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FOOD CONSUMPTION PARAMETERS IN BANGLADESH

by

Francesco Goletti

International Food Policy Research Institute (IFPRI)
Bangladesh Food Policy Project

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Abstract. This paper presents a Tobit estimation of food demand parameters based on the household expenditure survey that the Bangladesh Bureau of Statistics collected in 1988/89. The household data allow to incorporate socio-demographic variables and to conduct the estimation by income quartiles, and both for urban and rural areas. Price responsiveness was found to be pervasive both in rural and urban household. It was found that price and income elasticities decline with income, and wheat is an inferior good in rural areas, whereas it does not significantly vary with income in urban areas.

International Food Policy Research Institute
1200 17th Street, N.W.,
Washington, D.C., 20036, U.S.A.

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1. INTRODUCTION

Poverty in Bangladesh affects still a large proportion of the population. Various measures put the number of people with a daily calorie intake below 1800 calorie anywhere between 20 and 30 percent of the population. Numerous approaches have been attempted in the past to attack poverty. Direct approaches such as subsidies, employment programs, and credit for the poor have shown various effectiveness (see N. Islam 1992). Often, the main problem resides in identifying the poor, in particular in understanding the behavioral parameters underlying any adjustment to the economic environment. The responsiveness of food demand to prices, income, and socio-demographic variables is one of the main factors influencing the effectiveness of policy programs addressed to alleviate poverty.

This paper reports the results of estimates of food demand parameters from household budgets. Previous studies of food demand parameters in Bangladesh have used both time series and cross section data (see Alamgir and Berlage 1972, Mahmud 1979, Ahmed 1981, Pitt 1983, Deb 1986, Talukder 1990). With the exception of Talukder 1990, these studies have either estimated demand parameters for composite foodgrains only or for rural households only. Similarly to Talukder's study, this paper covers a wider range of food commodities both for urban and rural consumers, and presents separate estimates for various income groups. However, instead of using average for each district, it uses actual household data. The data come from the Household Expenditure Survey (HES) that the Bangladesh Bureau of Statistics conducted during 1988/89 (see BBS 1991). Estimation at the household level allows the incorporation of household composition variables into the demand analysis. Moreover, the sample size of 5675 households provides enough degrees of freedom to estimate numerous parameters of the demand system. The interest of this type of analysis lies in the estimation of price and income demand parameters in order to evaluate the effect of various policies, such as price stabilization, targeted programs to alleviate poverty, etc. Moreover, many of the demand parameters derived in this

chapter are of interest for the analysis of the perspectives of foodgrain situation during the rest of the decade.

The organization of the chapter is as follows. Section 2 gives the methodology used in the specification of the model that is estimated. Section 3 clarifies some issues relative to the data used. Section 4 reports the results on tests of hypotheses and elasticities. Section 5 presents the main conclusions.

2. SPECIFICATION OF THE FOOD DEMAND MODEL

In an household survey with as many observations as the HES 1988/89, it is not unusual (see Deaton and Irish 1984) that many commodities are observed with a value of zero consumption. In this case, the application of the usual continuous techniques would result in biased and inconsistent estimates, because the random disturbances have non zero means and are correlated with the exogenous variables. Moreover, dropping those households with zero observations would dramatically reduce the sample size and still give inconsistent estimates (see Pitt 1983).

The presence of zero observations is pervasive in the HES 1988/89 as pointed out by table 1. Apart from rice and turmeric, for which the fraction of zero observations is negligible, for the other foods, there is a consistent proportion of zeros ranging from 4.3 percent of the sample for onions to 92.4 for dry peas. One way to get around this difficulty with the data, is simply to aggregate food commodities by group. The results of aggregating into nine groups are also reported in table 1, and it is clear that a substantial number of zero observations is eliminated. However, the aggregation of food commodities cannot be pushed too far, because otherwise important information to understand the food system of Bangladesh is lost. Within cereals, for example, wheat has a high number of zero observations, whereas rice is consumed by everybody. Yet, it is fundamental to keep rice and wheat disaggregated in order to study the substitutability between these two foods.

Table 1–Number of zero observations in specific foods and in food groups

Food Name	Number of zero consumption observations	Percentage of total observations	Food Group Name	Number of zero observations	Percentage
RICE	0	0	RICE	0	0
WHEAT	2137	42.6	WHEAT	2137	42.6
RED LENTILS	1234	24.6	PULSES	522	10.4
PIGEON PEAS	2805	55.9			
MUGH	4192	83.5			
DRY PEAS	4640	92.4			
HILSA	2449	48.8	FISH	146	2.9
CATFISH	2762	55			
SOLE	3511	69.9			
PUTI	2265	45.1			
MOLA	2978	59.3			
PRAWN	2080	41.4			
DRY FISH	3159	62.9			
TENGRA	2947	58.7			
BEEF	3648	72.7	MEAT	2869	57.1
MUTTON	4560	90.8			
CHICKEN	4087	81.4			
POTATO	547	10.9	VEGET	53	1.1
BRINJAL	1157	23			
PUMPKIN	3351	66.7			
GOURD	2783	55.4			
POTOL	4191	83.5			
JHINGA	4275	85.1			
PLANTAIN	4054	80.7			
ARUM	3146	62.7			
CAULIF	4039	80.4			
TOMATOES	4112	81.9			
LADY FINGERS	4396	87.6			
MUSTARD OIL	874	17.4	OILS	29	0.6
SOYABEAN OIL	2848	56.7			
GHEE	4671	93			
GREEN CHILI	2030	40.4	SPICES	0	0
RED CHILI	566	11.3			
ONION	216	4.3			
GARLIC	1463	29.1			
TURMERIC	19	0.4			
CARDAMON	2636	52.5			
SUGARS	2990	59.5	SUGARS	1954	38.9
MOLASSES	3170	63.1			

Note: Based on BBS, HES 88/89 sample with 1200-3600 calorie/person/day bounds.

The limited dependent variable model of Tobin (1958) provides a method for estimating demand equations in this case since it permits a positive probability of observing zero consumption. The model is

$$y_i = X_i \cdot \beta + u_i \quad \text{if } X_i \cdot \beta + u_i > 0$$

$$y_i = 0 \qquad \text{if } X_i \cdot \beta + u_i \leq 0 \qquad [1]$$

In this model zeroes arise if and only if the household genuinely does not purchase the good.

The model rules out the application of some specifications of the demand system. As it was pointed out by Pitt 1983, the use of expenditures or budget shares would be inconsistent with the behavior of marginal consumers, since for inelastic commodities there is a positive probability of consuming those commodities when their price is increasing.

A model with enough flexibility adapted from Pitt is:

$$q_i^h = \alpha_i^H + \sum_j \gamma_{ij}^H \ln p_j^h + \beta_i^H \ln\left(\frac{y^h}{p^{*h}}\right) + \sum_j \theta_{ik}^H z_k^h + u_i^h \qquad [2]$$

where q^h_i is the consumption per capita of commodity i by household h, p^h_j is price of commodity facing household h, y^h is total expenditure of household h, p^{*h} is the index of prices used to deflate total expenditures for household h, and the z^h_k's are k socioeconomic variables related to household h. The parameters have a superscript H to denote the quartile of interest. In what follows the superscripts h and H are dropped for ease of notation.

In the Tobit model of equation [1] the expected value of the dependent variable is given by

$$E(y_i) = \zeta \cdot \sigma \cdot \Phi(\zeta) + \sigma \cdot \phi(\zeta) \qquad [3]$$

where $\zeta = X \cdot \beta / \sigma$, $\phi(\cdot)$ is the density function and $\Phi(\cdot)$ is the cumulative distribution of the normal distribution function.

Then the elasticity of demand of food i with respect to variable v is given by

$$\frac{\partial \log E(q_i)}{\partial \log v} = \frac{\Phi(\zeta)}{E(q_i)} \frac{\partial X\beta}{\partial v} \qquad [4]$$

Note that this formula differs from the usual elasticity in the presence of the term $\Phi(\zeta)$ denoting the probability that positive consumption occurs. In other words, if there were no censoring this probability would be equal to one.

