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Demand System Estimations and Welfare Comparisons: Application to Indian Household Data

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Abstract

In this study, we explore the relationship between the rank of a demand system and the estimation results both in terms of consumption behaviour and more importantly in terms of welfare analysis. Money-metric utility levels given by equivalent expenditures are taken as welfare indicators for calculating poverty and inequality measures as they incorporate substitution effects due to relative price changes. Estimations are carried out using relevant data concerning Indian households (rural and urban) collected from nation-wide surveys conducted by the National Sample Survey Organisation (NSSO). We find that although the specification does play an important role in the economic explanation of consumer behaviour with some models being more suited than others depending on the pattern of consumption, welfare comparisons do not change significantly from one model specification to the other. On the other hand, there are notable differences between results based on estimated equivalent expenditures and those based on observed real expenditures.

Keywords: Demand system estimation, household surveys, poverty, inequality, India

JEL Classification Codes: C3, D1, D6, O53

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1. Introduction

Poverty and inequality comparisons are in general based on income or total consumption expenditure deflated using the conventional Consumer Price Index as the deflator. The problem with this practice is that substitution effects in consumption due to changes in relative prices are ignored and therefore utility-compensated effects are not considered. Depending on the structure of preferences and the extent of relative price changes, the above method could seriously bias welfare comparisons. One way to solve this problem is to use equivalent expenditures calculated at some references prices.

What kind of consequences do we run into by ignoring substitution effects in the evaluation of total expenditures? Do demand systems of different ranks give different conclusions? How do distortions in the estimation of equivalent expenditures affect the welfare measures which are based on the distribution of these expenditures? Our study is an attempt to answer all these questions using appropriate econometric models and methods, and large-scale micro-level data for a developing country. It is mainly focused on taking substitution effects into account in calculating welfare measures, exploring different preference structures leading to demand systems of different ranks, and investigating the relationship between rank and welfare comparisons based on equivalent expenditures. As our data set refers to a developing country with a relatively low per capita expenditure, we give special attention to the substitution effects for the poor as it is often assumed that these effects are negligible for them.

The above research is carried out using household budget data from the 55th round of India's National Sample Survey (1999-2000) and price data for different categories of goods across different States published by the Labour Bureau of the Government of India. The next section gives a summary of the theoretical models used to estimated equivalent expenditures and goes over the poverty and inequality measures calculated in our analysis. A description of the data set is given in the Section 3. Section 4 analyses the estimation results both in terms of coefficients and elasticities. Here we also include a brief discussion on the quality of fit. Section 5 examines the distribution of equivalent expenditure estimates according to different models and ranks. This section also contains our main results on welfare measures based on our estimations comparing them among different models and with those based on observed real expenditures. Finally we end the paper with the main conclusions.

2. Theoretical Background

Poverty measures are often derived from income or total expenditure as a welfare indicator. However using any indicator in nominal terms can introduce apparent welfare improvements over time when it is not true. A practical and simple solution consists in deflating period 1 data by an aggregate price index given by a weighted average of elementary price indices with fixed weights (ω_j) :

$$P(1/0) = \sum_j \omega_j \frac{p_j^1}{p_j^0}$$

with period 0 as the reference period. However, this approach rules out substitution effects between various categories or groups due to changes in relative prices.

A more suitable choice is the indirect utility function $u(p^1, x^h, a^h)$ which gives the utility achieved in period 1, given prices p^1, income x^h and other relevant characteristics a^h. A money measure of this utility at constant prices is given by the equivalent expenditure:

$$x^{e,h} = c(u(p^1, x^h, a^h), a^0, p^0)$$

where p^0 and p^1 denote prices at periods 0 and 1 respectively, a^0 denotes the reference household characteristics, u(...) the indirect utility function, and c(..) denotes the cost function. Household composition can be accounted for either by demographic scaling or demographic translating, we decided to adopt the latter approach as a first attempt.

In demand analysis, Gorman (1981) investigated the class of polynomial demand systems which can be written in the form

$$q_j (p, x) = \sum_{s \in S} a_{js} (p) G_s(x)$$

and showed that the maximum column rank of the n × S matrix A= $\{a_{js}\}$ is three in the class of demand systems which are linear in functions of expenditure and aggregate over consumers. Full rank systems, i.e. systems with maximum column rank, maximise the degree of income flexibility of demands with the fewest number of parameters. Our analysis of the sensitivity of welfare measures to rank is based on three models of different ranks: Linear expenditure system of rank 1 (cf. Stone (1954)), Almost Ideal Demand System (AIDS) of rank 2 (cf. Deaton and Muellbauer (1980)) and Quadratic AIDS of rank 3 (cf. Banks, Blundell and

Lewbel (1997) and Ravallion and Subramanian (1996)). As these models are well-known in the economic literature, we only give below the expressions of the various quantities used in our further calculations without additional explanations.

Demand systems

Linear Expenditure System, LES

The simplest unit rank demand system we may consider is the linear demand system proposed by Stone (1954). Introducing the household characteristics with the translating method the demand function is given by

$$x_i = \alpha_i * + \sum_{s=1}^{S} \delta_{is} D_s + \frac{\beta_i}{p_i}\left(r - \sum_{k=1}^{n} p_k \alpha_i * - \sum_{k}^{n} \sum_{s}^{S} p_k \delta_{is} D_s \right), \text{ i} = 1,...,\text{M} \quad (1)$$

where D_s, s = 1,…,S denote the household's demographic characteristics. The indirect utility function is:

$$u(p,r) = \frac{r - \sum_k p_k \alpha_k * - \sum_k \sum_s p_k \delta_{ks} D_s}{\alpha_0 \prod_k (p_k)^{\beta_k}}$$

and the equivalent expenditure is given by

$$x^{e,h}(p^0, u) = u(p^1, r^1) \prod_k (p_k^0)^{\beta_k} + \sum_k p_k^0 \alpha_k * + \sum_k \sum_s p_k^0 \delta_{ks} D_s$$

The additivity restriction $\sum_i p_i q_i = r$ implies that $\sum_i \alpha_i = 1$.

Almost Ideal Demand System, AIDS

This model proposed by Deaton and Muellbauer (1980) is of a flexible functional form which derives the budget share equation starting from the specification of a cost function belonging to the PIGLOG family. The budget share is of the form:

$$w_i = \alpha_i + \sum_s \delta_{is} D_s + \beta_i \log\left(\frac{r}{P}\right) + \sum_j \gamma_{ij} \log p_j \quad (2)$$

The indirect utility function incorporates the demographic conditions is given by:

$$u(p^1, r) = \frac{\log r - \alpha_0 - \sum \alpha_k \log p_k^1 - \sum_s \delta_{ks} D_s \log p_k^1 - \frac{1}{2} \sum_i \sum_j \log p_i^1 \log p_j^1}{\prod_k (p_k^1)^{\beta_k}}$$

with log P = $\alpha_0 + \sum_k \left(\alpha_k + \sum_s \delta_{ks} D_s \right) \log p_k + \frac{1}{2} \sum_k \sum_j \gamma_{kj} \log p_j \log p_k$

Because of the additivity restriction given by $\sum_{i=1}^{M} w_i = 1$, parameters are constrained as follows:

$$\alpha_n = 1 - \sum_{i=1}^{M-.1} \alpha_i \ , \qquad \delta_{ns} = -\sum_{i=1}^{M-1} \delta_{is} \ , \qquad \beta_n = -\sum_{i=1}^{M-1} \beta_i \ , \ \gamma_{nj} = -\sum_{i=1}^{M-1} \gamma_{ij}$$

The equivalent expenditure function for this model is:

$$Log\, x^{e,h} = \log P^0 + u(p^1, r^1)\, b(p^0)$$

where $b(p) = \prod_i (p_i)^{\beta_i}$ defines a price aggregator.

Quadratic Almost Ideal Demand System

Bank, Blundell, and Lewbel (1997) proposed a QUAIDS model[2] which in fact adds a quadratic income term to the Deaton and Muellbauer AIDS model as we can see below:

$$w_i = \alpha_i + \sum_s \delta_{is} D_s + \beta_i \log\left(\frac{r}{P}\right) + \sum_j \gamma_{ij} \log p_j + \frac{\lambda_i}{b(p)} \left(\log\left(\frac{r}{P}\right) \right)^2 \quad (3)$$

where the price index is given by

$$\log P = \alpha_0 + \sum_k \left(\alpha_k + \sum_s \delta_{ks} D_s \right) \log p_k + \frac{1}{2} \sum_k \sum_j \gamma_{kj} \log p_j \log p_k$$

and a price aggregator is defined as $b(p) = \prod_i (p_i)^{\beta_i}$ **.** A new function λ is introduced:

$$\lambda(p) = \sum_i \lambda_i \, log(p_i), \ \lambda_n = \sum_{i=0}^{n-1} \lambda_i \quad \text{and all the constraints of AIDS hold.}$$

The equivalent expenditure[3] would be written as:

$$logx^{e,h} = \log \cdots P^0 + \frac{b(p^0)}{\log(u(p^1, r^1))^{-1} - \lambda(p^0)}$$

---

[2] denoted as BBLQ in our empirical results

[3] it is straightforward from this formula that if $\lambda(p^0) = 0$, the equivalent expenditure corresponds to the AIDS equivalent expenditure.

We also consider an alternative QUAIDS model[4] proposed by Ravallion and Subramanian (1996). The principal difference between BBLQ and RSQ resides in the specification of the parameter for the quadratic term whereas the price index and the constraints remain the same. The model is:

$$\mathrm{w}_{\mathrm{i}} = \alpha_{\mathrm{i}} + \sum_{\mathrm{s}} \delta_{\mathrm{is}} \mathrm{D}_{\mathrm{s}} + \beta_{\mathrm{i}} \log\left(\frac{\mathrm{r}}{\mathrm{P}}\right) + \sum_{\mathrm{j}} \gamma_{\mathrm{ij}} \log\left(\mathrm{p}_{\mathrm{j}}\right) + \left(\theta_i + \beta_i \sum_{\mathrm{j}} \theta_j \log\left(\mathrm{p}_{\mathrm{j}}\right)\right)\left(\log\left(\frac{\mathrm{r}}{\mathrm{P}}\right)\right)^2 \quad (4)$$

and the equivalent expenditure function is:

$$log\, x^{e,h} = \log \mathrm{P}^0 - \left[\mathrm{u}\left(\mathrm{p}^1, \mathrm{r}^1\right) \prod_{\mathrm{i}} \left(p_i^0\right)^{-\beta_i} + \sum_j \theta_{\mathrm{j}} \log p_j^0\right]^{-1}$$

In all the three models AIDS, QUAIDS-BBLQ and QUAIDS-RSQ, we impose the symmetry condition $\gamma_{ij} = \gamma_{ji}$.

Estimation method

The equations directly estimated using our data are (1), (2), (3) and (4). An error term ε_{i} is added to all these equations for estimation purposes. In addition, we assume that $vec\,\varepsilon \sim N\left(0, \left(\Sigma_{\mathrm{M}} \otimes I_N\right)\right)$ where $\varepsilon' \equiv \left[\varepsilon_1 \ldots \varepsilon_M\right]$, M is the number of equations (categories) and N the number of households. However the additivity restriction implies that Σ is singular. Therefore, one of the M demand equations is dropped from the system, the remaining (M-1) equations are estimated by maximum likelihood, and then the parameters of the last equation are recovered using the parameters constraints of each model. The likelihood function for the (M-1) equations is written as:

$$\log \mathrm{L} = -\frac{\mathrm{N}(\mathrm{M-1})}{2} \log 2\pi - \frac{1}{2} \log\left|\Sigma^* \otimes \mathrm{I}_{\mathrm{N}}\right| - \frac{1}{2}\left(\mathrm{vec}\varepsilon^*\right)' \left[\Sigma^* \otimes I_N\right]^{-1} vec\varepsilon^* \qquad (5)$$

denoting $\varepsilon^{*'} \equiv \left[\varepsilon_1 \ldots \varepsilon_{M-1}\right]$. Substituting the expressions of Σ* in terms ε* (derived from the first order conditions) into the above likelihood, one obtains the following concentrated likelihood function to be maximised with respect to θ, the vector of parameters:

$$\log \mathrm{L} = -\frac{\mathrm{N}}{2}\left\{(\mathrm{K}-1)\left[1 + \log\ 2\pi + \log\left|\Sigma^*\right|\right]\right\} \quad \text{with } \Sigma^*(\theta) \equiv \frac{1}{\mathrm{N}} \sum_{\mathrm{h}=1}^{\mathrm{N}} \varepsilon_{\mathrm{h}}^*(\theta) \varepsilon_{\mathrm{h}}^{*\prime}(\theta) \quad (6)$$

[4] denoted as RSQ in our empirical results

where h represents a household index. This gives a nonlinear SUR model and as the estimation program of such a model is not readily available, it was written in Stata. Here we should gratefully acknowledge the help of Brian P. Poi who kindly gave us a code[5] for estimating the QUAIDS model of Bundell *et al.* (cf. Poi (2002)). We wrote the estimation programs of all the four different models taking Poi's code as a base and modifying it appropriately.

Once the unknown parameters are estimated, the equivalent expenditures are calculated using the corresponding x^e functions given above. Using x^e as a welfare indicator, a LES specification will amount to assuming that an additional 100 monetary units will increment well-being by the same amount for poor and wealthy families alike. Rank 2 demand systems allowing for nonlinearities in the real expenditure response go some way in alleviating this deficiency, while rank 3 systems further add flexibility in the expenditure response.

Elasticities

An important element of the understanding of consumer behaviour is provided by income and price elasticities of demand. These depend on the model considered and the parameters therein. Income elasticity (or we should rather talk about total expenditure elasticity) captures the percentage variation of the demand for the i^{th} good for a 1% variation of total expenditure. Let η_i denote this income elasticity . Demand of a "normal" good should increase when the total expenditure increases ($\eta_i > 0$). If the variation is proportionally greater than the income growth ($\eta_i > 1$), the good is qualified as a "luxurious" item. On the other hand, if despite the income increase the demand of a good decreases ($\eta_i < 0$) , it is "inferior".

[5] Poi's estimation code in STATA is available in www.stata-journal.com .

TABLE 1

Income elasticity formulas

Model	$\frac{\partial w_i}{\partial log(r)}$	η_i
LES		$\frac{\beta_i}{w_i}$
AIDS		$\frac{\beta_i}{w_i}+1=\varphi_i+1$
BBLQ	$\mu_i=\beta_i+\frac{2\lambda_i}{b(p)}log\left(\frac{r}{P}\right)$	$\frac{\mu_i}{w_i}+1$
QRS	$\psi_i=\beta_i+2\log\left(\frac{r}{P}\right)\left(\theta_i+\beta_i\sum_j\theta_j\log p_j\right)$	$\frac{\psi_i}{w_i}+1$

Price elasticities give the "apparent" percentage variation of demand for the i[th] good for a 1% variation of either its own price (own price elasticity ϵ_{ii}) or the price of the j[th] good (cross price elasticity ϵ_{ij}). This is an "apparent" change because it is a mixture of the income effect and the substitution effect, namely a decrease of the price of the j[th] good for the same quantity purchased increases the amount available to consumption of other items and decreases demand of all substitutable goods. The price elasticities for our four models are given below:

LES cross price elasticity with demographic variables:

$$\epsilon_{ij}=-\frac{\beta_i\ p_j}{p_i\ q_j}\left(\alpha_j+\sum_s\delta_{js}\ D_s\right)\ \text{and}\ \epsilon_{ii}=-\frac{(1-\beta_i)}{p_i\ q_i}\left(\alpha_i+\sum_s\delta_{is}\ D_s\right)-1$$

AIDS cross price elasticity with demographic variables:

$$\epsilon_{ij}=\frac{\gamma_{ij}}{w_i}-\varphi_i\left(\alpha_j+\sum_s\delta_{js}D_s+\sum_k log(p_k)\gamma_{jk}\right)-\delta_{ij}\ ,\quad \text{with}\ \delta_{ii}=1,\delta_{ij}=0$$

BBLQ cross price elasticity with demographic variables:

$$\epsilon_{ij}=\frac{\gamma_{ij}}{w_i}-\frac{\beta_j\ \lambda_i}{b(p)\ w_i}\left(log\left(\frac{r}{P}\right)\right)^2-\frac{\mu_i}{w_i}\left(\alpha_j+\sum_s\delta_{js}D_s+\sum_k log(p_k)\gamma_{jk}\right)-\delta_{ij}$$

QRS cross price elasticity with demographic variables:

$$\epsilon_{ij} = \frac{\gamma_{ij}}{w_i} + \frac{\beta_j\,\theta_i}{w_i}\left(log\left(\frac{r}{P}\right)\right)^2 - \frac{\psi_i}{w_i}\left(\alpha_j + \sum_s \delta_{js} D_s + \sum_k log(p_k)\gamma_{jk}\right) - \delta_{ij}$$

The additivity restriction of the budget constraint $\sum_i p_i q_i = r$ or $\sum_i w_i = 1$ leads to the following restrictions on elasticities:

- Engel's aggregation restrictions in terms of elasticities given by: $\sum_i w_i \eta_i = 1$
- Cournot's aggregation restrictions : $\sum_i w_i \epsilon_{ij} + \eta_j = 0$

The homogeneity of degree 0 of demand functions with respect to income (or total expenditure) and prices also leads to a restriction in terms of elasticities: $\sum_j \epsilon_{ij} + \eta_i = 0$.

