Pakistan Journal of Life and Social Sciences
www.pjlss.edu.pk

Estimating Consumer Demand of Major Food Items in Pakistan: A Micro Data Analysis

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ARTICLE INFO
Received: April 29, 2012
Accepted: June 06, 2012
Online: June 09, 2012

Keywords
Almost ideal demand system
Food items
LAAIDS
Price elasticity

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ABSTRACT
Consumer demand for food items in Pakistan and its dynamic pattern has attracted the attention of various researchers. All of them had employed various functional forms for estimating consumer demand preferences and trends. This study focused on descriptive and econometric analysis of Household Integrated Expenditure Survey (2007-2008). Food consumption and expenditure patterns for seven food items (i.e. Rice, Wheat, Chicken, Milk, Mutton, Fish and Oil) for rural and urban areas of Pakistan were analyzed. The Linear Approximated version of Almost Ideal Demand System (LAAIDS) was used in parametric framework. The model was used to estimate the parameters of food demand equations as well. The uncompensated own-price elasticities were negative for all included food stuffs and their absolute values were lower than unity except for Mutton (1.108) and Fish (1.775) in rural areas. The values of the cross-price elasticities revealed both the substitution and complementary relationships. The estimates of price and income elasticities were also consistent with economic theory. The expenditure elasticities were indicating that Fish (1.20) was luxury good for rural areas and mutton both for urban and rural regions with income elasticities 1.11 and 1.23, respectively.

INTRODUCTION

Consumer demand analysis has attracted the attention in the last few decades in Pakistan as well as at international level. The recent unprecedented rise in food prices in Pakistan renewed interest in the empirical analysis of consumer demand. It is timely effort for undertaking research on current specific demand elasticities estimates. Indeed, price and income elasticities of demand not only grow our understanding of economic behavior in the country, but can also enhance our vision for policy analysis.

At present, demand functions estimation which is especially consistent with the economic theory is an attractive field of research. This advancement offers unique opportunities to the researchers in analyzing food demand and related policy issues. How households adjust their consumption in response to changes in income and price is crucial determinant of the effects of various shocks to market prices and commodity supplies. These adjustments in demand are particularly significant in Pakistan where many households consume inadequate quantities of calories, protein and other nutrients. Household consumption behavior in the country is also complex. Regional consumption patterns differ considerably with no single staple dominating.

Quantifying household responses to price and income changes requires a careful econometric analysis of household consumption patterns. This study utilizes household integrated expenditure survey data of 2007-08 for the sake of estimation of demand system (LAAIDS) for major food items in Pakistan.

The analysis of consumer demand is one of the oldest topics in applied economics (Theil, 1965). Earlier studies used single equation techniques to estimate commodity demand by consumers. Single equation specifications are primarily concerned with estimating elasticities and paid little attention to consumer theory. But in the last several years, demand analysis has switched from single equation estimation toward most sophisticated approaches (Lee et al., 1994).

System-wide approaches ensure the consistency of the demand systems with consumer theory. Generalized

Leontief, the Translog, the Rotterdam the Quadratic Expenditure system, the linear approximate version of AIDS are some examples of popular demand models. Their functional form is locally flexible which do not impose prior restrictions. A number of alternative flexible functional forms with larger regular regions have been developed. Example include the Quadratic AIDS model (QUAIDS) (Bank et al., 1997) the Laurent model (Barnett, 1983, 1985), Generalized Almost Ideal Demand System (GAIDS) proposed by Bollino (1987) and many others including Generalized Exponential Form (GEF) (Cooper and Mclaren, 1996).

At present various functional forms are available for consumer demand analysis but theory fails to answer the question that which is the most suitable for demand analysis and why. Thus, to eradicate this unavoidable ambiguity, an important issue in empirical analysis is choosing the appropriate functional form which would provide the most meaningful and statistically adequate estimates which showed the consistency with economic theory.

MATERIALS AND METHODS

One of the most commonly used specifications in applied demand analysis is the Almost Ideal Demand System/Model (AIDS) proposed by Deaton and Muellbauer (1980b). Its popularity is in part due to the fact that it satisfies a number of desirable properties and allows linear approximation at the estimation stage. The model has budget shares as dependent variables and logarithm of prices and real expenditure/income as repressors. The original AIDS was subsequently extended to permit non-linear Engel curves. The resulting model, proposed by Banks et al. (1997) is the Quadratic Almost Ideal Demand Model (QUAIDS).

