Analysis of Pakistan's House Hold Expenditure Data Based on Quadratic Spline Expenditure System

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Abstract

Generalizing quadratic expenditure system to spline specification in which the number and locations of knots are determined endogenously on the basis of Maximum Likelihood criterion, this study analyzes household expenditure patterns in rural and urban Pakistan for 12 food and 10 non-food commodity groups. Flexibility in the Engle equations systems resulting from the spline specification reveals that household consumption goods cannot be uniquely classified into necessities and luxuries, rather the classification changes substantially across income ranges. Thus a uniform structure of taxes and government expenditures will have varying implications for budget allocation and welfare of different income classes and, therefore, specific income transfer policies need to be supplemented with the uniform tax and expenditure packages.

1. Introduction

The analysis of Engle curves, which measure the relationship between total household expenditure and the expenditure on particular consumer goods, provide useful information on the differences in consumption pattern across various income classes. Since in applications to cross-section data goods' prices are held constant, the differences in consumption pattern across households during a given period of analysis can be mainly attributed to differences in incomes or expenditures. The use of Engle equations in the analysis of consumer behavior is a popular practice due to their simple econometric structure and easy data availability. The survey articles of Brown and Deaton (1972) and Blundell (1988) provide rich international evidence. In Pakistan a number of studies, including Ahmed and Malik (1989), Cheema and Malik (1984, 1985), Malik (1982), Malik *et.al.* (1987, 1988, 1993), Burney and Khan (1991) and Shamim (1999), have analyzed various aspects of household budget allocation behavior.

An important limitation of almost all these studies is that they impose a rigid parametric structure on the system to yield inflexible consumer behavior with respect to changes in household budget. The flexibility achieved through the so called flexible functional forms of demand systems, such as *Quadratic Expenditure System*, *Almost ideal demand System* or *Adilog System*, remains insufficient because even these systems assume the same set of parameters for all levels of household incomes. Thus almost all well-known Engle equations systems contain only few parameters and as such are unable to pick up all type of changes in behavior on the shape of Engle equations.

The availability of large sample through data has made it possible to carry out piece-wise regression analysis using dummy variables for shifts in the Engel curves. The flexibility of budget allocation behavior obtained through piece-wise regression is obtained at a cost. The resulting discontinuity of Engle curves means that it is no more possible to estimate income elasticities at certain levels of income. For obtaining smoothness in Engel curves appropriate restrictions on parameters of the system would be required. The use of shift dummies along with appropriate smoothing restriction results in the functions that are called spline functions. In words of Poirier (1976) "a spline function is a piece wise function in which the pieces are joined together in a suitably smooth fashion". In the system of Engel equations containing sufficient number of parameters, smoothing restrictions can be extended from continuity of the functions to continuity of slopes of the functions and possibility continuity of the curvatures. The resulting flexibility is far more extensive that the one obtained through conventional flexible functional forms. With spline functions specification the researcher also does not have to go through the tedious process of selection among competing functional forms.

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Some of the well-know applications of spline functions to economic analysis include the analyze the money demand elasticity by Barth, Kraft and Kraft (1976) and analysis of the effects of money supply and inflation on interest by Suits et. al. (1977). More recently Karunakaran and Ahmad (1996), and Ahmed and Karunakaran (1997) have employed systems of spline functions for the analysis of household budget data in Australia. The present study uses a comprehensive procedure for estimating spline Engle functions, which are derived on the basis of Quadratic Expenditure System and proposes a search algorithm to locate the number and position of knots (the shift points) of the functions. The empirical analysis is carried out separately for rural and urban samples of households and applies it on micro level data of HIES (Household Integrated Economic Survey) data for the years 2000-01 of Federal Bureau of Statistics, Islamabad. Household consumption is classified into 22 consumption categories consisting of 12 food and 10 non-food categories. The spline Engle equations system is estimated and analysed for these 22 categories of consumption.

2. Spline Engle Equations

Since flexibility of the consumers' budget allocation behavior is obtained through splice specification, we assume a simple demand system namely Pollak and Wales' (1979) Quadratic Expenditure System. This is an extension of the Linear Expenditure System, which assumes that a household's consumption decision is made in two stages. In the first stage the household spends income on purchasing a subsistence amount of each commodity. In the second stage the remaining income is spent on buying the commodities in a variable proportion to yield supernumerary expenditures. The Quadratic Expenditure System is flexible enough to allow continuity of Engle functions and their derivatives in the spline specification. Denoting the expenditure on consumption category i and total consumption expenditure by E_i and TE respectively and the random error term in Engle equation of category i by U_i, the Engle equations under the QES can be written as

$$E_i = \alpha_i + \beta_i TE + \gamma_i TE^2 + U_i \tag{1}$$

The parameters of the above system like those of the other well-known systems are independent of the level of total expenditure. However, the assumption of fixed parameters is not realistic because changes in control variables can induce changes in parameters of the system. Such changes can be captured through extension of the above system to spline functions. To capture these structural shifts in the relationships at m arbitrary point known as knots, define dummy variables $D_i = 1$ for $TE \geq TE_i$ and $= 0$ otherwise. Now the parameters of equation (1) can be varied across knots as

$$\alpha_i = \alpha_{i0} + \sum_{k=1}^{m} \alpha_{ik} D_k \,,\ \beta_i = \beta_{i0} + \sum_{k=1}^{m} \beta_{ik} D_k \,,\ \gamma_i = \gamma_{i0} + \sum_{k=1}^{m} \gamma_{ik} D_k \tag{2}$$

Substitution of (2) into equation (1) yields the following piece-wise equation.

$$E_i = \left(\alpha_{i0} + \sum_{k=1}^{m} \alpha_{ik} D_k\right) + \left(\beta_{i0} + \sum_{k=1}^{m} \beta_{ik} D_k\right) TE + \left(\gamma_{i0} + \sum_{k=1}^{m} \gamma_{ik} D_k\right) TE^2 + U_i \tag{3}$$

In order to make the above equation continuous at all knots we impose continuity conditions $\underset{TE \to TE_k^-}{\text{Limit}} (E_k) = \underset{TE \to TE_k^+}{\text{Limit}} (E_k)$, which yield after canceling out common terms from both sides:

$$\alpha_{ik} = -\beta_{ik} TE_k - \gamma_{ik} TE_k^{\,2}, \quad k = 1, \ldots, m \tag{4}$$

