A Note on Economic Analysis of Consumer Demand for Raw and Processed Fluid Milk in Lahore

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One of the first and most noticeable features of early stages of economic development is a marked increase in the demand for food. This is brought about by two factors: a rapid expansion of the entire population and a widespread prosperity that may both raise the general level of income and increase the proportion of the high and middle income groups, especially in the urban centres. Except for changes in age distribution, population growth causes the demand for all types of food to expand whereas rising per capita income creates a much larger demand for particular types of food such as milk and other dairy products.

Economic development labelled as 'Green Revolution', besides its other impacts on the economy of Pakistan, also raised the income levels which resulted in an increase in the demand for dairy products. This increased demand has required increased production of milk and other dairy products through concerted effort and careful planning for the dairy sector of the economy.

The traditional channels of fluid milk flow in the cities of Pakistan are characterized by the preponderance of milkmen vendors and milk retailers who sell raw fluid milk to the consumers. The long standing complaint against these intermediate agents has been that the milk distributed by them contains not only such impurities as would threaten the consumer's health but also the quality, freshness and cream content of the milk are far from satisfactory.

The greatest and most persistent problem in the fluid milk supply system in Pakistan from the consumer point of view is adulteration. An unsuspecting public consumes fluid milk which has been adulterated and diluted to the extent that there is very little nutritive value left in it, resulting in, to a great extent

malnutrition and child mortality. According to a press report,[1] milk is one of the most highly adulterated products in Pakistan. In developed countries, consumers have the choice of whole milk, skim milk, pasteurized, homogenized and vitaminized milk etc. But in Pakistan, except for certain large cities where pasteurized fluid milk is also available, there is usually just one choice of diluted and barely nutritive milk which forms the major protein base for the average child. Adulteration of fluid milk is just one, though most important, aspect of the whole dilemma as there are problems regarding transportation and handling of milk, lack of milk processing plants, and ineffective sanitary control.

With an awareness of the dilution dilemma for fluid milk, the federal government helped in setting up milk processing plants at Lahore and Karachi during the mid-sixties. Another similar facility went into operation in Islamabad during 1974. These fluid milk processing plants, established with the economic and technical assistance from other countries and international agencies, have been charged with the responsibilities of procuring, processing and/or reconstituting, packaging, and distribution of pasteurized fluid milk and milk products in the city areas.

Although these fluid milk processing plants have been in operation for several years, they continue to face competition from established interests which sell raw fluid milk. It is further believed that despite advertisement and government participation in these ventures to improve milk supply system, it has not been possible to convince the majority of the consumers of the advantages of processed fluid milk. Masses of consumers, thus, continue to prefer and buy the decisively impure raw fluid milk from the traditional milk vendors whose numbers have increased to thousands in urban centres. Given this situation, questions arise as to: what is the inter-relationship between processed and raw fluid milk; and what are the product characteristics of each that consumers do or do not prefer? Answers to the above and similar other questions covered by this research study are expected to provide guidelines for milk plant management and the government authorities in general, as to the future course of action to promote the growth of the fluid milk processing industry in the country.

This paper attempts to analyse household consumption patterns for fluid milk in Lahore. Major objectives of the study include: to determine the inter-relationships and the extent of usage of raw and processed fluid milk; to evaluate consumer attitudes towards processed fluid milk; and to identify the factors that determine the consumption of raw fluid milk and processed fluid milk.

METHODOLOGY AND ANALYTICAL APPROACHES

The selection of an appropriate mathematical or statistical model in economic analysis often presents certain problems. Essentially three approaches are used in empirical analysis in the field of demand [3].

The first of these is called the 'Single-quation least Squares Regression' technique. Fox [4] has given a comprehensive discussion of the applicability

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[1]Staff Reporter in "The Pakistan Times" October 4, 1974, Rawalpindi, Pakistan.

of this method as it applies to farm commodities in general. There are many questions that have to be answered before one can determine the applicability of the single equation approach. In case of fluid milk, where the price is fixed in the short run in each market, quantity is the dependent variable. The supply should be enough from all sources to meet consumer demand under the price structure.

