 71% of the gross cropped area and accounts for over 97% of total food grain production. In recent times emphasis has been provided on increasing production of other important food crops as well as fisheries and livestock not only to ensure intake of balanced diet but also to increase income of the rural poor for improvement of their livelihood (Rahman, 2007).

Domestic food production plays an important role to quest the food security for subsistence-oriented agrarian economy of Bangladesh. Major items in the food basket in Bangladesh are rice, wheat, pulses, potato, vegetables and fish. Currently substantial progress is attained in terms of ensuring availability of food, in the face of growing population in Bangladesh. At the end of the

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1990s, food grain production exceeded target requirements which is the first time in the history of Bangladesh. However, poor households do not have food security because they lack access to food, i.e., they lack sufficient food from own production, cash income and other resources to acquire enough food. Yet food security has not been achieved and whatever progress been made would be difficult to sustain in view of the growing pressure of population on extremely scarce natural resources. Increases in cereals production have not been accompanied by significant increases in availability of other foods. Nearly 40% of the population lives below the food consumption-based poverty line, lacking sufficient resources to afford diet of 2,122 kilocalories (kcal) per person per day, along with other basic necessities. Dietary imbalance reflects insufficient domestic production of non-cereal foods (pulses, oilseeds, fruits, meat, milk and eggs), low incomes, food preferences and lack of nutrition education (Hossain *et al*., 2005).

Rice occupies 71% of the gross cropped area and accounts for 94% of the food grain production. The green revolution in cereal production has not been an unmixed blessing. The rapid expansion of boro rice area reduced the area and production of pulses and oilseeds, which are important sources of protein and micronutrients for the poor. Production of fruits remained stagnant. Among other food crops, the growth was respectable only for potatoes and vegetables, because of higher productivity and profitability. In terms of nutrition, fish also occupies a significant position in the dietary habits of the people. The growth in fish production was sluggish in the 1970s. The growth picked up in the 1980s and was very rapid (7% per year) in the 1990s. The growth in the production of meat and milk has been unsatisfactory, while their demand has been growing fast. Imports have been growing very fast are oils, pulses, sugar, milk and fruits. The government has adopted a policy of promoting crop diversification to reduce the dependence on imports, but without much success (Hossain *et al*., 2005).

Food security is mainly rice based and food basket has not yet diversified towards high nutritive food in Bangladesh. Progress has remained slow towards achieving household nutritional food-security. Among food items, the inequalities is very low for cereals, but high for livestock, horticulture commodities and various types of fish species. The food poverty is high for pulses, horticulture and livestock commodities among both economically rich and poor households. Fish, livestock, horticulture and pulses sectors should be accorded high priority to diversify the dietary pattern towards high quality food and improve the nutritional food-security of households in Bangladesh (Bose and Dey, 2007).

Consumer demand for food is an important component of the structure within which the agricultural sector must operate. Since, the demand for food is in general inelastic and production or supply somewhat variable, accurate estimates of demand parameters are important as inputs for the development of national price, stabilization, trade, storage, production and other policies (Hassan and Johnson, 1976).

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 as supply do not co-relate with actual demand. This situation has led to serious bottlenecks in the process of marketing (Huq *et al*., 2004).

Ensuring a balance between the demand and supply of food is one of the important tasks of the Government or the planning authority in a developing economy. With a rise in income and/or population the demand for food is expected to increase in the coming years. Information on present and future food demand pattern and how they are likely to change as prices and incomes change is required to assess the welfare and distribution impacts of technological change, infrastructure development and economic policies. To formulate suitable production and distribution policy, a thorough knowledge on demand of different food items is needed (Huq *et al*., 2004). For the projection of demand for different food items, estimation of price elasticities and income elasticities also needed (Salazar *et al*., 2005; Islam and Nabiul, 2003; Baffes and Gautam, 2001).

