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Estimation of Demand Elasticity for Food Commodities in India[§]

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Abstract

The food demand in India has been examined in the context of a structural shift in the dietary pattern of its population. The results have reinforced the hypothesis of a significant diversification in the dietary pattern of households in recent years and has found stark differences in the consumption pattern across different income quartiles. The food demand behaviour has been explained using a set of demand elasticities corresponding to major food commodities. The demand elasticities have been estimated using multi-stage budgeting with QUAIDS model and another alternative model, FCDS. The study has revealed that the estimated income elasticities vary across income classes and are lowest for cereals group and highest for horticultural and livestock products. The analysis of price and income effects based on the estimated demand system has suggested that with increase in food price inflation, the demand for staple food (rice, wheat and sugar) may not be affected adversely but, that of high-value food commodities is likely to be affected negatively. Therefore, the study has cautioned that if inflation in food prices remains unabated for an extended period, there is the possibility of reversal of the trend of diversification and that of consumers returning to cereal-dominated diet, thus accentuating under-nourishment.

Key words: Food demand, Demand elasticity, QUAIDS model, FCDS model, Household food demand

JEL Classification: Q11, Q18

Introduction

One of the conspicuous outcomes of the economic development India has experienced in recent years is a marked change in the dietary pattern of its population. Several studies have shown dietary diversification of Indians towards the high-value food commodities such as milk, meat, fruits, fish, processed food products, etc. and away from the traditional cereals-dominated food basket (Kumar *et al.*, 2006; 2007). Rapid urbanization, increased disposable incomes of households, availability of a larger variety of food commodities in the market and growig food processing facilities in the country are some of the predominant factors behind this shift. Therefore, an analysis of food consumption pattern and its response to changes in income and prices is essential to estimate the future demand of agricultural products to attain food security in the country. This study is an attempt towards this direction, with focus on the changes in food consumption pattern of Indian households and estimation of the demand parameters of major food commodities. A better understanding of demand elasticities helps to predict future demand of food products under different scenarios of prices and income and could prove worthy for the policy planners on important policy decisions. The major food commodities included in the present analysis are: cereals, pulses, edible oils, fruits and vegetables, milk, sugar, meat, fish and eggs, as they constitute more than 95 per cent of the total food consumed by the Indian households. The food demand elasticities have been

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estimated using two alternative methodological tools, namely Quadratic Almost Ideal Demand System (QUAIDS) model and Food Characteristics Demand System (FCDS) model to enable a comparative as well as a realistic estimation.

Data and Methodology

The unit level data on dietary pattern and consumer expenditures collected by National Sample Survey Organization (NSSO) were used for this study. The household data collected under major rounds of National Sample Survey (NSS) covering the years 1983, 1987-88, 1993-94, 1999-00 and 2004-05 pertaining to 38th, 43rd, 50th, 55th and 61 rounds, respectively were used. The data referred to the average per capita consumption of all the food and non-food commodities in the sample households. The per capita expenditure was considered as a proxy for income, and therefore, these have been used interchangeably in the study. The sample households were categorized into four expenditure/ income groups. These were; very poor, moderately poor, non-poor lower and non-poor higher (Figure 1). The 'very poor' class comprised households which have income level below 75 per cent of the poverty line (PL), between 75 per cent of PL to PL were defined as 'moderately poor', between PL and 150 per cent of PL were grouped as 'Non-poor lower' (middle income group) and households having per capita income above 150 per cent of PL were categorized as 'Non-poor higher' (high income group). The poverty line for different states corresponding to various NSS rounds was used in the study.

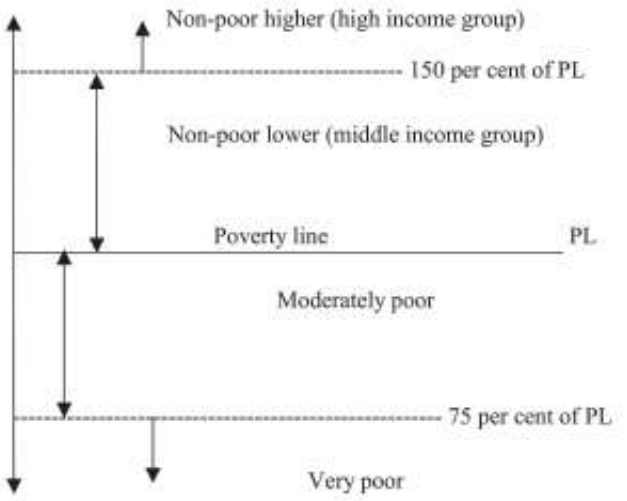

Figure 1. Categories of four income groups

The Demand Model

For estimating the price and income elasticities of demand for various food commodities, a number of demand models are available. The recent demand studies are centred on complete demand systems which take into account mutual interdependence of a large number of commodities in the budgetary allocations of the consumer. The functional form used in the demand study affects demand elasticity estimates. There are two important requirements for the functional form that are used to estimate income elasticities of food demand. First, these should be flexible enough to allow income elasticities to differ accros income groups, as the income elasticities of food demand generally fall with rise in income. Second, the functional form should account even if a household has zero consumption of a particular food commodity, since dropping these households from the sample could lead to estimation bias.