The second approach is the 'multiple-equation' approach. It is the simultaneous determination of inter-dependent relationships. Its application has, however, been limited and has not been shown clearly superior to other methods. West, working together with working [8], fitted a system of equations to time series data pertaining to the demand for meat. Their conclusion was that the coefficients of elasticity of demand for meat estimated by this method did not differ essentially from those estimated by the single-equation method.

Another approach used by some researchers as a supplement to mathematically derived least-squares equations is the short-cut graphic method. It is a useful tool for suggesting price-quantity, and income-quantity relationships.

Demand theory explains the reaction of consumers to various price and income situations. Some practical considerations, however, must be taken into account while developing models and hypotheses. From a practical point of view, it is hardly possible to subject a given group of consumers to various price and income situations. Hypothetical price situations usually used in short duration consumer surveys do not render very dependable consumer responses and, thus, their applicability to economic analysis, in general, is not very meaningful. Since inability to use full experimental control is a serious limitations in most economics research, it is necessary to measure as many variables as feasible in order to reduce unexplained variations.

The main variables considered in their influence on fluid milk consumption were income, household size and composition, sex, and education. Considering the limited advantage of multiple-equation models, the single-equation least squares multiple regression approach was used for the present study. The following three single-equation multiple regression models were developed to estimate the influence of selected variables on household consumption of fluid milk.

$$C_a = a + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + e$$
$$C_r = a + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + e$$
$$C_p = a + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + e$$

where

C_a = is the daily household consumption of fluid milk (raw and processed),

C_r = is the daily household consumption of raw fluid milk only,

C_p = is the daily household consumption of processed fluid milk only,

X_1 = is the monthly income available to the household (Rs.),

X_2 = is household size,

X_3 = is the number of children less than 5 years old,

X_4 = is the number of females in the household,

X_5 = is the education level of the household.

DATA BASE

The findings of this research study are based on data obtained through consumer household survey in the city of Lahore during early part of 1976. Due mainly to financial and time constraints, it became necessary to limit the size of the sample, which would be expected to have some effect on the adaptability of conclusions derived. A compromise was thus made by selecting the level of permissible error and the confidence interval in order to be sure that the percentages of the characteristics under study were within a specified confidence interval. Sufficient interviews were conducted to obtain 400^2 usable questionnaires from among the sample households in the city of Lahore. Since there was no information as to what percentage of households would be using pasteurized fluid milk, the above sample size was selected by using the expected frequency of 50 percent for the said criterion. Although there was a population census in 1972 but the census report for Lahore district was not available at the time of this survey in 1976. The records of the Lahore Municipal Corporation were, therefore, used for purposes of sample selection. The city was divided into four administrative zones and each zone comprised of varying number of mohallahs/localities (subzones). From each of the four zones, certain number of subzones were selected based on the total population of that zone and then equal number of households were randomly selected from each of these subzones. Zone C comprized of well-to-do localities like Gulberg, Model Town, Muslim Town, Samanabad etc. Whereas the other three zones represented a mixed distribution of households from economic viewpoint.

DISCUSSION OF RESULTS

The consumer survey was conducted in the city of Lahore where processed fluid milk was available to the consumers alongwith the traditional raw fluid milk. In order to determine inter-relationships between the two forms of milk and their characteristics, household survey data were subjected to descriptive analysis. The following discussion dwells on the information as revealed by households regarding their preferences and attitudes towards fluid milk consumption.

Fluid-milk was used by all the households in the survey. As high as 55 percent of the families indicated that all members of their household drank fluid milk whereas the remaining 45 percent of the families said that not all but only some members of their household (mostly children) drank milk.

Among the 45 percent of the households who indicated that only a few members consume fluid milk, 70 percent revealed that it was because they couldn't afford to provide fluid milk for all members of the family. Seventeen percent of the above households said that they use milk only as an additive to tea/coffee whereas in 10 percent of the cases, members did not like milk.

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²This number was selected by utilizing the statistical table No. 7.4 (p. 136) by Shrerier, as adapted from T.H. Brown, Use of Statistical Techniques in Certain Problems of Market Research (Cambridge, Harvard University Press, 1935).