In recent years, Almost Ideal Demand System (AIDS) model is being widely used by different economists for demand estimation (Grant *et al*., 2009; Wadud, 2006; Karangiannis *et al*., 2000; Balcombe *et al*., 2003; Verbeke and Ward, 2005; Buse and Chan, 2000; Mazzocchi, 2003; Tiffin and Aguiar, 1995; Abdulai, 2002). Empirical study dealing with food demand in the context of Bangladesh is very few. Past studies (Alamgir and Berlage, 1973; Mahmud, 1979; Sabur, 1983; Chowdhury, 1982; Pitt, 1983; Talukder, 1990a; Ahmed and Shams, 1994; Islam, 2002; Huq *et al*., 2004) have provided information on price and expenditure (income) elasticity for food and non-food commodities. Some of them used single equation model 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 of 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 elasticity by using data collected from rural Bangladesh. Huq *et al*. (2004) also applied AIDS model by using household expenditure survey 1995-96 data. They used cross sectional data which do not allow for adequate temporal price variation.

In this present study an attempt has been made to estimate the demand elasticity of food items by drawing meaningful implication of price change, substitution relationship between different food items which is of utmost importance for the policy makers and the like.

MATERIALS AND METHODS

The study was conducted under the Post-Doctoral research work of Institute of Agricultural and Food Policy Studies, Universiti Putra Malaysia during the period 2nd October 2009 to 1st October.

Data sources: The demand analysis is based on secondary data extracted from the Household Expenditure Survey (HES) during the year 2005-06, 2000, 1995-96, 1991-92, 1988-89 and 1983-84. This Survey was undertaken by Bangladesh Bureau of Statistics (BBS) wherein the data are segregated according to different income or expenditure group.

In this study information on monthly household income group for rural and urban household for the above mentioned years constructs the data set. Price of different food items are divided by the respective year's Consumer Price Index (CPI) to convert them into real term. A total of 212 samples 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 from varying options when confronted with different price stratum and/or limited disposable income. The choice for commodity turns out to be an option between utility maximising or cost minimising. The optimal solutions to these are Marshallian and Hicksian demand function perspective. Marshallian uncompensated demand functions, defined on prices and outlay, are contrasted with Hicksian compensated demand functions, 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 (Deaton and Muellbauer, 1980):

$$x \geq \sum_{i=1}^{n} p_i q_i \quad (1)$$

The implications of a linear budget constraint: To understand consumer behaviour, we must recognise that the budget constraint is the obstacle 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:

$$x = \sum_{k} p_k q_k \quad (2)$$

where, total expenditure is x and prices are p_k. The use of the equality, as opposed to the inequality of Eq. 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 their wants within the budget and as such there will be always some commodities which are more desirable. The use of Eq. 2 rules out the nonlinearities, indivisibilities, uncertainties and interdependencies of Eq. 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:

$$\sum p_k h_k(u,p) = \sum p_k g_k(x,p) = x$$

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 ≠ j.

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

Since, $h_i(u, p)$ is$\partial c(u, p)/\partial p_i$, $\partial h_i/\partial p_j$ is $\partial^2 c/\partial p_j\partial p_i$. Similarly, $\partial h_j/\partial p_i$ is $\partial^2 c/\partial p_i\partial p_j$, 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 x n matrix formed by the elements $\partial h_i/\partial p_j$ is negative semi definite, that is, for any n vector ξ, the quadratic form is:

$$\sum_i\sum_j \xi_i\xi_j \partial h_i / \partial p_j \le 0$$

If ξ 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 $\sum_j p_j\ \partial h_i/\partial_j$ 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, 1980; Talukder, 1990a).

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:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \ln P_j + \beta_i \ln\left(\frac{X}{P}\right) + \mu_t \qquad (3)$$

where, W_i is share of the ith good (i.e., wi = P_iQ_i/X), P_j is price of the jth good, X is total expenditure on all goods in the system, P si a price index, μ_t is the residuals and assumed to have zero mean and constant variance, α_i, β_i and γ_{ij} are parameters.

The price index (P) is a translog index:

$$\ln P = \alpha_0 + \sum_j \alpha_j \ln P_j + \frac{1}{2}\sum_i\sum_j \gamma_{ij} \ln P_i \ln P_j \qquad (4)$$

The price index from Eq. 4 makes Eq. 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):

$$\ln p^* = \sum_j w_j \ln P_j$$

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).