Linear Expenditure System (Stone, 1954), and Almost Ideal Demand System (AIDS) (Deaton and Muellbauer, 1980) are the demand models that have received considerable attention among the economists. These models are generally used for estimating demand equations for a group of commodities and not for commodities at a disaggregate level. Also, these models do not allow increasing or decreasing income elasticities. The normalized quadratic demand system (NQDS) and transcendental logarithmic demand system (TLDS), suggested by Swamy and Binswanger (1983), are the models which satisfy all general restrictions of demand theory and also allow the estimation of cross price elasticities within a group of close substitutes or complements, and do not assume the additive condition. These models also include linear and squared income terms which allow more flexibility in the response of consumer items to changes in income.

The Quadratic Almost Ideal Demand System (QUAIDS) with multistage budgeting framework, an extended version of AIDS model, is a modified version of the earlier model as it gives away the assumption of linearity in the expenditure function and also accounts for the zero consumption influence while estimating the income elasticity of demand. The modified model assumes that there is a non-linear relationship between income and consumption. Following Blundell *et al.* (1993), Dey (2000) and Kumar and Dey (2004), the specific functional forms used in the two stages have been discussed in the subsequent section.

Multi-stage Budgeting Framework with QUAIDS Model

A multi-stage (two-stage) budgeting framework is used to model the consumption behaviour of households. In the first stage, the model captures household decisions on how much of its total income (expenditure) is to be allocated for food consumption, conditional on consumption of non-food commodities and household as well as demographic characteristics. In the second stage, the household's allocation of total food expenditure across different items/groups, viz. cereals (rice, wheat, coarse cereals), pulses, milk, edible oils, vegetables, fruits, meat, fish & eggs, sugar, and other foods is modelled. The specific functional forms used in the two stages are as follows:

Stage 1: Food Expenditure Function

$$\ln (F) = \alpha + \gamma_1 \ln (P_f) + \gamma_2 \ln (P_{nf}) + \beta \ln (Y) + \Sigma \theta_j Z \quad \ldots(1)$$

where, F is the per capita food expenditure; Y is the per capita total expenditure (income); P_f is the household-specific price index for food; and P_{nf} is price index of non-food. The socio-demographic and conditioning variables (vector Z) include education, family size, and urban dummy. The parameter β varies as follows:

$$\beta = \beta_0 + \beta_1 \ln (Y)$$

Equation (1) was estimated by the ordinary least squares (OLS) method, and homogeneity of degree zero in prices and income was imposed by restricting $\gamma_1 + \gamma_2 + \beta_0 + 2\,\beta_1 \ln (Y) = 0$ at the sample mean of ln (Y).

Stage 2: Quadratic-AIDS (QUAIDS) Model

In stage 2 of the analysis, the quadratic extension to Deaton and Muellbauer's (1980) almost ideal model (QUAIDS) for food demand system was used. This model is quite popular and was adopted recently by Meenakshi and Ray (1999) for India food model, by Dey (2000) for fish demand model of Bangladesh, by Kumar and Dey (2004) for fish demand model of India, by Mittal (2006; 2007) for cereals, by Shinoj and Mathur (2006) for spices and by Dey *et al.* (2008) for fish demand in Asia. The specific functional form of this model for the ith items/groups is as follows:

$$S_i = a_i + \sum_j b_{ij} \ln (FP_i) + c_i \ln (F/I) + d_i \text{ Urban} + \sum_k e_{ik} \text{IMR}_k \quad \ldots(2)$$

where, FP_i is the price of ith item/group; I is the Stone price index; and Urban is a binary dummy variable for urban areas. The coefficient c_i is allowed to vary with per capita food expenditure (F) as:

$$c_i = c_{i0} + c_{i1} \ln (F/I)$$

The parameters of the model (a_i, b_{ij}, c_i, d_i and e_{ik}) were estimated by imposing the homogeneity (degree zero in prices), symmetry (cross price effects are same across the commodities), and adding up (all the budgetary shares add up to one) restrictions. The following restrictions are econometrically imposed:

Homogeneity: $\sum_{j=1}^{n} b_{ij} = 0;$

Symmetry: $b_{ij} = b_{ji}, \; c_{11}/c_{10} = c_{21}/c_{20} = \ldots\ldots = c_{n1}/c_{n0};$

Adding up: $\sum a_i = 1, \; \sum_i c_{i0} = \sum_i b_{ij} = \sum_i d_i = 0$

The homogeneity and symmetry restrictions are imposed at sample mean. Adding up restriction is imposed while computing the parameters of the last equation of the model, which is not included in the estimation. Given the quadratic specification of the demand system, a test of symmetry additionally requires that the ratio of the coefficients on the food expenditure and the square terms in food expenditure be the same for all items/groups (Blundell *et al.,* 1993). The predicted value of food expenditure obtained from stage 1 has been used as the explanatory variable. The income and price elasticities can easily be computed as follows:

Food item / group income elasticity:

$$\eta_I = (c_{i0} + 2c_{i1} \ln [F]/ w_i) + 1$$

Uncompensated price elasticity

$$\xi_{ij} = \left[\frac{b_{ij}}{w_i}\right] - (c_{i0} + 2c_{i1} \ln [F]) \left[\frac{w_j}{w_i}\right] - k_{ij}$$

where, k_{ij} is Kronecker delta, which takes the value one for own-price elasticity and zero for cross-price elasticity; and w_i is the share of the i^{th} item/group used as a weight in constructing Stone's price index. Once the expenditure and uncompensated price elasticities are estimated, the compensated own and cross-price

elasticities are computed using the Slutsky equation in elasticity form; i.e.

$$\xi_{ij}^{H} = \xi_{ij} + w_j \eta_i$$

where, ξ_{ij}^{H} is the compensated (Hicksian) price elasticity.