Types of Milk Purchased by Households

An indicated 79 percent of the household purchased raw fluid milk whereas only 43 percent purchased processed fluid milk. Only 22 percent of the households purchased both kinds of milk. Thus 57 percent of the families purchased raw fluid milk only and 21 percent purchased processed fluid milk only. The use of dry milk among the households interviewed was minimal and thus was not studied in detail.

The highest number of processed fluid milk users was found in zone C which could be attributed, in part, to the home delivery service provided in parts of that area. Relatively lower levels of processed fluid milk consumption in other zones were mainly due to insufficient distribution facilities and greater adherence to the common belief that processed fluid milk has had the cream removed and that it was not very nutritious or tasty. The taste element was the most prevalent reason for low or non-acceptability of processed fluid milk by households. Among the households surveyed, 78 percent indicated their preference for raw fluid milk whereas only 22 percent preferred processed fluid milk over raw fluid milk.

Fluid Milk Prices

Fluid milk prices (Table 1) indicate that for raw fluid milk, the source of purchase did affect the price level. Also higher prices for raw fluid milk were indicative of relatively higher quality milk which reveals that consumers were willing to pay more for high quality milk. Certain households also indicated that they would prefer to buy lesser amounts of high quality milk at relatively higher prices rather than buying more low quality cheap milk. The price of processed fluid milk was the same irrespective of source of purchase and was also lower than the price of raw fluid milk.

Table 1

Fluid Milk Prices According to Source of Purchase, Lahore, 1976

Type of fluid milk		Source of purchase	Price/lb. (Rs.)		Price/Seer (Rs.)	
			Lowest	Highest	Lowest	Highest
Raw fluid milk		Nearest milk store	0.85	0.97	1.75	2.00
		Home delivery	0.85	1.09	1.75	2.25
		Neighbouring Milkman	0.97	1.34	2.00	2.75
Processed fluid milk	3.5% B.F.	All sources	0.75	0.75	1.54	1.54
	5.0% B.F.	All sources	0.95	0.95	1.95	1.95

The above table reveals quite substantial price differentials among various sources of purchase for raw fluid milk. Home delivery purchasers paid relatively higher prices than those who purchased from nearest milk store but lower than those who purchased from the neighbouring milkman.

Price Relationships and
Consumer Behaviour

The average price of raw fluid milk, contrary to what economic theory would predict, was higher than the price of processed fluid milk. The reasons for this become clear when the reader is provided with some background and insight into the circumstances regarding the fluid milk processing industry in the country.

Since independence various dairy programmes were initiated but most of these were either abandoned a few weeks after going into operation or did not reach completion at all. All of such programmes dealing with fluid milk had been started by private firms and failed due mainly to lack of consumer acceptance of the milk they tried to sell. Milk plants started at Karachi and Lahore over a decade ago are not privately owned but instead are the pioneer projects of the government for an eventual milk supply system in the country in order to provide clean, pasteurized milk to consumers, especially in city areas. These projects were assisted by UNESCO and FAO and subsidies are still being provided by these agencies and by the Government of Pakistan. Consumers in these cities and elsewhere in the country are very much tradition-bound and are still partial to raw fluid milk. Given this situation, it is quite obvious that if such consumers are offered processed fluid milk at a higher price than the raw fluid milk, which the majority of them indicated as preferring to the former, they are not going to purchase it.

Due to the initial inacceptability of processed fluid milk by consumers, there seemed no alternative but to sell this milk below the average price for raw fluid milk to which consumers were very much used to. During recent years the consumption of processed fluid milk has increased mainly due to the increase in demand for fluid milk and also because the product is now more familiar to consumers.

With the above insight into the price structure, it was quite evident that those consumers who did not prefer processed fluid milk under the existing price conditions would prefer it less if the price of both types of milk were the same. Households which purchased both types of fluid milk were asked which milk they preferred to buy under equal prices for both types of milk. As high as 97 percent of the households indicated their preference for raw fluid milk. Putting this another way, the percentage of households preferring raw fluid milk increased from 78 under the existing price relationship (relatively lower prices for processed fluid milk) to 97 under equal price conditions (relatively higher prices for processed fluid milk).