The use of the Stone price index has been shown to be inappropriate as it makes the estimated parameters inconsistent (Pashardes, 1993; Buse, 1994; Moschini, 1995). Moschini attributes this problem to the fact that the Stone price index does not satisfy what Diewert (1987) calls the commensurability property and suggests that the problem may be solved by using a price index that satisfies this property. Moschini (1995) 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:

$$\ln P = \sum w_i \ln\left(\frac{P_i}{P_i^0}\right) \qquad (5)$$

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 Eq. 3 the adding-up condition implies:

$$\sum_i \alpha_i = 1, \sum_i \beta_i = 0, \sum_j \gamma_{ij} = 0 \qquad (6)$$

Homogeneity is satisfied if:

$$\sum_j \gamma_{ij} = 0 \quad (7)$$

while symmetry is satisfied provided.

$$\gamma_{ij} = \gamma_{ji} \quad (8)$$

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 Eq. 6. Equation 7 implies that the demands are homogenous of degree zero in prices and income and Eq. 8 shows the Slutsky Symmetry. The derivations of elasticity formulas for the AIDS model are found in Green and Alston (1990) and Buse (1994). The expenditure elasticity η_i and uncompensated (Marshallian) own and cross price elasticity ϵ_{ij} can take the following form:

$$\eta_i = 1 + \beta_i / w_i \quad (9)$$

$$\varepsilon_{ij} = -\delta_{ij} + (\gamma_{ij} - \beta_i w_j)/w_i \quad (10)$$

where, δ_{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:

$$\varepsilon_{ij} = \varepsilon_{ij}^H - w_j \eta_i \quad (11)$$

or

$$\varepsilon_{ij}^H = -\delta_{ij} + \left(\gamma_{ij} / w_i\right) + w_j$$

where, ε^H_{ij} is the compensated (Hicksian) price elasticity. (Deaton and Muellbauer, 1980; Baharumshah, 1993; Ahmed and Shams, 1994; Moschini, 1995; Asche *et al*., 1998).

RESULTS AND DISCUSSIONS

Estimation of price elasticity, cross price elasticities and income elasticity: The almost ideal demand system provided in Eq. 3 was estimated by eliminating 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 Likelihood ratio test where the estimated value of Chi-squared (44) was 1602.5, which is highly significant at 1% level. As such no evidence against the homogeneity and symmetry restrictions implied by consumer theory was found which implies that estimated results were consistent.

Estimated coefficients of LA/AIDS model are presented in Table 1 where 74 coefficients out of 99 were statistically significant.

