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Empirical analysis of Demand for Main Animal Products in Pakistan

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ABSTRACT

Animal products are major sources of calories and proteins so we calculated expenditure elasticities, the own and cross compensated and non-compensated price elasticities of main animal products of Pakistan by using the LA-AIDS model. The estimated expenditure elasticities for all meat products (beef, mutton and chicken), eggs and buffalo milk are generally positive (normal goods) except cow milk. The estimated compensated and uncompensated own price elasticities are negative *as priori*. Compensated and uncompensated own price elasticities are greater than unity for poultry meat, eggs and cow milk. The cross price compensated short and long run elasticities are having positive sign as expected for substitute products except f`-or mutton, eggs and cow milk. The demand for beef and buffalo milk found less elastic to price change. Beef is the substitute for mutton and chicken. Eggs have complementary relationship with mutton whereas have substitution impact for all other mentioned animal origin commodities. Cow milk is substitute for buffalo milk. However it can be concluded that demand of animal origin products is elastic both in term of price and income effect.A combination of income and price policies may be more effective in influencing consumption pattern of animal products for improving protein and calories intake. Government should target to improve income level of most vulnerable consumers (low income group) in these countries.

KEYWORDS: Amelioration, LA/AIDS, expenditure elasticities, price elasticities, protein and calorie intake, animalfood consumption

INTRODUCTION

Demand for animal products is increasing globally and the change in the composition of food consumed (increasing share of value added products and foods of animal origin) are caused by the rapidly increasing population, urbanization, changing lifestyles with income uplifts in developing economies (WHO, 2003; Gerosa and Skoet, 2012). Overtime changing composition of food intake in Pakistan shows a shrinking share of wheat in total calories available and a rising share of food from animals and other sources. However in Pakistan, dairy products and wheat together accounts for approximately 30 percent of the household budget and almost 16.47 percent of household expenditure went to dairy products (Friedmen *et al.* 2011).

The demand for animal based products is highly price and income elastic. Various studies has been conducted in the past to evaluate the expenditure, own price and cross price elasticities of meat and other animal origin products in order to analyze the actual situation of demand for these commodities in different countries and regions. According to Alboghdady and Alashry 2010 among meat products highest substitution effect was analyzed between beef and mutton and own price elasticities was calculated highest for fish followed by chicken, beef and duck. The study conducted by Taljaard *et al.* (2003), come up with the findings that compensated own price elasticities for all meat products are relatively inelastic and pork was identified as the strongest substitute for beef whereas all meat products are considered normal to luxury goods.

Demand for dairy products is also sensitive to the change in their respective retail prices. The study conducted by Davis *et al.* 2010, analysed the household dairy demand in United States and comes up with the findings that dairy products are sensitive to price changes and among fluid milk categories; whole milk, reduced fat milk and canned milk have strong substitution impact. Davis *et al.* 2009 also analyzed the demand pattern of fluid milk considering seven categories of fluid milk and concluded that price and income are main determinants of fluid milk demand. Almost all of the estimated own price elasticities of fluid milk categories (compensated and

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uncompensated) are greater than unity, demand of fluid milk were found inelastic except for reduced fat milk and also close substitutes for each other.

According to Tiffin *et al.* 2011, demand for eggs and dairy products happen to be in elastic in short run whereas almost unit elastic in long run which indicate that consumer responsiveness to price change of eggs and dairy products is stronger in long run however short and long run elasticities of meat are almost same.Another study conducted by Wohlgenant (1985), concluded that beef demand shifted towards poultry meat due to changes in the relative prices of poultry meat and poultry meat emerge as the strongest substitute for beef after 1970's. Febrianto *et al.* 2013 analyzed that egg demand is partially affected by prices, family income, family size and education, the own price elasticity of demand for eggs were elastic whereas expenditure elasticity was less than unity which stated eggs as normal good.

Haq *et al.* 2009, evaluate the compensated and uncompensated own and cross price elasticities for eight commodities by using LA-AIDS model for NWFP Pakistan and found that demand for milk was inelastic whereas elastic for meat. The expenditure elasticities stated milk as normal whereas meat as luxury product. Another study of Haq *et al.*2011, practiced the same exercise to check the demand for eight selected commodities for urban and rural Punjab, Pakistan and found that demand for all commodities including meat and milk are price inelastic and expenditure elasticities were greater than one for meat and milk. According to Farooq *et al.* 1999, meat and dairy products expenditure elasticities were greater than unity implying these products as luxury. They further concluded that demand for meat and dairy products increase with the increase in income whereas reduce it family size increases remaining other things constant. Ghafoor *et al.* 2012, exhibits positive relation of income with demand of animal origin products (milk, meat and eggs) in comparison of vegetal products.