Reasons for Preference of Type
of Fluid Milk by Households

Further justification for the shift of consumer preferences under different price situations for processed fluid milk, is provided when one considers the reasons for preference of each type of milk. Out of the total of 78 percent of

the households which preferred raw fluid milk, 80 percent revealed that raw fluid milk tastes better; whereas, out of the households that preferred processed fluid milk (22 percent), only 16 percent gave the above reason for their preference. It was further revealed that 72 percent of those households that preferred processed fluid milk did so because it was cheaper.

Another important reason that explains the greater consumer preference for raw fluid milk was its nutritional aspect.[3] Of those who preferred raw fluid milk, 60 percent did so because they considered it more nutritious than processed milk.

The only characteristic for which processed fluid milk excelled when compared to raw fluid milk was the former's non-adulteration. Of the households that preferred processed fluid-milk 87 percent revealed that they preferred this milk because it was not diluted or adulterated, whereas for raw fluid milk only 32 percent gave the above reason and the majority of those were buying milk from their neighbouring milkmen. Buying convenience which was mostly related to the source of purchase, was another reason for preferring one type of milk over the other. Of households that preferred raw fluid milk, 56 percent gave convenience as the reason for their preference whereas only 48 percent of those preferring processed fluid milk gave convenience of purchase as a reason.

SOURCES OF PURCHASE FOR RAW AND PROCESSED FLUID MILK

There were three major sources of purchase for raw fluid milk and respondent's concepts of quality level were different for each source depending upon personal contact between the households and the milk sellers. High quality (unadulterated) raw fluid milk at a relatively higher price was available from neighbouring milkmen. Forty-five percent of the households who purchased raw fluid milk, did so through this source. The neighbouring milkman was either a neighbour, a relative or someone living close-by with one or more milk animals and providing good quality raw fluid milk to a small number of households.

The most common source of purchasing raw fluid milk, however, was home delivery which accounted for 48 percent of the households. Only 7 percent of the households interviewed were buying their daily milk supply from the third source, the nearest milk store. It was reported that the Lahore city administration was in the process of removing all milk animals to the cattle colony outside the city limits. It is expected that this move would have much greater effect on households who purchased raw fluid milk from their neighbouring milkman as compared to those households who purchased from other sources.

There were three different sources of purchase for processed fluid milk. The most common of these was a set of distribution outlets operated by the milk plant management. The distribution outlets were in great demand as 51 percent of the households purchasing processed fluid milk did so through this

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[3]This type of consumer attitude had developed due to the difference in butterfat content of the two types of fluid milk. Standardized pasteurized fluid milk contained only 3.5 percent butterfat as compared to 5.0 to 8.0 percent for raw fluid milk which was obtained mostly from buffaloes.

source. These outlets operated under a two-shift system, one in the morning and one in the afternoon.

Another source of purchasing processed fluid milk was through milk stores which also sold raw fluid milk and other food items. Previously there was only one system, as described above, for the distribution of processed fluid milk in the city. The distribution booths under this system were manned by salaried salesmen who, as reported by the milk plant management, were not selling enough milk to justify their expenses. In order to increase sales through these salesmen, weekly targets with commission incentives were given to them as a condition of employment. On the other hand, raw fluid milk sellers were encouraged to sell processed fluid milk at their stores and they were given incentives to promote the sale of this milk. The efforts worked out well and at the time of this study, there were over 150 privately run distribution outlets throughout the city. Twenty-six percent of the households purchasing processed fluid milk indicated that they purchased through these privately owned milk stores in their area.

The third mode of purchasing processed fluid milk was through home delivery. This, however, being quite expensive and time-consuming, was not practiced very widely except for localities closer to the milk plant and having better layout and road structure. These included colonies like Model Town, Gulberg, and Samanabad etc. No extra charge was being made for this service which was provided by the milk plant management itself. Only 23 percent of the households that purchased processed fluid milk did so through home delivery service, which was expensive, especially when its cost was not being shared by its users and was more of a promotional concern than anything else. As a consequence, home delivery service was not to be extended to other areas in the future but rather was to be withdrawn when processed fluid milk became widely accepted, as disclosed by the milk plant management.