Income elasticity of demand for an individual item/ group $<\eta_i^y>$ is estimated as the product of expenditure elasticity of individual item/group $<\eta_i>$ and food expenditure elasticity with respect to total income (η^y):

$$\eta_i^y = \eta_i \times \eta^y \times \Phi_i$$

where, Φ_i = Probability that positive consumption of the 'i'th item occurs. It is estimated as the proportion of households consuming the ith item in the sample households during the survey.

Food Characteristic Demand System (FCDS)

In addition to econometric models, Bouis and Haddad (1992) suggested a non econometric model based on demand characteristics known as food characteristic demand system (FCDS). Several studies have shown that demand elasticities can vary widely across income groups (*see* Alderman, 1986, for a review) and regions as production environments and tastes change.

FCDS can be easily used for those households who spend a high proportion of their total income on food, and a large share of their total food expenditure on a low-cost-calorie staple, to avoid going hungry. How will such a low-income household react if the price of this low-cost-calorie staple (say wheat) falls? The household could afford to substitute a part of this staple with some preferred staple (say rice) without going hungry. A drawback of such a decision, however, is that the diet would still consist almost entirely of bland cereals. The household may instead prefer to continue eating nearly the same amount of wheat as before to meet its energy requirements, and may supplement the monotonous diet with some low-cost-per-kilo meat. If latter is the case, i.e. if consumption of non-staple diet is more important for the household than the superior taste of rice, then the uncompensated own-price elasticity for wheat may be (negative but) very low in absolute value.

Now suppose that a lower price of wheat in the above example prevails and the income of the household goes up on a regular basis. Then, the household may afford a substantial amount of some preferred food item (say meat) in the diet, and may even afford consumption of a relatively superior quality of rice. Suppose that the price of wheat rises (although still remains below the rice price), the household being economically stronger now, does not have to worry about the specter of hunger (a low energy intake), despite increase in wheat price. The household may even plan to substitute a substantial amount of wheat with rice. Since the household pays more for cereals now, the total consumption of both cereals and meat may be reduced marginally. However, although the total utility goes down, the marginal utilities of "energy" (calorie intake) and "variety" (non-staple food consumption) have declined enough so that the loss in utility is minimum by sacrificing some calorie intake from the non-staple food consumption, but recouping some utility from the superior "taste" of his choiced commodity.

Model Specification

Utility is a function of energy, variety, and tastes (characteristics of food consumed) and of non-food purchases. The total utility derived from these three food characteristics and non-food commodities is the weighted sum of their individual utilities, i.e.

$$U = w_e U_e(E) + w_v U_v(V) + \sum_{i=1}^{n} w_{ti} U_{ti}(q_i) + w_{nf} U_{nf}(q_{nf})$$

where,

U	=	Total utility from all food and non-food commodities,
q	=	Quantity of a commodity,
i	=	No. of food commodities, i =1,...,n,
E	=	A measure of energy in the diet,
V	=	A measure of variety in the diet,
U_e	=	Utility derived from energy,
U_v	=	Utility derived from variety,
$U_{ti}(q_i)$	=	Utility derived from the taste of q units of commodity i,
$U_{nf}(q_{nf})$	=	Utility derived from q units of the non-food commodity,
w_e	=	Weight placed on utility from energy,

w_v = Weight placed on utility from variety,

w_{ti} = Weight placed on taste from individual food commodity i, and

w_{nf} = Weight placed on utility from the non-food commodity.

The algorithm for solving the FCDS under FORTRAN program written by Bouis (1991) was used for computing the food demand elasticity matrix. In the FCDS, three characteristics—energy , variety, and tastes of individual foods—are assumed to be additive in the utility function. For estimation, prior knowledge of four parameters in the utility function from which shadow prices can be derived for the characteristics of energy, variety, and taste is needed. The assumptions made to fulfil this requirement are given in Table 1.

The assumption 1 indicates those levels of calorie consumption (per adult equivalent) at which the marginal utility to calorie consumption is zero. These levels are reduced marginally for successive expenditure quartiles under the assumption that physical activity levels are lower at higher income levels.

Changes in Food Basket and Nutritional Levels

Engels' Law on food demand appears to be fully operational in India, as is evident from the declining income elasticities for food with rise in income. In the past few decades, economists had closely followed the trend in cereals consumption and demonstrated that the per capita consumption and demand had levelled off (Kumar, 1998). Diversification in food supply and reforms in domestic market initiated during the 1990s had offered to consumers a wide choice in food, leading to changes in dietary patterns towards high-value grains (rice and wheat), and products of livestock (milk, meat), poultry, fisheries and horticulture (fruits and vegetables). It is widely believed that though food security has been achieved at the national level, household food security continues to be vulnerable. Therefore, a study on changes in food basket at the household level is of great significance. Since consumption-changes occur slowly, such an analysis should be based on long-term basis. This section provides empirical evidences on the nature and extent of long-term changes in consumption patterns and nutritional status of various socio-economic groups at the household level in India.