Deaton and Muellbauer (1980a; 1980b) developed a flexible demand system called (linear approximate version of the Almost Ideal Demand System) LAAIDS. The LAAIDS has considerable advantages over other functional models. This flexible demand system is extremely useful for estimating a demand with many desirable properties. As Moschini (1998) pointed out, the AIDS model automatically satisfies the aggregation restriction, and with simple parametric restrictions, homogeneity and symmetry can be imposed. In addition, the non-linear Engel curves of the AIDS model imply that any rise in income will lead to a decrease in the share of income allocated to a particular commodity, as well as a decrease in the income elasticity of that good when it is less than one. LAAIDS model has well-structured analytical framework with an easy mode of estimation. It satisfies the axiom of choice exactly, accommodates certain types of aggregation and permits testing of regularity conditions of the classical demand theory. Owing to its simplicity, LAAIDS is popular for empirical studies.

If data passes the tests of consistency with utility maximization then to estimate the demand parameters, we used the linear approximate version of the AIDS (LAAIDS) model developed by Deaton and Muellbauer (1980a). Symbolically, the Stone Index LAAIDS model is defined as:

$$w_i = \alpha_i + \sum_j^n \gamma_{ij} \ln p_{jt} + \beta_i \ln\left(\frac{x_t}{p_t}\right) + \mu_t \qquad i = 1,\ldots,n \quad (1.1)$$

Where p is the price index defined as:

$$\ln p_t = \alpha_0 + \sum_j^n \alpha_j \ln p_{jt} + \left(\frac{1}{2}\right)\sum_i^n \sum_j^n \gamma_{ij} \ln p_{it} \ln p_{jt} \qquad t = 1,\ldots,T \quad (1.2)$$

And the parameters $\gamma's$ are defined as:

$$\gamma_{ij} = \left(\frac{1}{2}\right)\left(\overset{*}{\gamma}_{ij} + \overset{*}{\gamma}_{ji}\right) = \gamma_{ji} \quad (1.3)$$

Where W_{it} represents the expenditure share of the i^{th} good, p_{it} is the price and x_t is total expenditure. Since prices will never be perfectly collinear, it is widely cited that applying the Stone index will introduce the units of measurement error and does not satisfy the fundamental property of index numbers because it is variant to changes in the units of measurement for prices (Alston and Foster and Green, 1994; Moschini, 1995; Asche and Wessells, 1997).

Laspeyres price index Moschini's suggestion (1995) can be used to overcome the measurement error. The Laspeyres price index becomes a geometrically weighted average of prices:

$$\ln(P^L) = \sum_i \bar{w}_i \ln(P_i) \quad (1.4)$$

LAAIDS model with the Laspeyres price index is written as follows:

$$w_i = \alpha_i^{**} + \sum_j \gamma_{ij} \ln(p_j) + \beta_i \ln(x) - \sum_j \bar{w}_j \ln(p_j) + \mu_i^{**} \quad (1.5)$$

$$\alpha_i^{**} = \alpha_i - \beta_i(\alpha_o - \sum_j \bar{w}_j \ln(p_j) \quad (1.6)$$

The most interesting feature of the LAAIDS model is that it is close to being linear; it can be estimated by equation using the OLS. The regularity conditions (i.e. adding up, homogeneity, and symmetry) on equation (1.1) apply directly to the parameters. The adding up condition is given by:

$$\sum_i^n \alpha_i = 1 \qquad \sum_i^n \gamma_{ij} = 0 \qquad \sum_i^n \beta_i = 0 \quad (1.7)$$

Homogeneity and the symmetry are defined in equations (1.8) and (1.9):

$$\sum_{j}^{n} \gamma_{ij} = 0 \quad (1.8)$$

$$\gamma_{ij} = \gamma_{ji} \quad (1.9)$$

Provided that restrictions in (1.7), (1.8), and (1.9) hold, equation (1.1) represents a system of demand functions which add up to total expenditure $\left(\sum w_{it} = 1\right)$, are homogeneous of degree zero in prices and total expenditure taken together $\sum_{j}^{n} \gamma_{ij} = 0$ and which satisfy Slutsky symmetry conditions $\gamma_{ij} = \gamma_{ji}$. However, unrestricted estimation of the AIDS will only automatically satisfy the adding-up restrictions so that the AIDS once more offers the opportunity of testing homogeneity and symmetry.