3. DATA SAMPLE SELECTION

The data used come from the Household Expenditure Survey that the Bangladesh Bureau of Statistics conducted in 1988/89.

A quick way to become familiar with the BBS data related to food is to look at the average quantities consumed, their calorie equivalents and their budget shares reported in table 2. The table shows that the average calorie per person per day, 2111, is about the level of the HES 1988/89 computed by BBS, that is 2215 . The word "about" is used here because the inclusion of the goods and the calorie conversion factors may be slightly different in this study and in the BBS computations. One observation is important at this stage. Given the fact that 1988/89 was a particularly harsh period for agricultural production in Bangladesh, it is remarkable that consumption per capita was not even lower than what the data show. An average level of 2111 calorie per day per person is consistent with calorie requirements commonly accepted in the literature (see Knudsen and Scandizzo 1982). Nevertheless, one should not forget the great variation hidden behind these means. In fact, there are large sectors of the population with an incredibly low diet. The plot of calorie per capita per day shows that there is a considerable number of people at the tails of the distribution (see figure 1). This is more apparent from the graph of the distribution of calorie per capita per day (see figure 2). It is very disturbing the fact

Table 2-Consumption, Calorie, and Food Budget Share of Food Commodities

Group	Food	Avg. Qty.	Calorie Coefficient	Edible Portion	Avg. Calorie/day	Calorie share	Food share
		(grams/day)	(per 100 grams)	(percent)		(percent)	(percent)
Cereals	rice	436.2	346	100	1509.3	71.5	43.4
	wheat	57.7	330	100	190.4	9	4.4
	puffed rice	5.2	325	100	16.9	0.8	0.8
	vermicelli	1.4	352	100	4.8	0.2	0.2
Pulses	red lentils	13.1	343	100	44.8	2.1	2.6
	pigeon pea	6.3	335	100	21.1	1	0.7
	mugh	1.2	334	100	4	0.2	0.2
	dry peas	0.8	315	100	2.4	0.1	0.1
Fish	hilsa	8.9	273	100	24.3	1.2	2.3
	catfish	5.1	86	100	4.4	0.2	1.7
	sole	2.5	94	100	2.4	0.1	0.8
	puti	6.3	106	100	6.7	0.3	1
	mola	3.5	103	100	3.6	0.2	0.7
	prawn	3.9	89	45	1.6	0.1	1.1
	dry fish	0.9	275	100	2.3	0.1	0.5
	tangra	3.1	144	100	4.4	0.2	0.8
Meat	beef	4.5	150	100	6.7	0.3	1.6
	mutton	1.1	114	100	1.2	0.1	0.6
	chicken/duck	2.1	130	100	2.8	0.1	1.1
Vegetables	potato	43.8	87	85	36.1	1.7	2.9
	brinjal	23.8	24	91	5.2	0.2	1.3
	pumpkin	7.4	25	79	1.5	0.1	0.3
	bottled gourd	19	12	86	2	0.1	0.6
	potol	2.7	55	100	1.5	0.1	0.2
	jhinga	2.7	17	82	0.4	0	0.2
	plantain	2.4	64	58	0.9	0	0.7
	cauliflower	10.2	30	70	2.1	0.1	0.4
	cabbage	4.9	27	88	1.2	0.1	0.3
	tomato	3.7	20	100	0.7	0	0.3
	ladies fingers	1.8	35	84	0.5	0	0.1
Leaf vegetables	palong	30.1	20	100	6	0.3	1.1
Milk	cow milk	20.4	67	100	13.7	0.6	2.1
	powder milk	1.8	357	100	6.4	0.3	0.6
	curds	0.6	60	100	0.4	0	0.1
	butter	0	729	100	0.2	0	0
Oils	mustard	6.5	900	100	58.4	2.8	2.5
	soyabean	4.1	883	100	36.3	1.7	1.2
	ghee	0.2	900	100	1.6	0.1	0.1
Spices	green chilli	4.2	29	90	1.1	0.1	0.5
	red chilli	5.5	248	100	13.5	0.6	1.4
	onion	11.7	59	100	6.9	0.3	1.3
	garlic	2.5	145	85	3.1	0.1	0.5
	turmeric	3.3	349	100	11.4	0.5	1
	cardamon	0.6	229	100	1.3	0.1	0.4
Sugars	sugar	4.8	389	100	18.6	0.9	1.2
	molasses	4.9	232	100	11.4	0.5	0.7
Eggs	hen eggs	2.9	173	100	5	0.2	1
	duck eggs	0.9	181	100	1.7	0.1	0.3
Fruits	banana	6.1	116	71	5	0.2	0.4
	mango	2.6	74	74	1.4	0.1	0.2
	jackfruit	0.4	20	30	0	0	0.3
	pine apple	0.5	46	60	0.1	0	0.1
Total		804.9			2111.5		88.4

Source: BBS, Household Expenditure Survey 1988-89.

Fig. 1: Per capita calorie by household

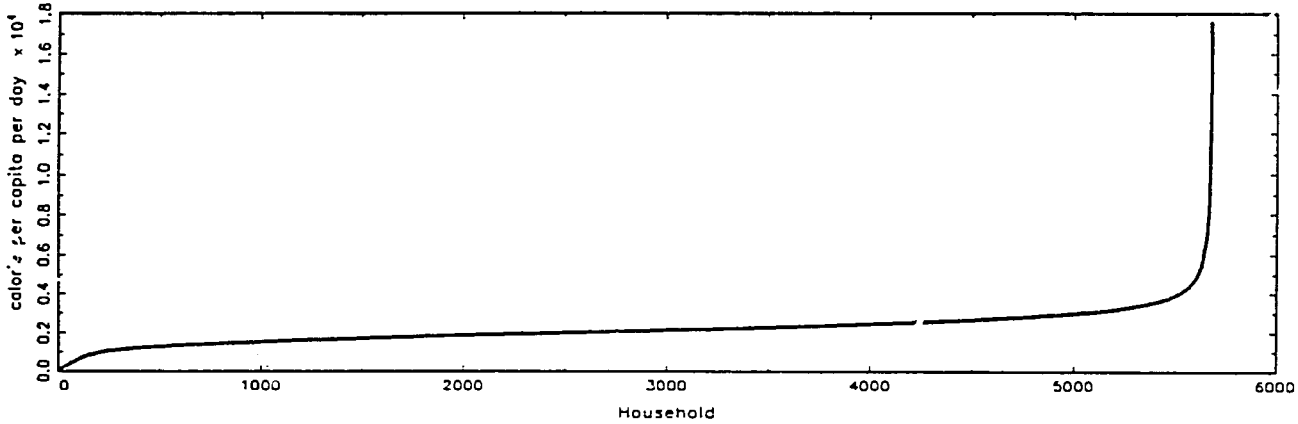
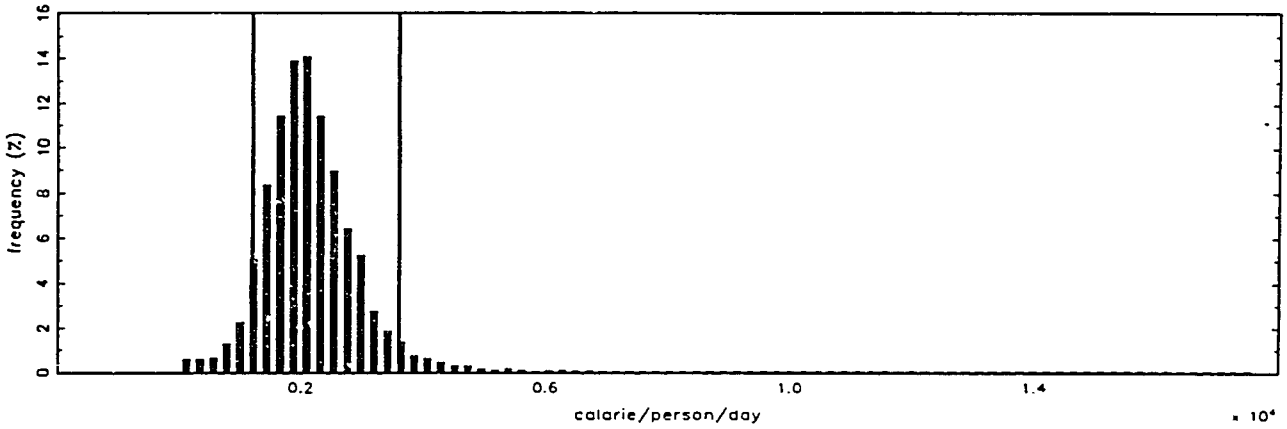


Fig. 2: Distribution of calorie equivalent



that these tails are quite fat. It may seem quite reasonable to exclude extreme observations from the analysis, for example those observations associated to calorie equivalent of food budgets with calorie per capita per day less than 1200 and more than 3600. Nevertheless, it is important to be aware of the implications of this procedure.