Changes in Food Consumption Pattern

The per capita consumption of different food commodities over the past two decades (1983-2004) across different income groups and changes therein are presented in Table 2. The changes reveal two types of effect: (i) Changes in the consumption pattern of an income group over time, which has been termed as "structural shift" on account of 'consumption diversification effect', as a result of easier access to supply, transformation in tastes and preferences, and varying relative prices, and (ii) Changes in food consumption as one moves from lower income to higher income group in the same year, which has been designated as 'pure income effect'; this change is the result of increase in income level of the consumer. The per capita consumption of all food items except coarse cereals has been found higher by the households in the upper income group in all the survey years. These differences, on account of the obvious pure income effect, were substantial for non-cereal products.

Table 1. Assumptions of food characteristic demand system

Expenditure group	Assumption			
	1	2	3	4
Very poor	3200	-0.04	0.30	-2.0
Moderately poor	3100	-0.05	0.45	-2.3
Non-poor lower	3000	-0.08	0.60	-2.4
Non-poor higher	2900	-0.15	0.70	-2.5

Note: Assumption 1 represents the levels of calorie consumption per adult equivalent at which the marginal utilities of calorie consumption are zero.
Assumption 2 is the magnitude of curvature in the quadratic function for utility from energy.
Assumption 3 is the shadow price for variety, and
Assumption 4 is the ratio of the flexibility of the marginal utility of income over non food income elasticity (Pinstrup-Andersen, 1976)

Table 2. Commodity-wise annual per capita food consumption by income group, India: 1983-2004

(kg/person/annum)

Food commodity	Income group	1983	1993	2004	Change, % 1983-2004
Rice	Very poor	53.6	61.0	68.2	27.2
	Moderately poor	75.7	73.6	75.9	0.3
	Non-poor lower	90.2	77.2	84.3	-6.5
	Non-poor higher	92.2	77.4	90.2	-2.2
Wheat	Very poor	42.7	40.3	40.7	-4.7
	Moderately poor	49.0	43.7	45.8	-6.5
	Non-poor lower	53.7	46.5	47.0	-12.5
	Non-poor higher	68.4	52.8	49.9	-27.0
Coarse cereals	Very poor	39.4	22.8	12.0	-69.5
	Moderately poor	33.2	17.6	11.5	-65.4
	Non-poor lower	30.4	15.5	11.8	-61.2
	Non-poor higher	27.2	12.5	8.1	-70.2
Total cereals	Very poor	135.6	124.1	120.9	-10.8
	Moderately poor	157.8	134.9	133.3	-15.5
	Non-poor lower	174.3	139.2	143.2	-17.8
	Non-poor higher	187.8	142.7	148.3	-21.0
Pulses	Very poor	6.7	4.6	5.9	-11.9
	Moderately poor	9.1	5.9	6.9	-24.2
	Non-poor lower	11.5	7.5	8.0	-30.4
	Non-poor higher	17.0	10.5	10.9	-35.9
Edible oils	Very poor	2.2	3.0	4.0	81.8
	Moderately poor	3.2	3.9	4.8	50.0
	Non-poor lower	4.3	5.1	5.7	32.6
	Non-poor higher	6.9	7.7	7.9	14.5
Vegetables	Very poor	31.4	40.2	44.0	40.1
	Moderately poor	40.0	50.7	53.2	33.0
	Non-poor lower	47.9	59.5	61.8	29.0
	Non-poor higher	63.7	77.3	79.9	25.4
Fruits	Very poor	1.3	2.8	3.8	192.3
	Moderately poor	1.8	4.7	5.0	177.8
	Non-poor lower	2.7	7.3	7.3	170.4
	Non-poor higher	6.0	16.5	16.0	166.7
Milk	Very poor	10.3	13.3	14.1	36.9
	Moderately poor	22.5	26.8	24.7	9.8
	Non-poor lower	40.4	48.5	42.4	5.0
	Non-poor higher	88.2	101.5	86.7	-1.7
Sugar	Very poor	5.4	5.4	5.3	-1.9
	Moderately poor	7.9	7.3	6.7	-15.2
	Non-poor lower	10.7	9.9	8.3	-22.4
	Non-poor higher	17.5	15.3	12.1	-30.9
Meat, fish & eggs	Very poor	2.5	2.4	2.9	16.0
	Moderately poor	3.7	3.8	3.8	2.7
	Non-poor lower	4.9	5.2	5.4	10.2
	Non-poor higher	8.8	9.2	9.8	11.4

The per capita consumption of coarse cereals has declined substantially over the years. The per capita annual consumption of high-value cereals like rice and wheat has increased on account of increase in income as well as changes in tastes and preferences, and easy availability of these grains due to institution of public distribution system and also due to higher productivity. However, total cereals consumption has declined by 11 per cent to 21 per cent due to dietary diversification towards horticultural and livestock products as well as rise in prices of cereals in real terms. Similarly, the annual per capita consumption of pulses has declined by 13 per cent for bottom income group and 36 per cent for top income group during two decades from 1983 to 2004, owing to their higher relative prices. Over the years, the per capita annual consumption of edible oils, vegetables, fruits, milk, meat, fish, eggs and sugar has increased substantially in each of the income groups. And this increase is quite substantial in the bottom group. The dietary shift in favour of high-value food products has been found prominent and pervasive for all the income groups.