The paper primarily incorporated the micro data from the HIES survey. Integrated Household Survey (PIHS) for the year 2007-08 was used for analysis. In this survey, the total 15512 households were taken which include 6255 from urban and 9257 from rural areas. The parameters of LAAIDS are estimated for specified seven major food items (Rice, Wheat, Chicken, Mutton, Fish, Milk and Oil). The elasticities were calculated for rural and urban areas separately to witness the difference of consumption pattern of both the categories.

RESULTS AND DISCUSSION

A system of share equations (subject to the restrictions) was estimated using Iterative Seemingly Unrelated Regression (ISUR) method of Zellner (1962). To avoid singularity problems, one of the expenditure share equations was dropped from the system. Now, we presented the results of our estimation.

The estimation was carried out for urban and rural regions separately and the same was further decomposed into uncompensated (table 2 and 4) and compensated (table 3 and 5) elasticities along with expenditure elasticities (table 2 and 4) for the specified regions and for the prescribed consumable items. The rural-urban consumption analysis was carried out in order to capture the effect of change in price and income over the consumption behavior of the natives.

Overall it was observed that the results are prior to theoretical expectations. The complementary and substitution relations in case of cross price elasticities were significant and as per our prior expectations. As far as the income elasticities were concerned, it was observed that all the included goods were falling in the range of necessitates except Mutton in case of urban analysis. While in rural regions Mutton and Fish were supposed to be luxuries for the inhabitants and it could be justified that due to low purchasing power (poverty) in those regions the people were responding more towards the consumption of these items as their income changes. Overall magnitude of income elasticities for rural regions was higher as compared to urban regions. It meant for rural inhabitants the same commodity was more income responsive and price responsive as compared to their urban counterparts.

Econometric estimates and associated t-values of the parameters in the LAAIDS model with homogeneity and symmetry restriction imposed are shown in Table 1. This table showed that the intercept terms for Rice, Wheat, chicken, Milk and Oil are positive and statistically significant except for Mutton and Fish. This indicates an exogenous growth in the demand for these commodities, independently from the movement in prices and income. The trend growth for Mutton and Fish had a negative sign. The negative and significant dummy for Milk suggested that the exogenous growth in the share of Mutton and Fish demand has declined. The observed decrease in the demand of Mutton and Fish may be explained by changes in tastes.

The estimated expenditure elasticities and uncompensated price elasticities are exhibited in Table 2. For urban regions the expenditure elasticities for all commodities are positive ranging from a minimum of 0.65 (for Wheat) to 1.11 (for Mutton). The expenditure elasticity for Mutton was comparatively higher as compared to other included items followed by Fish (0.88) and Milk (0.83). The coefficient of expenditure elasticities for Wheat and Rice were 0.65 and 0.70 respectively. These results implied that the component of selected group in urban regions of Pakistan have the status of necessities except Mutton. This was expected due to the smaller proportion of expenditures served in such consumables.

All the uncompensated own price elasticities were negative and were reasonable in magnitudes. The own price elasticities vary from -0.032 (for Milk) to -1.225 (for Fish). While for Wheat it is -0.115. The cross price substitution effects between Rice and Wheat, Rice and Fish, Rice and Milk and Rice and Oil showed that these were substitutes in nature. While on the other hand the cross price effects between Rice and Chicken and Rice and Mutton showed their complementary relationship. In other words, we found that Rice and Wheat were substitutes in nature and this observation was based on eating habits. Wheat is substitute with Rice, Chicken, Milk, Mutton and Fish. Chicken is substitute with Wheat, Mutton and Fish. Milk is substitute with all the included items. Mutton has complementary relation with Oil only and could be substituted with all Meats and Cereals included in the study. Same is true for Fish with the only exception that relationship of Fish and Rice is complementary in nature. The estimates of compensated elasticities are