In the analysis presented below, those observations that give rise to a number of calorie per day per person less than 1200 and more than 3600 are excluded. The effect of excluding those observations that give rise to unacceptable calorie equivalent is *to lower the estimate of calorie income elasticity*. Since most of the calorie intake is provided by rice, that will lower the estimate of income elasticity of demand of rice. Assuming rice substitution effects to be very low, that will in turn lower the estimates of own price elasticity of rice.

Note that the effect of lowering the calorie income elasticities is a movement in the right direction to reconcile the findings from household expenditure surveys with the insight from the nutrition literature (see Bouis 1992). In fact, that literature points out the inconsistency between calorie intakes coming from most household expenditure surveys and observed differences in weights of people across income groups. Too high a calorie income elasticity should be associated with a very high difference in weights (for more details, see Bouis 1992).

The effect on calorie income elasticities can be readily seen by regressing calorie intake per capita ($calcap_i$) on expenditures per capita ($income_i$) and other socioeconomic variables, as follows:

$$calcap_i = \alpha + \beta \cdot income_i + \gamma \cdot (income_i)^2 + \delta \cdot demos_i + \epsilon_i \qquad [5]$$

where $demos_i$ are socio-demographic variables of interest referring to household i, such as family size, number of children, sex, occupation and education of household head. ϵ_i is an error term. The quadratic term in expenditures comes from the observation that at higher income levels the rate of increase of calories grows at a decreasing rate.

As shown in table 3, the calorie income elasticity β declines with the number of extreme observations excluded. The relation between the sample, the calorie limits and the calorie

Table 3--Sensitivity of calorie income elasticity to sample selection

	minimum calories	maximum calories	mean calorie/ capita	expenditure /capita	calorie expenditure elasticity at mean	number of observations excluded below minimum	number of observations excluded above maximum
				Sample 1			
Urban	0	17618	2190	712	0.42	0	0
Rural	0	17618	2172	428	0.67	0	0
				Sample 2			
Urban	1200	3600	2147	698	0.27	95	70
Rural	1200	3600	2154	423	0.42	306	183

Note: Sample 1 includes the overall HES 1988/89, BBS dataset.

Sample 2 includes only the households whose calorie intake is between 1200-3600 calories/person/day.

The total number of observations in the original data set is 5675. The total number of observations in the sample 1200-3600 calorie/day/person is 5675 - (95+70+306+183) = 5021.

income elasticity allows to do some sensitivity analysis and understand within which ranges to put our estimates.

Nine commodity groups are considered in this analysis: rice, wheat, pulses, fish, meat, vegetables, oils, spices, and sugar. Together, these commodities represent 81 percent of total food expenditures and 97 percent of total calories. Prices are derived from unit values[1], since it was not possible to get market prices. Consumption and expenditures are considered in per capita terms in the estimation. Expenditures are deflated by a Stone index constructed by weighing each price with the share of that commodity in the total expenditure.

Household characteristics included in the specification of the model are family size, percentage of children aged 0 to 7, percentage of adults, sex of household head, percentage of employed members of the household, percentage of household members employed within the household, education of the household head[2].

4. RESULTS ON FOOD CONSUMPTION BEHAVIOR

Wald tests are used to do most of hypotheses testing, because they allow to test only the unrestricted model, without the need to estimate the restricted model as in the likelihood ratio test. This is particularly important given the computational burden of the estimation.
Given the hypothesis H_0: $g(\theta) = 0$, where θ is the vector of parameters, and g is a J-dimensional vector of functions, then

$$\sqrt{T}\cdot[g(\tilde{\theta}) - g(\theta)'] \xrightarrow{d} N[\,0, \lim TF(\tilde{\theta})'I(\tilde{\theta})^{-1}F(\tilde{\theta})\,]$$

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[1] As pointed out by Prais and Houthakker (1955) and more recently by Deaton (1987) unit values reflect quality differences as well as prices. Quality, as well as quantity is a choice variable; therefore, to regress quantity on unit values, implies to regress a choice variable upon another choice variable. One elegant way to solve this problem is to use the methodology suggested by Deaton, who makes use of cluster prices and the assumption that prices are constant within each cluster. Unfortunately there are two problems. First, BBS does not release information at the cluster level. Second, the Deaton methodology does not take into account the presence of zero observations. Recent methodology developed by Lee and Pitt (1984) and Yen and Roe (1986) obviates this last problem, but it introduces strong assumptions about separability besides being very exacting computationally.

[2] The summary statistics of consumption, prices, expenditures, and household characteristics are available upon request by the author.

where $\hat{\theta}$ is the unrestricted ML estimator, and F is the Jacobian $\partial g'(\theta)/\partial\theta$, which is a matrix n x J computed for $\theta=\tilde{\theta}$, and $I(\tilde{\theta})$ is the information matrix. Under H_0 the Wald λ_w statistics is asymptotically distributed as a chi-square with J degrees of freedom, where

$$\lambda_w = [g(\tilde{\theta})]'[F(\tilde{\theta})'I(\tilde{\theta})^{-1}F(\tilde{\theta})]^{-1}[g(\tilde{\theta})] \xrightarrow{d} \chi^2_{(J)}$$

Moreover, the use of Wald test is particularly useful when the hypotheses are expressed in highly non-linear form, as is always the case in Tobit models. The expression for the elasticities in equation [4] is an example of this non-linear behavior.

Hypotheses Tests

Wald tests are used to test the null hypothesis that each of the underlying parameters of the demand equations is zero. The test statistics indicate a *considerable degree of price response* for all foods. Of the 81 price coefficients for the nine food groups considered, almost half are significant at 90 percent level (see table A.1).

For rural households the price responsiveness is more *pervasive*, where pervasiveness of price response is measured by the percentage of price coefficients significantly different from zero. This is an interesting result because it indicates a high degree of responsiveness to price overall the country, not just in urban areas (see Talukder 1990). Finally, the higher is the income group the less pervasive becomes the price responsiveness indicating an increasing food price rigidity in upper classes.

The *homogeneity* hypothesis that the sum of the price coefficients is equal to zero was tested ($\Sigma_j\gamma_{ij} = 0$, for every commodity i; see table A.2). The violation of homogeneity of demand with respect to food prices suggests either some sort of money illusion on the part of consumers, or the exclusion of nonfood prices from the analysis. However, the lack of support of homogeneity does not seem to have grave consequences for both the values and the significance

of elasticities, as shown by a test on the equality of elasticities in the two cases when homogeneity is imposed and when homogeneity is not imposed. Therefore, in what follows only the estimates for the restricted model are reported, where homogeneity is imposed (see tables A.3–A.4).

The hypothesis of *varying coefficients* across groups could not be rejected for either price coefficients or income coefficients. In fact, a Wald test on equality of coefficients among any pair of expenditure groups was strongly rejected. The more "distant" are the groups in terms of their expenditure per capita, the stronger is the rejection of the hypothesis of equal coefficients. This is true both in rural and urban areas, suggesting that treating demand parameters of different groups equally is not warranted by this analysis (see table A.5).