Table 1: Estimated coefficients of AIDS model

	Food item								
Variables	Rice	Pulse	Edible oil	Vegetable	Fish	Meat	Fruit	Milk	Spices
Constant	1.0636^{HS}	0.06001^{HS}	-0.04537^{HS}	0.228714^{HS}	0.03117	-0.20936^{HS}	-0.03653^{S}	-0.05038^{HS}	-0.04186
	(16.63)	(5.36)	(-3.78)	(9.43)	(1.23)	(-6.22)	(-2.56)	(-2.50)	
Rice	0.23553^{HS}	0.00717	0.14890^{HS}	-0.20918^{HS}	-0.19095^{HS}	-0.01546	-0.06737^{HS}	-0.13735^{HS}	0.22870^{HS}
	(2.92)	(0.52)	(9.43)	(-6.97)	(-6.68)	(-0.44)	(-4.42)	(-7.31)	(6.52)
Pulse	0.00717	0.00934	-0.04226^{HS}	0.08638^{HS}	0.00110	-0.02059^{HS}	-0.00327	-0.01586^{HS}	-0.02201^{S}
	(0.52)	(1.05)	(-8.68)	(10.70)	(-0.15)	(-3.29)	(-0.87)	(-4.09)	(-2.47)
Edible oil	0.14890^{HS}	-0.04226^{HS}	-0.01683^{HS}	-0.00886	-0.02974^{HS}	-0.02797^{HS}	0.00778^{S}	0.02636^{HS}	-0.05738^{HS}
	(9.43)	(-8.68)	(-2.66)	(-1.09)	(-4.04)	(-4.06)	(1.99)	(6.61)	(-6.23)
Vegetable	-0.20918^{HS}	0.08638^{HS}	-0.00886	0.06344^{HS}	0.02553^{CS}	0.02032	-0.01176	0.03981^{HS}	-0.00567
	(-6.97)	(10.70)	(-1.09)	(2.94)	(1.83)	(1.38)	(-1.54)	(4.68)	(-0.33)
Fish	-0.19095^{HS}	0.00110	-0.02974^{HS}	0.02553^{CS}	0.07475^{HS}	0.04174^{HS}	0.03151^{HS}	0.03616^{HS}	0.00990
	(-6.68)	(-0.15)	(-4.04)	(1.83)	(4.16)	(3.13)	(4.22)	(4.41)	(0.63)
Meat	-0.01546	-0.02059^{HS}	-0.02797^{HS}	0.02032	0.04174^{HS}	0.03374	0.02906^{HS}	0.02984^{HS}	-0.09069^{HS}
	(-0.44)	(-3.29)	(-4.06)	(1.38)	(3.13)	(1.55)	(3.70)	(2.88)	(-5.48)
Fruit	-0.06737^{HS}	-0.00327	0.00778^{S}	-0.01176	0.03151^{HS}	0.02906^{HS}	0.01032^{S}	0.01776^{HS}	-0.01403
	(-4.42)	(-0.87)	(1.99)	(-1.54)	(4.22)	(3.70)	(1.97)	(3.85)	(-1.54)
Milk	-0.13735^{HS}	-0.01586^{HS}	0.02636^{HS}	0.03981^{HS}	0.03616^{HS}	0.02984^{HS}	0.01776^{HS}	0.02917^{HS}	-0.01846^{CS}
	(-7.31)	(-4.09)	(6.61)	(4.68)	(4.41)	(2.88)	(3.85)	(3.75)	(-1.69)
Spices	0.22870^{HS}	-0.02201^{S}	-0.05738^{HS}	-0.00567	0.00990	-0.09069^{HS}	-0.01403	-0.01846^{CS}	-0.03036
	(6.52)	(-2.47)	(-6.23)	(-0.33)	(0.63)	(-5.48)	(-1.54)	(-1.69)	
Stone price index	-0.23077^{HS}	-0.00982^{S}	0.03623^{HS}	-0.04980^{HS}	0.03646^{HS}	0.11167^{HS}	0.02421^{HS}	0.03665^{HS}	0.04516
	(-9.32)	(-2.25)	(7.75)	(-5.29)	(3.71)	(8.57)	(4.37)	(4.69)	
R^2	0.73	0.46	0.11	0.23	0.62	0.52	0.48	0.33	

Values in parenthesis indicate t-values. HS: Highly significant at 1% level. S: Significant at 5% level. CS: Critically significant at 10% level

Expenditure (income) elasticity: Household consumption expenditure was selected for analysis as this data was considered more reliable than income data.

In case of income elasticity, the model chosen for the study enabled us to identify the nature of the food items by tracking through its elasticity values. A commodity can be classified as superior, inferior, necessity or luxury depending on the degree of fluctuation of demand with a change in the income. Applying this scheme, some perception can be visualized on the status of various food items of Bangladesh.

Expenditure (income) elasticity measure the responsiveness of demand to a change in consumer income and is affected by the time period over which they are measured (the shorter the time period the lower the income elasticity of demand) and the degree of necessity of the good (the more necessary the good, the lower the income elasticity of demand) (Sloman and Norris, 2002). The expenditure (income) elasticity of demand may be interpreted as the percentages change in quality demanded when expenditure (income) changes (roughly) by 1% while other factors are constant. Since, elasticity of demand is independent of the units in which demand is measured, elasticity is more meaningful measures of the responsiveness of demand to change in income or prices. For example, estimated at the mean level of cereals expenditures for the entire sample, the income elasticity of demand for cereals was 0.514, suggesting that a 10% increase in household income would increase the demand for potato by 5.14%. All estimates of income elasticity for different food items 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, edible oil, fish, meat, fruit, milk and spices were expenditure (income) elastic and hence could be considered as a luxury, while cereals pulses and vegetables were income inelastic meaning that those were of necessity.