Table 1: Parameter Estimates of the LAAIDS Model

Equation	Rice	Wheat	Chicken	Milk	Mutton	Fish	Oil
Constant	0.06	0.12	0.03	0.07	-0.29	-0.43	0.31
	2.12**	1.97**	-1.53*	1.60*	-2.19**	-2.34**	-1.36
Expenditure	-0.04	-0.71	-0.10	-0.21	0.14	-0.01	0.03
	-1.23	-1.22	-0.52	-0.56	-1.14	-1.29	-0.32
Rice	0.52	-0.02	0.04	0.03	-0.06	-0.20	0.27
	3.12***	-0.07	-0.42	-0.20	-1.47*	-1.61	0.04
Wheat	-0.02	0.19	0.18	-0.23	-0.19	-0.33	0.01
	-0.07	3.85***	-1.00	-0.86	-2.32	-2.47**	-0.62
Chicken	0.04	0.18	0.19	-0.10	-0.03	-0.18	0.14
	-0.42	-1.00	-1.28	-0.86	-1.11	-1.25	-0.62
Milk	0.03	-0.23	-0.10	0.08	-0.05	-0.20	0.32
	-0.20	-0.86	-0.86	3.50***	-1.07	-1.21	3.74***
Mutton	-0.06	-1.88	-0.32	-0.05	0.33	0.18	0.19
	-1.47*	-2.32**	-1.11	-1.07	2.00**	1.86	-0.83
Fish	0.15	-1.67	-0.11	0.16	0.54	0.39	0.40
	-1.26	-2.11**	-0.90	-0.86	2.21**	2.07**	-0.62
Oil	0.36	-1.46	0.10	0.37	0.75	0.60	0.61
	-1.05	-1.90*	-0.69	-0.65	2.42**	2.28**	-0.41

Note: Figures in 2nd row are asymptotic t-values; *** Significant at 1%, ** significant at 5% and * significant at 10%.

Table 2: Expenditure and Uncompensated Price Elasticities for Urban Areas

Equation	Rice	Wheat	Chicken	Milk	Mutton	Fish	Oil
Expenditure	0.70	0.65	0.68	0.83	1.11	0.88	0.78
Uncompensated Own-Price and Cross-price Elasticities							
Rice	-0.263	0.217	-0.261	0.256	0.044	-0.274	0.361
Wheat	0.218	-0.115	0.319	0.103	0.477	0.707	0.419
Chicken	-0.379	0.859	-0.136	0.123	0.537	0.767	-0.036
Milk	0.249	0.003	-0.115	-0.032	0.204	0.026	0.215
Mutton	-0.189	0.137	0.084	0.191	-0.765	0.995	-0.184
Fish	0.041	0.094	0.146	0.039	0.995	-1.225	-0.046
Oil	0.271	-0.324	-0.376	0.269	-1.225	-1.455	-0.276

Table 3: Compensated Own-Price and Cross Price Elasticities for Urban Areas

Equation	Rice	Wheat	Chicken	Milk	Mutton	Fish	Oil
Rice	-0.219	0.181	-0.218	0.213	0.036	-0.228	0.301
Wheat	0.182	-0.096	0.266	0.086	0.397	0.589	0.350
Chicken	-0.316	0.716	-0.113	0.103	0.447	0.639	-0.030
Milk	0.208	0.003	-0.096	-0.027	0.170	0.022	0.179
Mutton	-0.158	0.114	0.070	0.159	-0.637	0.829	-0.154
Fish	0.034	0.078	0.122	0.032	0.829	-1.021	-0.038
Oil	0.226	-0.270	-0.313	0.224	-1.021	-1.212	-0.230

Table 4: Expenditure and Uncompensated Price Elasticities for Rural Areas

Equation	Rice	Wheat	Chicken	Milk	Mutton	Fish	Oil
Expenditure	0.75	0.57	0.89	0.70	1.23	1.20	0.87
Uncompensated Own-Price and Cross Price Elasticities							
Rice	-0.381	0.315	-0.379	0.370	0.063	-0.397	0.523
Wheat	0.316	-0.167	0.463	0.149	0.691	1.024	0.608
Chicken	-0.550	1.245	-0.196	0.178	0.778	1.111	-0.051
Milk	0.361	0.004	-0.166	-0.047	0.295	0.038	0.311
Mutton	-0.274	0.198	0.122	0.277	-1.108	1.441	-0.267
Fish	0.059	0.136	0.211	0.056	1.441	-1.775	-0.066
Oil	0.392	-0.469	-0.545	0.390	-1.775	-2.108	-0.400