Imposing the above restrictions on equation (3) yields after simplification:

$$E_i = \alpha_{i0} + \beta_{i0} TE + \gamma_{i0} TE^2 + \sum_{k=1}^{m} \beta_{ik} \left(TE - TE_k\right) D_k + \sum_{k=1}^{m} \gamma_{ik} \left(TE^2 - TE_k^{\,2}\right) D_k + U_i \tag{5}$$

Although the above function is continuous, its slope still remains discontinuous at knots. For many economic applications such as computation of income elasticities, continuity of slope is also required. Thus consider expression for slope of the function (5):

$$\frac{\partial E_i}{\partial TE} = \beta_{i0} + 2\gamma_{i0} TE + \sum_{k=1}^{m} \beta_{ik} D_k + \sum_{k=1}^{m} 2\gamma_{ik} TE\, D_k \tag{6}$$

To impose continuity of the slopes at various knots we set $\underset{TE \to TE_k}{Limit}\left(\frac{\partial Ei}{\partial TE}\right) = \underset{TE \to TE_k^+}{Limit}\left(\frac{\partial Ei}{\partial TE}\right)$. Evaluating the slopes from (6) and substituting in (5) yields after simplification:

$$\beta_{ik} = -2\gamma_{ik}\mathrm{TE}_k, \quad k = 1,\ldots,m \tag{7}$$

Substitution of the above restrictions into equation (5) yields the following spline function, which is continuous and is continuously differentiable at all the points including knots.

$$E_i = \alpha_{i0} + \beta_{i0}TE + \gamma_{i0}TE^2 + \sum_{k=1}^{m}\gamma_{ik}\left(TE - TE_k\right)^2 D_k + U_i \tag{8}$$

Following standard practice we divide both sides of equation (8) by total expenditure to yield:

$$E_i / TE_i = \alpha_{i0}TE^{-1} + \beta_{i0} + \gamma_{i0}TE + \sum_{k=1}^{m}\gamma_{ik}\left[\left(TE - TE_k\right)^2 / TE\right]D_k + V_i \tag{9}$$

3. Data and Estmation Process

For estimating of the above spline functions for Pakistan we use data from Household Integrated Economic Survey (HIES) 2000-01 of Federal Bureau of Statistics, Islamabad. The survey includes a nationwide sample of 14536 households with 9090 taken from rural sector and the remaining 5446 from the urban sector. The analysis is conducted separately for rural and urban sectors. We classify total expenditure into 12 food categories and 10 non-food categories of consumption. The details of this classification are given in Table A1 in the appendix. To account for demographic differences across households, the household members are classified into seven categories with respect to age and sex and the numbers of household members belonging to various categories are included directly into the spline functions as additional variables. These categories are: babies (age < 2), toddlers (2 ≤ age ≤ 5), female children (5 ≤ age ≤ 15), male children (5 ≤ age ≤ 15), female adults (15 ≤ age ≤ 60), male adults (15 ≤ age ≤ 60) and elderly (aged > 60).

We now turn our attention to the determination of the number and location of knots. The exact location of the knots is not much important because the general shape of spline function is quite flexible and it can in the light of the location. However, changes in the number of knots chosen can produce substantial differences in the shape of the Engle curves. The earlier studies (e.g. Ahmad and Karunakaran, 1997 and Karunakaran and Ahmad, 1996) have fixed arbitrary number of knots and have chosen the location of knots on qualitative judgments e.g. poverty line, average per capita income, etc. A major reason for bypassing the issue was the huge amount of computation work required, especially in the joint determination of the number and location of knots in a large system of equations. Assuming that the number of observations is n, we use the following procedure for the determination of the number of knots and their location.

1. Sort all data in ascending order with respect to total expenditure.
1. Estimate n-2 systems of Engle equations, allowing shift at the observations number m by setting m = 2,…, n-1 alternatively[1]
2. Consider the system that yields maximum value of log-likelihood function. If the shift at the chosen point is statistically insignificant then there is no shift in the system and the algorithm ends. If the shift is significant, the search yields one knot. Let this knot be at the observation number n_1.
3. Repeat the above procedure to search for a knot from observations 2 to n_1-1 and another one from observations n_1+1 to n-1.
4. Suppose the likelihood function attains maximum value with the shifts at observations n_a and n_b, where $n_a < n_1 < n_b$. If both the shifts are insignificant, the algorithm ends and there is only one knot at the observation

[1] Since only one parameter (representing curvature) is subject to change, there must be at least one observation in each of the shift point. If there are k parameters that are subject to change the algorithm will start at observation number k+1 and end at the observation number n-k.

n_1. If the shift at n_a (n_b) is insignificant and the one at n_b (n_a) is significant then there is no knot in the range of observations from 1 to n_1 (n_1 to n) while the point n_b (n_a) represents a knot and the search continues over the ranges of observations n_1 to n_b and n_b to n (1 to n_a and n_a to n_1). In case both the shift at n_a and n_b are significant, both are considered at the knots and the search is continued in the ranges 1 to n_a, n_a to n_1, n_1 to n_b and n_b to n.

5. Continue the above procedure till no more knots are obtained.

According to the above procedure the number and locations of the knots are determined sequentially. Thus at each step a knot is chosen assuming that the locations of the knots already chosen are correct. This introduces arbitrariness and calls for further fine-tuning, which is obtained by carrying out research in the neighborhood of each knot following the procedure outlined above. Thus if two knots come very close to each other or very close to the beginning or end of the data, attempt is made to choose one knot and search is carried out to locate more than one knot together in a single sequence.

