MILK QUALITY IN PAKISTAN: DO CONSUMERS CARE?

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ABSTRACT

A log-log-inverse econometric model, representing nonlinear Engel curve relationship for fresh milk in Pakistan proved to be a valid estimation technique of quantity and expenditure elasticities with respect to consumers' income. This model, when incorporated with dummy-variable for time-variations, indicated substantial changes in quantity and expenditure elasticities over time-period 2001-2005. During this period, the quantity and expenditure elasticities witnessed statistically significant changes in milk consumption. The quality elasticity of milk, which resulted as the difference between expenditure elasticity and quantity elasticity, turned out to be positive and enhanced in magnitude from 0.0532 during 2001 to 0.1684 during 2005.

Key words: Engel curve, Log-Log-Inverse function, quality elasticity, milk, Pakistan.

INTRODUCTION

Agriculture is the largest sector of the Pakistani economy, contributing 23 percent to the GDP and involving 42 percent of the total labor force. Livestock is the largest of the various agriculture sub sectors. Net foreign exchange earnings from livestock products and by products like meat, skins, hides etc were more than Rs. 53 billion in 2003-04 (FAO, 2006) that is about 11 percent of the overall export earnings of the country. Livestock accounts for 46.8 percent of agricultural value added and about 10.8 percent of the GDP. Milk is the largest commodity from the livestock sector accounting for 51 percent of the total value of the sector. The farm gate value of milk is estimated to be more than Rs. 390 billion. Pakistan is the Fifth largest producer of milk in the world with a total production of 28 billion liter of milk a year, whose value is more than that of the combined value of wheat and cotton, from a total herd size of 27 million milch animals of cows and buffaloes (SMEDA, 2007). Pakistan's milk production was 33.2 million tons during 2006-7 and its consumption has shown a steady annual growth of 28.6 % over the last seventeen years between 1991 and 2007 (GoP, 2007).

Milk contains ingredients necessary for the growth and maintenance of human body- proteins, fats, carbohydrates, vitamins and minerals. Milk and milk products form a significant part of the diet in many countries and a substantial part of food expenditure goes on milk and dairy products. According to Anjum et al. (1989), in Pakistan milk and milk based products accounts for 27% of the total household expenditure on food. Seale et al. (2003) report that during 1996, the share of dairy products in household food expenditure in Pakistan is 26.84%. In a recent study Shah (2004) estimates expenditure of milk as 14.3% of the total food expenditure.

In the quest for national food sufficiency, researchers in Pakistan have focused almost exclusively on production related disciplines and have overlooked the important allied areas of quality and yield. Quality seems to have become the most forgotten aspect in almost all stages of food production, processing, distribution and consumption. Consequently there is no comprehensive study on milk quality (Khan, 1999). On other hand consumers are becoming increasingly concerned with the quality, safety and production attributes of their food (Caswell, 1998). This paper attempts to study consumers' response to quality of fresh milk in Pakistan and estimates quality elasticity with respect to income over time.

Methodological and Analytic Framework

On the basis of pioneer work of Hicks and Johnson (1968), Gale and Huang (2007) presented methodology to capture effect of quality through a nonlinear Engel relationship. According to their model, Engel curve expresses the relationship between household expenditure and income, as given in equation (1).

$$e(Y) = pq(Y) \qquad (1)$$

Equation (1) expresses that expenditure (e), which is a product of price (p) and quantity (q), depends upon income (Y). If prices are held constant, then elasticity of expenditure (e) with respect to Y becomes equal to that of quantity (q) with respect to income (Y); that is:

$$\delta e/\delta y\ (Y/e) = \delta q/\delta y\ (Y/q) \qquad (2)$$

If cross sectional data is taken on consumption, expenditure, income and prices, then it can be assumed that prices do not change in the same year so relationship in equation 2 can practically be computed. Equation 2 suggests that if there is any increase in the expenditure that will be explicitly due to an increase in quantity consumed. And if any increase in price is observed that would then be because of the improvement in quality. Hence, to

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incorporate the effect of quality, equation (1) would transform, as follows. $e(Y) = v(Y)q(Y)$ (3)

Where v(Y) represents variation in prices paid for quality.

Taking natural log of equation (3) and then differentiating it with respect to lny, we get:

$$\delta lne/\delta lny = \delta lnv/\delta lny + \delta lnq/\delta lny \quad (4)$$

The left-hand side of equation (4) represents expenditure elasticity (ε), while the first part of the right-hand side represents quality elasticity (θ) and the second part quantity elasticity (η); namely.

$$\varepsilon = \theta + \eta \quad (5)$$

Equation (5) can be re-arranged to compute quality elasticity (θ), as follows.

$$\theta = \varepsilon - \eta \quad (6)$$

At low income level when income (y) rises, the effect of income on consumption (q) is positive ($\delta q/\delta y > 0$), with the second derivative negative ($\delta^2 q/\delta^2 y < 0$), suggesting that at sufficiently low income level almost all goods are normal. While with the further increase in income, $\delta q/\delta y$ drops and at some level reaches zero; so in practice, Engel curve is not linear but nonlinear. Thus to capture nonlinear relationship of consumption (q) and income (Y), the log-log-inverse (LLI) form of Engel equation can be used.