Demand Elasticities

The results for the elasticity matrices of different expenditures/location groups and the relative test for significance are reported in Appendix A (see tables A.6 to A.9). In what follows only information on own price elasticity, expenditure elasticity, and cross price elasticity for rice and wheat is reported (see table 4).

For rice, income elasticities show a tendency to decline with income, according to Engel's law. Moreover, they are higher in rural areas than in urban areas, suggesting that there is a tendency to diversify out of rice towards other foods in rural areas. Price responsiveness is quite high; in urban areas it is higher than in rural areas, suggesting higher substitution effects in urban areas. Moreover, there is a declining pattern for own price elasticities as income rises, confirming an observation made by other studies (for a review of the literature see Alderman 1987). As income increases, households become less responsive to variation in the price of the major staple commodity.

For wheat, the situation is rather different. For urban areas, the expenditure elasticities of wheat were not statistically different from zeros. In rural areas, only for poorer households is the expenditure elasticity significative at the 95 percent level, and negative. Even though wheat gives about 9 percent of the caloric intake of the average Bangladeshi diet, its consumption does

Table 4-Rice and Wheat Elasticities

	Own Price Elasticity		Expenditure Elasticity		Cross Price Elasticity	
	Rural	Urban	Rural	Urban	Rural	Urban
Rice						
Quartile 1	-0.89 *	-1.02 *	0.8 *	0.58 *	0.04	0.26 *
Quartile 2	-0.71 *	-0.76 *	0.71 *	0.43 *	-0.01	-0.18
Quartile 3	-0.55 *	-0.38 *	0.64 *	0.19	0	-0.05
Quartile 4	-0.39 *	-0.5 *	0.03	-0.03	-0.09	0
All	-0.56 *	-0.59 *	0.39 *	0.15 *	0.01	-0.01
Wheat						
Quartile 1	-1.23 *	-2.79 *	-1.37 *	-0.21	3.14 *	3.91 *
Quartile 2	-0.99 *	-2.49 *	0.05	0.33	2.1 *	3.43 *
Quartile 3	-0.49	-0.86	-1	-0.02	1.31 *	2.03 *
Quartile 4	-0.21	0.94 *	-0.19	0.29	1.88 *	0.34
All	-0.82 *	-1.06 *	-0.44 *	-0.01	2.05 *	2.25 *

Source: Computed by author based on HES data with 1200-3600 calories/person/day.

Note: "*" indicates elasticities significant at 90% level.

not seem to vary with income too much, once the effect of price is taken into account. The main pattern emerging from these figures is that, once consumers are above a certain income per capita, their wheat consumption does not change. For price elasticities, there is a tendency for own price elasticities of wheat to decline with income, from an initially high absolute value to zero. The positive sign on the own price elasticity for the upper urban quartile is puzzling. The fit of the equation generating this result is nevertheless very low. It is therefore a result to be taken with caution.

Finally, table 4 shows that in rural areas price responsiveness is less marked than in urban areas.

The cross price elasticities between rice and wheat point out that wheat prices do not affect rice demand significatively, whereas rice prices are strongly affecting wheat demand. As expected, wheat is a substitute for rice. Moreover, as observed for own price and income elasticities, even cross price elasticities of wheat demand with respect to rice price are declining with income.

Calorie Expenditure Elasticities

The total amount of calorie Γ equivalent to food consumption is given by the sum of the calorie content of different foods:

$$\Gamma = \Sigma_j \gamma_j \cdot q_j \qquad [6]$$

where γ_j is the calorie conversion factor for food j and q_j is the quantity consumed of good j. When a group of commodities is considered then γ_j is the weighted index of calorie coefficients of the commodities in the group, where the weights are given by the average quantities consumed.

The calorie price and income elasticities is derived from the estimated quantity elasticities by taking the weighted average of price and income elasticity of the food demands, where the weights are the calorie conversion factor of each food group.

Table 5–Calorie elasticities

	Rice	Wheat	Pulses	Fish	Meat	Veget	Oils	Spices	Sugars	Expenditure
Rural										
Quartile 1	-0.27	-0.13	0.02	0.12	-0.14	-0.01	0.03	0.01	-0.15	0.52
Quartile 2	-0.3	-0.11	-0.06	0.06	-0.18	-0.09	-0.05	0.03	0.02	0.66
Quartile 3	-0.3	-0.05	0.03	0.12	-0.15	-0.02	-0.03	0.05	-0.2	0.55
Quartile 4	-0.11	-0.11	-0.02	-0.04	-0.08	0.04	0.08	0.06	0.1	0.08
All	-0.21	-0.08	0.01	0.05	-0.12	-0.01	-0.01	0.05	-0.05	0.38
Urban										
Quartile 1	-0.34	-0.11	0.1	-0.18	0.05	-0.04	-0.03	-0.01	0.03	0.53
Quartile 2	-0.27	-0.35	-0.06	-0.2	0.07	-0.15	0.18	0.18	0.11	0.52
Quartile 3	-0.04	-0.08	-0.14	-0.19	-0.09	0.03	0.1	-0.06	0.22	0.25
Quartile 4	-0.11	0.06	-0.07	-0.01	-0.25	0.09	-0.03	0.09	0.16	0.06
All	-0.13	-0.11	-0.06	-0.14	0.04	0	0.02	0.04	0.11	0.23

Source: Computed by author based on HES data with 1200-3600 calorie/person/day bounds.

Table 6–Price of calories

	Cost of 1000 kilo-calories	Cost of calorie of each group with respect to its relative first quartile
Bangladesh		
First Quartile	4.03	100
Second Quartile	4.59	114
Third Quartile	5.33	132
Fourth Quartile	7.33	182
All	5.32	132
Rural		
First Quartile	3.97	100
Second Quartile	4.32	112
Third Quartile	4.79	124
Fourth Quartile	5.7	147
All	4.67	121
Urban		
First Quartile	4.79	100
Second Quartile	5.71	119
Third Quartile	6.6	138
Fourth Quartile	9.22	193
All	6.58	138

Note: Based on BBS, HES 1988/89 with 1200-3600 calorie/person/day bounds.

$$\eta_x = \frac{\sum_j \gamma_j E(q_j)\eta_{jx}}{\sum_j \gamma_j E(q_j)} \qquad [7]$$

where $E(q_j)$ is the predicted value of consumption of food j.

The results are reported in table 5. Caloric expenditure elasticities show a declining tendency with income. At high income levels, the decline is particularly strong, as a consequence of lower expenditure elasticity of demand for cereals. In rural areas expenditure elasticities are higher than in urban areas.

In choosing foods, poor households choose inexpensive sources of calories. At higher levels of expenditures, household substitute for foods desired on "taste" grounds even though this may mean obtaining calorie at higher average cost (see table 6).

5. CONCLUSIONS AND POLICY IMPLICATIONS

The main conclusions of the chapter follow.

First, as income grows, expenditure elasticities of rice decline according to Engel's law. Moreover, they are higher in rural areas than in urban areas. For wheat the behavior is different; income elasticities are not statistically different from zero for most of the groups considered, except poor rural households, for whom the elasticity is negative. This suggests that wheat is an inferior good for rural population, whereas for urban areas the claim that wheat is a superior good could not be supported by the data. Only considering a more disaggregated analysis of flour and wheat in major cities, it would be possible to have a better understanding of this issue.

Second, *most commodities are price responsive.* The percentage of significative own price elasticities and cross price elasticities is very high both in urban and in rural areas. The significance of price coefficients has been referred to as the pervasiveness of price response of food consumption. For important commodities, such as rice and wheat the price response in urban areas is higher than in rural areas.

Third, the cross price elasticities of wheat and rice have very high values. Wheat prices do not have any significant effect on rice demand. On the contrary, rice prices affect wheat demand very strongly. The cross price elasticity between wheat and rice is declining with income, an indication of lower substitution effects between rice and wheat at higher income levels.