Keeping in view the importance of demand analysis for the projection of future consumption patterns this paper has been organized to check the existing demand pattern of most commonly used animal origin products (beef, mutton, chicken meat, eggs , buffalo milk and cow milk) in Pakistan and to estimate their relative share, expenditure, own and cross price elasticities and substitution impact. Various previous study have investigated demand pattern in Pakistan by taking food commodity groups like cereals, pulses, fruits, meat and dairy products but the specific study for the demand pattern of animal products were missing which can provide the own and cross price elasticityfor most commonly used animal products. So this paper will be the good edition in the literature of food demand in Pakistan, specifically for animal products.

MATERIAL AND METHODS

This paper however incorporated time series data to calculate elasticities and their decomposition into price effect as well as income effect. The data (consumption and price) used in LA/AIDS model for Pakistan taken from Economic Survey of Pakistan of consecutive years since 1981-2010. Among the various animal products, this paper focused six most commonly used products such as beef, mutton, poultry meat, eggs, buffalo milk and cow milk. For the purpose of analysis expenditure and prices elasticities matrices for animal products has been calculated to estimate animal products demands with a two stage budgeting method.

The estimations has been made by linear approximation version of the AIDS model (proposed by Deaton A. and John Muellbauer 1980a; 1980b) called LA/AIDS employed by Alderman (1988) based on a particular form of the cost function (or expense) belonging to the class "Price Independent Generalized Logarithm" (see Holt *et al.*). Following classical method has been estimated for the n-1 share equations $s_i$for utility maximizing agents (see Holt *et al.*):

$$s_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} lnp_j + \beta_i ln\frac{M}{P} \qquad where\ i,j = 1,2,\ldots\ldots,n \qquad (1)$$

Where p_j is the price for each product, M the total expense by head for the products taken in account and P is a price index defined by

$$\ln P = \sum_{j=1}^{n} s_j * \ln p_j \qquad (2)$$

Linear homogeneity of cost function, symmetry of the second-order derivatives, and adding up across the share equations implies the following set of restrictions:

$$\sum_{i=1}^{n} \alpha_i = 1\ , \sum_{i=1}^{n} \gamma_{ij} = \sum_{j=1}^{n} \gamma_{ij} = 0, \sum_{i=1}^{n} \beta_i = 0, \qquad \gamma_{ij} = \gamma_{ij} \qquad (3)$$

The elasticities are calculated by the following expressions where $\bar{s}_i$ and $\bar{s}_j$ are the mean of the share on the whole period of estimation:

1) for the Marshallian (or uncompensated) elasticity of product i consumption relative to price of product j:

$$Marshallian\ elasticity = E_{ij}^{M} = -\delta_{ij} + \frac{\gamma_{ij}}{\bar{s}_i} - \beta_i \frac{\bar{s}_j}{\bar{s}_i} \quad (4)$$

Where δ_{ij} is the Kronecker delta term (that is 1 when $i = j$ or 0 when$i \neq j$)

2) for the expenditure elasticity of product i consumption

Expenditure elasticity $=E_i^R = 1 + \frac{\beta_i}{\bar{s}_i}$ (5)

RESULTS AND DISCUSSION

The results of six share equation of the AIDS model for Pakistan are presented in Table 1. In the regression analysis lagged variable also incorporated to correct the autocorrelation between years. Log of total expenditure has been incorporated in AIDS model to address the non stationary problems in time series data set and dummy variable introduced to take in account some discontinuities in data (mainly prices). Results of share equation indicate (see table 1) that majority of the estimated equations obtained statistically significant co-efficients and models are good fitted as having higher adjusted R^2 values such as 0.960, 0.981, 0.938, 0.934, 0.833 and 0.936 for beef, mutton, poultry meat, eggs, buffalo milk and cow milk respectively. Expenditure variable indicate the positive impact on buffalo and cow milk demand whereas, negative for all meat products and eggs. All other co-efficient of share equations are mentioned in Table1 along with their significance.