Compensated cross and own price elasticities ζ_{ij} identify the "pure" price effect once income has been compensated for the price increase. They are given by the Slustky equation:

$\zeta_{ij} = \epsilon_{ij} + \eta_i w_j$

If $\zeta_{ij} < 0$ goods i and j are complementary.
If $\zeta_{ij} < 0$ goods i and j are independent.
If $\zeta_{ij} > 0$ goods i and j are substitutable.

Our estimates of elasticities are calculated at the mean values of budget shares because median values are not very different from the mean ones in our sample.

Welfare measures

Sensitivity of welfare measurement to the rank of demand systems is analysed using poverty and inequality measures based on equivalent expenditure as a household welfare metric. This approach is adopted to incorporate utility-compensated substitution effects in response to relative price changes which are simply ignored if one deflates nominal expenditure by a fixed-weighted price index.

A first direct use of the equivalent expenditure, $\boldsymbol{x^e}$, is the well known cost of living index (CLI) which measures the impact of relative price change in terms of percentage variation of the cost function in order to keep the utility at a certain reference level :

$$CLI = \frac{c(p_1, u_1)}{c(p_0, u^1)}$$

Poverty measures

We have chosen six poverty measures and three inequality measures for our study. The first three poverty measures belong to the class of decomposable poverty measures in the sense that total poverty is a weighted average of the subgroup poverty levels and not in the sense of decomposability applied to inequality that involves a "between-group" term. The first two of them belong to the general class of Foster, Greer and Thorbecke (1984) measures:

$$FGT = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{z-y_i}{z}\right)^{\alpha}, \ \alpha \geq 0$$

where z is any given poverty line, y_i the income of the ith household and q the number of poor, i.e. person with an income less than or equal to z. The parameter α is a measure of poverty aversion therefore a larger α gives more importance to the poorest of the poor and implies greater severity of poverty.

When $\alpha = 0$, the Foster *et al.* measure becomes the well known head count ratio H and gives the proportion of the population living in households with per capita consumption below the poverty line.

When $\alpha = 1$, FGT is the poverty gap ratio PG and all the poor are given the same weight. This index is also the product of the head count ratio and the income gap I, which is the gap between the poverty line and the average income of the poor:

$I = \frac{z-\mu_z}{z}$ where μ_z is the mean consumption of the poor.

These first two measures are distribution insensitive in the sense that they do not consider the income distribution of the poor. Therefore two samples with the same mean income of the poor but different income distributions would have the same head count and poverty gap ratio.

All measures with $\alpha > 1$ are distribution sensitive with weights being equal to the income shortfalls of the poor. Thus they give importance to the extent of poverty among the poor and not just to the number of poor. When $\alpha = 2$ we have the squared gap ratio.

Our next measure, the Watts measure, is the first proposed distribution sensitive poverty measure (cf. Watts (1968)) and it gives the average of the income shortfall in logarithmic terms. This is also a decomposable poverty measure.

$$W = \frac{1}{n}\sum_{i=1}^{q} \log\left(\frac{z}{y_i}\right)$$

Next, we take the poverty measure proposed by Clark et al. (1981) (CHU), which is distribution sensitive, subgroup consistent but not decomposable. It is obtained as the deviation of an aggregate of individual poverty measures:

$$CHU = \begin{cases} z - \left(\dfrac{\sum_i^n \left(y_i^*\right)^{1-\varepsilon}}{n}\right)^{1/1-\varepsilon}, & \text{if } \varepsilon \neq 1 \text{ and } \varepsilon \geq 0 \\ \text{z - exp}\left(\dfrac{\sum_{i=1}^{n} \ln\left(y_i^*\right)}{n}\right), & \text{if } \varepsilon = 1 \end{cases} \quad \text{where} \quad y_i^* = \begin{cases} y_i, \text{if } y_i \leq z \\ z \text{ otherwise} \end{cases}$$

Finally Sen's poverty measure uses a poor person's rank within the poor (or the whole population) as an indicator of relative deprivation, Sen (1976). This aggregate measure combines income gap and Gini index, along with headcount ratio:

$S = H\left[I + K(1-I)G^p\right]$, where $K = \frac{q}{q+1}$ and G^p is the Gini index of the poor.

If there is no inequality among the poor ($G^p = 0$), then S = Poverty Gap = I H

Inequality measures

The first of the three inequality measures considered is the well-known Gini index which gives the extent to which the actual distribution of income and/or consumption expenditure differs from a hypothetical distribution in which each person receives an identical share. This index is scaled from a minimum of zero (no inequality) to a maximum of one (maximum inequality in the distribution).

For the linear expenditure system (LES), Kakwani (1980) establishes a direct link in between the Gini index and the expenditure elasticity:

$$G_i = \overline{\eta}_i \; G^*$$

where $\overline{\eta}_i$ is the expenditure elasticity of the i[th] commodity calculated at the mean prices and G^* is the Gini index of total expenditure. According to this relation, the expenditure elasticity of the i[th] commodity at the mean expenditure is equal to the ratio of the Gini index of the distribution of the i[th] commodity expenditure and the total expenditure, respectively. If $\overline{\eta}_i$ >(<) 1, expenditure on the i[th] good is more (less) unequally distributed than the total expenditure. Using both definitions together mean that all luxurious item are also more unequally distributed.

The second inequality measure proposed by Atkinson (1970) incorporates a normative judgement of social welfare and is given by the Atkinson index:

$$A = \frac{\mu - y_e}{\mu}, \quad \mu = \text{actual mean income}$$

y_e is the equity sensitive average income, defined as that level of per capita income which, if enjoyed by everybody, would make total welfare exactly equal to the total welfare generated by the actual income distribution:

$$y_e = \left(\sum_{i=1}^{G?} f(y_i) . y_i^{\,1-\xi} \right)^{1/1-\xi},$$

where $f(y_i)$= proportion of total income earned by the i[th] group, i = 1,…G. Here ξ[6] is the inequality aversion parameter, with higher values of ξ implying that society has greater aversion towards inequality. We have $0 \leq A \leq 1$ with inequality increasing as A approaches 1.

The third measure, Theil's (1967) entropy measure is derived from the notion of entropy in information theory. The simple form of this measure is shown below,

$$T = \sum_{i=1}^{G?} S_i \left[\log S_i - \log\left(\frac{1}{n}\right) \right]$$

---

[6] Note that ξ here is different from the errors of the estimating equations, though the same notation is used.

where s_i = share of the i[th] group in total income, G = total number of income groups. Higher values of T imply more inequality.

3. Data

Consumer Price Index for Rural Labourers and Industrial workers are obtained from the Labour Bureau (Government of India) on a monthly basis and Statewise with a 1986-87=100 base for Rural Labourers and a 1982=100 base for Industrial workers. A simple average is used to get a single value for each State in the sample, assuming that all the households in a same State and a same area (rural or urban) face the same price level for each item. Data on price index allows a five way split of consumption categories, namely Food (FD); Fuel and light (FL); Pan, tobacco and intoxicants (PTI); Clothing, bedding and footwear (CBF) and Miscellaneous[7] (MISC).

Expenditures are based on unit record data from the 55th Round of India's National Sample Survey (1999-2000), from which total expenditure for the five major categories are calculated. The sample is composed of 71'385 rural households and 48'924 urban ones. In order to constitute the sample for our analysis, we consider the number of households consuming food as the maximum possible size for each State (which should also be the total size of the survey). However not all the households consuming food, consume all the five categories. Thus we consider only the households consuming all the items groups which correspond in fact to the total number consuming pan, tobacco and intoxicants. PTI being typically an item where zero expenditures may indicate a deliberate choice not to consume rather than due to lack of resources, we are well aware that ignoring this decision making process may induce a bias in the estimation (though the number of households retained in the final sample is still large). It is our intention in the future to carry out estimations that take into account the null values in an appropriate way.

To get an idea of the extent of bias that may be introduced in our results, we make a few comparisons between the full distribution and the distribution used in the estimations. This was done for each category by calculating the percentage variation between the mean,

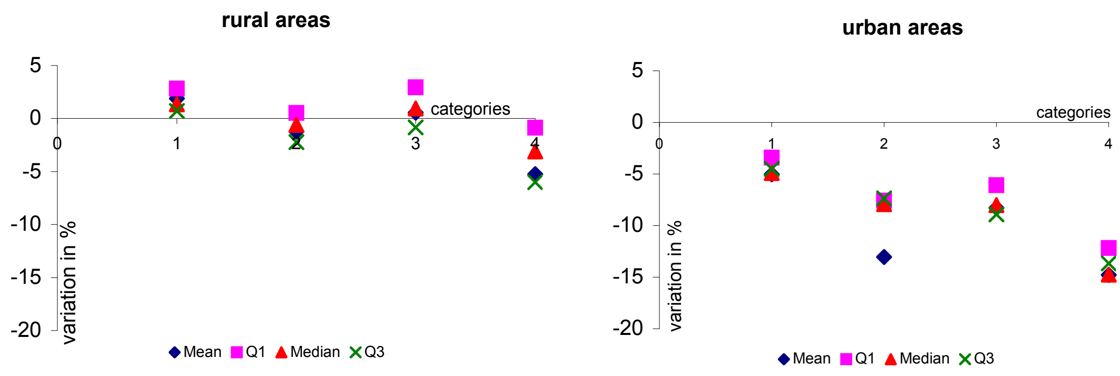
[7] In urban areas miscellaneous and housing price indices are considered separately whereas in rural areas they belong to same price index. In order to have the same definition in both areas we have included housing in the miscellaneous price index using a weighted average.

median, first and third quartile of the whole sample and the final one used in our estimations. Figure 1 illustrates these variations for food, fuel, clothing and miscellaneous whereas pan-tobacco is ignored as it has determined the number of households included in the final sample.

<u>FIGURE 1</u>

Percentage variation of mean, median,

first (Q1) and third quartile (Q3) of total expenditure by commodity



1: Food / 2: Fuel / 3: Clothing / 4:Miscellaneous

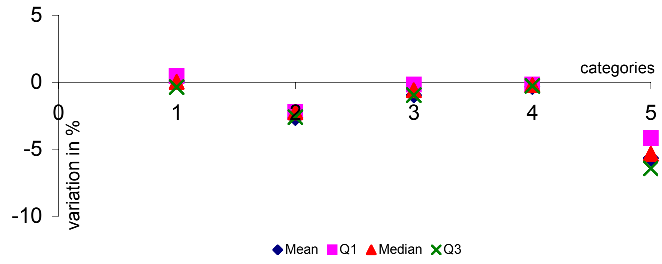
1: Food / 2: Fuel / 3: Clothing / 4:Miscellaneous

It clearly appears that in urban areas all measures are systematically underestimated for all items. Miscellaneous percentage decrease is the most important with all measures having a variation greater than 10% in absolute value. Mean of fuel is also considerably underestimated whereas consumption of food is subject to the least decrease. In rural areas the bias is less important and never exceeds 10% in absolute terms. Moreover, some items are underestimated and some others overestimated. This result could mean that in rural areas consuming pan-tobacco leads to a trade-off in consumption among different commodities because of a more restrictive budget constraint than in urban areas where the money that is not used in the consumption of PTI is simply allocated to all other items. For the rural sector, the expenditure on miscellaneous items is always underestimated whereas that of food is always overestimated.

In terms of budget shares (Figure 2) we see that the key values of PTI distribution are also underestimated. In fact the summary statistics of the distributions of all budget shares are subject to an under-evaluation, with the most important bias in miscellaneous and the least important one in food. Our final sample consist of 51’355 households in rural areas and 20’226 in urban ones.

FIGURE 2

Percentage variation of the budget share in rural areas



1: Food / 2: Fuel / 3: Clothing / 4: Pan-tobacco / 5:Miscellaneous

Let us continue with a brief descriptive analysis of the households' consumption behaviour starting with the budget shares allocated per item. As shown in Table 2 below, more than 50% of budget shares in both regions are allocated to consumption of food, with a median in rural areas at 0.625 against 0.544 in urban areas. Miscellaneous items represent more than 15% of the budget share for more than 50% of the households with a higher median in urban areas. In both areas fuel and clothing median represent around 7% whereas the pan-tobacco median consumption is down at 3%. The matrix of correlations among the different budget shares is given in Table A.1. In rural areas budget the share of food, fuel and clothing are positively correlated with one another whereas in urban regions food is positively correlated only with fuel. This means that an increase in the budget share for food leads to a decrease in the proportion of total expenditure allocated to all goods except fuel.

Among the various socio-demographic characteristics household demand is likely to depend on, such as household size, household type, religion, the amount of land possessed and many others, we retained four major ones that turned out to be significant in our preliminary trials. These variables, described in Table A.2, capture the impact of the following important characteristics: the economic situation of the household, its level of education, its demographic composition and the region of location of the household.

The NSS surveys introduced the concept of a second stage stratum in the 46th round. According to this, all rural and urban households are divided into two categories, namely 'affluent households' forming the second stage stratum 1, and the 'rest' forming the second stage stratum 2. However, the criterion for identifying a household as 'affluent' is different in rural and urban samples. In rural areas, households owning land or livestock in excess of certain limits or having items like motor car or jeep, colour TV, telephone are in the ‘affluent’ category. In the urban regions, households having a monthly per capita expenditure (MPCE) greater than a certain limit for the given town/city, are considered as ‘affluent’ households. Non-affluent household constitute the majority of the sample with 88% in rural areas and 90.2% in urban ones. Thus by taking into account the stratum to which a household belongs, one can capture the effect of wealth possessed by the household on consumption (a stock variable in addition to that of income which is a flow variable).

TABLE 2

Descriptive statistics of budget shares and total household expenditure (Rs.)

Rural areas		W1	W2	W3	W4	W5	Total expenditure
Mean		0.614	0.079	0.079	0.044	0.184	2866.220
SD		0.107	0.039	0.034	0.043	0.107	2248.454
CV(%)		17.496	48.665	43.389	98.265	57.882	78.447
Minimum		0.010	0.000	0.000	0.000	0.000	170
Maximum		0.990	0.640	0.990	0.940	0.970	92325
Percentiles	25%	0.551	0.053	0.055	0.017	0.110	1604
	50%	0.625	0.073	0.075	0.031	0.160	2324
	75%	0.689	0.098	0.097	0.056	0.231	3440
Urban areas		W1	W2	W3	W4	W5	
Mean		0.536	0.079	0.073	0.045	0.267	3783.3
SD		0.120	0.038	0.033	0.047	0.132	3119.4
CV (%)		22.458	47.939	45.697	103.814	49.269	82.5
Minimum		0.010	0.000	0.000	0.000	0.000	87.4
Maximum		0.990	0.890	0.500	0.570	0.990	168849.5
Percentiles	25%	0.458	0.053	0.051	0.016	0.167	2079.1
	50%	0.544	0.074	0.069	0.031	0.248	3090.3
	75%	0.622	0.098	0.091	0.057	0.346	4759.5

Education level of the head of a household is used to see what influence education has on consumer pattern. In rural regions there are almost as many illiterate heads as literate ones (48.83% and 51.17% respectively) whereas the cleavage is drastically more important in urban areas with only 22.46% with an illiterate head.

Table 3 below, gives the mean per capita expenditure per type of households. As expected affluent households have a higher mean consumption in both areas but two important features have to be pointed out: not only affluent households in urban areas consume in average three times more than rural ones but rural affluent households and urban non-affluent ones have almost the same mean! Using the mean as an indicator of the spending capacity of a particular group (median being not very different), it appears that head illiterate households have the least mean consumption, followed by non-affluent, literate and affluent. If literate households have the second best mean in both regions, difference between their mean and that of affluent ones is much more important in urban areas than in rural ones. In general, urban values have a higher variation than rural ones.

TABLE 3

Mean per capita expenditure by type of household

	Rural	Urban
Affluent	736.00	2236.86
Non-affluent	455.85	740.32
Head Illiterate	417.44	548.40
Head Literate	522.44	888.73

Regional dummies were added to determine how consumption patterns change across different regions of India and how different levels of economic development may affect spending habits as Northern states are mainly agricultural based whereas West is more industrial and South is rather mixed. States were divided into different regions according to the official classification retaining only those for which CPI were either available or easily attributable (cf. Table A.3). Frequency of the number of households in rural and urban samples per region are given in the following figure. The highest percentage of households come from the East and the Center in rural areas and the South in urban ones whereas North West has the least frequency in our sample.