Budgetary Allocation by Food Commodities

Across different food commodities, cereals dominated in budgetary allocation in the total food expenditure of all income groups (Table 3). It was as high as 58 per cent by very poor households, followed by 52 per cent by moderately poor, 45 per cent by non-poor lower and 33 per cent by non-poor higher in 1983. In 2004 also, cereals have been found to receive maximum budgetary allocation among all income groups; however a consistent decline has been observed in this allocation across all income groups. Maximum decline of 28.7 per cent was depicted in very poor group, followed by moderately poor (26.8%), non-poor lower (25.0%) and non-poor higher (23.7%) groups. The share of budgetary allocation to cereals was inversely related to household income level.

There has not been a significant change in budgetary allocation to pulses across all income groups during the two-decade period. It has been hovering around 4-6 per cent. A close look, however, has revealed that there has been a rise in the budgetary allocation to pulses by both the poor groups, 13.3 per cent by very poor and 7.5 per cent by moderately poor groups in 2004 over 1983. Both the upper income groups have, on the other hand, depicted a decrease in their budgetary allocations to pulses over this period.

The share of vegetables and fruits in total food expenditure has depicted maximum change in total food expenditure across all income groups. And the important observation is that rise in budgetary allocation to both vegetables and fruits is maximum across very poor households and it decreases as income rises.

The budgetary allocation to edible oils has depicted the second maximum rise, after vegetables and fruits, particularly across both poor groups, it is 51 per cent for very poor and 35 per cent for moderately poor groups. This shows the rising trend in consumption of edible oils by the poor strata of the society. On the other hand, the non-poor higher group has depicted a rise of only 1.6 per cent over the period 1983-2004, indicating not much change in their consumption level of edible oils.

In the total food expenditure, the share of milk has shown a considerable rise; it has been maximum by very poor (42.4%) and moderately poor (21.9%) groups. It shows a higher increase in consumption of milk by the poor segment of the households over these two decades. Contrastingly, the rise in budgetary allocation to milk has been nominal (2.5%) by the top income group.

A contrasting trend has been observed in the budgetary allocation to sugar in total food expenditure has shown an interesting trend. It has depicted maximum rise for very poor category (17.96%) and maximum fall for non-poor higher category (21%). The level of sugar consumption did not vary much across different income groups in 2004. It varied from 3.7 kg to 4.1 kg only across different income groups.

The budgetary allocation to meat, fish and eggs in total food expenditure has depicted a consistent rise across all the income groups during the past two decades. This rise in budgetary allocation has been significant, varying from 39 per cent among the very poor category to 25 per cent among high income group. This shows the rising diversification in consumption towards livestock products across all the income groups.

The share of total food expenditure on other food commodities has revealed an increasing trend during the period 1983-2004. The rise has been consistent across all the income groups throughout the period, but it was maximum (32.9%) among very poor households and decreased with increase in income category to 24.0 per cent for non-poor higher group.

Table 3. Changes in budgetary shares of different food commodities in total food expenditure by income group, India: 1983-2004

(in per cent)

Food commodity	Income group	1983	1993	2004	Change, % 1983-2004
Cereals	Very poor	58.2	49.5	41.5	-28.7
	Moderately poor	52.4	44.1	38.4	-26.8
	Non-poor lower	45.8	37.5	34.4	-25.0
	Non-poor higher	33.1	26.0	25.2	-23.0
Pulses	Very poor	5.6	5.2	6.4	13.3
	Moderately poor	5.7	5.1	6.2	7.5
	Non-poor lower	5.8	5.0	5.7	-0.6
	Non-poor higher	5.7	4.5	5.0	-11.8
Edible oils	Very poor	6.1	7.8	9.2	50.9
	Moderately poor	6.6	7.7	8.9	34.9
	Non-poor lower	6.9	7.7	8.4	21.5
	Non-poor higher	7.3	7.4	7.4	1.6
Vegetables	Very poor	7.8	10.5	12.9	64.6
	Moderately poor	8.0	10.5	12.7	58.4
	Non-poor lower	8.1	10.3	12.2	50.6
	Non-poor higher	8.1	9.9	11.4	40.3
Fruits	Very poor	1.1	1.4	1.8	60.6
	Moderately poor	1.3	1.8	2.0	46.6
	Non-poor lower	1.8	2.5	2.4	35.4
	Non-poor higher	3.2	4.4	4.1	28.1
Milk	Very poor	5.3	7.2	7.6	42.4
	Moderately poor	8.5	10.7	10.4	21.9
	Non-poor lower	12.3	10.4	13.9	13.5
	Non-poor higher	18.5	21.9	19.0	2.5
Sugar	Very poor	3.5	4.4	4.1	17.9
	Moderately poor	3.8	4.5	4.1	7.1
	Non-poor lower	4.1	4.8	4.0	-2.6
	Non-poor higher	4.6	4.7	3.7	-21.0
Meat, fish & eggs	Very poor	3.7	4.5	5.1	38.6
	Moderately poor	4.7	5.7	5.9	24.5
	Non-poor lower	5.6	6.5	7.1	25.5
	Non-poor higher	7.3	8.2	9.1	25.1
Other food commodities	Very poor	8.6	9.4	11.4	32.9
	Moderately poor	8.9	9.8	11.5	30.4
	Non-poor lower	9.6	10.6	11.9	23.9
	Non-poor higher	12.2	13.7	15.1	24.0