Two sets of 22 equations are estimated one each for rural and urban samples. All the equations are estimated as a system using OLS technique.[2]

4. Results and Discussion

The estimated parameters of spline functions for rural and urban samples are shown in Tables A2 and A3 of the appendix. These parameter estimates are used to estimate expenditures on the 22 commodity groups at various levels of total expenditure, while holding the values of demographic variables at the sample means. The estimated expenditures are in turn used to compute total expenditure Elasticities. Tables 1 (a, b) present the estimated total expenditure Elasticities for rural as well as urban samples respectively. The elasticity estimates show that with the exception of wheat all the goods are treated as normal goods at all levels of total expenditure both in rural and urban samples. However, the relationships of Elasticities with the level of total expenditure indicate more complex expenditure patterns than would be revealed by even flexible Engle equations systems. By and large Engel's law seems to have been validated, as expenditure elasticities for the majority of non-food items are greater than one in most income ranges, while the elasticities for the majority of food items are less than one in most income ranges. It is further observed that the magnitudes of expenditure elasticities tend to decline with the increase in total expenditure and this pattern is more prominent in the urban sample. Furthermore, the number of necessities increases with the increase in total expenditure.

Coming now to the patterns of expenditure elasticities of the individual commodity groups, we observe that both in the rural and urban samples the expenditure elasticity of wheat initially declines with the increase in total expenditure and later on it starts increasing. This apparently unexpected change of behaviour can be explained by the observation that household expenditure includes expenditure on servants and beggars, which is expected to rise with the increase in income. In the urban sample wheat also turns into an inferior good in the middle range of total expenditure. Apart from this pattern, elasticity estimates for wheat, pulses & other cereals, edible oil, fruits and vegetables, sugar, tea & drinks and fuels & lightings indicate almost similar consumption behaviour. By and large these expenditure categories are treated as necessity items among poor as well as rich households. In the case of rice, fruit & vegetables, tea & drinks, tobacco and fuel & lighting the expenditure elasticities are around unity for poor households. This shows a stability in their budget shares when there is a moderate change in overall budget size. In other words, these commodities are considered equally important compared to the consumption of other goods. The results show a decline in the elasticities of these items, when we consider the range of middle to higher total expenditure levels, but elasticities remain positive. Thus the expenditures on these categories of goods increase with the increase in total expenditure, but at diminishing rates.

[2] Although contemporaneous correlation across error terms of various equations is possible, OLS technique is still applicable because all equations contain the same set of explanatory variables.

Table 1(a): Total Expenditure Elasticities for Food Groups

Commodity Group	Region	Per Capita Annual Total Expenditure									
		5000	7500	10000	15000	20000	25000	30000	35000	40000	50000
Wheat	Rural	0.330	0.267	0.186	0.447	0.861	0.904	0.938	0.966	0.990	1.030
	Urban	0.255	0.135	0.101	-0.065	-0.378	-0.002	0.303	0.317	0.325	0.328
Rice	Rural	1.164	1.065	0.793	0.775	0.897	0.897	0.894	0.888	0.880	0.862
	Urban	1.293	0.870	0.762	0.522	0.213	0.353	0.452	0.483	0.509	0.548
Pulses & other cereals	Rural	0.890	0.702	0.500	0.483	0.631	0.689	0.734	0.771	0.802	0.852
	Urban	0.748	0.548	0.493	0.284	-0.058	0.289	0.532	0.555	0.573	0.594
Dairy	Rural	1.360	1.319	0.974	0.864	0.925	0.991	1.046	1.092	1.132	1.199
	Urban	1.089	0.904	0.798	0.574	0.303	0.602	0.779	0.794	0.805	0.817
Edible oils	Rural	0.864	0.711	0.694	0.664	0.662	0.764	0.851	0.927	0.994	1.105
	Urban	0.786	0.588	0.538	0.352	0.056	0.303	0.476	0.502	0.521	0.548
Meats	Rural	1.653	1.400	1.370	1.007	0.726	0.773	0.809	0.837	0.859	0.895
	Urban	1.890	1.502	1.267	1.042	0.900	0.865	0.857	0.877	0.894	0.919
Poultry & fish	Rural	2.401	1.984	1.363	1.232	1.270	1.175	1.112	1.064	1.025	0.962
	Urban	4.002	2.437	1.836	1.501	1.389	1.121	1.003	0.994	0.986	0.971
Fruit & vegetables	Rural	0.937	0.810	0.852	0.668	0.455	0.538	0.613	0.680	0.741	0.847
	Urban	0.954	0.886	0.832	0.714	0.577	0.634	0.674	0.698	0.716	0.740
Sugar	Rural	0.844	0.564	0.461	0.566	0.772	0.802	0.822	0.836	0.845	0.857
	Urban	0.668	0.304	0.303	0.223	0.059	0.157	0.234	0.257	0.277	0.308
Tea & drink	Rural	0.887	0.689	0.700	0.719	0.728	0.726	0.714	0.695	0.670	0.608
	Urban	1.042	0.761	0.784	0.792	0.775	0.655	0.602	0.637	0.666	0.711
Tobacco	Rural	0.854	0.971	1.211	0.884	0.481	0.450	0.399	0.328	0.238	0.008
	Urban	1.320	1.108	0.963	0.736	0.515	0.758	0.889	0.900	0.907	0.917
Misc. food	Rural	1.136	0.984	1.273	1.320	1.241	1.120	1.033	0.962	0.899	0.782
	Urban	0.894	1.005	1.335	1.690	1.812	0.991	0.647	0.672	0.691	0.716