FIGURE 3

Frequency of the number of households by region

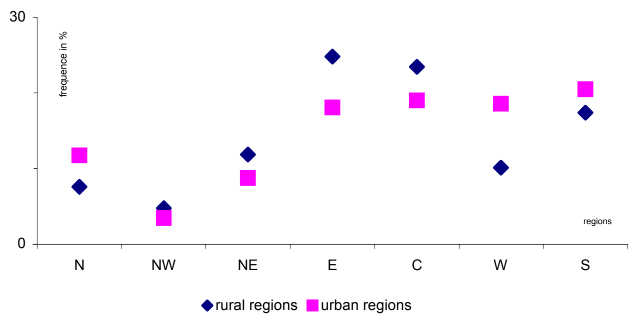
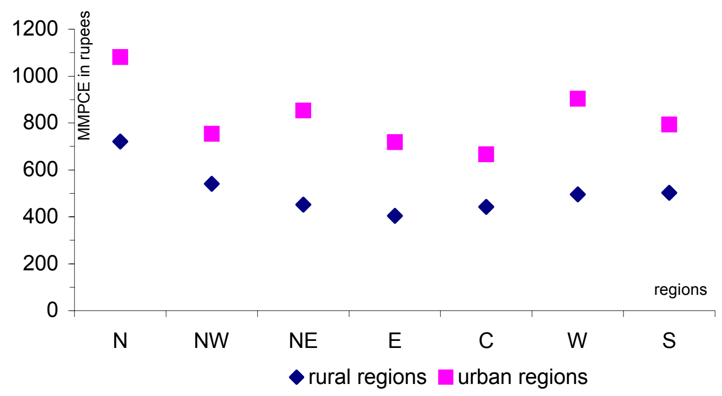


Figure 4 shows that urban means of monthly per capita expenditure (MMPCE) are systematically greater than Rs. 600 whereas rural ones never exceed Rs. 600 except in the North (Rs. 721.1). Further North has the highest mean in both areas, followed by the North West in rural and West in urban.

FIGURE 4

Mean of per capita expenditure by region



Household size was disaggregated into three variables: number of children, number of adult males and number of adult females.

4. Estimation results

We fitted four different models with three different ranks in order to evaluate how rank affects welfare comparisons based on equivalent expenditure. Equivalent expenditures are calculated with 1997 as the reference period. We chose 1997 as the reference period as this is as far as one can go back without changing the base for rural price index calculations.

In order to construct the relevant welfare measures, the first step is to convert the nominal monthly per capita expenditure (MPCE) to real terms using the 2000 CPI for Industrials Workers for urban and Rural Labourers for rural. As 2000 CPI rural is in 86-87 base and 2000 CPI urban is in 82 base, deflating, using these indices, gives the real MPCE at

86-87, and 82 prices respectively. So in order to compare with equivalent expenditures, we still have to multiply these deflated expenditures by the corresponding 1997 Consumer Price Index to bring them up to 1997 base. Poverty lines are those of India's Planning Commission.

Tables A.4 to A.11 give the maximum likelihood estimates of LES, AIDS, BBLQ[8] and RSQ[9] models for rural and urban areas estimated separately. The same socio-demographic variables[10] are included in all the four models: household size decomposed into number of children, number of adult males and number of adult females, regional dummies, dummy for affluent/non-affluent and dummy for head illiterate/literate.

Parameter estimates

Linear expenditure system, LES

LES urban and rural parameters are all significant at 1% level; only some demographic ones are not significant even at 5% level. There are however important difference in the signs and values of coefficients between the two areas.[11].

Minimum required quantities given by α_i in Tables A.4 and A.5 show some basic difference in the adjustment of the rural and urban models. If both models estimate a negative sign for minimum quantities of miscellaneous, in rural clothing-bedding-footwear parameter is also negative and in urban it is the food parameter that is negative. Usually a negative sign denotes a non-essential good, namely an item that is only consumed if income (or total expenditure in our case) exceeds a certain amount. So having a negative sign for the minimum consumption of food is, in that sense, very inconvenient as this commodity is always considered as a necessary good but this problem is eliminated with higher rank models which may be better suited for urban data, as we argue later.

Marginal effects of supernumerary income[12] denoted by β_i are all positive in both models with almost the same parameter value for food and fuel whose confidence intervals intersect. This last result suggests that an increase of supernumerary income has the same

[8] Bundell et al. quadratic almost ideal demand system (1997)
[9] Ravallion and Subramaniam's quadratic almost ideal demand system (1996)
[10] see Table A.2
[11] Whenever there is no mention about the statistical significance of the parameters it means they are significant at 1% level.
[12] income available once all essential quantities have been bought

effect in terms of expenditure on food and fuel in rural and urban areas. The biggest values are in both cases found for food and miscellaneous.

Demographic parameters included in our model (Tables A.4, A.5) capture sensitivity of demand for i^{th} good with respect to household's economic status, its composition and its location as well as head's education level. As mentioned earlier, we use second stage stratum variable as a base for classifying a household into the affluent or the non-affluent category. In theory, non-affluent households should have a smaller expenditure in all items (because they consume lower quality goods) but a bigger budget share for necessary goods, leading to a smaller income elasticity of primary items. We find two major differences between urban non-affluent households and rural ones:

- Rural poor households consume less food ($\delta_{11} < 0$) and less fuel than the affluent whereas urban ones have a higher demand for food ($\delta_{11} > 0$) than affluent ones.

- In rural areas non-affluent households, with respect to affluent ones, spend less on food and fuel but more on clothing and miscellaneous. However their expenditure on pan-tobacco is not statistically different from that of affluent ones. In urban areas the non-affluent spend less on PTI and CBF whereas they have the same consumption of miscellaneous as the affluent.

The problem with the above rural results is that it is hard to explain why poor households should consume more of miscellaneous and clothing especially in this area as these are luxurious goods. One plausible explanation could be that the affluent ones have a reasonable stock of these goods (being durable) and hence do not necessarily buy more of them whereas the non-affluent buy as need arises and thus may show a higher consumption. This problem is however sorted out with models in terms of budget share.

In rural areas head illiterate households spend less on food and fuel but more on pan-tobacco compared to literate ones but their consumptions of clothing and miscellaneous are not different from those of literate ones. In urban areas, head illiterate and non-affluent households spend more on food and miscellaneous and less on all other items except for pan tobacco for which there is no significant difference.

Household demographic composition also influences demand for all goods: in theory one extra person should definitely increase expenditure on food and fuel; impact on PTI and MISC is less certain whereas consumption of clothing-bedding-footwear may not increase as this category contains goods that can be shared[13]. These demographic effects are given by δ_3 to δ_5 in our model:

In rural areas, a household with one more child or one more adult (male or female) consumes more food, more fuel and less of all other items, all other characteristic being equal. The same household in an urban area, consumes less miscellaneous and more of everything else. There are only two exceptions: an extra woman has no significant influence on consumption of PTI in rural regions whereas in urban areas she decreases its consumption and it is an extra child that has no influence on its expenditure.

Let us finish this discussion with what we have called the "regional" influence, namely, how sensitive is a household demand to the region where it is located, with North being taken as the reference. Let us remind the reader that the regional classification is given in Table A.3. These effects are captured by δ_6 to δ_{11} in Tables A.4 and A.5. In rural areas households' demand for fuel is less than its demand in the North for all regions. Demand for food is also less than the North for East, Centre, West and South. All regions, except North West, have a positive impact on demand for miscellaneous. In urban areas, fuel demand is higher in the North East and the North West whereas it remains smaller in the other regions; clothing demand in all other regions is always less than in the North and miscellaneous expenditure is higher than the North for Centre, West and South. In addition to significant differences in consumption behaviour between the North, the South, the East and the West, it is interesting to notice important variations within the same region e.g. households living in the North West and the North East have a different behaviour than those living in the North.

AIDS, BBLQ and RSQ

Looking at the results for AIDS, BBLQ and RSQ (Tables A.6 to A.11), a first remark has to be made: in general the performances of both the QUAIDS models are very similar, the difference in parameters never exceed 1% and both models have the same significant parameters. We should also point out that AIDS always overestimates the budget share

[13] Because of a budget constraint households cannot increase all their expenditures: if they want to consume more on one item they have to spend less on another one.

allocated to food and underestimates the one given to miscellaneous whereas both QUAIDS models give a higher budget share to miscellaneous.

A second important remark concerns the interpretation of the alpha parameter in these models. LES models have a concept of subsistence expenditure, namely what is consumed in the absence of income (which may be financed by savings or borrowings) and this effect is given by the intercept. AIDS and QUAIDS models estimate budget shares linear in logarithm of prices and logarithm of deflated income (which is also introduced in square terms in QUAIDS). Therefore a concept of subsistence budget share in the sense of commodities share in the absence of income is impossible! As a result, the intercept denoted by alpha, gives the budget share for the reference point at which the logarithm of prices are equal to the logarithm of deflated income, namely when the general index price denoted by P is equal to one (see equation (2)) and total expenditure (or income) is equal to the general index price giving a ratio also equal to one. Estimations of the three models in both areas always give positive and statistically significant intercepts, greater than 55% for food, 10% for fuel and the rest is divided into clothing, pan-tobacco and miscellaneous (2%-6% in rural areas, and 7%-16% in urban). Like in LES, in QUAIDS, confidence intervals of alpha for food in urban and rural areas overlap, which means that both areas may have the same budget share for food around the value of alpha.

In terms of budget share we can distinguish between two types of behaviour in general: an increase in real income should lead to a decrease in the budget share for all necessary goods whereas it increases the budget share of luxurious items. In all the models, the marginal effect of “deflated income” is given by the beta parameter. In urban and rural AIDS, this parameter is always significant at the 1% level. According to these models the only luxurious good in both areas is miscellaneous but LES classifies clothing as a luxurious good in rural areas. All the other goods have a negative coefficient implying their essential nature. Both the QUAIDS models gives the same sign to beta coefficient but RSQ values are always slightly smaller for food and hardly bigger for all other commodities. In rural areas, these models do not seem appropriate to capture household’s consumption behaviour because marginal effect of income is positive for food and clothing and negative for all other items. This is a problem that we already mentioned when trying to estimate urban expenditure with LES: food cannot be a luxurious item though the above result leads to that interpretation. On the other hand in urban areas they seem more appropriate because food, fuel and pan-tobacco coefficients are negative, the miscellaneous one is positive whereas the clothing coefficient is not statistically significant meaning that a variation of the real income has no impact on its budget share.

Effects of changes in prices are captured through γ_{ij} but we would discuss their effects more in detail with compensated elasticities further on. Here we would just emphasize that in rural areas all coefficients are significant at 1% level in all models (except for price effect of food on food and on pan tobacco in AIDS). In urban areas (and all models) on the other hand budget share for fuel is not significantly influenced by a variation of the logarithm of the price for food, miscellaneous and even by a variation of its own logarithm of price suggesting that this commodity could be very inelastic with respect to prices but it has to be confirmed with compensated elasticities. Combining this last result with QUAIDS income elasticity of fuel implies that fuel's budget share is not influenced by price variation but only by income fluctuations.

Social and economic effects defined by δ_{1i} (dummy for a non-affluent household compared to an affluent one) and δ_{2i} (dummy for a head illiterate household compared to a head literate) show that a non-affluent household or a head illiterate one has always a higher budget share of food in both regions and according to all models. According to AIDS, non-affluent ones do not have a significantly different budget share for miscellaneous in rural and in urban, they also assign the same part of their total expenditure to pan-tobacco. In all other cases their spend proportionately less of all other items. Head illiterate households in rural areas have a smaller budget share for pan-tobacco and miscellaneous than head literate ones in all models with the same share for fuel in both QUAIDS. In urban regions they also give a smaller part of their income to miscellaneous but consumption of pan-tobacco is not significantly different in both QUAIDS whereas it is superior in urban AIDS.

Household composition also influences the budget shares of different commodities. In rural areas and for all models, a household with one more child or one more adult (male or female), assigns a bigger part of its income to clothing and a smaller proportion to miscellaneous consumption with all other characteristics remaining constant. For AIDS it also implies a higher share for food whereas the QUAIDS models indicate a higher budget share only in the case of one extra child and one extra man. In urban regions and for AIDS any supplementary person in a household decreases the budget share of pan-tobacco and increases all others. Both the QUAIDS models give higher proportions to consumption of fuel for any extra individual, behaviour with respect to food remains the same as in rural regions whereas an extra woman does not influence the share of clothing statistically speaking.

The regional effect is very important in terms of budget share allocated to commodities. Recalling the rural LES results, namely that a household living in any region different from the North consumes less fuel, more miscellaneous (except for those living in the North West) and less food in the East, Center, West and South, AIDS and both QUAIDS models results point out almost the same behaviour. AIDS also assigns a smaller budget share for fuel in all regions compared to the reference household living in the North. BBLQ and RSQ corroborate this except for a household living in the South that does not have a statistically different behaviour according to BBLQ and the difference is significant and positive according to RSQ.

Like in LES but in terms of budget share, both the QUAIDS models give a higher consumption of miscellaneous in all States except in the North West where households consume less. Another general trend is pointed out by all the three models: Households living in North West, North East, Center, West or South have a smaller budget share for clothing than those living in the North; on the other hand those living in the East spend more on clothing. In urban areas this is also true except for southern households in QUAIDS models that do not have a significantly different consumption to those living in the North. A further general trend can be noted regarding the budget share of pan-tobacco: in AIDS, southern households consume proportionally more than households living in the north whereas they do not have a statistically different consumption in both QUAIDS which also do not identify any different behaviour for households living in the west. All other households have a higher budget share of pan-tobacco.

This section will end with a discussion about the quadratic term in both the QUAIDS models considering the significance of the related parameters and using the Wald test. In rural areas, results with Bundell et al. quadratic model gives parameter estimates significant at the 1% level for all commodities with negative signs for fuel and clothing and positive for all others. Wald test corroborates these results. However Ravallion and Subramanian model gives non-significant parameters for food and miscellaneous (with positive estimated values in both cases), indicating that a quadratic term does not provide any further information in their consumption. In urban areas results for both quadratic models are coherent: miscellaneous is the only non-significant parameter at 1% level with negative signs for clothing and pan-tobacco. Even though almost all parameters are significant, coefficient values are almost negligible in both areas and for both models.

Elasticities

Income elasticities

At all India level

Now, let us look at another measure that considers income effect on demand for each good in terms of percentage variation, namely income elasticity. We have calculated this elasticity for all the models at all India level, by household type and by region. Table A.12 gives expenditure elasticities at all India level and for all models calculated at the mean expenditures. In the case of LES, income elasticity values allow us to make use of Kakwani's relation[14] between commodity Gini index and the overall Gini index. For these models, there are two main similarities between rural and urban areas:

- food ($\eta_1 \approx 0.6$), fuel ($\eta_2 \approx 0.3$) and pan-tobacco ($\eta_{4,rural} = 0.57$ and $\eta_{4,urban} = 0.83$) are normal commodities implying less inequality in expenditure on these items than in total purchase.
- miscellaneous is a luxurious item ($\eta_{5,rural} = 2.495$ and $\eta_{5,urban} = 2.022$) and therefore its consumption (or expenditure) is more unequally distributed than the total expenditure.

It is also important to emphasize that for the same percentage variation of the total expenditure[15] the percentage variation of demand for the i^{th} good is always superior in rural areas compared to urban ones. Considering miscellaneous in particular, an increase of 1% of the total expenditure leads to an increase of its demand of 2.022% in urban areas and of 2.495% in rural so the demand but also the inequality increases more in rural regions for the same income growth. CBF expenditure is also a luxurious item in rural and consequently more unequally distributed, whereas it is a normal good with less inequality in the urban sector.

[14] This relation is given on page 187, Kakwani (1980) and recalled on p.11 of this paper.
[15] We are using 'expenditure' and 'income' in an indifferent manner.

AIDS income elasticities at all India level give similar results to LES income elasticities: miscellaneous remains a luxurious item in both sectors with a value less than 1.7 ($\eta_{5,rural}$ = 1.632 and $\eta_{5,urban}$ = 1.577), which confirms the higher inequality level in terms of consumption of this item than in terms of total expenditure. On the other hand CBF becomes a normal good in both areas. In urban areas QUAIDS income elasticities corroborate AIDS results: miscellaneous is again identified as a luxurious good but fuel appears to be one too ($\eta_{2,\ urban} \sim 1.028$). If clothing remains a normal item in rural QUAIDS (like in AIDS), food is the only luxurious good ($\eta_{1,rural} \sim 1.09$)! Even if this result suggests that consumption of food is more unequally distributed than total expenditure, which can be reasonably accepted, not considering food as a necessary item is more difficult to explain. This problem has already been discussed when analysing parameters and it strengthens our belief that QUAIDS models are not appropriate in rural areas with our data set.