Expenditure (income) elasticity were 0.51, 0.72, 1.77, 0.50, 1.30, 2.46,1.96, 1.86 and 1.60 for cereal, pulse, edible oil, vegetable, fish, meat, fruit, milk and spices respectively (Table 2). Expenditure elasticity obtained for different food item indicated that if the household income increased, demand for different food items also increased. Given that the supply of food items are fixed, the upward shift of demand curves will imply that the equilibrium market prices will increase. Since the own-price elasticity of food items except oil and spices are less than unity, it is anticipated that the increase in price due to the shift of demand curves will result in a decrease in demand by less than the proportionate price. So, any policy for increasing the income of the people is likely to enhance the chances of having a high quality diet.

Table 2: Own price and expenditure elasticity of all commodities

	Own price elasticity		
Food items	Uncompensated	Compensated	Expenditure elasticity
Cereal	-0.27336^{HS}	-0.02915	0.51415^{HS}
Pulse	-0.72512	-0.69970	0.72137^{S}
Edible oil	-1.39223^{HS}	-1.30873	1.76643^{HS}
Vegetable	-0.31425^{HS}	-0.26430	0.50076^{HS}
Fish	-0.43154^{HS}	-0.27151	1.29507^{HS}
Meat	-0.67011	-0.48202	2.46136^{HS}
Fruit	-0.61115^{S}	-0.56195	1.96894^{HS}
Milk	-0.34485^{HS}	-0.26604	1.86919^{HS}
Spices	-1.44669	-1.32592	1.59728

HS: Highly significant at 1% level. S: Significant at 5% level

Ahmed and Shams (1994) estimated expenditure elasticity for vegetables and rice at 1.3 and 0.68, respectively by applying AIDS model. They found vegetable as luxury commodity, but it is not realistic. Ali (2002) determined that expenditure elasticity for cereals and vegetables were 0.78 and 0.70, respectively. Chowdhury (1982) calculated the expenditure elasticity for vegetables and rice at 0.40 and 0.81. Hyeon (1994) observed that the expenditure elasticity for canned vegetable, frozen vegetables and fresh vegetables were 1.14; 0.66 and 1.08, respectively based on the AIDS model. The present study also found cereal, pulse and vegetable as a necessity commodity and present findings is more realistic than previous studies.

Price elasticity: Price elasticity of demand measure the responsiveness of quantity demanded for with a change in price and are specific to the product, market conditions and time period over which the analysis is done (Petersen, 2005). Estimation of price elasticity 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). The data used in the present study are from the nationwide consumption survey covering the whole of Bangladesh for the year 2005-06, 2000, 1995-96, 1991-92, 1988-89 and 1983-84. Thus, it is likely to have reasonably captured temporal price variations.

Own price elasticity: The own price elasticity of a product is expected to have a negative sign, according to economic theory, indicating the negative slope of the demand curve. Uncompensated elasticity of demand refers to changes in the demand quantity of major household food items as a result of changes in prices in

the absence of any compensation in terms of either price change or income change. Or in other words, this represents the general prices elasticity of demand. On the other hand, compensated elasticity of demand for major household food items refers to that portion of total change in the quantity of household food items demanded which is compensated by price changes. Once the allowance for price compensated to total change in the quantity demanded (of the uncompensated elasticity) is made, the remaining is the income effect. That is, price effect plus income effects equals' total effect.

Table 2 shows the estimated uncompensated and compensated own price elasticity and income (expenditure) elasticity for different food 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 elasticity indicated that all food items (except edible oil and spices) were price inelastic.

The uncompensated own-price elasticity of edible oil and spices were -1.39 and -1.45, respectively indicating that edible oil and spices were sensitive to price. The compensated and uncompensated own price elasticity indicate that all food (except edible oil and spices) items are price inelastic.