As all processed fluid milk was packed and distributed by the Lahore Milk Plant, its quality being the same, there was no reason other than convenience to prefer one source of purchase to the other.

Advertising processed fluid milk in a situation where consumers were not well-informed and in the presence of severe competition from raw fluid milk distributors, was not being carried out on a regular basis. The usual practice was showing cinema slides, signboard displays and LMB (Lahore Milk Board) symbols at or close to the distribution outlets. Advertisement through television and newspapers was also done at intervals.

Consumer Attitudes on the Prevailing Raw Fluid Milk Supply System

In order to have an overall evaluation of the raw fluid milk supply system, households included in the survey were asked to indicate whether or not they were satisfied with the existing circumstances. Out of the 79 percent of the households that purchased raw fluid milk, only 52 percent indicated that they were satisfied with the quality of raw fluid milk and the supply system (Table 2).

Satisfied households were further classified according to source of purchase. About two-thirds of these were those that purchased raw fluid milk from neighbouring milkmen. Thirty-three percent of the satisfied households

Table 2

Consumer Attitudes on the Prevailing Raw Fluid Milk Supply System, Lahore, 1976

Comparative criterion	Households interviewed	Households that purchased raw fluid milk	Households satisfied	Households not satisfied	Satisfied households according to source of purchase			Households not satisfied regarding			
					Milk store	Home delivery	Neighbouring Milkman	Quality	Cleanliness	Distribution	Others
Number	400	317	165	152	4	55	106	138	124	8	7
Percent	100	79	52	48	2	33	65	90	82	5	5

Table 3

Consumer Attitudes on the Prevailing Processed Fluid Milk Supply System, Lahore, 1976

Comparative criterion	Households interviewed	Households that purchased processed fluid milk	Households satisfied	Household not satisfied	Households not satisfied regarding			
					Taste	Cream-content	Distribution	Packaging/others
Number	400	173	63	110	88	72	24	35
Percent	100	43	36	64	80	65	22	32

purchased raw fluid milk through home delivery. As pointed out earlier, this analysis further strengthens the view that quality level was different for each source of purchase and hence the different range of prices for each source.

Of the households that indicated dissatisfaction with the existing raw fluid milk supply, 90 percent were not satisfied with the quality of raw fluid milk. Eighty-two percent of dissatisfied households showed concern regarding the cleanliness and other hygienic aspects of the supply system. Because of the fact that home delivery of milk was the most common means of distribution, only 5 percent of the households complained about the distribution system. Another 5 percent of these households voiced their concern about other factors such as lack of government supervision, and lack of special education for milk dealers and retail sellers.

Consumer Attitudes on the Prevailing
Processed Fluid Milk Supply System

The consumer survey revealed that a relatively higher than anticipated percentage of households were purchasing processed fluid milk. Forty-three percent of the total households indicated that they consumed processed milk. Table 3 shows that only 36 percent of these households expressed their satisfaction regarding the existing processed fluid milk supply system and the remaining 64 percent were dissatisfied. When probed further, 80 percent of the dissatisfied households complained about the taste of the processed milk while 65 percent were not satisfied with the lower cream content of the milk.

Reconstituted milk seemed to be the basis for such complaints as the butter oil used in this process leaves its taste in the final product. It may be mentioned that more than 50 percent of daily production of processed milk was being reconstituted due to non-availability of sufficient raw fluid milk. Another 22 percent of dissatisfied households voiced their complaints regarding the distribution of processed fluid milk. They reported that late deliveries and lack of sufficient supplies at the distribution booths were quite common and these irregularities made households resentful towards processed milk. The type of milk packaging was also a reason for dissatisfaction. About 32 percent of the households were not satisfied with the existing packaging system. It was alleged that imperfect shape, poor sealing, and improper handling of the polyethylene bags by distributors lead to losses of the product. Among other complaints were the occasional curdling of milk and an offensive smell when it is boiled. Another complaint was against the salesmen at the distribution booths who sell most of their processed fluid milk supply to milk dealers, leaving their retail customers with an inadequate supply.