Going into the different characteristics of a household, we selected two of them to see the difference they made in the magnitude of the elasticity : first an indicator of the wealth possessed by the households given by the classification affluent or non-affluent and second the level of education of the head. From Table A.13 for LES, it clearly appears that miscellaneous is a luxurious good for all types of households in both sectors (urban and rural). In both areas head illiterate and 'non-affluent' households are the poorest and have the biggest income elasticity which means that they also suffer the most inequality in expenditure on this item. Between the other two types - affluent and head literate - affluent types have a higher mean per capita total expenditure as they are richer and their miscellaneous income elasticity is also greater than that of head-literate. In both areas fuel's income elasticity is less than one for all types and hence less unequally distributed. In rural areas clothing is also a luxurious good which implies more inequality in its purchase.

AIDS income elasticities by type of household (Table A.14) do not change the results obtained either with AIDS at all India level or with LES by type of household, namely miscellaneous is a luxurious item for all types and in both sectors. However one can note some distinctions with LES results: elasticity of miscellaneous for affluent is less than the one for literate headed households and clothing is a normal good in rural areas. On the other hand fuel remains the most inelastic item in terms of income in both areas. Differences are more important between income elasticities of commodities and not really so between households types.

QUAIDS rural income elasticities (Table A.15) remain unsuitable from an economic point of view, classifying food as a luxurious good for all types of households as well as miscellaneous but only for affluent and literate ones that are richer than non-affluent and head illiterate! In urban areas we find the same conclusions as urban all India and again the main differences are among commodities.

At the regional level

At the regional level for the LES model (see Figure 5**.**) the classification of commodities in terms of income elasticities remains the same as at the all India level: miscellaneous is a luxurious good in all regions of both areas. In rural North East and East, income elasticity reaches its highest values in all India ($\eta_5^{\text{north-east}} = 3.498$, $\eta_5^{\text{east}} = 3.165$!) and recalling that these States are the poorest rural States in terms of mean per capita expenditure, having such high elasticities implies that expenditure on this item is also the most unequally distributed compared to total expenditure. In urban areas, the North West, North East and East share the biggest income elasticities in miscellaneous (around 2.25) but only North West and East belong to the three poorest urban States whereas East is the third richest one. On the other hand Centre has the smallest mean per capita expenditure but not the highest income elasticity. Clothing-bedding-footwear is also a luxurious good in all rural regions as well as pan-tobacco in rural East and as at all India level, fuel has the smallest income elasticity in all rural and urban regions with values around 0.3 in both areas. Fluctuations among LES income elasticities are also more important in rural regions than in urban ones.

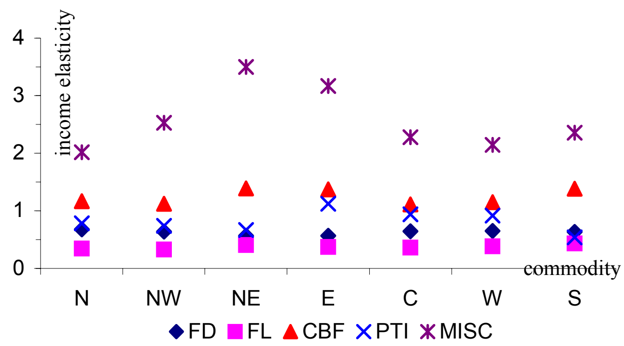
AIDS income elasticities by region again show that elasticities are more sensitive to the commodity type than across regions. LES and AIDS income elasticities have the same structure across regions even though variations are more important with LES. Miscellaneous is always a luxurious good in all regions and for both models, with the highest values in the rural North East and urban East. On the other hand clothing is a luxurious item only in rural LES but in AIDS its income elasticity is really close to 1. Now if we consider income elasticities for food, clothing and pan-tobacco we can see that they are almost constant within urban and within rural regions. This stability is also observed in BBLQ where there is practically no difference among elasticities of different regions leading to a constant difference among goods for all regions alike. Consumption of pan-tobacco is the least elastic but the most sensitive to regions in urban BBLQ with its smallest value in the West. Miscellaneous remains a luxurious good in QUAIDS urban model and in rural North and North West. However, food which was inelastic in LES and AIDS becomes elastic in the QUAIDS model for rural areas with a value greater than 1. In urban areas its elasticity stays less than 1.

FIGURE 5

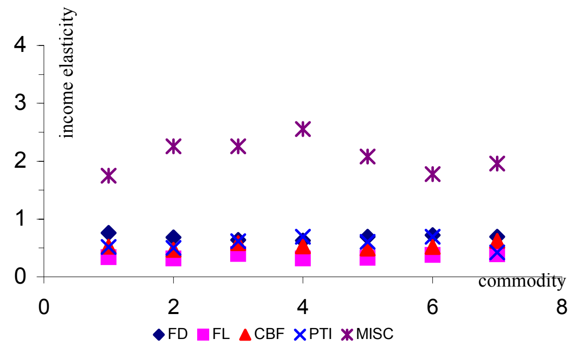
Income elasticities by region

LES

Rural

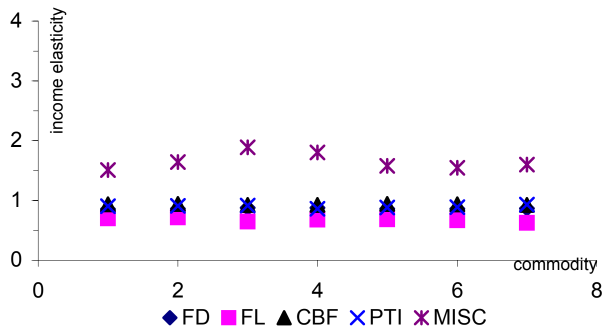


Urban

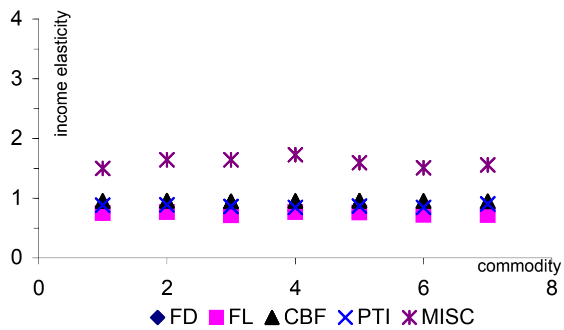


AIDS

Rural

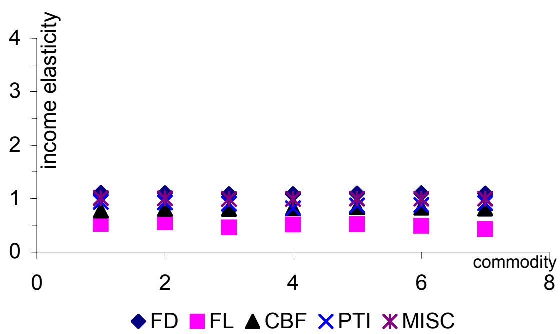


Urban

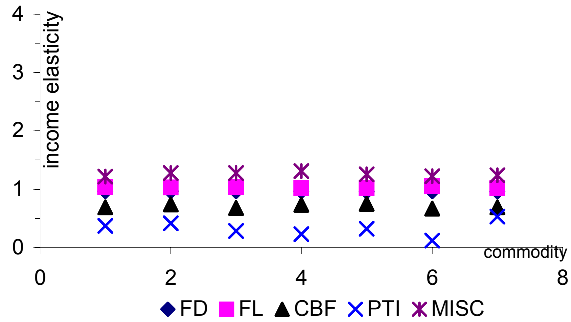


BBLQ

Rural



Urban



Compensated price elasticities

Compensated price elasticities give the percentage variation of the demand for the i^{th} good with respect to a one percent variation of the price of the j^{th} good after compensating for the loss in purchasing power. As they depend on the socio-demographic characteristics, we present the results for a reference household which is non-affluent, has an illiterate head and lives in the Centre[16]. We have chosen such characteristics because the Centre is the most populated region, around 90% of the population is non-affluent in both areas and in rural sector almost 50% of the households have an illiterate head whereas this ratio becomes 20% in the urban sector.

Own compensated elasticities describe the variation of the demand of a good when its own price changes. Figure 6 (and Table A.16) illustrate these elasticities for all models. So far we have seen that the differences in income elasticities are not very important between LES and AIDS; even though values are different they lead to the same conclusions in terms of luxurious and necessary items and the most elastic goods in a given region are the same one in both models. On the other hand LES and QUAIDS results are drastically different and can even be contradictory. In terms of own compensated elasticities concordance between LES and AIDS results is no longer there whereas a general common trend exists between AIDS and QUAIDS own price elasticities (See Figure 6, as the results of BBLQ and RSQ are very close we have presented only one of the two.).

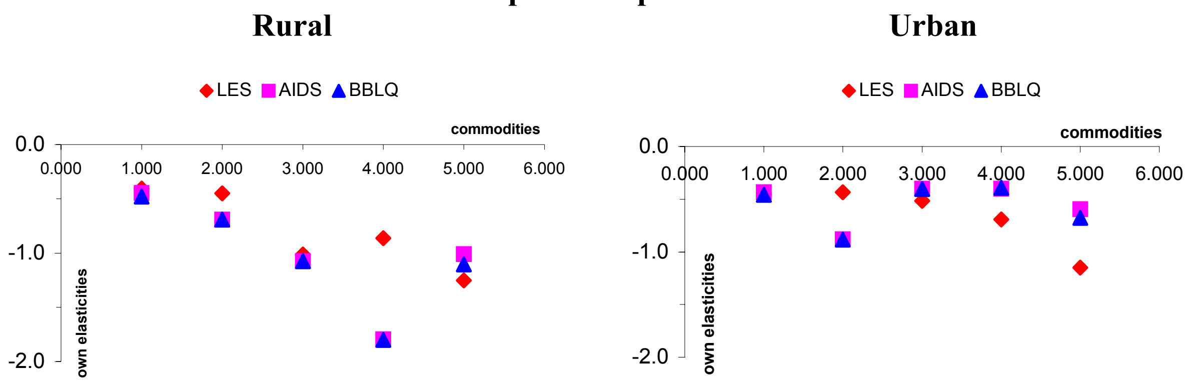
In rural areas pan-tobacco is the most elastic item in both AIDS and QUAIDS. The least sensitive good to its own price variation is food which confirms the essential nature of this commodity. LES results corroborate the trend given by AIDS and QUAIDS except for the own price elasticity of pan-tobacco that is much smaller. For LES the most elastic item is miscellaneous (-1.25) and it is followed by clothing with a value of –1.014. For AIDS and QUAIDS the most elastic good is PTI (-1.8) followed by CBF/MISC (very close to each other with a value around -1.1). The main difference in these elasticities between LES on one hand and AIDS/QUAIDS on the other is that of PTI.

[16] We calculated these elasticities all types of households in all regions but do not reproduce them here as they will add even more tables to an already lengthy text.

In urban areas food remains the most inelastic item for all models (Figure 6). According to LES, miscellaneous is the only elastic item whereas all goods are inelastic for both AIDS and QUAIDS. Here the differences between LES and AIDS/QUAIDS are more important than in rural especially for fuel, pan-tobacco and miscellaneous.

Figure 6

Own compensated price elasticities



In terms of cross compensated elasticity, all the models have, in general, inelastic and substitutable relations. Although standard LES does not allow for complementarity, the presence of socio-demographic variables makes it possible to have positive and negative compensated price elasticities in our results. In rural areas we find some complementary effects for fuel with respect to a relative change of the price of clothing and pan-tobacco and for food with respect to pan-tobacco price variation. However the percentage decrease of both demands is so small (it hardly reaches 0.015%) that it is almost insignificant in economic terms. In urban areas all elasticities are positive meaning that all items are also substitutable but again the percentage variations do not exceed 0.2% except for miscellaneous whose elasticities are slightly bigger but remain less than 1. AIDS and QUAIDS results lead to the same conclusions: complementary effects are only found in demand for fuel and clothing. All other items are substitutes and the only strong variation is given in rural areas by the elasticity of demand for clothing with respect to a variation of the price for food which is equal to one. All elasticities satisfy restrictions of additivity and homogeneity.

Quality of fit

Of the four models that we estimated, LES and AIDS seem to be the better ones to estimate households' consumption behaviour in our context. Measures such as R-squared and correlation between estimated expenditure and actual expenditure favour LES **(**Tables A.17 and A.18**)** but AIDS has better standardised residual plots and qq-plots. As we are using the maximum likelihood estimation method, which assumes normality of residuals, AIDS would thus be the best model. Regarding QUAIDS results, let us recall that households' consumption basket is composed of food for more than 50%, followed by miscellaneous with not even 20 % of the total budget. It is well known that a linear Working-Leser form is often adequate for the necessary commodity groups like food. This may explain why both the QUAIDS models give very poor results for food with a negative correlation and a decreasing structure in the standardised residual plot (which is not present in AIDS) whereas QUAIDS results for other items are relatively better though still less performing than those obtained with the LES and AIDS models.

5 .Welfare analysis and rank

At this point we once again recall that the main aim of our study is twofold: (i) take substitution effects into account for calculating welfare indicators based on equivalent expenditure and exploring different preference structures leading to demand systems of different ranks; (ii) investigate the relationship between rank and welfare comparisons. In this framework, one has to ask oneself more questions than just the ones relating to standard measures of quality of fit. What kind of consequences do we run into ignoring substitution effects in expenditures of commodities and total expenditure? How do distortions in the estimation of equivalent expenditures affect the welfare measures which are based on the distribution of these expenditures? Finally do different ranks give different conclusions?

Equivalent expenditures and real total expenditures

In order to answer the first question, we first compared distributions of deflated expenditures by item and the estimated expenditures. To evaluate the sensitivity of welfare measures we compared distributions of deflated total expenditure (which ignore substitution effects) and the estimated equivalent expenditure at reference prices (which take into account the substitution effects) both among themselves and among the different models (for rank effects) and using different measures like the mean, median, first and third quartile.

The comparison by commodity is made in terms of percentage rate variation and is given in Figure 7. Ignoring substitution effect leads to an overestimation of the mean of food with respect to LES model (rank 1) in urban and rural areas whereas it is underestimated compared to all other demand specifications; the underestimation increasing with the rank of the model. In both areas the mean of the total expenditure on miscellaneous is overestimated compared to the equivalent expenditure of the same item estimated with LES and both QUAIDS and again the bias rises with the rank. For the AIDS mean of miscellaneous, the mean of the given distribution is underestimated. In rural areas mean of fuel is always overestimated if price effects are not considered. Now analysing results by model leads to the following observations: According to LES ignoring substitution effect overestimates all means in urban areas whereas in rural regions means of clothing and pan-tobacco are underestimated. AIDS on the other hand indicates that means of clothing and pan-tobacco are over-evaluated in both sectors as well as the mean of fuel in rural areas. According to both the QUAIDS models clothing and pan-tobacco are overestimated in urban regions as well as the mean of miscellaneous whereas in rural areas only the mean of miscellaneous and fuel are overestimated. In general the impact on rural means is less than that on urban ones. Differences between rural and urban areas are less important with LES and AIDS than with both QUAIDS except for miscellaneous for which the rural mean of the deflated total expenditure is more than two times greater than the mean of the estimated expenditure!!!!! In urban areas this ratio falls to 1.26!

A first remark can be made here. When behaviour on consumption of an item is similar in urban and rural areas, results in both areas lead to the same conclusions within the same model. However not all the results are coherent across models in the kind of distortions introduced when ignoring substitution effects. In other words, comparing the mean of the total expenditure (or budget share) of a given item to the means of the estimated distribution of the same item does not produce the same consequences: for example, mean of food is overestimated according to LES but underestimated according to AIDS. What happens in cases when different demand systems detect the same distortion? If rank two and three models are coherent we see the bias increasing with the rank, however when all models lead to the same conclusions AIDS demand system (rank 2) gives the smallest impact, followed by LES (rank 1) and both QUAIDS (rank 3). When both QUAIDS give an important bias, RSQ model has the bigger variation between the two.

It is often assumed that substitution effects are negligible for the poor. In order to analyse this statement we consider the first quartile of the total expenditure or budget share and the equivalent expenditure per commodity. Percentage differences are also shown in Figure 7. In both areas, all models indicate that not considering the price effect is far from being negligible for food which is underestimated. In rural regions the percentage variation vary from –6.89% to –20.6% and in urban ones from –2.01% to –6.48%. Once again, a higher variation is given by the demand system with a higher rank. In urban regions ignoring substitution effects uniformly leads to an underestimation of the consumption of fuel and pan-tobacco of the poorest since all the models give the same result (here the difference is greater than 19%). In rural areas they are also underestimated except for fuel with RSQ and PTI with LES. In general the first quartile of the total expenditure for all commodities is underestimated according to LES in urban areas whereas only the consumption of the poor on clothing and pan-tobacco is underestimated in rural areas. According to AIDS all consumptions are underestimated in both sectors. Consumption of miscellaneous goods leads to different conclusions depending on the model considered: for LES and AIDS consumption or budget share of the poor is underestimated. According to both the QUAIDS it is overestimated and in rural areas this overestimation rises to +137% (BBLQ) and +139% (RSQ) whereas it falls to +26% and +27% respectively in urban areas. Therefore ignoring substitution effect clearly implies some distortion whether it is overestimation or underestimation of the consumption of the poor and even though all models do not agree on the direction of the impact, they all give variations greater than 2% in absolute terms!