Fourth, *price and expenditure response changes significantly across expenditure groups.* Moreover, the hypothesis of higher price response for lower income groups could not be rejected for some important commodities such as rice, and wheat.

Finally, calorie expenditure elasticity for rural areas is higher than in urban areas. Moreover, as expenditure level grows the price of calories also increases suggesting that both urban and richer households buy more expensive calories, in the attempt to diversify the diet both in terms of food consumed and quality. This suggests that by targeting subsidies to either wheat or to the rice quality consumed by the lower quartiles, significant improvements in calorie intake could be achieved, and therefore have an effective instrument to reduce poverty. Given the recent decline in rice prices relative to wheat prices , the targetting of subsidies to the low qualities of rice is becoming a cost effective way to improve the nutrition status of the poor.

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Table A.1-Price responsiveness of food demand system

	Rural					Urban				
	Q1	Q2	Q3	Q4	Percentage of price coefficients significant at 90% level	Q1	Q2	Q3	Q4	Percentage of price coefficients significant at 90% level
	Number of significant price coefficients					Number of significant price coefficients				
Rice	7	3	5	4	53	5	5	4	2	44
Wheat	4	4	2	3	36	5	3	1	2	31
Pulses	4	7	6	5	61	5	4	3	4	44
Fish	8	6	4	8	72	6	6	6	6	67
Meat	4	2	2	3	31	5	3	2	5	42
Vegetables	3	4	5	5	47	5	6	4	0	42
Oils	2	4	4	2	33	4	5	4	4	47
Spices	6	4	5	5	56	3	6	2	5	44
Sugars	4	4	3	3	39	3	1	2	4	28
Percentage of coefficients significant at 90%	52	47	44	47		51	43	35	40	

Source: Computed by author based on HES 1988/89 data with 1200-3000 calorie/person/day bounds.

Note: Price coefficients refer to the significant γ_i in the demand equation:

$$q_i = \alpha_i + \sum_j \gamma_{ij} \ln p_j + \beta_i \ln(y/p) + \sum_k \beta_{ik} z_k + u_i$$

The level of significance is 90%.

Table A.2-Chi-squares for homogeneity tests

	Rice	Wheat	Pulses	Fish	Meat	Veget	Oils	Spices	Sugars	Number of comodities for which homogeneity holds
Rural										
Quartile 1	22.63	13.18	1.54	6.54	6.02	2.93	2.46	1.09	11.68	3
Quartile 2	5.03	0	0.85	7.03	0.04	12.52	1.65	0.02	0.4	7
Quartile 3	9.92	1.18	1.08	4.84	2.85	0.17	0.42	0.38	0.62	6
Quartile 4	14.6	6.37	1.03	15.82	3.23	0	0.15	0.01	0.08	5
All	44.11	0.3	0.26	50.6	8.36	1.6	2.84	0	3.03	6
Urban										
Quartile 1	2.27	0.82	1.03	1.38	0.04	19.57	0.76	2.75	1.82	8
Quartile 2	2.91	3.99	3.06	14.32	0.43	0.22	0.02	0.6	0	5
Quartile 3	10.39	1.72	0.01	2.18	1.26	0.3	1.1	2.21	0.14	5
Quartile 4	1.07	9.38	1.66	1.43	8.88	0.18	2.83	8.56	2.05	4
All	1	10.19	0.38	22.37	17.89	1.56	1.07	0.23	0.18	6

Source: Computed by author based on HES data with 1200-3600 calories person/day bounds.

Note: Homogeneity holds if the corresponding chi-square is less than the 90% critical value. Critical chi-square at 90% level is 2.70.

Table A.3: Chi-squares for rural elasticity differences by quartile with respect to homogeneity restriction

	Rice	Wheat	Pulses	Fish	Meat	Vegetables	Oils	Spices	Sugar	Expenditure
First Quartile										
Rice	0.76	3.92	1.45	4.32	2.28	0.01	2.77	1	4.01	0.63
Wheat	0.59	1.98	0.97	2.64	1.42	0	1.66	0.57	2.34	0.34
Pulses	0.06	0.27	0.09	0.31	0.16	0	0.2	0.07	0.28	0.04
Fish	0.23	1.15	0.43	1.19	0.67	0	0.82	0.31	1.16	0.19
Meat	0.23	1.14	0.44	0.96	0.64	0	0.61	0.3	1.08	0.17
Vegetables	0.1	0.52	0.18	0.56	0.3	0	0.36	0.13	0.53	0.08
Oils	0.09	0.43	0.16	0.48	0.26	0	0.31	0.11	0.44	0.07
Spices	0.04	0.19	0.07	0.21	0.11	0	0.13	0.05	0.19	0.03
Sugar	0.54	2.3	0.88	2.53	1.4	0.02	1.57	0.58	1.48	0.32
Second Quartile										
Rice	0.11	1.02	0.25	0.68	0.39	0.08	1.1	0.37	0.35	1.68
Wheat	0	0	0	0	0	0	0	0	0	0
Pulses	0.02	0.17	0.04	0.11	0.07	0.01	0.19	0.06	0.06	0.28
Fish	0.15	1.5	0.35	0.87	0.55	0.11	1.58	0.51	0.49	2.36
Meat	0	0.01	0	0	0	0	0.01	0	0	0.01
Vegetables	0.28	2.59	0.59	1.64	0.95	0.17	2.7	0.92	0.89	4.06
Oils	0.04	0.34	0.08	0.22	0.13	0.03	0.35	0.12	0.12	0.54
Spices	0	0	0	0	0	0	0	0	[illegible]	0.01
Sugar	0.01	0.08	0.02	0.05	0.03	0.01	0.09	0.03	0.02	0.14
Third Quartile										
Rice	0.21	1.24	0.28	0.7	0.53	0	1.73	1.15	0.92	2.36
Wheat	0.03	0.13	0.04	0.09	0.07	0	0.2	0.14	0.11	0.29
Pulses	0.02	0.14	0.03	0.08	0.06	0	0.2	0.12	0.1	0.26
Fish	0.11	0.61	0.14	0.33	0.25	0	0.87	0.57	0.45	1.18
Meat	0.05	0.36	0.1	0.17	0.13	0	0.51	0.35	0.3	0.76
Vegetables	0	0.02	0	0.01	0.01	0	0.03	0.02	0.02	0.04
Oils	0.01	0.05	0.01	0.03	0.02	0	0.07	0.05	0.04	0.1
Spices	0.01	0.05	0.01	0.03	0.02	0	0.07	0.04	0.04	0.09
Sugar	0.01	0.08	0.02	0.04	0.03	0	0.12	0.08	0.05	0.15
Fourth Quartile										
Rice	0.53	2.14	0.47	0.89	0.95	0	3.28	1.25	0.78	0.04
Wheat	0.22	0.73	0.23	0.37	0.49	0.01	1.59	0.53	0.29	0.02
Pulses	0.04	0.15	0.03	0.06	0.07	0	0.23	0.09	0.05	0
Fish	0.58	2.25	0.53	0.88	1.02	0	3.54	1.36	0.86	0.06
Meat	0.11	0.51	0.11	0.18	0.17	0	0.84	0.26	0.17	0.01
Vegetables	0	0	0	0	0	0	0	0	0	0
Oils	0.01	0.02	0	0.01	0.01	0	0.03	0.01	0.01	0
Spices	0	0	0	0	0	0	0	0	0	0
Sugar	0	0.01	0	0	0.01	0	0.02	0.01	0	0

Note: The chi-squares refer to the hypothesis of Ho: $\eta^{*}_{ij} = \eta^{h}_{ij}$ where η^{h}_{ij} is the elasticity estimated when homogeneity is imposed and η^{*}_{ij} is the elasticity estimated without imposing homogeneity.