$$lnq = \alpha + \beta_q(1/Y) + \gamma_q lnY + \mu \quad (7)$$

Similarly, for expenditure (e) and income (Y) relationship, equation (7) can be modified as:

$$lne = \alpha + \beta_e(1/Y) + \gamma_e lnYy + \mu \quad (8)$$

Estimation of equations (7) and (8) would give values of parameters α, β, γ and if β is equal to zero, the LLI model would simplify to double log model, suggesting constant elasticities. Similarly, if γ is equal to zero, LLI model would simplify to log inverse model. However, if both β and γ are not equal to zero, then elasticities would be worked out, as follows:

$$\eta = -\beta_q(1/Y) + \gamma_q \quad (9)$$

$$\varepsilon = -\beta_e(1/Y) + \gamma_e \quad (10)$$

Substituting values of η and ε from equations (9) and (10) into Equation (5) & (6), the quality elasticity (θ) would be computed.

The methodological framework presented in equations (1) through (10) is what we adopted from Hicks and Johnson (1968) and Gale and Huang (2007). We further extend this model to capture consumers' response to quality over time. For this purpose, we modify equations (7) & (8), incorporating dummy-variable (D) for time differences, as follows.

$$lnq = \alpha_1 + \beta_{q1}(1/Y) + \gamma_{q1} lnY + \alpha_2 D + \beta_{q2}(D/y) + \gamma_{q2} ln(DY) + \mu \quad (11)$$

$$lne = \alpha^*_1 + \beta^*_{e1}(1/Y) + \gamma^*_{e1} lnY + \alpha^*_2 D + \beta^*_{e2}(D/Y) + \gamma^*_{e2} ln(DY) + \mu^* \quad (12)$$

Equations (11) & (12) incorporate dummy-variable (D = 0 for base period; D = 1 for new period) in both of its differential intercept (α_2 & α^*_2) and differential slope (β_{q2}, γ_{q2}, β^*_{e2} & γ^*_{e2}) forms (Gujarati 2003, pp.297-324). The level of significance (t-ratio) of the respective differential intercept and differential slope would indicate whether consumers' response to quality had significantly changed, while the signs (+ or -) would indicate the direction of the change.

RESULTS AND DISCUSSION

Using data of 16182 households from Pakistan Integrated Household Survey (PIHS) and 15453 households from Pakistan Social and Living Standards Measurement (PSLM) Survey, conducted during 2001 and 2005 respectively, we estimated equations (11) and (12) for 'milk. The results of the estimated equations along with diagnostic statistics (t-ratio, F statistic and R^2) are provided in table 1.

These results are discussed and interpreted, as follows.

- The differential intercept and differential slope, in both equations, have turned out to be statistically significant indicating that significant changes have occurred in quantity and expenditure elasticities during 2005 compared to the base year 2001.
- The coefficients β_q and β_e, explained in equation (7) & (8), have turned out to be statistically significant suggesting that log-log-inverse (LLI) formulation of the model validate the non-linear behavior of Engel curve for milk consumers in Pakistan.
- Quantity elasticity of demand for milk with respect to consumer income is estimated at 0.1961 and 0.4019 for year 2001 and 2005 (Table 2). Expenditure elasticity with respect to income is estimated at 0.2494 and 0.5703 for 2001 and 2005. The quality elasticity is thus positive and is estimated at 0.0532 and 0.1684 for 2001 and 2005.

CONCLUSIONS

The quantity and expenditure elasticities with respect to consumers' income for milk have witnessed substantial changes during 2005 compared to the study's base period of year 2001. The quality elasticity with respect to consumer's income turns out to be positive and enhanced in magnitude in from 0.0532 and 0.1684 for year 2001 and 2005.

Table 1 ***Empirical Results of Quantity and Expenditure Elasticity models (equation 11 &12)***

Empirical results/estimated model
lnq = 8.658 + 96.48(1/y) + 0.205lnY – 1.422D – 105.271(D/Y) + 0.196ln(DY)
(203.9) (13.4) (43.5) (-16.2) (-2.4) (21.25)
F-ratio = 2665.7 R^2 = 0.346
lne = 3.984 + 94.263(1/Y) + 0.258lnY – 2.601D + 78.695(D/Y) + 0.329ln(DY)
(120.9) (16.9) (70.6) (-38.1) (2.3) (45.9)
F-ratio = 7482.9 R^2 = 0.598

(Figures in parenthesis represent t-ratios)

Using various elasticity estimates from table 1, we estimated quantity, expenditure and quality elasticities using relationships given in equations 5 and 6. The so calculated elasticities are provided in table 2.

Table II ***Quantity, Expenditure & Quality Elasticity of Milk (2001 & 2005)***

Quantity Elasticity (η)		Expenditure Elasticity (ε)		Quality Elasticity (θ)	
2001	2005	2001	2005	2001	2005
0.1961	0.4019	0.2494	0.5703	0.0532	0.1684

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