Table 1(b): Total Expenditure Elas ticities for Non-Food Groups

Commodity Group	Region	Per Capita Annual Total Expenditure									
		5000	7500	10000	15000	20000	25000	30000	35000	40000	50000
Fuel & lighting	Rural	0.941	0.752	0.801	0.744	0.670	0.742	0.800	0.850	0.893	0.964
	Urban	0.730	0.592	0.588	0.517	0.394	0.568	0.687	0.735	0.776	0.845
Entertainment	Rural	5.576	2.984	2.192	1.660	1.458	1.355	1.299	1.264	1.242	1.218
	Urban	3.559	2.708	2.313	2.101	2.013	1.221	0.930	0.957	0.980	1.018
Transport	Rural	1.720	1.616	1.395	1.497	1.561	1.420	1.342	1.295	1.263	1.227
	Urban	2.711	2.283	1.910	1.719	1.678	1.562	1.480	1.405	1.357	1.301
Clothing & footwear	Rural	0.826	0.787	0.834	0.787	0.733	0.819	0.891	0.952	1.005	1.094
	Urban	0.890	0.712	0.774	0.852	0.894	0.705	0.621	0.663	0.699	0.758
Housing	Rural	1.143	1.441	1.421	1.314	1.214	1.087	0.992	0.911	0.837	0.693
	Urban	1.320	1.632	1.454	1.336	1.302	1.257	1.219	1.179	1.150	1.111
Health	Rural	1.151	1.042	1.107	0.990	0.879	0.926	0.963	0.994	1.020	1.066
	Urban	1.012	1.183	1.063	0.909	0.787	0.870	0.912	0.918	0.922	0.925
Education	Rural	1.792	1.936	1.705	1.072	0.762	1.231	1.577	1.807	1.953	2.100
	Urban	2.842	2.615	1.926	1.564	1.455	1.309	1.227	1.179	1.144	1.095
Personal care	Rural	1.012	1.021	1.132	1.041	0.938	0.972	0.999	1.022	1.042	1.076
	Urban	1.127	1.119	1.114	1.123	1.135	1.012	0.961	0.970	0.977	0.989
Durables	Rural	1.778	1.806	1.946	1.343	1.032	1.297	1.489	1.625	1.721	1.841
	Urban	2.393	1.708	1.712	1.749	1.760	1.070	0.827	0.926	1.012	1.155
Misc. non-food	Rural	1.276	1.302	1.489	1.604	1.562	1.353	1.228	1.139	1.070	0.959
	Urban	1.325	1.140	1.212	1.318	1.399	1.532	1.518	1.410	1.338	1.247

The elasticity estimates for dairy and health initially decrease with the increase in total expenditure. As the total expenditure increases further, the elasticity again starts increasing. Similar pattern holds for education in the rural region. There can be two explanations for this pattern. The first explanation, which seems more plausible, is that poor households cannot afford spending on these commodity groups because they need to meet the expenditures on more basic consumption items like cereals, edible oils, fruits & vegetables and sugar. Middle-income households, on the other hand, are in a better budgetary position to treat these important goods as necessities. The elasticities among the rich households are again higher because as the budget size increases, households can switch to better quality products like packed milk, important cheese, private health services and education from private institutes, the expenditures on which are more sensitive to changes in the total expenditure as compared to the relatively lower

quality products. Another explanation could be that at higher income levels households get more aware of the importance of these three commodity groups and their expenditures increase faster than the increase in income. In the urban region expenditure elasticity for education continues to remain above one, though it decreases monotonically with the increase in total expenditure.

The expenditure elasticities for the high quality sources of protein, namely meat and poultry & fish, are substantially greater than one among the rich households and gradually decline towards one. Poultry & fish remains a luxury good even at the higher levels of total expenditure, especially among rural households. The expenditure elasticities for clothing & footwear and personal care are close to one and remain fairly stable between rural and urban households and across different levels of total expenditure. On the other hand, the expenditure elasticities for entertainment, transport, housing, education, durables, and miscellaneous non-food are generally quite high, especially among the poor and middle-income households. An interesting observation is that the expenditure elasticities for cereals (wheat, rice, pulses and other cereals), dairy products are substantially lower among rural households as compared to the ones among the urban households.

5. Concluding Remarks

Using micro level household data this study analyzes household expenditure patterns in rural and urban Pakistan by classifying the total household expenditure into 12 food and 10 non-food commodity groups. The analysis is based on Engle equations estimated under quadratic expenditure system extended to construct quadratic spline functions. A novel aspect of the analysis is that the number and locations of knots for the systems of spline functions are determined endogenously using Maximum Likelihood criterion. The study finds that in rural Pakistan the expenditure elasticities of all the 22 commodity groups are positive at all levels of total expenditure. Almost the same pattern holds for urban households except that wheat is considered 'inferior good' among middle-income households. The data supports Engel's law as expenditure elasticities for the majority of non-food items are greater than one in most income ranges, while the elasticities for the majority of food items are less than one in most income ranges. It is further observed that the magnitudes of expenditure elasticities tend to decline with the increase in total expenditure and this pattern is more prominent in the urban sample. Furthermore, the number of necessities increases with the increase in total expenditure.

The analysis shows that the expenditure elasticities vary substantially between rural and urban households and across various income levels. However, the relationships of elasticities with the level of total expenditure indicate more complex expenditure patterns than would be revealed by even flexible Engle equations systems. The flexibility of Engle equations resulting from Spline specification reveals unveils many interesting patterns of the household budget allocation. The changing slopes and curvatures of Engle equations suggest that even a uniform tax structure will have varying implications for budget allocation and welfare of households belonging to different income classes. This suggests that a uniform tax structure will have varying implications for budget allocation and welfare of households belonging to different income classes. This information can be gainfully utilized in preparing income transfer policies that could supplement uniform tax regimes.