Table A.4: Chi-squares for urban elasticity differences by quartile with respect to homogeneity restrictions

	Rice	Wheat	Pulses	Fish	Meat	Vegetables	Oils	Spices	Sugar	Expenditure
First Quartile										
Rice	0.48	0.48	0.08	0.05	0.16	0.01	0.42	0.29	0.15	0.02
Wheat	0.18	0.14	0.03	0.01	0.08	0	0.16	0.09	0.07	0.01
Pulses	0.22	0.22	0.04	0.02	0.07	0.01	0.15	0.13	0.07	0.01
Fish	0.3	0.3	0.05	0.03	0.09	0.01	0.25	0.18	0.09	0.01
Meat	0.01	0.01	0	0	0	0	0.01	0	0	0
Vegetables	3.98	3.84	0.64	0.42	1.09	0.09	3.41	2.39	1.23	0.15
Oils	0.16	0.16	0.03	0.02	0.04	0	0.14	0.1	0.05	0.01
Spices	0.58	0.58	0.09	0.06	0.2	0.02	0.5	0.35	0.18	0.02
Sugar	0.42	0.4	0.05	0.05	0.12	0.01	0.32	0.21	0.12	0.02
Second Quartile										
Rice	0.52	0.96	0.09	0.03	0.12	0.03	0.57	0.29	0.18	0.37
Wheat	0.74	1.11	0.13	0.04	0.16	0.04	0.87	0.39	0.24	0.55
Pulses	0.55	1	0.09	0.03	0.1	0.03	0.59	0.31	0.19	0.39
Fish	2.58	4.78	0.46	0.12	0.49	0.13	2.74	1.42	0.88	1.82
Meat	0.07	0.13	0.02	0	0.03	0	0.1	0.04	0.02	0.05
Vegetables	0.04	0.07	0.01	0	0.01	0	0.04	0.02	0.01	0.03
Oils	0	0.01	0	0	0	0	0	0	0	0
Spices	0.11	0.2	0.02	0.01	0.03	0.01	0.12	0.06	0.04	0.08
Sugar	0	0	0	0	0	0	0	0	0	0
Third Quartile										
Rice	0.46	2.47	0.6	0.19	0.46	0.04	1.65	0.46	1.36	1.22
Wheat	0.08	0.35	0.11	0.03	0.1	0.01	0.29	0.08	0.26	0.22
Pulses	0	0	0	0	0	0	0	0	0	0
Fish	0.1	0.54	0.13	0.04	0.08	0.01	0.36	0.1	0.3	0.27
Meat	0.06	0.28	0.08	0.02	0.08	0.01	0.22	0.06	0.18	0.16
Vegetables	0.01	0.07	0.02	0	0.02	0	0.05	0.01	0.04	0.04
Oils	0.05	0.27	0.07	0.01	0.05	0	0.18	0.05	0.15	0.13
Spices	0.1	0.54	0.14	0.04	0.1	0.01	0.36	0.1	0.3	0.27
Sugar	0.01	0.03	0.01	0	0.01	0	0.02	0.01	0.02	0.02
Fourth Quartile										
Rice	0.02	0.19	0.03	0	0.14	0	0.26	0.03	0.23	0
Wheat	0.2	1.45	0.28	0.04	1.28	0.01	2.26	0.27	2.01	0
Pulses	0.04	0.3	0.05	0	0.21	0	0.39	0.05	0.35	0
Fish	0.03	0.26	0.04	0	0.19	0	0.34	0.04	0.3	0
Meat	0.23	1.54	0.26	0.02	1.06	0.02	2.34	0.25	1.85	0
Vegetables	0	0.03	0.01	0	0.02	0	0.04	0	0.04	0
Oils	0.06	0.5	0.08	0.01	0.37	0.01	0.67	0.08	0.59	0
Spices	0.17	1.46	0.24	0.02	1.11	0.02	1.97	0.23	1.75	0
Sugar	0.04	0.38	0.07	0	0.26	0	0.51	0.06	0.4	0

Note: The chi-squares refer to the hypothesis of Ho: $\eta^{*}_{ij} = \eta^{b}_{ij}$ where η^{b}_{ij} is the elasticity estimated when homogeneity is imposed and η^{*}_{ij} is the elasticity estimated without imposing homogeneity.

Table A.5–Chi-squares for varying coefficients among different expenditure/locality groups.

	Quartile 1 vs Quartile 2	Quartile 1 vs Quartile 3	Quartile 1 vs Quartile 4	Quartile 2 vs Quartile 3	Quartile 2 vs Quartile 4	Quartile 3 vs Quartile 4	# of cases where equality of coefficients is rejected
Rural							
Rice	6.29	19.41	268.66	17.7	87.83	134.53	5
Wheat	46.7	35.44	66.93	20.88	29.53	21.63	6
Pulses	49.63	53.71	79.63	41.79	62.42	75.1	6
Fish	50.93	70.11	478.24	33.78	269.63	118.88	6
Meat	28.96	27.13	15.32	10.84	38.05	35.41	4
Vegetables	40.69	31.38	100.08	11.17	54.92	56.4	5
Oils	20.18	87.61	27.3	33.8	17.03	57.84	6
Spices	26.99	31.35	99.79	20.52	51.97	53.47	6
Sugars	8.52	44.04	42.36	18.04	20.49	27.95	5
Urban							
Rice	126.55	206.73	258.57	64.88	118	25.41	6
Wheat	29.37	53.57	110.69	26.19	56.17	17.51	6
Pulses	36.77	170.03	86.38	80.56	25.53	6.63	5
Fish	12.57	96.51	228.47	51.87	173.58	65.36	5
Meat	39.84	49.05	299.98	10.58	294.11	70.98	5
Vegetables	34.09	61.99	146.6	57.25	116.92	55.73	6
Oils	33.55	102.46	409.38	74.36	430.08	58.62	6
Spices	61.51	52.73	776.34	64.52	452.16	84.34	6
Sugars	44.56	115.45	170.59	39.89	147.75	44.32	6

Note: Computed by the author. Critical chi-squares with 10 degrees of freedom are 18.30 for 95% level of significance and 15.98 for 90% level of significance.