The coefficients of lagged expenditure share appearing in Table 1 are generally significant and important, which indicated high "memory effects", that is the consumption of animal origin commodities in year t is influenced by consumption during the preceding years. When the coefficient of lagged variable in share equation is positive, the long term elasticities are greater than short term elasticities (this is generally the case and multiplicative coefficient can be important).

Expenditure and Uncompensated/Marshallian Elasticities

The estimated expenditure elasticities for all meat products (beef, mutton and chicken), eggs and buffalo milk are generally positive (normal goods) except cow milk. Among the meat products higher value is estimated for mutton in Pakistan (3.8) followed by poultry meat (0.7) and beef (0.4). Mutton is taken as a luxury good in Pakistan whereas poultry meat and beef are analyzed as necessities/normal goods. This finding is justified by Mudassar *et al.* 2010 whose estimated expenditure elasticities were higher for mutton and stated mutton as luxury good relative to chicken and other food products. The expenditure elasticity was highest estimated for the eggs (28.6) among all the animal origin commodities mentioned in analysis. This indicate that in case of increased income people increase their expenditure by great extent on eggs realative to other mentioned products. The analysis articulate that among meat products more revenue allocated for mutton in case of increased expenditure followed by poultry meat and beef. Among dairy products buffalo milk is normal good having positive elasticity whereas cow milk is "inferior good" in Pakistan having negative sign (-4.1) (see Table 2). This can be explained by the fact that in Pakistan, more population live in rural areas and when expenditure increase then rural people preferred to buy more animal products as protein source. Estimated expenditure elasticity for buffalo milk is aligned with the findings of Aziz and Malik 2010, as their estimated expenditure elasticity for milk was 0.84 and 0.90 for rural and urban Pakistan respectively.

Marshallian/uncompensated elasticities for six animal origin products (beef, mutton, poultry meat, eggs, buffalo milk and cow milk) of Pakistan are figured in Table 2. The estimated own price elasticities are negative as expected. The results of the uncompensated/marshallian own price elasticities indicate that absolute value is highest for poultry meat (1.31) among meat products followed by beef (0.15) and mutton (0.14), which postulates that, when expenses on meat products is constant people of Pakistan reacts more in case of poultry meat price changes than beef and mutton. Among dairy commodities the highest own price uncompensated elasticity in absolute term is estimated for cow milk (4.82), followed by buffalo milk (0.92). In case of eggs the expenses remains constant, any increase in quantity demanded is highly reactive to price change of eggs as its estimated own price elasticity is (-2.10).

Short and Long Run Compensated/ Hicksian Elasticities

The estimated short and long run own price elasticites for all the selected animal origin products have negative sign as expected (see Table 3). The compensated own price elasticities for poultry meat, eggs and cow milk are greater than unity both in short and long run and more elastic to response in any price change whereas for beef, mutton and buffalo milk its less than one, means inelastic to price change. Among meat products(beef, mutton and

poultry meat) the estimated compensated own price elasticity (taken in absolute value) is more elastic for poultry meat (1.29 and 1.25) both in short and long run respectively followed by mutton (0.82 and 0.84) and beef (0.01 and 0.10). Results however postulate that short and long run elasticities for meat are almost same and this finding is justified by Tiffin *et al.* 2011. Among dairy products cow milk is more price elastic than buffalo milk as the estimated own price elasticities for cow milk (5.5 and 4.9) were highest than estimated short and long run elasticities of buffalo milk (0.50 and 0.52) respectively. Buffalo milk is price inelastic as stated by Davis *et al.* 2009.Eggs are also price elastic as the absolute value of short and long run compensated elasticities are estimated (1.5 and 1.4) respectively.

The cross price compensated short and long run elasticities are having positive sign as expected for substitute products except for mutton, eggs and cow milk. When looks at the overall results of the all commodities the strongest substitution response was estimated between consumption of buffalo milk with the price of eggs (25.65 and 24.23) both in short and long run respectively whereas consumption of eggs is not as much responsive to the price of buffalo milk. Both buffalo milk and eggs are rich source of protein and fats that's why any change in prices of eggs can have strong impact on buffalo milk consumption as the people will prefer the cheaper source for protein intake. Among the meat products cross price elasticity indicates highest substitution response of beef consumption with mutton (0.66 and 0.68) and poultry meat (0.50 and 0.49) in both short and long run respectively, whereas beef prices have negative and minimal impact on mutton (-0.14 and -0.16) and poultry meat (0.008 and 0.009) consumption both in short and long run respectively. The consumption of cow milk has substitution impact for price of poultry meat (6.15) and buffalo milk (1.63).