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Appendix

Table A1: Commodity Groups

Commodity Group	Details
Wheat	Wheat flour and grains
Rice	Whole and broken rice
Pulses & Other Cereals	Rice flour, maize (whole & flour), barley and jawar (whole & flour), semolina, white flouu, gram flour and other cereal products such as corn flakes, wheatics, rice flakes, astoo, gram (black & white), mash, moong, masoor and arhar.
Dairy	Milk, lassi, milk (packed), milk powder for infants and adults, condensed milk, butter, margarine, cheese, ice cream, kulfi, yogurt, cream, firni, kheer.
Edible Oil	Butter oil, vegetable ghee, mustard oil, cooking oil, other edible oils.
Meat	Mutton, beef, dried meat
Poultry & Fish	Fish (fresh, frozen and dried), prawn (fresh and canned), chicken (live and meat), eggs, others.
Fruits & Vegetables	Bananas, oranges, apples, grapes, mangos, dates, apricots, jamans,. Potatoes, tomatoes, onions, garlic, tinda, okra, peas, mustard leaves, carrot, green chilies, moongra, other fresh and cold storage, canned and dried fruits and vegetables.
Sugar	Sugar (mill prepared), brown sugar, and gur/shakar.
Tea & Drink	Black & green tea (lose and packed), coffee and other preparations like ovaltine and horlics, etc., Syrups, carbonated beverages like Coca Cola, Fanta etc., squashes, sugarcane juice, fruit juices and tetra pack.
Tobacco	Cigarettes, cigar, raw tobacco, chewing tobacco and snuff, pan leaves, katha, choona and sonf-suparee.
Miscellaneous food	Salt, cinnamon, caraway, red chillies, coriander seed, ginger, garlic, cloves, and other spices; backed and fried food: biscuits, bread etc., pastries, puri, samosa, and other backed and fried products such as pop corn; readymade food, readymade food purchased from restaurants, and hotels, and consumed at home; breakfast, lunches, dinners and snacks consumed in hotels; honey, chocolate, burfi, jalebi, halwa, other sweets, pickles, jams, custard, artificial flavors, baking powders, yeast, ice, vinegar; dry fruits: almond, walnut, pistachio, chilgoza, and other nuts.
Fuel & Lighting	Gas (pipe and cylinder), electricity, firewood, kerosene oil, cher oil, dung cakes, match box, candles, agricultural wastes for fuel purposes such as cotton and tobacco sticks.
Entertainment	Tickets for cinemas and musical concerts, camera films and developing charges, expenses on news papers, magazines and novels, etc., lodging charges at hotels, lottery tickets, social and recreational fee, expenses on hobbies, children toys, annual license fee, radio, television, VCR cassettes, photographic equipments such as cameras, other musical instruments, other recreational equipments, such as shot gun, sports goods, etc.
Transport	Petrol charges, lubricants and oils, repairing of wheel puncture, garage rent, expenses on travelling by road, by train fee, expenses on tyres, and by air, other travelling charges like camels, donkeys etc, for cars, motorcycles registration fee, annual insurance, annual driving license repair charges and service charges.
Clothing & Footwear	Woollen and cotton cloth, cotton rayon, wool for sweaters, new and second hand readymade garments, dupattas, tread and yarn of wool, other tailoring and embroidery, New foot wear made of leather, plastic and other material, second hand footwear made of other material, repair of footwear, polishes, shoe shining etc.
Housing	House rent, rent free accommodation, owner occupied accommodation, expenses on miner repairs, house and property tax, summer cottage rent, other household expenses such as insurance.
Health	Purchase of medicine, eye glasses, hospitalization expenses, medical fees, expenditure incurred on dental services, optics, laboratory, physician's charges and hearing aids.
Education	School and college fees, books, membership fee of societies etc, hostel charges, exercise notebooks, electrical devices such as calculators, other educational expenses like bags for carrying books, stationary supplies such as pen, pencils, stapling machine, ink etc.
Personal Care	Personal care: Toilet soap, toothpaste, tooth brush, miswak, cosmetics, shampoo, facial cream, hair oil, hair cutting, dry cleaning, dying charges, beauty parlour services. Personal effects: brief case and handbags of leather and plastic, imitation and plastic jewellery, gloves, socks, umbrella, repair charges of personal effects and personal durable effects.

Durables	Kitchen appliances: refrigerators (electric and kerosene oil), cooking stove (electric, gas and kerosene oil), pressure cooker, cooking range (electric and gas), stainless steel, other non-electric items, and other equipments for kitchen. Fixture and furniture: Wooden, metal and plastic furniture, sanitary fittings, floor covering (hand made and machine made), and other furnishing. Other household effects: electric fan, table lamp (electric and kerosene oil), air conditioner, air cooler, heater (electric, gas and kerosene oil), sewing machine, knitting machine, trunks, suit cases and other like scissors, lunch kit, thermos etc. Laundry equipments: washer and washer/dryer combination machine, iron (electric and coal), and other laundry equipments such as buckets, mugs, vacuum cleaners etc.
Miscellaneous non-food	Crockery, earthenware such as ghara and sorahi etc, glassware, plastic-ware, wood-ware, cutlery for daily use, chinaware and silverware. Readymade pillow covers, bed sheets, quilts etc, purchase of cloth for bed sheets, blankets, pillows and table cloths, purchase of cotton for quilts, pillows and sheets etc, carding and stitching charges of cotton, other attaching charges for household textiles. Household laundry, cleaning and paper articles: soap, bleaches, and other laundry articles, washing powder, cleaners, sponges, buckets, wrappers, paper napkins, wax paper and other paper articles. Other miscellaneous household expenses on goods and services: wages and Salaries paid to servants, gardeners, sweepers etc, telephone and postal charges, storages, safe deposits and locker charges, pocket money to children, expenses on maintenance of pets, poultry etc. Other household effects: bulbs, tubes, plugs, battery cells, others like lampshades, chimneys etc. Other miscellaneous expenditure: losses of cash, personal and household effects, expenditure on religious and other occasional functions, such as marriages, birthdays, deaths etc, legal expenses, insurance premiums such as fire, accident and travel insurance.