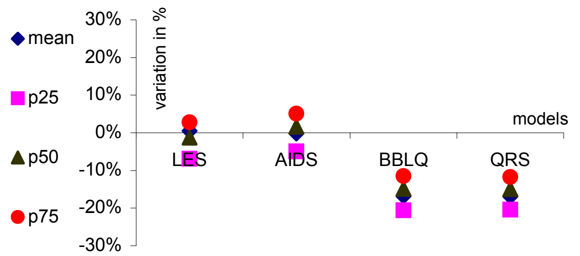
The same kind of observations can be made with the median and the third quartile. The median shows that consumption of fuel and pan-tobacco is again underestimated in urban areas whereas in rural areas the direction of the effect depends on the rank of the demand system and the item considered. The median of miscellaneous is overestimated except for AIDS; clothing and pan-tobacco medians on the other hand are underestimated except for LES. Considering the consumption (or budget shares) of 75% of the total number of households, results in rural areas become clearer: fuel, pan-tobacco and miscellaneous are definitely overestimated when price effects are ignored. In urban areas pan-tobacco is also overestimated as well as clothing.

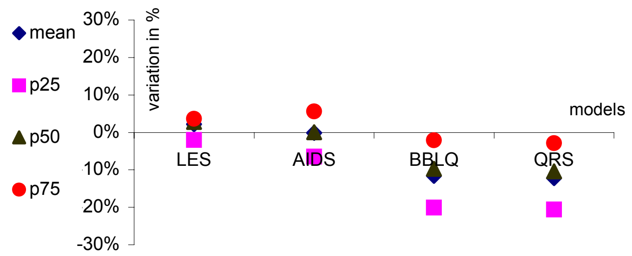
Figure 7

Rate of variation of the mean, median, first and third quartiles of the expenditure

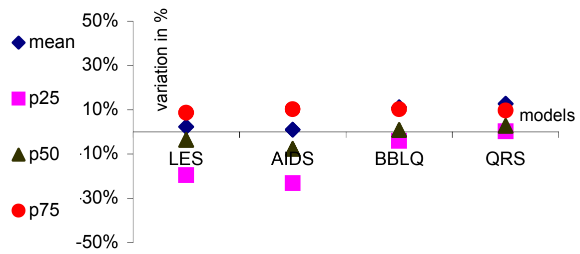
Rural | **Urban**

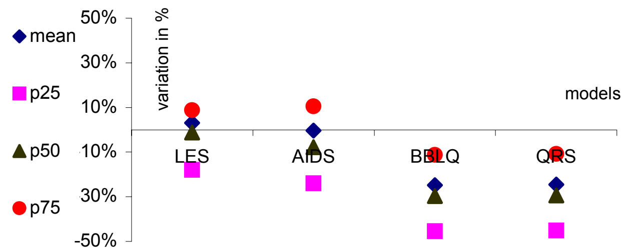
Food



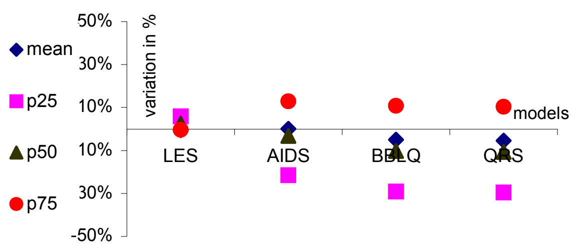


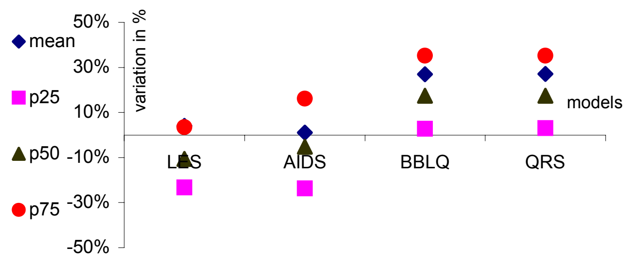
Fuel



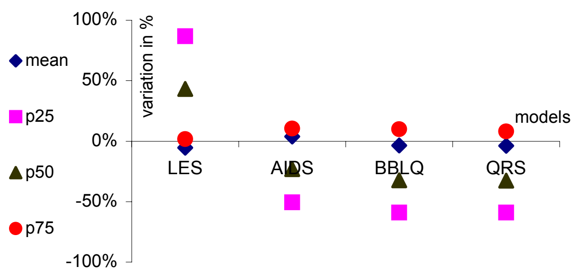


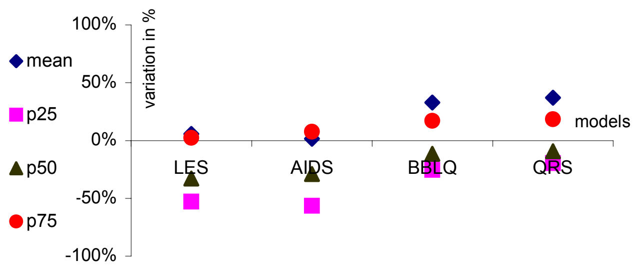
Clothing, bedding and footwear



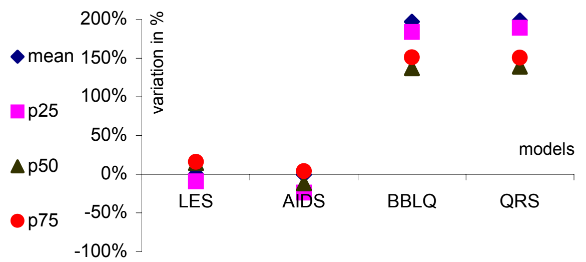


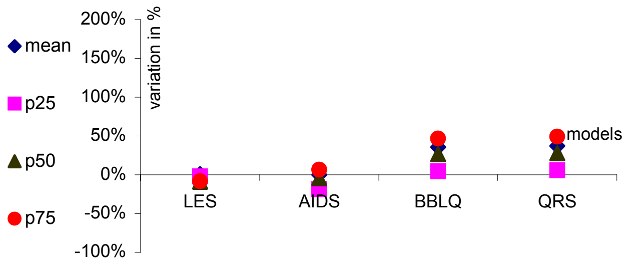
Pan-tobacco





Miscellaneous





Equivalent expenditure and rank

So far we have seen that commodity share estimations are very sensitive to the rank: Ignoring substitution effect has an impact but that impact can be different according to the demand system and item considered. However when the item represents an important expenditure, all the models tend to indicate the same distortion. In general the main bias is given by rank 3 models. In order to analyse the sensitivity of the welfare measures to the rank, we have to first investigate the effect on equivalent expenditure or per capita equivalent expenditure (pcee) which is a metric of the utility achieved. To do so, we have again considered the mean, median, first and third quartiles of the per capita CPI deflated expenditure and our estimations of equivalent expenditures for each model. The difference (in percentage) between the deflated total per capita expenditure and the estimated per capita expenditure is illustrated in Figure 8**.** It appears that ignoring substitution effects has a major effect in urban areas than in rural ones. Whereas the percentage variation is greater than 3 in absolute value in urban areas, it does not even reach two percent in rural ones. **In urban areas**, all models indicate the same impact: consumption is underestimated and the under-evaluation **increases with the rank**. **In rural areas**, LES, AIDS and BBLQ also indicate an underestimation of the distribution but the underestimation **decreases with the rank** turning into an overestimation for RSQ where we find an overestimation of all measures except for the first quartile. In this case, the main impact is given by AIDS. Substitution effects cannot reasonably be ignored for the poorest (represented by the first quartile), especially in the urban sector, even though distortion is in general the smallest one. In terms of correlations between per capita equivalent expenditure and real per capita expenditure or, correlation between equivalent expenditure and real expenditure, they are very similar and high for all the models in both sectors.

If we now consider differences among the models and we take rank one model (LES) as the reference[17], Figure 9, it appears that AIDS results are the closest results to LES in both areas with a percentage variation for all measures of at most 0.16% in rural areas!!!! Here both the QUAIDS underestimate all measures of pcee compared to LES and again a bigger variation is found in RSQ model which is at most of 2.3% in absolute value. In urban areas

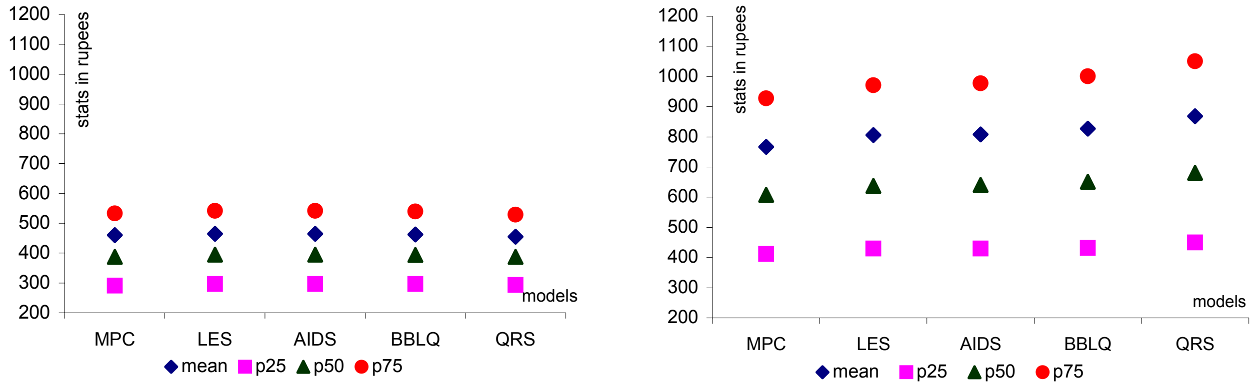
[17] LES being the simplest formulation (of rank 1) has been taken as the base model for making comparisons as rank increases.

not only the percentages are more important than for rural, but the percentage variation increases with the rank and again RSQ gives the most distortion. In these areas, all measures are overestimated compared to LES results, AIDS differences remain below 1% whereas RSQ go up to the +7.8%. We can point out here that in all cases, differences among the models are the smallest for the poorest (given by Q1) but the ratio increases with the rank (Figure 9).

Figure 8

Statistics of per capita equivalent expenditure

Rural **Urban**



Rate of variation of the mean, median, first and third quartiles of per capita total expenditure

Rural **Urban**

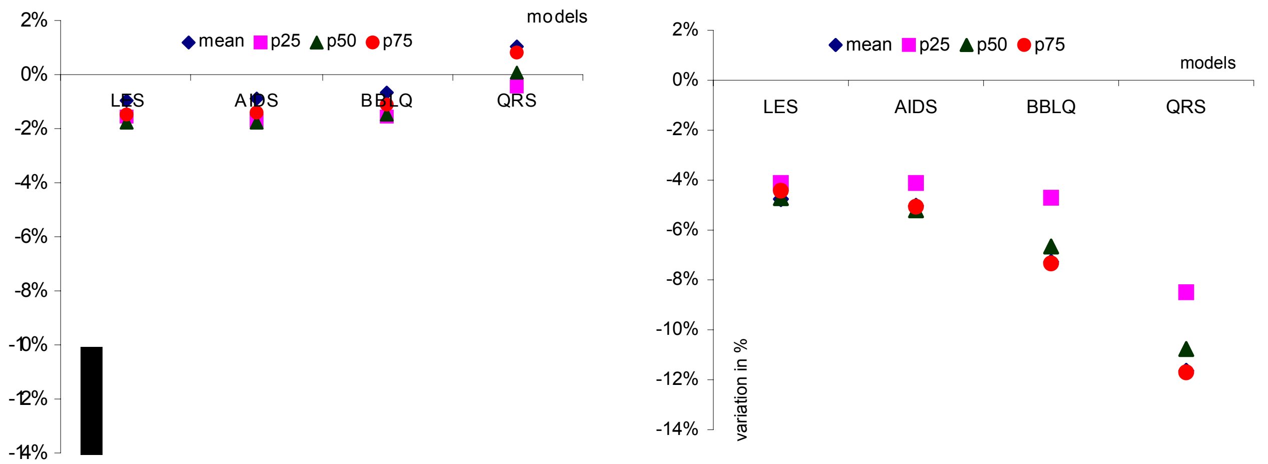
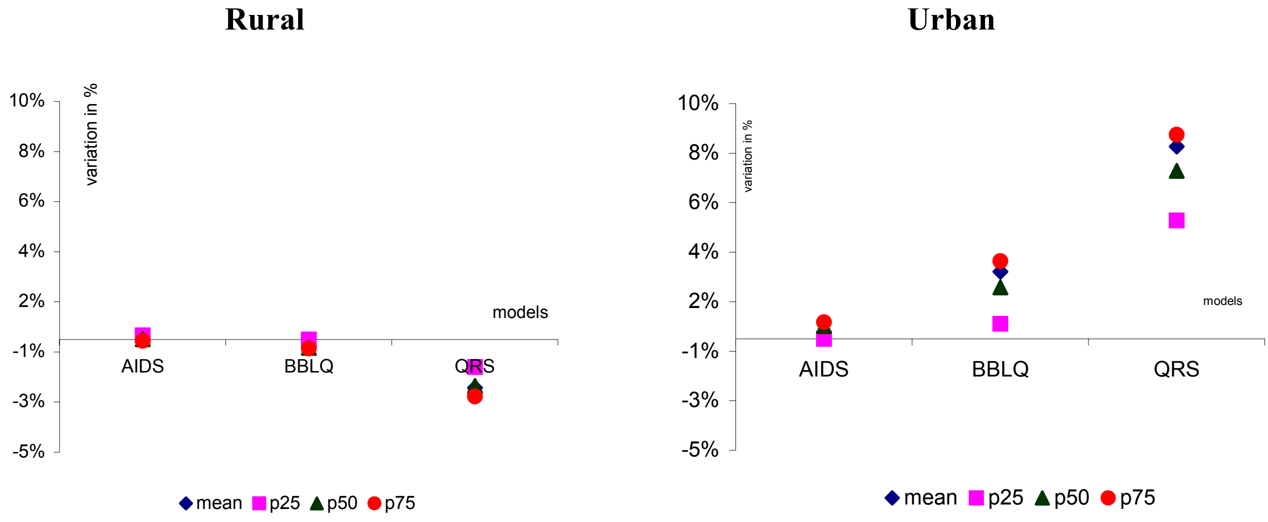


Figure 9

Percentage variation of the per capita equivalent expenditure among models

LES model is the reference



One of our main motivations for estimating different demand systems is to capture utility compensated substitution effects in the calculation of our welfare indicator. Estimating different rank demand systems allows for better adjustment to non-linear behaviour of some commodities shares. Using the estimated parameters we calculate indirect utilities at current prices, and then the cost functions and per capita equivalent expenditure at reference period prices for all models. We chose 1997 was chosen as the reference period it was the first year for which prices are available in the new base (base 1986-1987).

So how does welfare compare across the different models? Before looking into welfare measures, we first look at another aspect relevant to consumption analysis namely the cost of living index. In consumer demand theory, this index is constructed as the ratio of the cost functions of two different periods, keeping utility constant. Here we examine how the cost of living has evolved between 1997 and 2000 according to the different models:

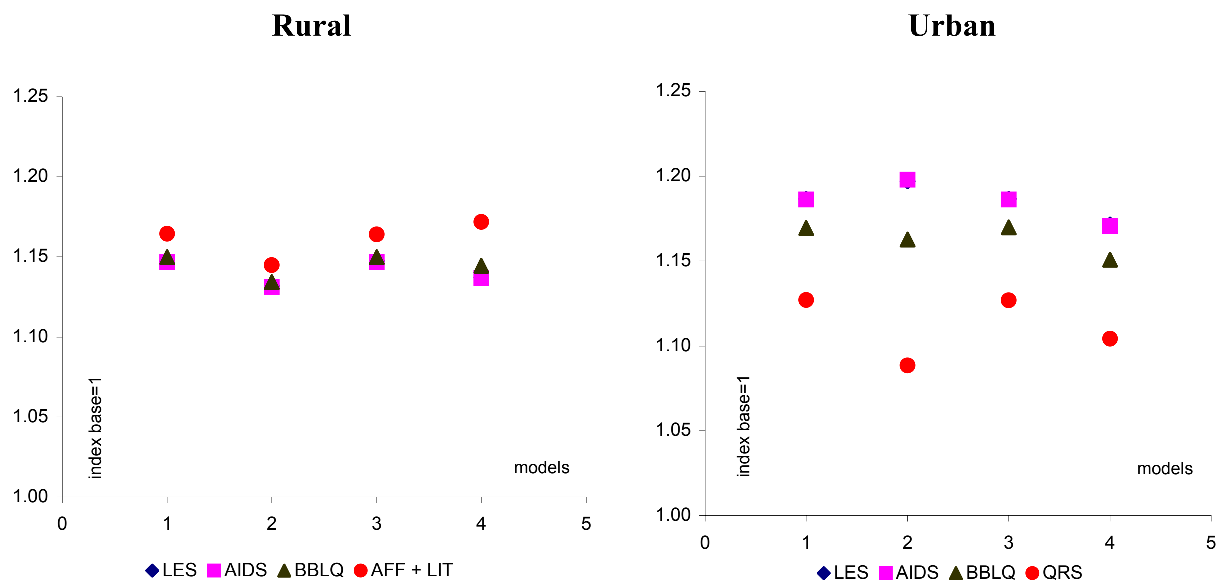
(1) at all India level and by type of household

(2) by regions in urban and rural for all households

In order to evaluate how households have been affected in terms of cost of living, we decide to calculate the index for four types of households: a head illiterate household (which is among the poorest), a non-affluent one, a rich household which is affluent with a literate head and finally the poorest household which is head illiterate and non-affluent. Figure 10 shows that according to all models the cost of living index has increased in both areas between 8% and 20% for all types of households and all models. Urban results have more variance. LES and AIDS cost of living differences are negligible (not even 0.05%!) in both areas. On the other hand both the QUAIDS estimate a higher increase of the cost of living in rural than in urban. In rural head illiterate households suffer the maximum increase for all models and non-affluent the smallest one. In urban areas head illiterate as well as poor households are the most affected ones whereas the rich households are the least affected.