Table 5: Compensated Own-Price and Cross-Price Elasticities for Rural Areas

Equation	Rice	Wheat	Chicken	Milk	Mutton	Fish	Oil
Rice	-0.318	0.262	-0.315	0.309	0.053	-0.330	0.436
Wheat	0.264	-0.139	0.386	0.125	0.576	0.854	0.507
Chicken	-0.458	1.037	-0.164	0.149	0.648	0.926	-0.043
Milk	0.301	0.004	-0.139	-0.039	0.246	0.032	0.259
Mutton	-0.229	0.165	0.102	0.231	-0.923	1.201	-0.222
Fish	0.049	0.113	0.176	0.047	1.201	-1.479	-0.055
Oil	0.327	-0.391	-0.454	0.325	-1.479	-1.757	-0.333

reported in Table 3, which are broadly consistent with the uncompensated elasticities. For all commodities, the compensated own-price elasticities were lower - in absolute terms than the uncompensated ones, thereby suggesting that a rise or fall in the price of the respective commodities would have considerable real expenditure effects. The results showed similarities with the study of Aziz (2009) where expenditure elasticities for Meat products and oil were 1.22 and 0.821 respectively but the results are different in case of milk and milk products. Considering the own-price elasticities, the results were same as the results of Aziz (2004). Anwar (2011) also employed the LAAIDS for major food items in Pakistan, in comparison to this study, the elasticities of our study were smaller in magnitude particularly in case of Mutton the own price elasticity in less than unity.

The estimated expenditure elasticities and uncompensated price elasticities for rural region are exhibited in Table 4. For rural regions the expenditure elasticities for all commodities were positive ranging from a minimum of 0.57 (for Wheat) to 1.23 (for Mutton). The expenditure elasticity for Mutton and Fish was comparatively higher as compared to other included items followed by chicken (0.89) and Oil (0.87). The coefficient of expenditure elasticities for Wheat and Rice were 0.57 and 0.75 respectively. The elasticity of Wheat as compared to urban regions was lower. It could be justified that as the inhabitants of rural regions were self grower of Wheat so they were less income responsive towards its consumption as compared to their counterparts belonging to urban regions. The same was the case of Milk as the income elasticity of milk for rural region (0.70) which was low as compared to the same for urban regions (0.83). These results implied that the component of selected group in rural regions of Pakistan have the status of necessities except Mutton and Fish. This was expected due to the smaller proportion of expenditures for these consumables.

All the uncompensated own price elasticities were negative and reasonable in magnitudes. The own price elasticities varied from -0.047 (for Milk) to -1.775 (for Fish). While for Wheat it was -0.167. The cross price substitution effects between Rice and Wheat, Rice and Fish, Rice and Milk and Rice and Oil show that these are substitutes in nature. On the other hand, the cross price effects between Rice and Chicken and Rice and Mutton show their complementary relationship. In other words, we found that Rice and Wheat were substitutes in nature and this observation was in accordance to our eating habits. Wheat was substitute with Rice, Chicken, Milk, Mutton and Fish. Chicken was substitute with Wheat, Mutton and Fish. Milk was substitute with all the included items. Mutton has complementary relation with Oil only and could be substituted with all Meats and Cereals included in the study and same is true for Fish with the only exception that relationship of Fish and Rice was complementary in nature. The estimates of compensated elasticities for rural areas are reported in Table 5, which are broadly consistent with the uncompensated elasticities. Overall it was observed that people of rural regions were more price and income responsive as compared to their urban counterparts.

Comparison of our result with other studies was not easy to make due to different data sets and estimation techniques used by earlier studies. Most of the studies used double log forms, linear expenditure system or its extension. Only studies by Alderman (1988); Burki (1997); Aziz (2004) and Shahnawaz and Babar (2005) offer results that can be compared with our results, since they employed LAAIDS model. The magnitudes of our elasticities were smaller than Aldermans, which was as expected.

However, we can make a comparison with Malik and Aziz (2005), Aziz (2004), Burki (1997) and Alderman (1988), because all have employed LAAIDS model for their analysis. Malik and Aziz (2005) and Burki (1997) have made use of time series data set. Our results are in accordance with these two studies and consistent as well. Alderman (1988) has estimated price elasticities by introducing price variations using for quarterly prices for which four rounds of survey was completed. However, the problem with Alderman's estimation was that it used incorrect elasticity formulas for the AIDS model.

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