Commodities→	Wheat	Rice	Cereals & pulses	Dairy	Edible oil	Meat	Fish & poultry	Fruit & vegetable	Sugar	Tea & drink	Tobacco
Intercept	0.0901 (6.94)*	0.0169 (3.00)*	0.0454 (7.59)*	0.0652 (3.09)*	0.0983 (13.48)*	0.0377 (4.86)*	-0.0048 (-1.03)	0.1133 (14.65)*	0.0690 (13.84)*	0.0372 (10.83)*	0.0196 (2.46)*
Number of babies	-0.0093 (-3.72)*	0.0027 (2.50)*	-0.0001 (-0.05)	0.0019 (0.47)	-0.0033 (-2.37)*	0.0016 (1.08)	0.0019 (2.12)*	0.0000 (0.00)	-0.0011 (-1.17)	-0.0016 (-2.48)*	-0.0003 (-0.18)
Number of toddlers	-0.0029 (-1.32)	0.0009 (0.98)	0.0013 (1.31)	-0.0022 (-0.64)	-0.0022 (-1.79)**	0.0001 (0.05)	0.0024 (3.07)*	-0.0039 (-3.03)*	-0.0006 (-0.69)	-0.0002 (-0.41)	-0.0019 (-1.44)
Number of male children	0.0001 (0.09)	-0.0006 (-0.91)	-0.0007 (-1.02)	-0.0005 (-0.19)	-0.0017 (-2.02)*	0.0009 (1.06)	0.0004 (0.79)	-0.0021 (-2.35)*	-0.0000 (-0.05)	-0.0008 (-2.14)*	-0.0015 (-1.68)**
Number of female children	-.0003 (-0.16)	-0.0004 (-0.53)	-0.0005 (-0.67)	0.0026 (0.95)	-0.0005 (-0.49)	0.0036 (3.66)*	0.0008 (1.37)	-0.0003 (-0.29)	0.0008 (1.20)	0.0003 (0.69)	-0.0021 (-2.02)*
Number of male adults	-0.0011 (-0.61)	0.00091 (1.18)	-0.0003 (-0.36)	0.0006 (0.20)	-0.0007 (-0.67)	0.0018 (1.68)**	0.0005 (0.81)	-0.0025 (-2.33)*	-0.0009 (-1.24)	-0.0010 (-2.08)*	0.0046 (4.17)*
Number of female adults	-0.0004 (-0.21)	0.0006 (0.64)	0.0007 (0.68)	0.0071 (2.07)*	-0.0018 (-1.54)	-0.0021 (-1.69)**	-0.0007 (-0.89)	-0.0021 (-1.64)**	0.0004 (0.52)	0.0002 (0.35)	-0.0031 (-2.40)*
Number of elderly	-0.0052 (-1.67)**	0.0009 (0.63)	-0.0003 (-0.19)	0.0081 (1.59)	-0.0003 (-0.17)	-0.0028 (-1.52)	-0.0014 (-1.24)	-0.0021 (-1.14)	0.0012 (0.99)	-0.0003 (-0.40)	0.0006 (0.34)
Inverse of total expenditure	276.18 (11.90)*	-10.064 (-1.00)	-17.899 (-1.68)**	-19.050 (-0.51)	-29.543 (-2.27)*	-64.971 (-4.69)*	-3.9017 (-0.47)	-44.853 (-3.24)*	-40.112 (-4.50)*	-18.071 (-2.94)*	14.923 (1.05)
Total expenditure	-0.0451 (-3.08)*	0.0013 (0.21)	-0.0202 (-3.00)*	0.0862 (3.63)*	-0.0407 (-4.96)*	0.0025 (0.29)	0.0257 (4.91)*	-0.0397 (-4.55)*	-0.0413 (-7.35)*	-0.0177 (-4.57)*	0.0016 (0.17)
D1(TE-5600)/TE	0.0162 (0.62)	-0.0154 (-1.36)	0.0008 (0.07)	-0.1840 (-4.32)*	0.0297 (2.03)*	0.0079 (0.51)	-0.0373 (-3.99)*	0.0401 (2.58)*	0.0263 (2.62)*	0.0152 (2.20)*	0.0123 (0.77)
D2(TE-9200)^2/TE	0.0610 (2.53)*	0.0166 (1.59)	0.0221 (1.99)*	0.1010 (2.58)*	0.0048 (0.36)	-0.0314 (-2.18)*	0.0160 (1.85)**	-0.0285 (-1.99)*	0.0210 (2.27)*	0.0015 (0.23)	-0.0300 (-2.03)*
D3(TE-15000)^2/TE	-0.0308 (-2.31)*	-0.0029 (-0.50)	-0.0024 (-0.40)	0.0047 (0.22)	0.0092 (1.23)	0.0213 (2.67)*	-0.0052 (-1.10)	0.0299 (3.76)*	-0.0062 (-1.22)	0.0002 (0.04)	0.0140 (1.71)**

Note: The parameters in the last four rows are multiplies by 10000. The t-statistics significant at 5% and 10% level are indicated by * and ** respectively.

Commodities→	Misc. food	Fuels & energy	Entertainment	Transport	Clothing& footwear	Housing	Health	Education	Personal care	Durables	Misc. non-food
Intercept	0.0552 (5.85)*	0.1281 (12.56)*	-0.0071 (-2.09)*	0.0039 (0.479)	0.1019 (11.53)*	0.0095 (0.52)	0.0414 (4.49)*	-0.0101 (-2.98)*	0.031588 (6.99)*	0.00133 (0.25)	0.0564 (3.40)*
Number of babies	0.0001 (0.06)	0.0016 (0.84)	0.00113 (1.74)**	0.0024 (1.551)	-0.0011 (-0.63)	-0.0009 (-0.24)	0.0032 (1.81)**	-0.0009 (-1.36)	0.000736 (0.85)	-0.0002 (-0.24)	0.0014 (0.44)
Number of toddlers	-0.0022 (-1.37)	-0.0038 (-2.21)*	0.0006 (1.00)	0.0041 (3.021)*	-0.0022 (-1.49)	0.0051 (1.65)**	0.0019 (1.24)	-0.0005 (-0.91)	-0.00015 (-0.20)	-0.0006 (-0.65)	0.0069 (2.50)*
Number of male children	0.0018 (1.65)**	-0.0011 (-0.97)	0.0002 (0.43)	0.0010 (1.062)	0.0001 (0.09)	-0.0013 (-0.61)	-0.0005 (-0.47)	0.0028 (7.28)*	-0.00073 (-1.42)	0.0009 (1.44)	0.0033 (1.76)**
Number of female children	-0.0004 (-0.31)	0.0006 (0.48)	0.0006 (1.39)	-0.0001 (-0.134)	-0.0016 (-1.40)	-0.0055 (-2.36)*	-0.0010 (-0.80)	0.0024 (5.55)*	0.000213 (0.37)	-0.0006 (-0.93)	0.0012 (0.59)
Number of male adults	-0.0001 (-0.04)	-0.0066 (-4.70)*	0.0011 (2.33)*	0.0035 (3.111)*	0.0012 (0.98)	-0.0057 (-2.25)*	-0.0004 (-0.33)	0.0019 (3.97)*	0.000716 (1.15)	-0.0005 (-0.69)	0.0029 (1.28)
Number of female adults	-0.0012 (-0.76)	-0.0003 (-0.16)	-0.0001 (-0.22)	-0.0002 (-0.125)	0.0012 (0.86)	0.0004 (0.14)	-0.0008 (-0.53)	0.0004 (0.69)	0.0001 (0.13)	0.0018 (2.19)*	-0.0002 (-0.06)
Number of elderly	-0.0016 (-0.69)	0.0041 (1.67)**	0.0003 (0.42)	-0.0024 (-1.234)	0.0018 (0.84)	-0.0025 (-0.57)	0.0031 (1.38)	-0.0000 (-0.04)	-0.0023 (-2.06)*	-0.0002 (-0.13)	0.0014 (0.34)
Inverse of total expenditure	-51.349 (-3.04)*	-72.632 (-3.98)*	2.199 (0.36)	-15.737 (-1.078)	17.929 (1.14)	153.936 (4.70)*	-32.907 (-1.99)*	7.454 (1.23)	-4.032 (-0.50)	-3.529 (-0.38)	-43.95 (-1.48)
Total expenditure	-0.0213 (-2.01)*	-0.0566 (-4.93)*	0.0100 (2.63)*	0.0269 (2.93)*	-0.0299 (-3.01)*	0.1280 (6.18)*	-0.0090 (-0.86)	0.0134 (3.50)*	-0.0016 (-0.32)	0.0084 (1.43)	0.0195 (1.04)
D1(TE-5600)/TE	0.0481 (2.54)*	0.0565 (2.76)*	-0.0074 (-1.09)	-0.0274 (-1.67)**	0.0306 (1.72)**	-0.0858 (-2.33)*	0.0159 (0.86)	-0.0099 (-1.46)	0.0120 (1.32)	0.0047 (0.45)	0.0503 (1.51)
$D2(TE-9200)^2/TE$	-0.0237 (-1.35)	-0.0137 (-0.72)	-0.0022 (-0.35)	0.0208 (1.37)	-0.0157 (-0.96)	-0.0366 (-1.08)	-0.0147 (-0.86)	-0.0109 (-1.74)**	-0.0167 (-1.99)*	-0.0209 (-2.16)*	-0.0196 (-0.64)
$D3(TE-15000)^2/TE$	-0.0070 (-0.72)	0.0155 (1.48)	-0.0002 (-0.05)	-0.0192 (-2.29)*	0.0192 (2.11)*	-0.0216 (-1.15)	0.0088 (0.93)	0.0129 (3.71)*	0.0074 (1.59)	0.0131 (2.44)*	-0.0606 (-3.56)*