From the above discussion it is clear that the massive reduction (24-28%) in the budgetary allocation to cereals has been diverted to higher allocation to more nutritive food commodities like vegetables, fruits, milk, meat, fish and eggs across all income categories. This indicates an increasing nutritional consciousness of the population as well as their urge to shift consumption from the traditional cereal-based food basket to more nutritious and tasty food items as income increased. This tendency was visible more in lower income groups than higher income groups.

Calorie Consumption Pattern

The estimates of per capita calorie consumption for the years 1983, 1993-94 and 2004-05 are shown in Table 4. The per capita calorie consumption seems to have a direct relationship with income, the absolute calorie consumption being highest for the top income group. However, the per capita calorie consumption declined in 2004-05 as compared to 1983 across all income groups, except among very poor category. The rate of decline varied from 1.5 per cent to 3.8 per cent and was higher for higher income categories. And this change has been due to the effect of diversification from cereals to high-value commodities. The per capita calorie consumption among very poor households increased slightly from 1544 kcal in 1983 to 1612 kcal in 2004-05; an increase of about 4.4 per cent.

The decline in per capita calorie consumption has also been pointed out in several studies, including those of Rao (2000; 2005), Meenakshi and Viswanathan (2005), Ray and Lancaster (2005), Palmer-Jones and Sen (2001), Patnaik (2004; 2007), Radhakrishna *et al*. (2004), Radhakrishna (2005) and Kumar *et al*. (2007).

A pertinent question in the context of dietary transition was how these changes were affecting the energy-nutrition balance, particularly of the poor. The calorie intakes from different food commodities by all the four expenditure groups between 1983 and 2004-05 have been recorded in Table 5. The cereals were the major suppliers of calories and non-cereals like pulses, edible oils, horticultural products, and animal & fishery products were major providers of proteins, fats, vitamins, minerals, etc. Closely following the trends described earlier, the cereals accounted for 71 per cent of the total calorie intake for very poor and 54 per cent in high income group in the year 2004-05. The share of cereals in total per capita calorie consumption was 83 per cent for very poor households and 66 per cent for non-poor higher households in 1983. The decline in calorie intake from cereals on account of decrease in their consumption was compensated by a marked increase in intake of calories from edible oils, vegetables, fruits, sugar and milk. With lesser consumption of cereals and more of non-cereals, the sources of calorie supply have witnessed a structural change.

Food Demand Elasticities

Demand elasticities at disaggregate level vary widely across income groups as influenced by production environment and changes in tastes. Demand elasticities at disaggregate level are consistent with the long-term changes in consumption for cereals and other foods. The QUAIDS model consists of demand equations for cereals, pulses, vegetables and fruits, milk, edible oils, sugar and other foods. The FCDS includes major commodities, viz. rice, wheat, other cereals, pulses, edible oils, vegetables, fruits, sugar, milk, meat (meat, fish & eggs), and other foods. The demand elasticities for major commodities were derived for each income group households based on QUAIDS and FCDS models.

Income and Price Elasticities of Food Based on QUAIDS Model

The income and price elasticities of food groups based on QUAIDS model have been presented in Table

Table 4. Trends in calorie consumption across different income groups: 1983 to 2004-05

(kcal)

Income class	1983	1993-94	2004-05	Change, % 1983-2004
Very poor	1544	1478	1612	4.46
Moderately poor	1879	1707	1850	-1.54
Non-poor lower	2180	1910	2096	-3.85
Non-poor higher	2663	2333	2561	-3.83

Table 5. Changes in share of commodities in total food calories by income groups, India: 1983-2004

(% share in total calories)