Figure 10

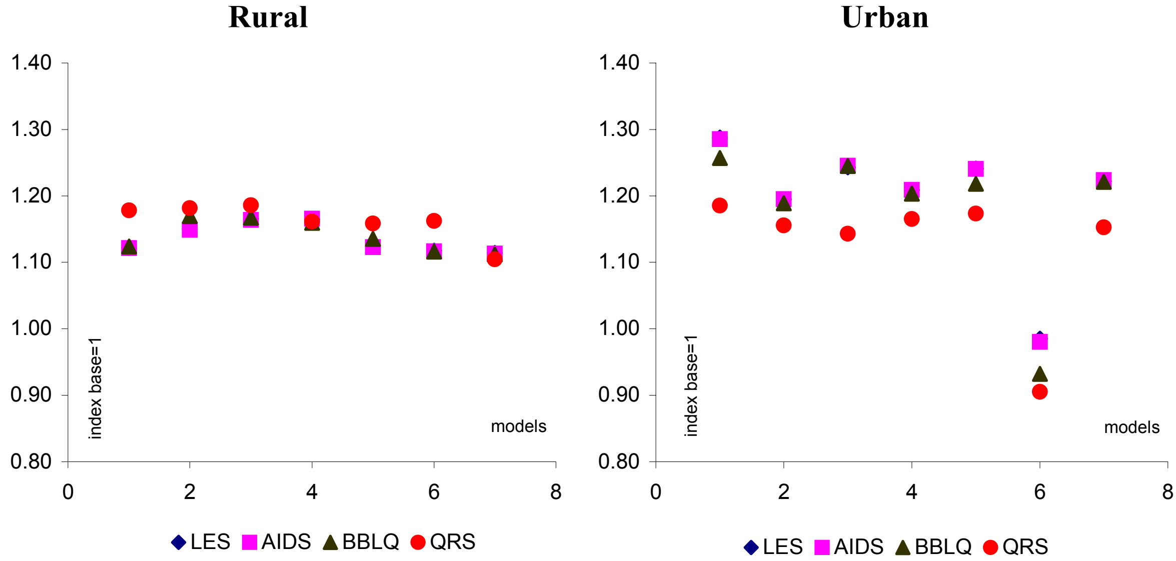
Cost of living index by type of household



Across regions (Figure 11) the cost of living index has also increased according to all models in both areas except in urban West whose index has decreased for all models. The increase in rural regions vary from 10% to 20% whereas in urban ones it reaches almost 30% and even decreases for the West as we have already mentioned. The North suffers the most increase in urban areas whereas in rural ones the rise is rather homogenous.

Figure 11

Cost of living index across regions



Effects of rank on poverty and inequality measures are analysed through head illiterate and head literate types of households. We have seen that households with an illiterate head are among the poorest (when they are not actually the poorest) whereas literate ones are rather rich. Considering these two types of household has the advantage of not only capturing the bias introduced in welfare measures when using a CPI deflated expenditure but also to point out sensitivity of the poorest to substitution effects.

Poverty measures[18]

According to poverty measures (Table 4), at the rural all India level about 30% of the population is below the poverty line; however the average shortfall of the poor households is 6% from the poverty line. Foster et al. and Watts poverty measures also confirm that poor households are close to the poverty line. However Sen's measure, which takes into account inequality among poor, indicates that there is some inequality in their distribution as the value of the index is closer to the poverty gap than to the head count ratio. In urban areas at all India level, poverty is less important with about 20% of the population below the poverty line. Only 5% increase (on average) would be necessary for the poor to reach the poverty line and FGT

[18] All poverty and inequality indices have been computed with the help of DAD software (see Duclos *et al.* (2004a, 2004b) and Duclos and Araar (2004)).

confirms they are close to the poverty line with almost the same value as in rural areas. Sen's measure indicates that there is some inequality among the poor, however the value is even closer to the poverty gap than in rural areas.

In general head illiterate households suffer from more poverty than literate ones. In rural areas around 38% of the former are below the poverty line against 20% for the second type (Table 4). The aggregated value of the percentage difference between the incomes of the poor illiterate headed households and the poverty line is about 7.5% whereas it is about 4% for the poor households with a literate head. In other words if the income of the poor head illiterates households was 7.5% higher on average they would reach the poverty line which in turn means that poor households are not that far from the minimum required to live in a "decent" way (defined by the poverty line). If we give more importance to the distribution of the poor considering Foster et al. measure it appears that distribution is close to the poverty line for both types as FGT2[19] $_{hill}$ ~ 0.02 and $FGT2_{hlit}$ ~ 0.01 and difference between head illiterate and literate is only of 1%. Watts measure confirms that poor households are rather close to the poverty line for both types of households. Sen's poverty measure is closer to the poverty gap than to the head count ratio for both types of households (Sen_{hill} ~ 0.1 and Sen_{hlit} ~0.05) meaning there is inequality among the poor, even though they are close to the poverty line, and inequality is more important among illiterates than within the literate group as their index is twice that of the literates ones.

In urban areas there is also more poverty among illiterate households than within literates and moreover the difference in the severity of the poverty suffered by both types is much more important than in rural areas. Here the first group is composed of more or less 40% of poor whereas the second one has "only" around 15%. Head illiterate households need 10% rise in income on average to reach the poverty line whereas literate ones would do it with 3% more on average. Even though illiterate households in urban areas need more than rural ones to reach the poverty line they remain close to it. Literate households are even closer in urban areas than in rural one. FGT and Watts measure corroborate this last result meaning that income levels among the poor are close to the threshold.

[19] FGT2 is Foster et al. measure with alpha = 2.

Rank and Poverty

Now that we have given a general view of poverty among illiterate and literate households we can analyse the sensitivity of the poverty measures to the rank by looking at the different model results. First we examine the well known Foster et al. family type, namely the head count ratio, the poverty gap (both being insensitive to distribution of the poor) and the squared gap ratio (which is sensitive to the distribution) taking official all India poverty lines. In both areas, for all models and with CPI per capita deflated expenditure (Table 4) there are more poor among head illiterate than among literate households ($HCR_{hill} > HCR_{hlit}$), the gap between the poverty line and the average income of the poor is more important for illiterate ($PGR_{hill} > PGR_{hlit}$) and they suffer greater poverty ($FGT2^{20}_{hill} > FGT2_{hlit}$).

In general measures based on real MPCE overestimated all Foster et al. measures considered (distribution sensitive and insensitive), however the bias is more important in urban areas than in rural ones. We have emphasized that distribution of total expenditure is underestimated when ignoring substitution effect in both areas and the distortion *decreases* with the rank of the demand system in rural areas whereas it *increases* according to the rank in urban ones. In rural areas the maximum effect is given by AIDS.

If distributions are underestimated it means that poverty measures based on CPI deflated expenditure will tend to give greater poverty. Comparing real expenditure with estimated distributions of equivalent expenditures confirms this intuition: ignoring substitution effect results in an overestimation of all FGT measures but the overestimation decreases according to the rank of the demand system considered in rural areas and increases in urban ones. In rural areas the main overestimation of the MPCE is found in AIDS whereas it is given by RSQ in urban areas.

Head illiterate households are always poorer than literate ones in both areas; moreover their expenditure distribution has less variance than literate ones. Also dispersion among rural illiterate households is less than that of urban illiterate ones. This has mainly two effects:

- real MPCE overestimates poverty in both areas and according to all models; the overestimation is more important for literate heads than for illiterate ones.
- overestimation is more important in urban areas for both household types.

[20] FGT2 is Foster et al. measure with alpha = 2.

Considering the question: are substitution effects less important for poor households? According to our results (Table A.19) and for all FGT measures: if the overestimation with real MPCE is relatively small in rural areas and is of the same order for all measures (with a percentage difference below 7%), in urban ones the percentage ratio is always greater than 8% and increases when the poverty aversion parameter increases. In other words, in urban areas the head count ratio of illiterate heads based on deflated per capita expenditure is overestimated by 8% with respect to results obtained with per capita equivalent expenditure based on LES; PGR is over-evaluated by 17% and FGT by 23%. Thus when substitution effects are taken into account, poverty among head illiterate household is more stable in urban areas.

So far we have seen that poverty measures are sensitive to substitution effect and all models lead to this conclusion. However how sensitive are they to rank of the demand system? We pointed out earlier that the bias increases or decreases with rank, RSQ always giving always the most extreme values. Now all these assertions are made comparing results with CPI deflated expenditure and estimated equivalent expenditure. Thus what happens when comparing results among demand systems? If LES is taken as the reference model to calculate the percentage variation of FGT measures for higher rank models (Table 5**),** it appears that in rural areas AIDS results give a lower value of severity of poverty of both types of households whereas RSQ gives a higher one. In urban areas, the opposite is observed: AIDS is higher and QUAIDS lower. In rural areas Bundell et al. equivalent expenditures lead to smaller poverty gap and FGT whereas they imply higher head count ratios for both types of households. In the urban sector, models of rank 2 and 3 give smaller measures than LES except in the case of FGT for illiterate head households which is bigger. Now, we have to be careful with these statements because the degree of sensitivity within rural is very different from within urban. In rural areas the difference between results obtained with AIDS or BBLQ compared to LES poverty measures is at most of 1.17% in absolute terms for head illiterate and literate ones. RSQ ratio is higher but remains below 5%. In urban areas percentage variation of poverty measures of head illiterate between LES and AIDS/BBLQ remains moderate (at most 6%) but is more important between LES and RSQ (13.3%). For head literate households the variations exceed 10%. In general in urban areas, AIDS and LES results are the closest whereas BBLQ/RSQ are higher.

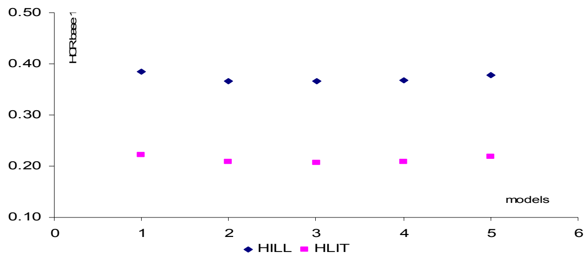
All the above statements are confirmed with Watts and Clark et al. poverty measures. Sen's measures in rural and urban areas and for all models are higher for head illiterate than for literate households. Once again, illiterate suffer from greater poverty. Ignoring substitution effect leads to overestimating poverty in both regions and once again the main overestimation is pointed out by AIDS in rural areas and by RSQ in urban. Compared to LES Sen's measures, AIDS ones are higher in urban and lower in rural, RSQ measures are on the other hand greater in rural and smaller in urban whereas BBLQ head illiterate measure is lower in both areas.

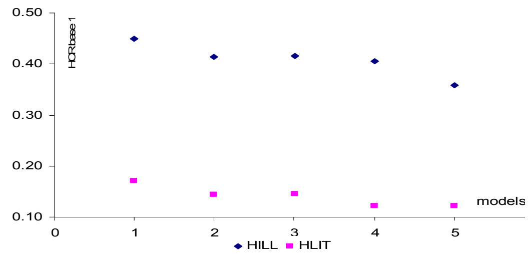
Figure 12

Poverty measures by model

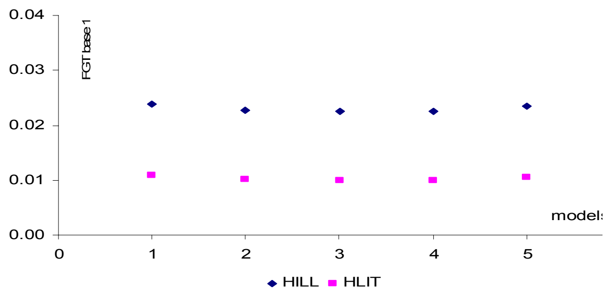
Rural **Urban**

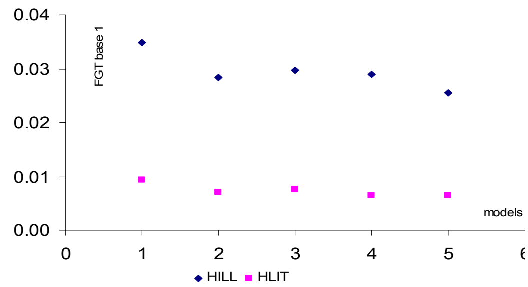
Head count ratio



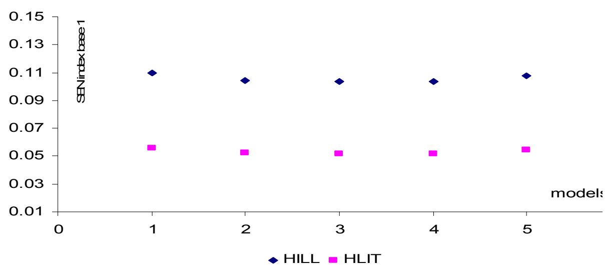


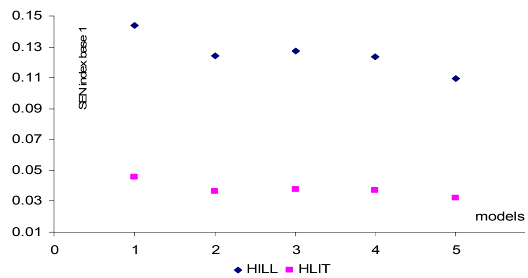
Foster et al. index with alpha = 2





Sen index





<u>**Table 4**</u>

Welfare measures

	Rural					Urban				
	MPCE30	LES	AIDS	BBLQ	RSQ	MPCE30	LES	AIDS	BBLQ	RSQ
<u>**POVERTY**</u>										
HCR										
At all India level	0.307	0.291	0.290	0.291	0.302	0.247	0.217	0.218	0.214	0.186
hill	0.384	0.366	0.365	0.367	0.378	0.450	0.414	0.416	0.406	0.359
hlit	0.223	0.208	0.207	0.208	0.219	0.172	0.144	0.146	0.122	0.122
PGR										
At all India level	0.060	0.057	0.057	0.057	0.059	0.051	0.043	0.044	0.043	0.038
hill	0.079	0.075	0.075	0.075	0.078	0.104	0.089	0.091	0.088	0.079
hlit	0.040	0.037	0.037	0.037	0.039	0.032	0.026	0.027	0.022	0.022
FGT										
At all India level	0.018	0.017	0.017	0.017	0.017	0.016	0.013	0.014	0.013	0.012
hill	0.024	0.023	0.022	0.023	0.023	0.035	0.028	0.030	0.029	0.026
hlit	0.011	0.010	0.010	0.010	0.011	0.009	0.007	0.008	0.006	0.006
WATTS										
At all India level	0.072	0.068	0.068	0.068	0.071	0.062	0.051	0.053	0.052	0.045
hill	0.096	0.091	0.090	0.091	0.094	0.129	0.108	0.112	0.108	0.096
hlit	0.047	0.044	0.043	0.044	0.046	0.038	0.050	0.032	0.027	0.027
CHU										
At all India level	9.830	9.305	9.276	9.326	9.663	9.030	7.934	7.994	7.830	6.808
hill	12.306	11.727	11.705	13.871	14.392	16.502	15.144	15.231	14.874	16.662
hlit	7.125	6.658	6.622	6.667	6.997	6.285	5.283	5.334	5.239	4.476
SEN										
At all India level	0.084	0.079	0.079	0.079	0.082	0.072	0.060	0.062	0.061	0.053
hill	0.109	0.104	0.103	0.104	0.107	0.144	0.124	0.127	0.124	0.110
hlit	0.056	0.052	0.052	0.052	0.055	0.045	0.036	0.038	0.037	0.032
<u>**INEQUALITY**</u>										
GINI										
At all India level	0.252	0.254	0.254	0.253	0.252	0.321	0.327	0.328	0.338	0.340
hill	0.231	0.233	0.232	0.232	0.230	0.252	0.259	0.263	0.271	0.272
hlit	0.258	0.260	0.259	0.259	0.258	0.316	0.320	0.320	0.331	0.333
ATKINSON										
At all India level	0.053	0.054	0.054	0.054	0.053	0.084	0.087	0.087	0.093	0.094
hill	0.045	0.046	0.046	0.045	0.045	0.056	0.058	0.060	0.064	0.064
hlit	0.055	0.056	0.056	0.056	0.055	0.081	0.083	0.083	0.089	0.089
THEIL										
At all India level	0.164	0.120	0.119	0.119	0.119	0.189	0.195	0.194	0.208	0.211
hill	0.100	0.102	0.101	0.101	0.101	0.131	0.139	0.142	0.152	0.154
hlit	0.123	0.124	0.123	0.123	0.123	0.179	0.183	0.181	0.197	0.197

Inequality

Inequality in rural areas at all India level is less important than in urban areas but in both cases it is closer to 0 than to 1 meaning that distributions of income among poor in both areas is not so unequally distributed. Atkinson measure indicates that if income was equally distributed only 95% and 92% of the income would be necessary to reach the same level of welfare in rural and urban areas respectively.