Note: The parameters in the last four rows are multiplies by 10000. The t-statistics significant at 5% and 10% level are indicated by * and ** respectively.

Commodities→	Wheat	Rice	Cereals & pulses	Dairy	Edible oil	Meat	Fish & poultry	Fruit & vegetable	Sugar	Tea & drink	Tobacco
Intercept	0.0857 (5.14)*	0.0361 (4.75)*	0.0397 (5.42)*	0.1562 (6.49)*	0.0873 (8.96)*	0.0388 (2.64)*	-0.0039 (-0.41)	0.0910 (6.85)*	0.0652 (10.25)*	0.0374 (6.64)*	0.0264 (1.91)**
Number of babies	-0.0044 (-2.29)*	-0.0008 (-0.92)	-0.0018 (-2.20)*	0.0002 (0.08)	-0.0027 (-2.43)*	0.0044 (2.64)*	0.0015 (1.36)	-0.0014 (-0.91)	-0.0010 (-1.32)	0.0000 (0.01)	-0.0019 (-1.20)
Number of toddlers	-0.0051 (-2.87)*	0.00118 (1.44)	-0.0001 (-0.18)	0.0012 (0.47)	0.0001 (0.10)	0.0007 (0.47)	0.0018 (1.75)*	0.0013 (0.89)	0.0000 (0.06)	-0.0006 (-1.03)	0.0016 (1.02)
Number of male children	-0.0005 (-0.42)	-0.0009 (-1.58)	-0.0008 (-1.54)	-0.0021 (-1.18)	-0.0010 (-1.38)	0.0017 (1.57)	0.0003 (0.38)	-0.0020 (-2.01)*	-0.0009 (-1.86)**	-0.0002 (-0.46)	-0.0003 (-0.28)
Number of female children	-0.0014 (-1.12)	0.0004 (0.75)	-0.0003 (-0.56)	-0.0065 (-3.59)*	-0.0013 (-1.78)**	0.0026 (2.32)*	0.0013 (1.84)**	-0.0003 (-0.26)	-0.0012 (-2.46)*	-0.0006 (-1.30)	-0.0004 (-0.39)
Number of male adults	-0.0025 (-1.95)*	0.0006 (1.02)	-0.0006 (-1.02)	-0.0002 (-0.13)	0.0005 (0.71)	0.0011 (0.93)	0.0005 (0.63)	-0.0015 (-1.49)	-0.0008 (-1.69)**	-0.0002 (-0.35)	0.0015 (1.38)
Number of female adults	0.0011 (0.79)	0.0002 (0.41)	0.0001 (0.07)	0.0019 (0.95)	-0.0013 (-1.55)	-0.0001 (-0.09)	0.0016 (2.04)*	-0.002 (-1.80)**	-0.0004 (-0.79)	-0.0001 (-0.12)	-0.0018 (-1.57)
Number of elderly	-0.0019 (-0.72)	0.0015 (1.28)	-0.0032 (-2.77)*	0.0003 (0.07)	-0.0016 (-1.07)	-0.0020 (-0.85)	-0.0021 (-1.42)	-0.0025 (-1.22)	-0.0011 (-1.13)	-0.0012 (-1.40)	-0.0000 (-0.01)
Inverse of total expenditure	291.31 (7.65)*	-50.67 (-2.91)*	-4.212 (-0.25)	-115.87 (-2.11)*	-17.478 (-0.784)	-87.428 (-2.60)*	-21.372 (-0.99)	-14.468 (-0.48)	-19.952 (-1.37)	-31.937 (-2.48)*	-28.338 (-0.90)
Total expenditure	-0.0540 (-3.39)*	-0.0188 (-2.58)*	-0.0197 (-2.82)*	-0.0495 (-2.15)*	-0.0434 (-4.66)*	0.0073 (0.52)	0.0179 (1.98)*	-0.017 (-1.37)	-0.0439 (-7.22)*	-0.0178 (-3.31)*	-0.0045 (-0.34)
$D1(TE-5800)^2/TE$	0.0411 (2.25)*	0.0122 (1.47)	0.0128 (1.60)	0.0138 (0.53)	0.0283 (2.65)*	-0.0155 (-0.96)	-0.0161 (-1.56)	0.0023 (0.16)	0.0396 (5.69)*	0.0165 (2.68)*	-0.0015 (-0.10)
$D2(TE-15900)^2/TE$	0.0289 (3.29)*	0.0080 (1.98)*	0.0115 (2.96)*	0.0569 (4.48)*	0.0225 (4.38)*	0.0051 (0.66)	-0.0067 (-1.34)	0.0153 (2.18)*	0.0056 (1.66)**	-0.0019 (-0.64)	0.0096 (1.31)
$D3(TE-22200)^2/TE$	-0.0165 (-2.72)*	-0.0014 (-0.51)	-0.0048 (-1.78)**	-0.0220 (-2.50)*	-0.0077 (-2.18)*	0.0032 (0.60)	0.0047 (1.35)	-0.0008 (-0.16)	-0.0014 (-0.59)	0.0032 (1.55)	-0.0036 (-0.71)