Food commodity	Income group	1983	1993	2004	Change, % 1983-2004
Cereals	Very poor	82.7	79.6	70.8	-14.4
	Moderately poor	79.2	74.9	68.0	-14.1
	Non-poor lower	75.4	69.1	64.4	-14.6
	Non-poor higher	66.4	58.0	54.6	-17.8
Pulses	Very poor	4.1	3.2	3.4	-17.1
	Moderately poor	4.6	3.6	3.5	-23.9
	Non-poor lower	5.0	4.0	3.6	-28.0
	Non-poor higher	6.1	4.6	4.0	-34.4
Edible oils	Very poor	3.5	4.9	6.1	74.3
	Moderately poor	4.2	5.7	6.4	52.4
	Non-poor lower	4.9	6.6	6.7	36.7
	Non-poor higher	6.4	8.2	7.6	18.8
Vegetables	Very poor	3.2	3.8	10.7	234.4
	Moderately poor	3.3	4.1	11.2	239.4
	Non-poor lower	3.4	4.2	11.4	235.3
	Non-poor higher	3.6	4.3	12.8	255.6
Fruits	Very poor	0.2	0.6	0.7	250.0
	Moderately poor	0.2	0.8	0.8	300.0
	Non-poor lower	0.2	1.2	1.0	400.0
	Non-poor higher	0.4	2.1	1.7	325.0
Milk	Very poor	1.8	2.5	2.4	33.3
	Moderately poor	3.1	4.3	3.6	16.1
	Non-poor lower	4.9	7.0	5.5	12.2
	Non-poor higher	8.6	11.9	9.2	7.0
Sugar	Very poor	0.5	0.5	0.6	20.0
	Moderately poor	0.6	0.7	0.6	0.0
	Non-poor lower	0.7	0.9	0.8	14.3
	Non-poor higher	0.9	1.3	1.2	33.3
Meat, fish & eggs	Very poor	3.7	3.9	3.6	-2.7
	Moderately poor	4.5	4.6	3.9	-13.3
	Non-poor lower	5.3	5.5	4.3	-18.9
	Non-poor higher	7.1	7.0	5.1	-28.2

6. These were found to be in accordance with *a-priori* expectation. The income elasticities of food commodities are positive and decline with increase in household income. The income elasticities are much higher for poor households than for richer households. The income elasticities for all income groups are maximum for milk (1.64), followed by sugar (0.94), vegetables & fruits (0.82), edible oils (0.77), pulses (0.72) and least for cereals (0.19). The results suggest that with the increase in income, demand for all food commodities other than staple food (cereals) will increase much faster. With inclusive growth, government should plan for a relatively bigger supply of food to fight inflation in food prices. The own price

Table 6. Income and price elasticities of food based on QUAIDS model, India

Food	Income group				
	Very poor	Moderately poor	Non-poor lower	Non-poor higher	All
Income (Expenditure) elasticities of food					
Cereals	0.514	0.424	0.312	-0.006	0.187
Pulses	0.993	0.895	0.793	0.580	0.716
Vegetables & fruits	0.759	0.785	0.811	0.839	0.817
Milk	2.342	2.018	1.773	1.556	1.640
Edible oils	0.935	0.876	0.817	0.695	0.772
Sugar	1.052	1.007	0.968	0.898	0.942
Other food commodities	0.840	0.872	0.895	0.894	0.887
Uncompensated own price elasticities of food					
Cereals	-0.309	-0.242	-0.150	-0.127	-0.031
Pulses	-0.710	-0.691	-0.661	-0.602	-0.635
Vegetables & fruits	-0.893	-0.901	-0.908	-0.928	-0.917
Milk	-0.820	-0.923	-0.999	-1.076	-1.035
Edible oils	-0.476	-0.454	-0.415	-0.332	-0.377
Sugar	-0.081	-0.083	-0.065	-0.036	-0.010
Other food commodities	-1.301	-1.298	-1.285	-1.250	-1.259

Table 7. Income elasticities of food based on FCDS model

Food	Income group				
	Very poor	Moderately poor	Non-poor lower	Non-poor higher	All
Rice	0.182	0.102	0.030	-0.025	0.024
Wheat	0.102	0.083	0.070	0.071	0.075
Coarse cereals	-0.123	-0.154	-0.141	-0.095	-0.125
Pulses	0.578	0.423	0.279	0.105	0.219
Milk	0.862	0.694	0.539	0.276	0.429
Edible oils	0.703	0.537	0.375	0.156	0.297
Vegetables	0.693	0.518	0.370	0.174	0.259
Fruits	0.753	0.599	0.492	0.282	0.362
Meat, fish & eggs	1.034	0.900	0.799	0.531	0.669
Sugar	0.337	0.205	0.107	0.010	0.062
Other food commodities	1.160	1.003	0.911	0.638	0.748
Non-food commodities	2.403	2.421	2.321	1.819	1.993

elasticities for all the food commodities have been found negative. Across commodities and income groups, the magnitude of own price elasticities is highly correlated with the income elasticities. Magnitudes of price elasticities are much lower for cereals than for high-value commodities. With inflation in food prices, the food basket with nutritive diet will be adversely affected. The consumers would shift their dietary pattern towards cereals to meet their need of calories.

Income and Price Elasticities of Food Based on FCDS Model

The national level estimates of income and own price elasticities based on FCDS model are given in Tables 7 and 8, respectively. Income elasticities have been found to vary widely across lifestyles and income groups due to changes in production environment and tastes & preferences. The elasticites for staple food (rice, wheat, coarse cereals) have been found highly