Interesting remarks can be made with Sen's measure to introduce inequality: Sen showed in his article of 1976, that when all poor have the same income, the Gini index of the poor is zero and Sen's measure is equivalent to the Poverty Gap Ratio. On the other hand, the lower the income of the poor, the closer will his measure be to head count ratio whereas the larger the proportion of the poor, the closer will S be to the income gap ratio.

In both sectors, Sen's poverty measure of the literate headed households is very close to their poverty gap ratio and both measures are close to 0.05 and 0.04 (Table 4**)**. This has two interpretations: poor households with literate head have expenditure close to the poverty line and income distribution among poor literate household is rather equitable. Gini index shows on the other hand that there is more equality among head illiterate households than among literate ones in both areas as the Gini index of illiterates is closer to zero. In rural areas inequality of both types of households is less important than in urban ones. Atkinson and Theil inequality measures corroborate these statements. Atkison index value implies that, in rural areas about 95% and 94% of the current mean per capita expenditure, distributed equally among the households, should be enough to achieve the same level of welfare of head literate and illiterate households respectively. In urban areas the corresponding figures are 94% for head illiterate and around 91% for literates.

Inequality and Rank

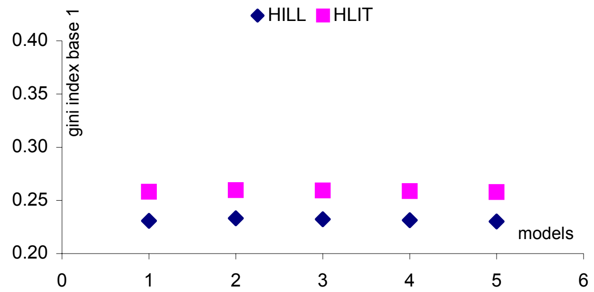
Looking at Figure 12 it is straightforward that in urban areas all inequality indices increase with the rank. This can be seen in Table 5 which gives, as we have already seen, the percentage bias introduced in measures based on CPI deflated per capita expenditure ignoring substitution effects. In urban areas, all inequality measures are underestimated and the distortion increases with the rank. Measures of head illiterate suffer the most underestimation which is always greater than 4% for Atkinson and Theil indices. In rural areas, according to LES, AIDS and BBLQ inequality measures are underestimated when ignoring price effect but they are overestimated according to RSQ. Again the main bias is for head illiterate households but it does not even reach –2% for illiterate and is at most 1% for literates, so it could be neglected. Sensitivity of inequality measures to the rank is also analysed comparing rank 2 and rank 3 derived indices with rank 1 measures. Once again, the difference is more important for head illiterate than for literate ones and increases with the rank. However it can be neglected in rural areas where it is below 0.2% in absolute terms where AIDS and both QUAIDS equivalent expenditure distribution give a lower inequality compared to LES! In urban areas on the other hand rank 2 and rank 3 demand systems indicate higher inequality among both types of households with the difference being negligible (-1.3%) for AIDS.

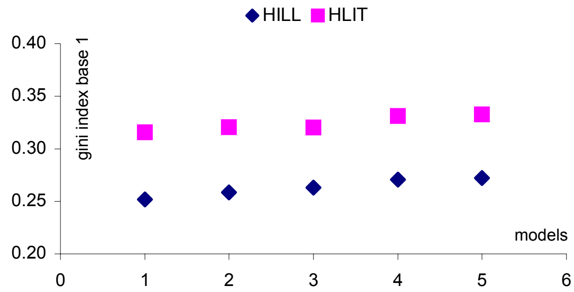
Figure 12

Inequality measures by model

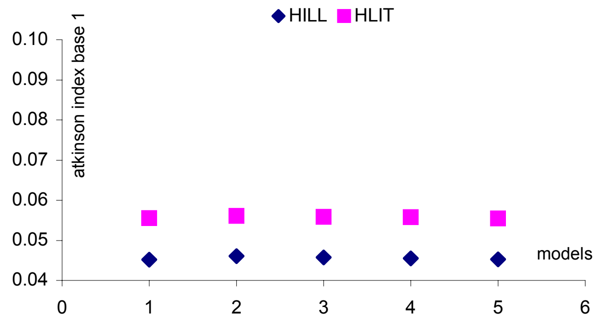
Rural **Urban**

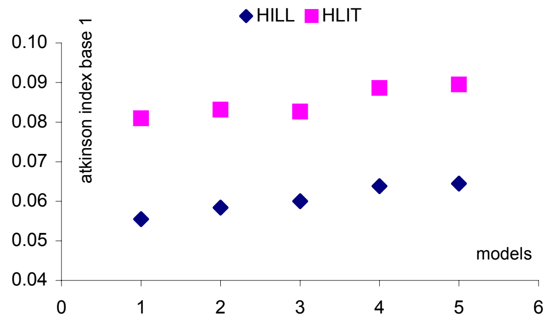
Gini



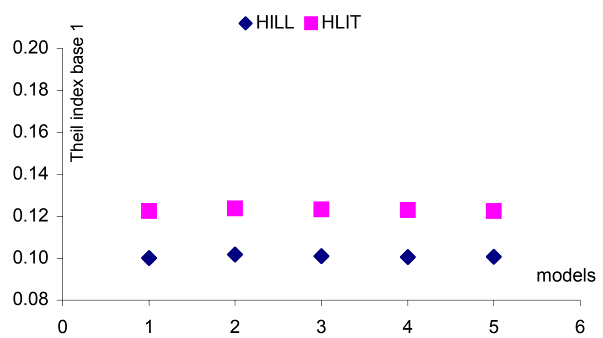


Atkinson





Theil



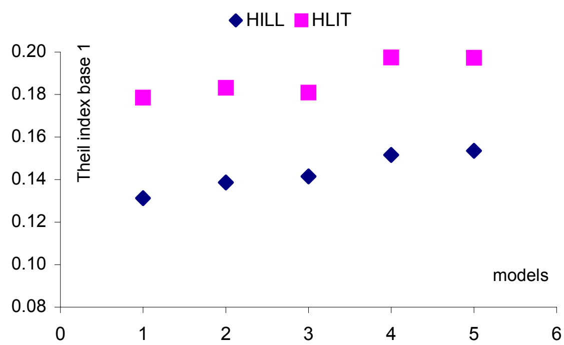


Table 5
Percentage rate variation of poverty and inequality measures with respect to rank one model

Rural				Urban		
POVERTY	**AIDS**	**BBLQ**	**RSQ**	**AIDS**	**BBLQ**	**RSQ**
HCR						
hill	-0.183%	0.285%	3.194%	0.518%	-1.827%	-13.245%
hlit	-0.544%	0.143%	5.100%	0.946%	-15.342%	-15.298%
PGR						
hill	-0.718%	-0.249%	3.461%	2.579%	-0.581%	-11.404%
hlit	-0.915%	-0.257%	4.743%	4.495%	-12.222%	-12.177%
FGT						
hill	-1.171%	-0.840%	3.288%	5.084%	1.824%	-9.841%
hlit	-1.380%	-0.861%	4.416%	7.724%	-9.180%	-9.133%
WATTS						
hill	-0.832%	-0.399%	3.380%	3.237%	0.052%	-11.032%
hlit	-1.016%	-0.389%	4.655%	-36.274%	-46.423%	-46.449%
CHU						
hill	-0.187%	18.280%	22.724%	0.569%	-1.783%	10.020%
hlit	-0.546%	0.140%	5.097%	0.966%	-0.823%	-15.280%
SEN						
hill	-0.682%	-0.274%	3.321%	2.764%	-0.093%	-11.478%
hlit	-0.950%	0.621%	5.153%	4.313%	2.200%	-12.173%
INEQUALITY						
GINI						
hill	-0.327%	-0.674%	-1.170%	1.745%	4.770%	5.302%
hlit	-0.180%	-0.311%	-0.685%	-0.099%	3.329%	3.813%
ATKINSON						
hill	-0.659%	-1.231%	-1.704%	2.755%	9.255%	10.429%
hlit	-0.339%	-0.566%	-1.160%	-0.600%	6.581%	7.636%
THEIL						
hill	-0.724%	-1.187%	-1.047%	2.079%	9.253%	10.746%
hlit	-0.320%	-0.521%	-0.953%	-1.241%	7.813%	7.769%

6. Conclusions

The issue of taking substitution effect into account when analysing poverty and inequality has led us to consider different preference structures in order to estimate equivalent expenditure. Of course adjusting different models to the same data is bound to give different estimation results and different quality of fit but we have seen that differences are more important in estimation of expenditure **at the commodity level** than in the estimation of **equivalent** expenditure. Moreover adjusting the same model to different sectors (like rural and urban) also gives different quality of fit. In rural areas a rank three model which allows more flexibility to the effect of the real income is found to be inappropriate, giving parameter estimates which are not justifiable in an economic sense. In urban areas on the other hand these types of models are not so inconvenient though not as good as rank two. This difference could be explained by the fact that in a developing country rural regions are really poorer than urban ones and the consumption basket is basically composed of only essential goods. Such goods are well represented by a linear Working-Leser form; therefore the rank one model gives a good adjustment in rural areas. In urban, the level of the development being greater in general, a more flexible form such as AIDS works better though even more flexibility given by QUAIDS is not warranted. AIDS model (which is rank two) is the only model that gives a good estimation in both areas. Ignoring substitution effects has an impact but that impact can be different according to the demand system and item considered. However when the item represents an important expenditure, all the models tend to indicate the same distortion. In general the main bias is given by rank 3 models.

We also considered two different rank three models in order to see if the specification of the quadratic term in the budget share had an influence in the adjustment. While BBLQ introduces a new parameter to identify the effect of the squared deflated expenditure[21], RSQ model also combines the effect of the price with that of a quadratic real expenditure. Despite this difference it appears in our results that the performance of both the QUAIDS was very similar with the same significant socio-economic parameters. If the quadratic term is significant for the same goods in urban regions, in rural ones it is not: Bundell et al. model's squared term is significant for all commodities while Ravallion and Subramanian coefficients

[21] See equation 3 and 4.

for food and miscellaneous are not, indicating that in this case the substitution effect is more important than the income effect. Even when the “quadratic term” parameters are relevant, coefficient values are so small that they are almost negligible in both sectors. Knowing that the major difference between AIDS and QUAIDS model is the quadratic term and that the effect on total expenditure is not so “important”, this explains why estimated total expenditure are not so different with both models.

Our welfare measures are based on distributions of equivalent expenditures and therefore any difference between deflated and equivalent expenditure distribution will be translated into poverty measures. In both rural and urban, ignoring substitution effects leads to an underestimation of total consumption and the under-evaluation increases with the rank in urban areas whereas it decreases with the rank in rural ones. As a consequence, poverty measures based on deflated expenditure distributions which ignore substitution effects are overestimated and the over-evaluation does also increase with the rank in urban areas and decrease with the rank in rural ones. The more the measure is sensitive to distribution among poor the higher is the bias introduced. On the other hand inequality measures are underestimated when changes in relative prices are not considered and again the bias increases with the rank in urban areas and decreases in rural ones. It clearly appears that when trying to take into account substitution effects the quality of the adjustment directly interferes with the welfare analysis. Another indication is that the variance of the bias in urban areas is much more important than in rural ones therefore the variance of the distortion is also much more important in urban. However all models indicate the same direction of the bias; so if we are only interested in knowing whether measures based on deflated expenditures are under or over evaluated any model will answer this question.

If we compare the effect of the rank only among the estimated equivalent expenditure it also appears that it is directly linked to the quality of adjustment. As we go from rank one model to higher rank models, we see that in urban areas per capita equivalent expenditures tend to be higher with a bigger variance. Once again this leads to decreasing poverty measures and increasing differences as rank increases. Inequality measures also become higher as rank increases. In rural areas estimated equivalent expenditure is very similar for all models. Therefore difference in poverty measures is at most of 5% for all poverty measures except for Clark et al. index whereas it can be higher than 10% in urban ones. In rural areas difference in inequality measures among models never exceeds 1.5%!

In order to determine if substitution effect matters for poor households, welfare measures are calculated for head illiterate households (which are among the poorest ones) and head literate ones which belong to the wealthier type of households. It clearly appears that substitution effect does influence the welfare for "poor" households especially in the evaluation of the degree of poverty whereas the bias in inequality measures is less important than for poverty. The distortion in poverty measures is also more important than that in inequality for "richer" households. However, between the rich and the poor, the poorer the household is, the higher the underestimation of inequality.

This work also allows us to calculate income and price elasticities of the different commodities at all India level, by type of household and by region. In general the differences between income elasticities implied by LES and AIDS models are not important; even though the values are different they lead to the same conclusions in terms of luxurious and necessary items and the most elastic good in a given sector is the same one in both models. On the other hand LES and QUAIDS results are drastically different and can even be contradictory. In general one can say that all food, fuel and pan-tobacco are essential in rural and clothing and miscellaneous are "luxury" goods. In urban clothing becomes essential and only miscellaneous is "luxury". In terms of own compensated price elasticities concordance between LES and AIDS results less obvious though not completely dissimilar and AIDS and QUAIDS own price elasticities are more or less the same. Food is the least elastic to its own price in both sectors whereas miscellaneous is the most elastic in both sectors according to LES. AIDS/QUAIDS give the maximum elasticity to pan-tobacco in rural and fuel in urban. All goods are basically substitutes according to all models for both rural and urban.

Greater differences arise when analysing income elasticities between commodities than between household type or between regions for a given model. However different models give different results for the same type of household and the same region. LES and AIDS income elasticities have the same structure across regions even though variations are more important for LES. Fluctuations among LES income elasticities are also more important in rural regions than in urban ones. Income elasticities with BBLQ are almost constant within urban and within rural regions leading to a constant difference among goods for all regions alike.

Now some directions for future work. The present research was carried out using only those households that consumed all the items and a further step could be to integrate all households independently of whether they consume a commodity or not. Due to the technical complexities involved in the programming of systems of demand equation in which some expenditure are continuous and others are censored at 0, we have left this issue to a later stage. Next, the substitution effect has only been considered through regional price changes for the same period. Another way to incorporate them is to capture the effects over time when prices change. This will be done in another paper. Finally, discussion on poverty and inequality was mainly concentrated on the effect of ignoring substitution effect and the effect of the model specification as per the stated purpose of the paper. No doubt welfare distributions across various States of India and different socio-economic and religious groups are also interesting aspects of welfare analysis to be considered. We did not go into these points in this paper to keep our analysis focused on the aim of the study without overwhelming the reader with numerous additional comparisons. We plan to do it in a separate paper devoted to the spatial distribution of welfare across India.