Note: The parameters in the last four rows are multiplies by 10000. The t-statistics significant at 5% and 10% level are indicated by * and ** respectively.

Commodities→	Misc. food	Fuels & energy	Entertainment	Transport	Clothing& footwear	Housing	Health	Education	Personal care	Durables	Misc. non-food
Intercept	0.0439 (1.46)	0.1168 (7.28)*	-0.0063 (-0.58)	-0.0243 (-1.34)	0.1274 (7.95)*	-0.0162 (-0.33)	0.0092 (0.57)	-0.0361 (-2.57)*	0.0342 (3.32)*	0.0087 (0.74)	0.0827 (2.57)*
Number of babies	-0.0014 (-0.40)	-0.0018 (-0.97)	0.0006 (0.48)	0.0037 (1.80)**	-0.0028 (-1.51)	0.0049 (0.88)	-0.0000 (-0.00)	0.0009 (0.59)	0.0000 (0.03)	-0.0013 (-0.94)	0.0047 (1.29)
Number of toddlers	-0.0023 (-0.73)	-0.0045 (-2.62)*	-0.0001 (-0.11)	0.0017 (0.86)	-0.0019 (-1.08)	0.0042 (0.79)	0.0003 (0.18)	0.0002 (0.14)	-0.0010 (-0.93)	0.0017 (1.37)	-0.0001 (-0.04)
Number of male children	-0.0024 (-1.06)	-0.0039 (-3.26)*	0.0001 (0.07)	0.0048 (3.54)*	-0.0014 (-1.15)	-0.0017 (-0.45)	0.0003 (0.24)	0.0068 (6.54)*	-0.0007 (-0.91)	0.0006 (0.74)	0.0041 (1.74)**
Number of female children	-0.0001 (-0.06)	-0.0029 (-2.42)*	0.0008 (0.94)	0.0019 (1.38)	-0.0000 (-0.03)	-0.0021 (-0.55)	0.0009 (0.74)	0.0043 (4.05)*	0.0007 (0.87)	-0.0001 (-0.14)	0.0044 (1.81)**
Number of male adults	0.0023 (1.00)	-0.0028 (-2.27)*	0.0008 (0.94)	0.0062 (4.42)*	0.0021 (1.70)**	-0.0120 (-3.17)*	0.0009 (0.74)	0.0027 (2.53)*	0.0009 (1.13)	-0.0013 (-1.39)	0.0019 (0.77)
Number of female adults	-0.0071 (-2.83)*	-0.0020 (-1.47)	0.0001 (0.08)	-0.0007 (-0.47)	0.0009 (0.64)	0.0056 (1.36)	-0.0009 (-0.66)	0.0003 (0.26)	-0.0002 (-0.28)	0.0019 (1.90)**	0.0030 (1.10)
Number of elderly	-0.0012 (-0.23)	-0.0004 (-0.14)	0.0002 (0.07)	0.0020 (0.72)	-0.0002 (-0.09)	0.0093 (1.22)	0.0063 (2.51)*	0.0028 (1.26)	-0.0007 (-0.46)	-0.0016 (-0.86)	-0.0028 (-0.55)
Inverse of total expenditure	25.209 (0.37)	13.164 (0.36)	1.8568 (0.08)	-7.0228 (-0.17)	-55.025 (-1.50)	217.60 (1.93)*	24.384 (0.66)	27.031 (0.84)	-10.201 (-0.43)	-23.84 (-0.89)	-112.74 (-1.54)
Total expenditure	0.0051 (0.18)	-0.0476 (-3.10)*	0.0129 (1.26)	0.0470 (2.72)*	-0.0594 (-3.88)*	0.235 (5.00)*	0.0160 (1.04)	0.0465 (3.46)*	0.0043 (0.44)	0.0010 (0.09)	-0.0174 (-0.57)
D1(TE-5800)^2/TE	0.0336 (1.02)	0.0351 (2.00)*	-0.0040 (-0.34)	-0.0297 (-1.50)	0.0609 (3.472)*	-0.211 (-3.92)*	-0.0213 (-1.21)	-0.0426 (-2.77)*	-0.0014 (-0.123)	0.0056 (0.44)	0.0414 (1.18)
D2(TE-15900)^2/TE	-0.0967 (-6.09)*	0.0189 (2.23)*	-0.0200 (-3.50)*	-0.0101 (-1.06)	-0.0206 (-2.44)*	-0.0140 (-0.54)	0.0069 (0.81)	-0.0050 (-0.68)	-0.0082 (-1.51)	-0.0168 (-2.73)*	0.0109 (0.64)
D3(TE-22200)^2/TE	0.0572 (5.22)*	-0.0057 (-0.96)	0.0115 (2.93)*	-0.0053 (-0.80)	0.0196 (3.353)*	-0.0111 (-0.62)	-0.0018 (-0.30)	0.0072 (0.14)	0.0055 (1.47)	0.0117 (2.75)*	-0.0355 (-3.03)*

Note: The parameters in the last four rows are multiplies by 10000. The t-statistics significant at 5% and 10% level are indicated by * and ** respectively.