CONSUMPTION FUNCTION ESTIMATION

In the conventional theory of consumer behaviour, variables other than income, price and quantity consumed are usually considered to be constant. But in order to obtain a prediction equation of a higher degree of reliability, as many variables as possible have to be included in the estimating equations. Variables other than income, such as household size, age composition, sex, and education level of the household were added with the expectation that the inclusion of these would improve the reliability of the models used. The justifications for the inclusion (or removal) of certain variables in the consumption function estimation equations are discussed as follows.

Household size is important as a predictor of milk consumption level since it is expected that milk consumption would increase as family size increases. This is of special concern in developing countries where family size is generally very large. These larger families include a larger number of children who tend to consume larger quantities of milk than adults.[4] Coles [2] studied the consumption of dairy products by urban families in California and found a positive relationship between family size and family milk consumption. Similar results were obtained by Ratnam and Spielman [5]. Their analysis indicated that consumption of regular milk per household increases with an increase in the household size. They further concluded that this holds true in general irrespective of income, and any other socio-economic characteristic of the household.

Certain studies indicate that the rate of milk consumption tends to decrease as one grows older. Scott [7] points out that children in less than 5 years age group consumed 7.9 pints of milk per week while those in the age group of 31 to 40 years consumed 3.3 pints per week. In this study information on age composition was obtained for three groups: less than 5 years; 5 to 19 years; and 20 years and over. However, based on the economic situation of the population under study, only the first group was included in the estimation equations.

Some of the empirical studies on milk consumption have shown that females consume smaller quantities of milk than males. Coles [2] indicated that, irrespective of the age group, females consumed lesser amounts of milk than males. Similar conclusions were also made by Baum and Corbridge [1] and Roberts [6, pp. 23-24] in their studies on milk consumption. This variable was of particular interest in the current study because of the social and cultural characteristics of the population. Generally speaking, males command a higher social status than females in most developing societies and this is important when the consumption of high-nutrient foods, such as milk, is being considered in the families of these societies. It is for this reason that the number of females in the household was used as a determinant of the family's milk consumption. The sign of ths variable was expected to be negative.

The level of education[5] of a family was also included as a determining variable for its milk consumption. It can be argued that higher educational levels imply a greater awareness and knowledge of nutritional aspects of the food items being purchased by the household. Thus, with other factors as constant, it would be expected that highly educated families have a higher level of processed fluid milk consumption.

Data on various characteristics of households as obtained from the consumer survey were subjected to statistical analysis. Least-square multiple regression techniques were used to obtain estimates of the coefficients of variables included in the consumption function estimation equations. The cor-

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[4]Swope D.A., Factors Associated with Level of Milk Consumption: A Summary of Literature on Research Findings, Pennsylvania Agricultural Experiment Station, A.E. and R.S. 3, University Park, 1956, p. 12.

[5]Family's education level was measured by the total number of years spent in school by husband or wife. The greater of the two was counted as the family's education level.

relation[6] matrix of the determining variables is shown in Appendix Table 1. An examination of Appendix Table 1 suggests that there tends to be a low degree of correlation in the data obtained on the independent variables.

EMPIRICAL FINDINGS

Tables 4 to 6 show the statistical results of regression analysis performed to determine the important factors that affect the level of milk consumption of the households. As indicated earlier, three separate equations were used: all milk households, those that consumed raw fluid milk only, and those that consumed processed fluid milk only. These estimates were obtained using consumption of fluid milk per household as the dependent variable.

For the regression model for households that consumed both raw and processed fluid milk, the sign of the income variable was positive and its coefficient was found significant at the one percent level indicating a strong relationship between household income and the amount of milk consumed. The coefficient for the household size was also positive and significant at one percent level indicating that milk consumption increases as household size increases. With the addition of one member, there would be an increase of 0.36 pounds in the amount of milk consumed per day in the household.

Table 4

Statistics for the Consumption Function Estimation Equation for All Households, Lahore, 1976

Variable or Statistic	Unstandardised B's	F-Ratio	R^2
Income	0.00116	209.30*	0.39259
Household size	0.36259	57.62*	0.48669
No. of children less than 5 years	0.48648	41.53*	0.54579
No. of females in the household	−0.21534	10.30*	0.55698
Household education	0.01363	1.15	0.55828
Constant	0.19517	—	—

*Significant at the one percent level.