Table 8. Uncompensated own price elasticities based on FCDS model

Food	Income group				
	Very poor	Moderately poor	Non-poor lower	Non-poor higher	All
Rice	-0.487	-0.377	-0.266	-0.161	-0.247
Wheat	-0.480	-0.470	-0.300	-1.611	-0.340
Coarse cereals	-0.333	-0.281	-0.196	-0.109	-0.194
Pulses	-0.738	-0.667	-0.526	-0.339	-0.453
Milk	-0.850	-0.810	-0.708	-0.521	-0.624
Edible oils	-0.777	-0.708	-0.591	-0.381	-0.504
Vegetables	-0.769	-0.730	-0.600	-0.453	-0.515
Fruits	-0.824	-0.777	-0.682	-0.540	-0.595
Meat, fish & eggs	-0.908	-0.897	-0.864	-0.779	-0.821
Sugar	-0.643	-0.580	-0.434	-0.255	-0.340
Other food commodities	-0.945	-0.942	-0.933	-0.906	-0.917
Non-food commodities	-1.318	-1.280	-1.298	-1.184	-1.237

inelastic, close to zero and even negative for coarse cereals. The magnitude of elasticities declined with rise in income across all income groups. The income elasticity was much higher for livestock and horticultural products and other food groups. Demand for high-value food commodities will increase faster with rise in income.

The own price elasticities had the expected negative sign. The price elasticities have been found lower for the richer households as compared to poor households. With increase in inflation in food prices, the poor households will be affected much more than richer households. A comparison of own price and income elasticities based on QUAIDS and FCDS models has revealed that the cheapest source of calories (cereals and sugar) has a lower income elasticity under FCDS than under QUAIDS model. Price elasticity trend with rise in income exhibited a more realistic view under FCDS than under QUAIDS model to explain the consumer behaviour for food basket. The income and own price elasticities of food demand by commodities and groups of commodities have been found to vary widely across commodities and income groups. The income elasticities for cereals and sugar were highly inelastic being an essential food commodity in the human diet.

Income and Price Effect on Food Demand

To understand the impact of changes in income and prices, the income effect, price effect and net effect on food demand were derived from the demand system based on FCDS model and have been presented in Table 9. The income effect was positive but mild (sum of own and cross price elasticities) for rice and wheat, and negative for coarse cereals. The net price effect was positive for rice and coarse cereals and negligible for wheat. However the total net effect consisting of income and price effects was positive and was 0.13 for rice, 0.065 for wheat and 0.279 for coarse cereals. With increase in price inflation in cereals, the demand of coarse cereals for human consumption is bound to increase. It may have an adverse impact on the manufacturing of feed concentrate that in turn may influence the rearing of livestock adversely. The income has a positive and significant effect on demand for sugarcane (0.062), pulses (0.219), vegetables (0.259), edible oils (0.297), fruits (0.362), non-vegetarian food, viz. meat, fish and eggs (0.669), and other high-value foods (0.748). The net price effect on food demand was found negative with high in magnitude and the estimates were -0.344 for pulses, -0.760 for milk, -0.496 for edible oils, -0.464 for vegetables, -0.682 for fruits, -1.22 for non-vegetarian food and -2.379 for high-value food. The price effect will dominate the income effect and thus pure price inflation (sum of income and price elasticities) will be negative for most of the high-value nutritive food commodities. Thus, increase in inflation of food price will adversely affect the dietary diversification towards non-cereal food commodities and may lead to under-nourishment of consumers. The effect of increasing inflation in food prices would be more pinching for the lower income groups.

Table 9. Commodity-wise income and price effects on food demand, India

Commodity	Income effect	Price effect	Total effect
Rice	0.024	0.107	0.131
Wheat	0.075	-0.010	0.065
Coarse cereals	-0.125	0.404	0.279
Pulses	0.219	-0.344	-0.126
Milk & milk products	0.429	-0.780	-0.351
Edible oils	0.297	-0.496	-0.198
Vegetables	0.259	-0.464	-0.206
Fruits	0.361	-0.643	-0.282
Meat, fish & eggs	0.669	-1.222	-0.553
Sugar	0.062	-0.020	0.042
Other food commodities	0.748	-2.379	-1.631

Conclusions and Policy Implications

The study on trends in consumption of major food commodities in the country has revealed a structural shift in the dietary pattern of its population that has been taking place for the past two decades across different income groups. The consumers have been found to shift their budgetary allocation from cereals-based food towards high-value commodities like fruits and vegetables, milk, fish, meat and meat products, etc. The study has attributed this structural shift to 'consumption diversification effect' arising out of changes in tastes and preferences, easier access to supply, variation in relative prices, etc. on the one hand and to 'pure income effect', resulting from the increase in income levels of the consumers, on the other. Such a transition has significant implications on resource allocations and research priority setting and the state policy needs to be reoriented towards meeting the challenges arising from this structural change in food consumption.

The demand elasticities, worked out using two alternative models, namely QUAIDS and FCDS, have been used to explain the food demand behaviour of the people. Demand elasticities have been observed to vary widely across income groups, and food commodities. The estimated income elasticities have been found to vary across income classes and are lowest for cereal groups and highest for horticultural and livestock products. The magnitudes of elasticities have been estimated higher for lower income groups and these tend to decrease as income increases. The analysis of price and income effects based on the estimated demand system has suggested that with increase in food price inflation, the demand for staple food (rice, wheat and sugar) may not be affected adversely but, that of high-value food commodities is likely to be affected negatively. Therefore, the study has cautioned that if inflation in food prices remains unabated for an extended period, there is the possibility of reversal of the trend of diversification and that of consumers returning to cereal-dominated diet, thus accentuating under-nourishment.

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