The uncompensated own-price elasticity consist of two component effects, i.e., price or substitute effect and income effects. The estimated uncompensated own-price elasticity of demand for cereal, pulse, edible oil, vegetable, fish, meat, fruit, milk and spices indicates that if the price falls by 10% then the demand for cereal, pulse, edible oil, vegetable, fish, meat, fruit, milk and spices would increase by 2.73, 7.25, 13.92, 3.14, 4.32, 6.70, 6.11, 3.45 and 14.47%, respectively. Of this total increase in demand, 0.29, 7.00, 13.09, 2.64, 2.72, 4.82, 5.62, 2.66 and 13.26% were purely due to price effect (i.e., the substitute effect) as the compensated elasticity suggests. The income effect of the price falls accounts for the remaining 2.44 (i.e., 2.73-0.29% =2.44%), 0.25, 0.84, 0.50, 1.60, 1.88, 0.49, 0.79 and 1.29, respectively for cereal, pulse, edible oil, vegetables, fish, meat, fruit, milk and spices increase due to the increase in real income, although the absolute amount of money income remain static. If the per capita income also increased by 10% accompanied by a 10% fall in food items price, the demand for cereal, pulse, edible oil, vegetable, fish, meat, fruit, milk and spices would increase by 7.87 (5.14+2.73%=7.87%), 14.46, 31.59, 8.15, 17.27, 31.31, 25.80, 22.14 and 30.44%, respectively . However, the increase in per capita income represented a shift in the food items demand curve that normally leads to an increase in food items price which is not desirable in a country like Bangladesh where majority of the people belongs to the low-income group and are dependent on markets. The estimation of resulting equilibrium level of food items consumption will require the information on the supply elasticity of food items.

The estimates of uncompensated and compensated own price elasticity in Table 2 reveals that the income effect of change in prices is insignificant for different food items. This is primarily due to low share in household expenditure (income) for which 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. Compensated own price elasticity were in general lower than the uncompensated elasticity. This implies that the price responsiveness of the different food types was dependent on income, in that, when income is held constant (i.e., income is not a constant in the decision process), consumers tend to be less responsive to food prices.

Ahmed and Shams (1994) estimated uncompensated and compensated elasticity of potato as -1.27 and -1.26, respectively which implied that it was a luxury commodity, but it may not be realistic. They also estimated uncompensated and compensated elasticities of vegetables as -0.77 and -0.72, respectively. Talukder (1990b) also found potato as a luxury commodity since 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 (1983) 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) estimated direct demand elasticity with respect to price as -0.52 for potato.

In earlier studies, AIDS model was used with cross section data which cannot capture temporal variation. Some studies used single equation model which was inconsistent with demand theory. Present study used AIDS model with panel data and obtained result is more realistic than previous studies.

Cross-price elasticity: Cross price elasticity measures the responsiveness of the demand for one commodity to a change in price of another (Petersen, 2005). Cross price elasticity indicates the relationship between two products, i.e., whether the products are compliment or substitutes. A negative cross price elasticity indicates that the two products so considered are compliments and positive cross elasticity indicates that the two products are substitutes. Generally cross price elasticity of demand for major households' foods items refers to changes in quantity demanded of single food as results of changes in prices of other food.

Table 3: Uncompensated own and cross price elasticity of all commodity groups

Food item	Cereal	Pulse	Edible oil	Vegetable	Fish	Meat	Fruit	Milk	Spices
Cereal	-0.27336	0.03222	0.33646	-0.39193	-0.03066	0.02978	-0.01986	-0.04475	0.14536
Pulse	0.13260	-0.72512	0.01168	0.03084	0.03447	0.02057	0.00685	0.01119	0.02029
Edible oil	-0.35700	-0.02901	-1.39223	-0.07687	-0.09611	-0.05989	-0.01878	-0.03107	-0.06066
Vegetable	0.21626	0.02621	0.02272	-0.31425	0.06424	0.04018	0.01130	0.02502	0.03718
Fish	-0.16375	-0.01026	-0.01762	-0.02628	-0.43154	-0.01739	-0.00348	-0.00797	-0.02109
Meat	-0.69530	-0.05308	-0.07122	-0.14422	-0.17739	-0.67011	-0.03430	-0.05934	-0.11742
Fruit	-0.46191	-0.03423	-0.04561	-0.09695	-0.11894	-0.07332	-0.61115	-0.04041	-0.07361
Milk	-0.41864	-0.03130	-0.03998	-0.08502	-0.10588	-0.06516	-0.02097	-0.34485	-0.06650
Spices	-0.26640	-0.02271	-0.03258	-0.06001	-0.07306	-0.05250	-0.01599	-0.02658	-1.44669