The number of children less than 5 years of age was another factor having a positive bearing on household milk consumption level. A one-unit increase in this variable would induce an increase of about one-half pound of fluid milk consumed (Table 4). As expected, the coefficient for the variable-number of females in the household was negative indicating that females drink less milk than male members of the household. All of the variables discussed so far exhibited regression coefficients that were significant at the one percent

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[6]Simple correlation coefficients such as these are useful in determining the existence of the problem of multicollinearity among the independent variables. Coefficients in Table 1, however can only be useful to determine multicollinearity of the simplest form, that is, when one variable is almost a multiple of another variable. It may not be possible to see from these coefficients whether or not a variable is a linear combination of a set of other variables.

level. The education level of the household was, however, not found to be a significant factor in determining the amount of fluid milk consumed.

For households which consumed raw fluid milk only, the regression coefficients and other relevant statistics are presented in Table 5. The effect of the income variable on consumption of raw fluid milk was significant at the one percent level. The sign of this coefficient was positive but its magnitude was quite small suggesting that a large enough change was needed to bring about a change in the amount of raw fluid milk consumed. The coefficient which measured the effect of household size on raw fluid milk consumption was also significant at the one percent level. The effect of a member's addition to the household was an increase of 0.29 pounds of raw fluid milk purchased. Similarly, the regression coefficient for the variable representing children less than 5 years of age in the household was significant at the one percent level. The other two variables (number of females in the household and the education level of the household) were not found significant.

For households which consumed processed fluid milk only, a similar regression anlaysis was performed. In this case, however, the variables found to be significantly related to the amount of processed fluid milk cousumed included income and the number of children less than 5 years of age in the household. Both of these variables had coefficients that were significant at the one percent level. It appeared that unlike the other analyses, the number of children less than 5 years variable came out more forcibly to determine the amount of processed fluid milk consumed by the household. An additional child would increase the amount of processed fluid milk purchased by the house hold by 0.84 pounds (Table 6). All the other variables (household size, number of females, and education level of the household) were not significantly related to the amount of processed fluid milk consumed by the houeshold.

Table 5

Statistics for the Consumption Function Estimation Equation for Raw Fluid Milk Households only, Lahore, 1976

Variable or Statistic	Unstandardized B's	F-Ratio	R^2
Income	0.00151	177.21*	0.50906
Household size	0.29428	25.34*	0.59689
No. of children less than 5 years	0.44271	23.72*	0.63920
No. of females in the household	−0.08864	1.12	0.64098
Household education	0.00684	0.16	0.64125
Constant	−0.21881	—	—

*Significant at the one percent level.

The foregoing regression analyses suggest that household income and the number of children less than 5 years of age were the two variables that were found significantly related to the amount of fluid milk consumed in all

three regression models. Whereas household size did matter very significantly for all milk households and those which consumed raw fluid milk only, it was not significant in case of those households which consumed processed fluid milk only. This may be because of the fact that processed fluid milk was purchased by most of the household which were not quite satisfied with their previous experience of buying raw fluid milk and had instead switched to processed fluid milk due to its non-adulteration. The number of females in the household had a significant effect on the amount of fluid milk consumed by the households when all of them were considered together. However, it did not make a significant difference when considered for households consuming each kind of milk separately. Contrary to what was expected, education did not appear to be a significant factor in determining fluid milk consumption in any of the three regression equations considered separately.

Table 6

Statistics for the Consumption Function Estimation Equation for Processed Fluid Milk Households only, Lahore 1976

Variable or statistic	Unstandardized B's	F-Ratio	R^2
Income	0.00098	79.93*	0.53921
No. of children less than 5 years	0.84480	34.93*	0.70629
Household size	0.10161	1.29	0.71058
Household education	0.01474	0.69	0.71339
No. of females in the household	−0.08565	0.45	0.71506
Constant	1.07848	—	—

*Significant at the one percent level.