Table A.6- Rural elasticities by quartile

	Rice	Wheat	Pulses	Fish	Meat	Vegetables	Oils	Spices	Sugar	Expenditure
First Quartile										
Rice	-0.89	0.04	0.01	0.09	-0.19	-0.01	0.1	0.16	-0.11	0.8
Wheat	3.14	-1.23	0.3	0.64	-0.21	-0.04	-0.01	-0.59	-0.63	-1.37
Pulses	-0.28	0.26	-0.83	-0.44	0.51	1.3	-0.26	-0.68	-0.3	0.71
Fish	-0.48	0.29	-0.52	-1.81	1.52	0.27	-0.49	0.44	-0.3	1.18
Meat	-0.99	0.13	-0.32	0.94	-7.72	-1.6	1.25	1.57	3.22	3.51
Vegetables	-0.57	0.16	0.11	0.04	0.33	-1.78	0.17	-0.21	0.71	1.04
Oils	-0.29	-0.37	0.05	-0.01	-0.3	0.06	-0.93	0.09	0.94	0.76
Spices	-0.01	0.5	-0.14	0.23	0.25	0.09	-0.67	-1.16	0.1	0.81
Sugar	0.29	-0.28	0.25	-0.77	0.58	0.81	0.62	-1.04	-2.26	1.81
Second Quartile										
Rice	-0.71	-0.01	-0.03	0.1	-0.09	-0.05	0.06	0.07	-0.04	0.71
Wheat	2.1	-0.99	-0.21	0.39	-1.02	-0.44	-0.18	0.03	0.28	0.05
Pulses	0.31	0.02	-0.88	-0.61	-0.37	0.57	-0.82	-0.5	1.23	1.04
Fish	-0.45	0.6	-0.07	-1.45	1.45	0.13	-0.42	-0.36	0.12	0.45
Meat	0.46	1	0.65	0.02	-4.57	0.46	-0.02	0.2	1.08	0.71
Vegetables	-0.08	-0.05	0.27	-0.03	0.04	-1.17	0.13	-0.25	-0.13	1.26
Oils	-0.11	0.15	-0.01	-0.03	0.06	-0.07	-1.27	0.1	0.3	0.87
Spices	-0.11	0.25	0.03	-0.19	0.07	0.28	-0.1	-0.86	0.14	0.48
Sugar	0.54	-0.3	0.62	-0.54	-0.02	0.52	0.1	0.02	-2.42	1.48
Third Quartile										
Rice	-0.55	0	0.02	0.16	-0.33	0.02	0.1	0.14	-0.19	0.64
Wheat	1.31	-0.49	0.36	0.42	0.4	-0.47	-0.35	0.06	-0.25	-1
Pulses	-0.04	-0.21	-1	-0.28	0.76	0.69	-0.25	-0.95	0.02	1.27
Fish	0.03	0.06	-0.39	-1.13	1.4	0.22	-0.09	-0.23	-0.17	0.29
Meat	0.27	0.28	1.07	0.65	-2.94	-0.28	-0.38	0.31	0.52	0.51
Vegetables	-0.16	0.13	0.24	-0.04	0.3	-1	-0.13	0	-0.21	0.89
Oils	-0.13	-0.09	0.08	-0.14	0.31	0.02	-1.27	-0.25	0.02	1.46
Spices	0.2	0.39	-0.11	-0.04	0.16	0.14	-0.05	-1.06	-0.24	0.61
Sugar	-0.09	-0.64	1.1	-0.33	-0.07	-0.18	-0.33	0.16	-1.53	1.92
Fourth Quartile										
Rice	-0.39	-0.05	-0.03	0	-0.2	0.1	0.26	0.07	0.26	0.03
Wheat	1.88	-0.21	0.3	0.72	0.45	-0.77	-0.49	0.3	-1.98	-0.19
Pulses	0.44	-0.33	-0.84	-0.85	0.31	0.76	-0.18	-0.17	0.56	0.3
Fish	0.34	-0.55	-0.34	-1.26	0.93	0.4	-0.4	-0.11	0.6	0.4
Meat	-0.01	-0.46	-0.14	0.53	-1.87	-0.08	0.43	0.18	0.42	0.99
Vegetables	0.12	0.05	0.22	0.14	0.14	-0.7	-0.42	0.22	0.08	0.14
Oils	-0.02	0	0.15	-0.07	0.1	-0.02	-0.9	0	0.36	0.4
Spices	0.1	0.47	-0.16	-0.35	0.39	-0.06	0.11	-0.7	0	0.19
Sugar	0.75	-0.16	0.78	-0.4	-0.23	-0.19	-0.28	0.15	-0.96	0.53

Note: Computed by the author.

Table A.7- Urban elasticities by quartile

	Rice	Wheat	Pulses	Fish	Meat	Vegetables	Oils	Spices	Suga	Exrenditure
First Quartile										
Rice	-1.02	0.26	0.32	0.06	0.02	0.11	-0.07	-0.08	-0.18	0.58
Wheat	3.91	-2.79	-1	-1.43	0.16	-1.49	0.74	0.64	1.47	-0.21
Pulses	1	-0.22	-0.75	-0.31	-0.1	1.08	-0.36	-0.93	0	0.59
Fish	-0.07	0.45	0.26	-1.29	0.04	0.6	-0.68	-0.16	-0.22	1.05
Meat	-0.34	-2.68	0.09	-2.01	0.58	-1.56	0.85	2.26	-0.07	3.48
Vegetables	-0.89	-0.09	0.11	0.57	0.52	-1.39	-0.28	0.06	0.62	0.77
Oils	-0.24	0.1	-0.14	-0.4	0.25	0.21	-0.76	0.22	-0.05	0.81
Spices	-0.27	-0.1	-0.17	-0.61	-0.04	0.46	-0.26	-0.27	0.28	0.88
Sugar	0.45	0.53	-0.96	-1.62	-0.27	-0.06	1.77	0.58	-0.95	0.53
Second Quartile										
Rice	-0.76	-0.18	0.06	-0.14	0.06	-0.22	0.37	0.12	0.25	0.43
Wheat	3.43	-2.49	-0.74	-0.56	0.12	-0.31	-0.21	0.93	-0.51	0.33
Pulses	0.35	-0.41	-0.91	-0.25	0.12	0.78	-0.51	0.23	-0.05	0.65
Fish	0.09	0.17	0.33	-1.15	0.08	0.38	-0.44	0.2	-0.45	0.79
Meat	0.68	-1.76	-0.84	0.38	0.69	0.14	0.27	-0.01	-0.8	1.26
Vegetables	-1.03	0.06	0.2	0.13	0.30	-0.9	-0.21	-0.25	0.51	1.12
Oils	-0.12	-0.22	-0.39	-0.1	0.13	0.06	-0.63	0.03	0.1	1.13
Spices	-0.43	0.2	0.43	-0.73	-0.21	0.53	-0.37	-0.37	-0.2	1.15
Sugar	0.1	-0.66	0.03	0.32	-0.22	0.29	0.45	0.34	-1.6	0.95
Third Quartile										
Rice	-0.38	-0.05	-0.09	-0.22	-0.21	0.04	0.24	0.09	0.4	0.19
Wheat	2.03	-0.86	-0.05	0.21	0.07	-0.59	0.25	-0.62	-0.44	-0.02
Pulses	0.48	0.18	-1.5	-0.34	0.68	0.76	-0.16	-0.37	0.28	-0.03
Fish	0.22	0.57	-0.15	-1.44	0.3	0.43	-0.07	-0.09	-0.33	0.56
Meat	0.77	-1.34	0.08	-0.02	0.1	0.2	0.06	-0.5	-0.08	0.73
Vegetables	-0.51	0.19	-0.09	0.12	0.64	-0.68	0.1	-0.44	0.05	0.61
Oils	0.52	-0.22	0.21	-0.07	-0.11	0.21	-0.94	-0.09	-0.08	0.57
Spices	0.04	0.16	-0.17	-0.07	-0.01	0.23	-0.05	-0.71	0.12	0.46
Sugar	0.1	0.38	-0.45	0.99	-0.43	-0.03	-0.48	-0.63	-0.94	1.5
Fourth Quartile										
Rice	-0.5	0	-0.09	0.07	-0.26	0.12	0.07	0.37	0.24	-0.03
Wheat	0.34	0.94	-0.52	-0.1	0.17	-0.47	-0.24	-0.28	-0.14	0.29
Pulses	0.34	0.35	-1.06	-0.21	0.21	0.62	-0.5	-0.17	0.29	0.14
Fish	0.47	0.16	0.31	-0.79	-0.61	0.47	0.11	0.14	-0.37	0.13
Meat	1.82	-0.78	-0.4	0.24	-1.31	0.79	-0.31	-0.03	-0.55	0.51
Vegetables	0.09	-0.26	-0.24	0.19	0.09	-0.09	0.3	-0.19	0.11	-0.01
Oils	0.54	-0.11	0.59	-0.06	-0.4	-0.05	-0.25	-0.61	0.09	0.27
Spices	1.04	-0.19	0.38	-0.32	-0.12	-0.24	0.3	-1.58	0.46	0.26
Sugar	0.25	-0.15	0.65	0.23	-0.99	0.09	-0.86	0.29	0.32	0.18

Note: Computed by the author.