Table 4: Compensated own and cross price elasticity of all commodity groups

Food item	Cereal	Pulse	Edible oil	Vegetable	Fish	Meat	Fruit	Milk	Spices
Cereal	-0.02915	0.05034	0.36076	-0.34065	0.03287	0.06907	-0.00701	-0.02307	0.18424
Pulse	0.47523	-0.69970	0.04579	0.10279	0.12361	0.07569	0.02487	0.04161	0.07484
Edible oil	0.48202	0.03325	-1.30873	0.09933	0.12216	0.07509	0.02536	0.04341	0.07290
Vegetable	0.45411	0.04386	0.04639	-0.26430	0.12612	0.07844	0.02382	0.04614	0.07505
Fish	0.45138	0.03538	0.04360	0.10290	-0.27151	0.08157	0.02888	0.04664	0.07683
Meat	0.47380	0.03367	0.04514	0.10130	0.12676	-0.48202	0.02721	0.04445	0.06868
Fruit	0.47330	0.03516	0.04747	0.09946	0.12436	0.07714	-0.56195	0.04261	0.07526
Milk	0.46919	0.03457	0.04839	0.10143	0.12509	0.07767	0.02574	-0.26604	0.07483
Spices	0.49227	0.03358	0.04294	0.09932	0.12432	0.06956	0.02393	0.04077	-1.32592

Table 3 provide the entire uncompensated price elasticity matrix. The uncompensated cross-price elasticity provides the gross cross effects that include both the substitution effect and the income effect. Table 4 provide compensated price elasticity matrix. The compensated cross-price elasticity 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 58 out of 81 (72%) cross-price elasticity had statistically significant relationships.

Some cross-price elasticity changed the + or - signs between their uncompensated and compensated forms. The negative uncompensated cross-price elasticity indicating the products were gross complements (Table 3). However, the positive compensated cross-price elasticity indicating the products were net substitutes (Table 4). The cross price effects had no clear direction and a relatively low degree of complementarities and substitutability existed among the food items considered in the model.

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

CONCLUSIONS

In the present study, almost all food items had a positive income elasticity of demand signifying that are normal goods. On the contrary edible oil, fish, meat, fruit, milk and spices were expenditure (income) elastic for which these could be considered as a luxury while cereal, pulse and vegetable were income inelastic indicating that those were necessity. Any increase in household's total expenditure (income) would be accompanied by an increase in expenditure on cereal, pulse and vegetable 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 cereal, pulse and vegetables by lower extent. On the other hand, any increase in household's total expenditure (income) would be accompanied by an increase in expenditure on edible oil, fish, meat, fruit, milk and spices with higher than proportionate increase in total expenditure. This implies that increase in average total household expenditure (income) would lead to an increase in demand for edible oil, fish, meat, fruit, milk and spices by higher extent. The food sector production policy should therefore be based on the demand-supply balance in the market.

The compensated and uncompensated own price elasticity indicated that all food items except edible oils and spices were price inelastic. The cross price effects had no clear direction and a relatively low degree of complementarities and substitutability existed among the food items considered in the model. Policies can, therefore, be undertaken only on the basis of the market condition of the food items. Cross price elasticity 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. As well as, no systematic differences in the absolute magnitudes of the expenditure elasticity and own price elasticity were found (for instance, it could not be said that households are more responsive to expenditure

changes than price changes) this means that a combination of income and price policies may be more effective in influencing consumption pattern than those based solely on one and not the other.

Effective analysis of agriculture and food policy requires a comprehensive view of the sector. The analysis must take into consideration the interrelationships within the agriculture sector and in particular on the consumption side of the markets. For Bangladesh, this aspect of policy analysis is relevant especially because of the importance of linkages among food consumption, agriculture and trade policy. The high sensitive nature of economy, especially in the transformation to a market system, requires careful and comprehensive approaches to policy. The agriculture and food sectors are important to food security and political stability and in themselves as major component of the economic system in Bangladesh.

Modern consumer theory is valuable in indicating plausible assumption for making estimating of demand parameters in a statistically tractable framework. In particular, the theory offers conditions under which own-and cross-price and income elasticity of demand can be estimated with an economy of parameter and with systematic behavioural interrelations. Although, data base required for estimating the demand system are not often complete in Bangladesh and other nations, the estimates can be made and provide useful policy information.

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