Substitution Elasticities

The estimates for substitution elasticity (see table 4) indicates that highest own price elasticities for eggs (-75.67) followed by poultry meat (-47.47), cow milk (-32.85), mutton (5.18), buffalo milk (1.0) and beef (0.65) which shows that eggs, poultry meat, cow milk and mutton consumption is highly sensitive to any change in their prices. The demand for beef and buffalo milk is less elastic to price change. Beef is the substitute for mutton as one percent increase in mutton prices will increase the beef consumption by 4.88 percent and their substitution effect is highly elastic. Increase in poultry meat prices also shift the consumption towards beef by 3.72 percent whereas change in price of beef have minimal effect of less than 1 percent (0.3) on poultry meat consumption. This shows that beef consumption is more elastic to price change than poultry meat. Eggs have complementary relationship with mutton whereas have substitution impact for all other mentioned animal origin commodities. Cow milk is substitute for buffalo milk as the 1 percent increase in buffalo milk price will increase the cow milk consumption by 9.738. The higher elasticity value indicates that these are close substitute and highly elastic to price change (see Table 4).

Conclusion and Recommendations

Demand of animal origin products found more responsive to price and income changes. Results of share equation are highly significant. The estimated elasticities for all meat products (beef, mutton and chicken), eggs and buffalo milk are generally positive (normal goods) except cow milk. Mutton is taken as a luxury good in Pakistan whereas poultry meat and beef are analyzed as necessities/normal goods. The estimated own price elasticities both compensated and uncompensated are having negative sign as expected with highest value of poultry meat among meat products. Demand for eggs is also price elastic. The cross price compensated short and long run elasticities are having positive sign as expected for substitute products except for mutton, eggs and cow milk. Among the meat products cross price elasticity indicates highest substitution response of beef consumption with mutton and poultry meat in both short and long run. Substitution response was also noticed for consumption of cow milk with prices of poultry meat and buffalo milk.

The results of present paper have strong implications at policy level as maintenance of expectable minimum wages and price control can emerge as the viable options to increase the consumption of animal origin products in Pakistan (especially for low income vulnerable groups) to address the nutrition food security issues. The combination of income acceleration and price control policy can be effective to change the consumption pattern of animal origin products in order to tackle the problem of malnutrition in Pakistan. The livestock farming sector is virtually free from public interventions like fixation of prices of its products (though some price control is implemented in the form of fixing price of meats in cities, but it is not very effective). In this scenario government can go for the buy-back mechanism, (controlling supplies like wheat, etc., therefore, relatively true production enhancing signals are reaching to the farmers and prices can be stabilized through enhanced supplies). More attention should be given to enhance the production of beef and mutton in the country instead of only supporting poultry industry to avoid price escalation problem, in this regard cooperative animal fattening enterprises can be a do able option. Public-private partnership in this regard should be encouraged to have the government interference

on the demand and supply mechanisms of red meat (beef and mutton). Establishment of milk collection centres and milk cooperatives by the government agencies can be helpful to control the prices of milk in Pakistan.