Table A.8- Chi-squares for rural elasticities by quartile

	Rice	Wheat	Pulses	Fish	Meat	Vegetables	Oils	Spices	Sugar	Expenditure
First Quartile										
Rice	154.74	0.49	0.01	1.77	3.48	0.03	2	4.9	1.08	219.41
Wheat	79.25	18.01	0.86	3.43	0.16	0.02	0	2.59	1.39	26.51
Pulses	0.94	1.25	10.34	2.42	1.5	40.32	0.9	5.11	0.48	10.44
Fish	5.24	2.86	10.55	74.19	23.86	3.24	5.93	4.08	0.83	51.69
Meat	1.05	0.03	0.13	0.33	28.19	5.66	1.71	2.38	5.02	19.38
Vegetables	9.49	1.09	0.43	0.05	1.50	177.05	0.93	1.19	6.6	53.42
Oils	1.61	3.95	0.07	0	0.81	0.14	18.15	0.16	7.43	18.57
Spices	0	12.52	0.74	1.82	1.01	0.54	16.12	40.1	0.14	34.96
Sugar	0.29	0.4	0.25	2.07	0.53	4.44	1.4	3.36	7.48	18.64
Second Quartile										
Rice	98.18	0.06	0.18	2.1	0.8	0.91	0.68	1	0.17	46.85
Wheat	31.61	9.6	0.42	1.29	3.64	2.89	0.25	0.01	0.26	0.01
Pulses	1.64	0.01	17.33	7.36	1.12	11.39	12.59	4	12.11	8.9
Fish	5.72	14.69	0.19	66.88	28.26	0.93	5.52	3.4	0.21	2.76
Meat	0.64	4.16	1.53	0	29.11	1.31	0	0.1	1.62	0.72
Vegetables	0.21	0.1	3.21	0.03	0.03	97.17	0.65	2.02	0.3	27.07
Oils	0.5	1.35	0	0.05	0.07	0.41	72.82	0.43	1.82	15.2
Spices	[illegible]	3.25	0.06	1.61	0.1	6.22	0.4	24.8	0.35	4.1
Sugar	1.65	0.71	2.79	1.93	0	3.14	0.07	0	15.64	5.97
Third Quartile										
Rice	54.59	0	0.08	5.19	11.12	0.18	1.6	3.1	3.66	37.96
Wheat	11.36	1.52	1.02	1.3	0.59	3.09	0.78	0.02	0.22	3.35
Pulses	0.02	0.84	24.45	1.75	6.18	19.07	1.12	15.57	0.01	15.69
Fish	0.04	0.12	6.16	45.25	35.23	3.34	0.25	1.62	0.52	1.28
Meat	0.31	0.34	5.88	2.04	21.2	0.75	0.58	0.38	0.64	0.39
Vegetables	1.25	0.8	3.13	0.1	2.35	86.72	0.81	0	1.15	19.09
Oils	0.87	0.35	0.35	1.01	2.58	0.05	71.42	2.77	0.01	51.54
Spices	1.54	6.03	0.55	0.06	0.57	1.74	0.1	39.8	1.24	7.43
Sugar	0.07	3.24	11.92	1.01	0.02	0.54	0.86	0.18	10.62	15.45
Fourth Quartile										
Rice	28.78	1.7	0.23	0	4.58	4.31	11.27	1.04	8.45	0.8
Wheat	16.91	0.23	0.53	3.03	0.55	6.04	1.01	0.51	12.37	0.99
Pulses	3.94	2.39	19.31	18.21	1.15	24.66	0.61	0.7	4.3	11.79
Fish	3.45	9.58	4.48	57.03	14.74	9.97	4.37	0.44	7.2	29.58
Meat	0	1.27	0.14	1.99	11.37	0.07	0.92	0.21	0.67	34.65
Vegetables	0.71	0.14	2.95	1.18	0.57	49.56	7.54	2.72	0.22	5.78
Oils	0.01	0	1.15	0.28	0.23	0.04	29.08	0	3.59	39.09
Spices	0.34	7.81	1.05	4.93	2.84	0.24	0.35	18.28	0	7.28
Sugar	4.56	0.23	6.14	1.58	0.24	0.6	0.54	0.2	4.96	13.84

Note: Computed by the author. The critical value for chi-square at 90% with 1 degree of freedom is 2.70.

Table A.9- Chi-squares for urban elasticities by quartile

	Rice	Wheat	Pulses	Fish	Meat	Vegetables	Oils	Spices	Sugar	Expenditure
First Quartile										
Rice	102.58	10.33	16.64	0.49	0.13	3.41	0.74	0.99	2.71	81.61
Wheat	36.98	27.83	3.94	6.24	0.31	13.82	1.92	1.58	4.54	0.28
Pulses	11.19	0.89	10.19	1.39	0.52	31.64	2.15	15.52	0	8.36
Fish	0.06	4.54	1.55	28.07	0.1	12.39	9.37	0.54	0.56	35.32
Meat	0.11	9.9	0.01	4.82	1.37	6.03	1.01	7.53	0.38	25.51
Vegetables	15.11	0.24	0.4	7.76	23.14	89.7	2.13	0.1	6.41	27.01
Oils	0.95	0.29	0.58	3.41	4.52	1.97	14.52	1.33	0.04	26.44
Spices	1.57	0.34	0.98	9.93	0.16	11.22	2.06	2.41	2.55	38.18
Sugar	0.47	1.02	3.4	7.5	0.9	0.02	10.18	1.22	1.79	1.54
Second Quartile										
Rice	33.94	2.36	0.5	2.42	1.77	8.58	10.86	1.59	3.64	11.72
Wheat	26.57	16.67	2.77	1.58	0.34	0.71	0.13	3.45	0.57	0.27
Pulses	1.07	1.76	15.6	1.25	1.03	16.21	2.93	0.82	0.02	3.96
Fish	0.11	0.52	3.55	39.9	0.76	6.47	3.69	0.96	2.85	9.71
Meat	0.74	5.91	2.53	0.54	5.38	0.1	0.15	0	0.99	2.74
Vegetables	22.26	0.09	1.89	0.78	22.09	52.86	1.2	2.25	5.42	28.92
Oils	0.36	1.32	7.91	0.5	3.73	0.31	12.17	0.03	0.24	32.14
Spices	3.38	0.86	7.47	20.95	8.34	5.72	3.23	4.4	0.7	26.01
Sugar	0.03	1.64	0.01	0.72	1.46	0.81	0.84	0.62	7.82	3.04
Third Quartile										
Rice	7.57	0.14	0.82	5.14	3.69	0.27	4.1	0.75	8.15	2.2
Wheat	10.41	1.94	0.01	0.22	0.02	2.39	0.23	1.56	0.49	0
Pulses	2.32	0.33	42.71	2.21	4.95	15.53	0.35	2.22	0.79	0.01
Fish	0.96	6.71	0.81	74.76	2.39	10.27	0.14	0.26	2.21	7.59
Meat	1.62	5.11	0.03	0	0.04	0.31	0.01	1.09	0.02	1.75
Vegetables	5.51	0.8	0.31	0.59	10.32	28.1	0.33	6.66	0.06	9.92
Oils	4.82	0.8	1.53	0.19	0.38	2.2	22.51	0.22	0.1	7.04
Spices	0.02	0.33	0.68	0.12	0	1.79	0.05	10.06	0.19	3.21
Sugar	0.04	0.58	1.42	7.3	1.38	0.01	1.23	2.42	3.33	10.15
Fourth Quartile										
Rice	14.72	0	0.71	0.55	2.57	1.57	0.37	13.62	3.02	0.92
Wheat	0.4	4.71	1.31	0.06	0.07	1.25	0.23	0.45	0.06	3.77
Pulses	1.62	2.55	23.27	1.22	0.41	8.74	4.16	0.69	1	3.86
Fish	4.5	0.77	2.75	25.14	5.05	7.49	0.28	0.65	2.46	4.77
Meat	17.59	4.79	1.22	0.63	5.97	5.6	0.59	0.01	1.45	19.69
Vegetables	0.18	2.23	1.88	1.64	0.12	0.31	2.51	1.35	0.23	0.01
Oils	6.68	0.4	10.83	0.19	2.45	0.09	1.64	14.06	0.15	22.21
Spices	20.15	0.98	3.85	3.81	0.17	1.87	2.04	74.53	3.61	17.83
Sugar	0.41	0.22	3.89	0.72	4.28	0.08	5.75	0.95	0.57	2.83

Note: Computed by the author. The critical value for chi-square at 90% with 1 degree of freedom is 2.70.