CONCLUSIONS

The results of this study indicate the extent of usage of processed fluid milk and consumer attitudes in this regard. The proportion in which raw and processed fluid milk was purchased by households varied from one household to the other. In general, the majority of the households purchased processed fluid milk only to supplement their daily milk supply because they were not able to purchase enough good quality raw fluid milk.

The Lahore Development Authority's (LDA) plan to transfer milk producing animals and their owners to outskirts of the city would have far reaching effects on the fluid milk supply system in the city of Lahore. Specifically, this shift would create problems not only for the neighbourhood milkman's source for raw fluid milk but also for consumers in general. This was believed to be the only source through which good quality milk, could be obtained.

However, in the wake of LDA's planned transfer of milk animals and their owners to cattle colonies outside the city, consumer acceptance of processed fluid milk could be enhanced by opening additional distribution booths and through adequate promotional measures. As a result of this plan, some of the raw fluid milk producers might sell their milk animals and prefer to stay

in the city rather than moving to distant areas with their animals. Similarly, certain raw fluid milk dealers and retailers may find it more convenient and profitable to sell processed fluid milk if they are provided certain incentives by the milk plant management such as free delivery of processed fluid milk to their, shops etc. These suggestions emphasize the need to increase and stabilize the production of processed fluid milk by the Lahore Milk Plant. When enough raw fluid milk made available, this could be accomplished by utilizing the unused capacity of the present plant instead of opening another similar plant. The inability of the milk plant to secure enough supplies of raw fluid milk makes it necessary to reconstitute milk from dry skim milk and butter oil which imparts an unpleasant flavour to processed milk and thus affects consumer acceptability. The fact that consumers are used to high butterfat milk indicates the need to market processed milk with a higher butterfat content. Moreover, reconstituted milk (due to its different taste) should be sold under a separate name and possibly, at a lower price.

A great majority of the households were not satisfied with processed fluid milk because they did not consider it as tasty and nutritious as raw fluid milk. This suggests the need for consumer education to familiarize them with the process of pasteurization and the nutritive value of the clean, unadulterated pasteurized fluid milk. Unless the qualitative and nutritive worth of processed fluid milk is established, government plans for establishing milk plants in other cities would face similar lack of acceptance and rigidity on the part of consumers.

Based on the results of this study, it is recommended:

> that butterfat content of processed fluid milk be increased from the present 3.5 percent to at least 5 percent. This is necessary because consumers are traditionally used to raw fluid milk which contains 5 to 8 percent butterfat;

> that processed fluid milk should not be homogenized. It was the common practice of the household to boil milk before use which forms a layer of butterfat and protein at the top. Boiling homogenized processed fluid milk does not show as thick a layer which is believed to restrict consumer acceptability;

> that the price of processed fluid milk with higher butterfat content could be increased to the level of raw fluid milk or higher without an adverse effect on sales. The survey indicated that consumers were satisfied with the quality of processed fluid milk as compared to raw fluid milk. Thus, it is believed that if high butterfat pasteurized milk is provided at a higher price but at better quality than available raw milk, it would be preferred by a great majority of households;

> that the number of distribution booths be increased to facilitate consumers in purchasing processed fluid milk and milk products;

> that an aggressive sales and advertising policy be adopted in order to promote the use of processed fluid milk;

> that enough refrigeration facilities be provided at the distribution booths and also refrigerated mini-trucks be used for transporting processed fluid milk to these booths and other outlets. This would ensure the supply of milk and milk products in their best condition to consumers. Furthermore, such facilities would allow the distri-

bution outlets to remain open for more hours which would result in increased sales of available products. This would also minimize losses to the milk plant due to unsold milk becoming unfit for use, especially during hot summer months.

Appendix Table 1

Correlation Matrix of Independent Variables Included in Consumption Function Estimation Equations

Variable	Income	Household Size	No. of children less than 5 years old	No. of females in the household	House-hold Educa-tion
Income	1.000	0.337	0.073	0.127	0.119
Household size		1.000	0.154	0.752	0.087
No. of children less than 5 years old			1.000	0.005	0.114
No. of female in the household				1.000	0.057
Household education					1.000

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