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Annexes

Table 1: Coefficients of Shares Equations for Pakistan

	Beef	Mutton	Poultry Meat	Eggs	Buffalo Milk	Cow Milk
	Pakistan	Pakistan	Pakistan	Pakistan	Pakistan	Pakistan
Constant	-0.128***	-0.331***	0.009	-0.032***	0.555***	0.718***
	(0.03)	(0.046)	(0.028)	(0.009)	(0.075)	(0.089)
Beef	0.105***	-0.040**	-0.003*	-0.004	-0.058***	-0.069**
	(0.01)	(0.016)	(0.001)	(0.003)	(0.005)	(0.032)
Mutton	-0.040**	0.083***	0.003	-0.011***	-0.035***	0.039
	(0.017)	(0.017)	(0.002)	(0.003)	(0.007)	(0.033)
Poultry Meat	-0.003*	0.003	0.010***	-0.002***	-0.009***	0.000
	(0.001)	(0.002)	(0.001)	(0.000)	(0.002)	(0.004)
Eggs	-0.003	-0.011***	-0.002***	0.029***	-0.012***	0.071***
	(0.003)	(0.003)	(0.000)	(0.002)	(0.002)	(0.015)
Buffalo Milk	-0.058***	-0.035***	-0.009***	-0.012***	0.114***	-0.042***
	(0.005)	(0.007)	(0.002)	(0.002)	(0.009)	(0.013)
Cow Milk	0.016**	0.013	0.002	-0.012***	0.005	-0.030*
	(0.006)	(0.008)	(0.004)	(0.002)	(0.011)	(0.016)
Expenditre	-0.075***	-0.117***	-0.004	-0.011***	0.032*	0.231***
	(0.010)	(0.013)	(0.008)	(0.003)	(0.019)	(0.026)
Lag (1)	0.138**	0.449***	0.163***	0.506***	0.312***	0.113***
	(0.059)	(0.035)	(0.054)	(0.055)	(0.066)	(0.029)
Dummy (79-05)	-0.022	0.028***	-0.009***	-	0.004	-
	(0.003)	(0.005)	(0.003)	-	(0.008)	-
R^2	0.973	0.987	0.958	0.956	0.922	0.955
R^2 adjust	0.960	0.981	0.938	0.934	0.883	0.936

Source: Authors' estimations

Table 2: Expenditure and Marshallian/Uncompensated elasticities

Variables	Expéditeur Elasticity	Marshallian or Uncompensated Elasticities					
		Beef	Mutton	PoultryMeat	Eggs	Buffalo Milk	Cow Milk
Beef	0.446	**-0.149**	-0.210	-0.004	-0.017	-0.159	0.210
Mutton	3.834	-1.428	**-0.142**	0.149	-0.278	-1.311	-1.211
Poultry Meat	0.662	0.414	-0.025	**-1.309**	0.088	0.013	6.039
Eggs	28.612	-2.281	-4.975	-0.168	-2.097	11.583	-4.605
Buffalo Milk	0.860	0.251	0.032	0.069	0.637	**-0.923**	1.486
Cow Milk	-4.087	-1.352	1.082	0.011	-1.476	-0.248	**-4.815**

Source: Authors' estimation

Table 3: Estimated Sort run and Long run Hicksian/Compensated Elasticities

Variables	Marshallian or Uncompensated Elasticities					
	Beef	Mutton	PoultryMeat	Eggs	Buffalo Milk	Cow Milk
Short Run						
Beef	**-0.088**	-0.140	0.008	-0.008	0.060	0.285
Mutton	0.661	**-0.820**	-0.044	-0.201	0.573	-0.569
Poultry Meat	0.504	0.079	**-1.291**	0.101	0.338	6.150
Eggs	1.590	-0.439	0.611	**-1.521**	25.646	0.185
Buffalo Milk	0.367	0.169	0.093	0.654	**-0.501**	1.630
Cow Milk	-1.905	0.434	-0.100	-1.558	-2.256	**-5.499**
Long Run						
Beef	**-0.103**	-0.162	0.009	-0.009	0.070	0.330
Mutton	0.680	**-0.844**	-0.045	-0.206	0.590	-0.585
Poultry Meat	0.488	0.077	**-1.252**	0.098	0.328	5.962
Eggs	1.502	-0.415	0.577	**-1.437**	24.231	0.175
Buffalo Milk	0.382	0.176	0.096	0.681	**-0.521**	1.697
Cow Milk	-1.709	0.389	-0.090	-1.398	-2.024	**-4.933**

Source: Authors' estimation

Table 4: Estimated Substitution Elasticities

Variables	Substiution Elasticities					
	Beef	Mutton	Poultry Meat	Eggs	Buffalo Milk	Cow Milk
Beef	**-0.654**	-0.881	0.299	-0.375	0.122	1.701
Mutton	4.884	**-5.175**	-1.629	-9.983	1.166	-3.397
Poultry Meat	3.722	0.501	**-47.473**	5.017	0.689	36.738
Eggs	11.750	-2.772	22.451	**-75.667**	52.179	1.105
Buffalo Milk	2.715	1.065	3.403	32.541	**-1.019**	9.738
Cow Milk	-14.083	2.737	-3.676	-77.511	-4.591	**-32.848**

Source: Authors' estimation