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Annex

TABLE A.1

Correlation matrix of budget shares

	W1	W2	W3	W4	W5
In rural areas					
W1	1				
W2	0.9169	1			
W3	0.4172	0.4423	1		
W4	-0.595	-0.2667	-0.2486	1	
W5	-0.992	-0.952	-0.4853	0.5148	1
In urban areas					
W1	1				
W2	0.098	1			
W3	-0.113	-0.021	1		
W4	-0.114	-0.081	-0.092	1	
W5	-0.874	-0.342	-0.113	-0.205	1

TABLE A.2

Description of demographic variables used in our models

Label	Unit	variable	coefficient
Household's "economic" situation:	dummy		
Non-affluent	1=Yes; 0= No or no answer	NA	δ_1
Affluent	reference modality		
Head's education level:	dummy		
Illiterate	1=Yes; 0= No or no answer	HILL	δ_2
Literate	reference modality		
Household's demographic composition:			
Number of children	Integer	NCHLD	δ_3
Number of adult male	Integer	NAMAL	δ_4
Number of adult female	Integer	NAFEM	δ_5
Household's living region:	Dummy		
North	reference modality		
North west	1=Yes; 0= No	NW	δ_6
North east	1=Yes; 0= No	NE	δ_7
East	1=Yes; 0= No	E	δ_8
Center	1=Yes; 0= No	C	δ_9
West	1=Yes; 0= No	W	δ_{10}
South	1=Yes; 0= No	S	δ_{11}

TABLE A.3

Regional Classification of States

N	Punjab, Jammu and Kashmir, Himachal Pradesh, Chandigarh, Haryana and Delhi
NW	Rajasthan
NE	Assam, Manipur and Meghalaya
E	West Bengal, Bihar and Orissa
C	Uttar Pradesh and Madhya Pradesh
W	Gujarat, Maharastra, Daman & Diu, Dadra Nagar and Haveli
S	Tamil Nadu, Pondicherry, Kerala, Karnataka, Andra Pradesh and Goa

TABLE A.4

LES rural estimates

log likelihood = -1311208.4

Coefficient Std.err	FD	FL	CBF	PTI	MISC
α	**0.571**	**0.705**	**-0.183**	**0.128**	**-1.222**
	0.047	0.011	0.031	0.014	0.051
β	**0.382**	**0.0289**	**0.0993**	**0.0319**	**0.458**
	0.002	0.000	0.001	0.001	0.002
δ_1	**0.177**	**-0.094**	**0.104**	**0.012***	**0.155**
	0.027	0.006	0.018	0.008	0.030
δ_2	**-0.066**	**-0.039**	**0.025****	**0.037**	**0.043****
	0.016	0.004	0.0107	0.005	0.018
δ_3	**0.260**	**0.018**	**-0.016**	**-0.007**	**-0.255**
	0.005	0.001	0.003	0.001	0.005
δ_4	**0.385**	**0.035**	**-0.021**	**-0.007**	**-0.393**
	0.008	0.002	0.006	0.003	0.009
δ_5	**0.333**	**0.045**	**-0.005***	**0.019**	**-0.353**
	0.010	0.002	0.006	0.003	0.010
δ_6	**0.073***	**-0.184**	**0.060****	**0.032****	**0.019***
	0.047	0.010	0.031	0.015	0.052
δ_7	**0.179**	**-0.404**	**-0.030***	**0.066**	**0.189**
	0.037	-0.009	0.025	0.011	0.041
δ_8	**-0.153**	**-0.400**	**-0.020***	**-0.128**	**0.702**
	0.034	0.008	0.022	0.010	0.037
δ_9	**-0.675**	**-0.291**	**0.048***	**-0.076**	**0.994**
	0.034	0.008	0.023	0.010	0.037
δ_{10}	**-0.453**	**-0.285**	**0.016***	**-0.067**	**0.790**
	0.039	0.009	0.027	0.011	0.043
δ_{11}	**-0.419**	**-0.454**	**-0.111**	**0.062**	**0.921**
	0.035	0.008	0.024	0.010	0.038

* not significant at 5% level

** not significant at 1% level but significant at 5% level

TABLE A.5

LES urban estimates

log likelihood = -538820.26

Coefficient	FD	FL	CBF	PTI	MISC
Std.err					
α	**-0.488**	**0.329**	**0.503**	**0.282**	**-0.626**
	0.086	0.016	0.019	0.012	0.086
β	**0.374**	**0.028**	**0.039**	**0.023**	**0.535**
	0.003	0.495	0.0005	0.001	0.003
δ_1	**0.500**	**-0.100**	**-0.373**	**-0.109**	**0.081***
	0.065	0.012	0.015	0.009	0.066
δ_2	**0.048***	**-0.065**	**-0.136**	**0.004***	**0.149**
	0.042	0.008	0.010	0.006	0.042
δ_3	**0.199**	**0.016**	**0.035**	**0.002***	**-0.251**
	0.013	0.002	0.003	0.002	0.013
δ_4	**0.273**	**0.045**	**0.093**	**0.006****	**-0.418**
	0.020	0.004	0.004	0.003	0.019
δ_5	**0.149**	**0.074**	**0.116**	**-0.018**	**-0.321**
	0.021	0.004	0.005	0.003	0.021
δ_6	**0.121***	**0.068**	**-0.095**	**-0.018***	**-0.076***
	0.106	0.022	0.023	0.016	0.107
δ_7	**0.807**	**0.042****	**-0.228**	**-0.050**	**-0.572**
	0.080	0.018	0.016	0.011	0.082
δ_8	**0.389**	**-0.071**	**-0.153**	**-0.114**	**-0.051***
	0.064	0.012	0.014	0.009	0.064
δ_9	**-0.109***	**-0.078**	**-0.075**	**-0.098**	**0.359**
	0.062	0.012	0.015	0.010	0.062
δ_{10}	**0.060***	**-0.037**	**-0.141**	**-0.120**	**0.238**
	0.066	0.012	0.015	0.009	0.065
δ_{11}	**0.051**	**-0.121**	**-0.194**	**-0.009***	**0.273**
	0.061	0.012	0.015	0.009	0.061

* not significant at 5% level
** not significant at 1% level but significant at 5% level

TABLE A.6

AIDS rural estimates

log likelihood = 326820.59

Coefficient

Std.err	FD	FL	CBF	PTI	MISC
α	**0.674**	**0.153**	**0.084**	**0.063**	**0.026**
	0.004	0.001	0.001	0.002	0.003
β	**-0.081**	**-0.025**	**-0.005**	**-0.004**	**0.116**
	0.001	0.000	0.000	0.000	0.001
γ_1	**-0.044***	**-0.034**	**0.043**	**-0.014**	**0.050****
	0.007	0.002	0.003	0.003	0.006
γ_2		**0.018**	**-0.010**	**0.009**	**0.017**
		0.001	0.001	0.001	0.002
γ_3			**-0.015**	**0.011**	**-0.029**
			0.004	0.003	0.003
γ_4				**-0.030**	**0.025**
				0.004	0.006
γ_5					**-0.063**
δ_1	**0.018**	**-0.003**	**-0.004**	**0.001***	**-0.012**
	0.001	0.001	0.001	0.001	0.001
δ_2	**0.005***	**0.000**	**-0.003**	**0.006**	**-0.008**
	0.001	0.0003	0.0003	0.0004	0.001
δ_3	**0.015**	**0.000**	**0.000**	**-0.001**	**-0.013**
	0.000	0.0001	0.0001	0.0001	0.000
δ_4	**0.015**	**0.000***	**0.002**	**-0.001**	**-0.016**
	0.000	0.0002	0.0002	0.0002	0.000
δ_5	**0.012**	**0.001**	**0.003**	**-0.002**	**-0.014**
	0.001	0.0002	0.0002	0.0002	0.000
δ_6	**0.004**	**0.000***	**0.005**	**0.001***	**-0.010**
	0.003	0.001	0.001	0.001	0.002
δ_7	**0.056**	**-0.022**	**-0.014**	**0.008**	**-0.028**
	0.002	0.001	0.001	0.001	0.002
δ_8	**0.035**	**-0.021**	**-0.005**	**-0.018**	**0.009**
	0.002	0.001	0.001	0.001	0.002
δ_9	**-0.029**	**-0.011**	**0.004**	**-0.006**	**0.042**
	0.002	0.001	0.001	0.001	0.002
δ_{10}	**-0.011**	**-0.016**	**-0.003**	**-0.002***	**0.032**
	0.002	0.001	0.001	0.001	0.002
δ_{11}	**-0.004***	**-0.032**	**-0.013**	**0.016**	**0.033**
	0.002	0.001	0.001	0.001	0.002

* not significant at 5% level
** not significant at 1% level but significant at 5% level

TABLE A.7

AIDS urban estimates

log likelihood = 126237.71

Coefficient Std.err	FD	FL	CBF	PTI	MISC
α	**0.649**	**0.119**	**0.096**	**0.065**	**0.072**
	0.005	0.002	0.002	0.003	0.005
β	**-0.124**	**-0.021**	**-0.003**	**-0.005**	**0.153**
	0.002	0.001	0.001	0.001	0.002
γ_1	**-0.037**	**-0.002***	**-0.017**	**0.012**	**0.043**
	0.004	0.002	0.002	0.002	0.004
γ_2		**0.002***	**0.024**	**-0.019**	**-0.004***
		0.002	0.002	0.002	0.003
γ_3			**0.043**	**-0.013**	**-0.037**
			0.004	0.003	0.003
γ_4				**0.024**	**-0.004***
				0.005	0.006
γ_5					**0.002**
δ_1	**0.011**	**0.003**	**-0.005**	**-0.004**	**-0.005***
	0.003	0.001	0.001	0.001	0.003
δ_2	**0.010**	**0.002****	**-0.004**	**0.006**	**-0.013**
	0.002	0.001	0.001	0.001	0.002
δ_3	**0.022**	**0.001**	**0.001**	**-0.002**	**-0.022**
	0.001	0.0002	0.0002	0.0003	0.001
δ_4	**0.027**	**0.001**	**0.003**	**-0.001**	**-0.029**
	0.001	0.0003	0.0003	0.0004	0.001
δ_5	**0.023**	**0.005**	**0.004**	**-0.007**	**-0.025**
	0.001	0.0003	0.0003	0.0004	0.001
δ_6	**-0.004***	**0.002***	**0.001***	**0.001***	**0.001***
	0.004	0.002	0.001	0.002	0.004
δ_7	**0.058**	**-0.007**	**-0.020**	**-0.013**	**-0.018**
	0.003	0.002	0.002	0.003	0.004
δ_8	**0.038**	**0.005**	**-0.009**	**-0.013**	**-0.020**
	0.003	0.001	0.001	0.001	0.003
δ_9	**-0.023**	**0.004**	**0.004**	**-0.006**	**0.022**
	0.003	0.001	0.001	0.001	0.003
δ_{10}	**0.010**	**0.005**	**-0.005**	**-0.007**	**-0.003***
	0.003	0.001	0.001	0.001	0.003
δ_{11}	**-0.013**	**-0.006**	**-0.010**	**0.002***	**0.027**
	0.003	0.001	0.001	0.001	0.003

* not significant at 5% level

** not significant at 1% level but significant at 5% level

<u>**TABLE A.8**</u>

BBLQ rural estimates

log likelihood = 328071.65

Coefficient Std.err	FD	FL	CBF	PTI	MISC
α	**0.569**	**0.157**	**0.074**	**0.071**	**0.129**
	0.004	0.002	0.002	0.002	0.004
β	**0.048**	**-0.031**	**0.007**	**-0.014**	**-0.011**
	0.003	0.001	0.001	0.001	0.003
γ_1	**-0.048**	**-0.030**	**0.042**	**-0.012**	**0.048**
	0.007	0.002	0.003	0.003	0.006
γ_2		**0.017**	**-0.009**	**0.008**	**0.013**
		0.001	0.001	0.001	0.002
γ_3			**-0.015**	**0.012**	**-0.030**
			0.004	0.003	0.003
γ_4				**-0.030**	**0.023**
				0.004	0.006
γ_5					**-0.054**
λ	**0.002**	**-0.002**	**-0.005**	**0.002**	**0.003**
	0.001	0.0003	0.0003	0.0003	0.001
δ_1	**0.007**	**-0.001***	**-0.003**	**0.006**	**-0.010**
	0.001	0.001	0.001	0.001	0.001
δ_2	**0.015**	**0.000***	**0.000***	**-0.001**	**-0.013**
	0.001	0.0003	0.0003	0.0004	0.001
δ_3	**0.016**	**0.000**	**0.002**	**-0.001**	**-0.018**
	0.0003	0.0001	0.0001	0.0001	0.0002
δ_4	**0.015**	**0.001**	**0.003**	**-0.003**	**-0.016**
	0.0005	0.0002	0.0002	0.0002	0.0004
δ_5	**-0.001**	**0.001**	**0.004**	**0.001**	**-0.005**
	0.001	0.0002	0.0002	0.0002	0.0005
δ_6	**0.049**	**-0.022**	**-0.015**	**0.009**	**-0.021**
	0.003	0.001	0.001	0.001	0.002
δ_7	**0.030**	**-0.020**	**-0.006**	**-0.018**	**0.013**
	0.002	0.001	0.001	0.001	0.002
δ_8	**-0.033**	**-0.011**	**0.003**	**-0.006**	**0.046**
	0.002	0.001	0.001	0.001	0.002
δ_9	**-0.017**	**-0.016**	**-0.004**	**-0.001***	**0.038**
	0.002	0.001	0.001	0.001	0.002
δ_{10}	**-0.009**	**-0.032**	**-0.014**	**0.017**	**0.037**
	0.002	0.001	0.001	0.001	0.002
δ_{11}	**-0.033**	**0.001***	**-0.003**	**0.003**	**0.032**
	0.002	0.001	0.001	0.001	0.002

* not significant at 5% level

** not significant at 1% level but significant at 5% level

TABLE A.9

BBLQ urban estimates

log likelihood = .126522.71

Coefficient Std.err	FD	FL	CBF	PTI	MISC
α	**0.580**	**0.109**	**0.090**	**0.069**	**0.151**
	0.006	0.002	0.003	0.003	0.006
β	**-0.038**	**-0.008**	**0.003****	**-0.011**	**0.054**
	0.004	0.002	0.002	0.002	0.005
γ_1	**-0.028**	**-0.001***	**-0.017**	**0.013**	**0.033**
	0.004	0.002	0.002	0.002	0.004
γ_2		**0.002***	**0.024**	**-0.019**	**-0.006****
		0.002	0.002	0.002	0.003
γ_3			**0.043**	**-0.013**	**-0.037**
			0.004	0.003	0.003
γ_4				**0.024**	**-0.005***
				0.005	0.006
γ_5					**0.014**
λ	**0.004**	**0.003**	**-0.006**	**-0.004**	**0.003****
	0.001	0.0004	0.0004	0.001	0.001
δ_1	**0.012**	**0.002***	**-0.004**	**0.006**	**-0.016**
	0.003	0.001	0.001	0.001	0.003
δ_2	**0.021**	**0.000***	**0.001***	**-0.002****	**-0.021**
	0.002	0.001	0.001	0.001	0.002
δ_3	**0.027**	**0.001**	**0.003**	**-0.001**	**-0.029**
	0.001	0.0002	0.0002	0.0003	0.001
δ_4	**0.022**	**0.005**	**0.004**	**-0.007**	**-0.025**
	0.001	0.0003	0.0003	0.0004	0.001
δ_5	**-0.008**	**0.002**	**0.000***	**0.001**	**0.005**
	0.001	0.0003	0.0003	0.0004	0.001
δ_6	**0.056**	**-0.007**	**-0.020**	**-0.013**	**-0.016**
	0.004	0.002	0.001	0.002	0.004
δ_7	**0.037**	**0.005**	**-0.009**	**-0.013**	**-0.019**
	0.003	0.002	0.002	0.003	0.004
δ_8	**-0.025**	**0.004**	**0.004**	**-0.006**	**0.024**
	0.003	0.001	0.001	0.001	0.003
δ_9	**0.007**	**0.005**	**-0.005**	**-0.007**	***0.000**
	0.003	0.001	0.001	0.001	0.003
δ_{10}	**-0.015**	**-0.006**	**-0.010**	**0.002***	**0.029**
	0.003	0.001	0.001	0.001	0.003
δ_{11}	**-0.021**	**-0.003**	**-0.002***	**0.001***	**0.024**
	0.003	0.001	0.001	0.001	0.003

* not significant at 5% level
** not significant at 1% level but significant at 5% level

TABLE A.10
RSQ rural estimates

log likelihood = 328069.04

Coefficient Std.err	FD	FL	CBF	PTI	MISC
α	**0.569**	**0.157**	**0.074**	**0.070**	**0.130**
	0.004	0.002	0.002	0.002	0.004
β	**0.048**	**-0.031**	**0.008**	**-0.013**	**-0.012**
	0.003	0.001	0.001	0.001	0.003
γ_1	**-0.035**	**-0.034**	**0.044**	**-0.014**	**0.040**
	0.007	0.002	0.003	0.003	0.006
γ_2		**0.017**	**-0.009**	**0.008**	**0.018**
		0.001	0.001	0.001	0.002
γ_3			**-0.015**	**0.011**	**-0.031**
			0.004	0.003	0.003
γ_4				**-0.030**	**0.025**
				0.004	0.006
γ_5					**-0.051**
θ	**0.002***	**-0.002**	**-0.005**	**0.002**	**0.003***
	0.002	0.001	0.0005	0.001	0.001
δ_1	**0.007**	**-0.001***	**-0.003**	**0.006**	**-0.010**
	0.001	0.001	0.001	0.001	0.001
δ_2	**0.015**	**0.000***	**0.000***	**-0.001**	**-0.013**
	0.001	0.0003	0.0003	0.0004	0.001
δ_3	**0.016**	**0.000**	**0.002**	**-0.001**	**-0.018**
	0.0003	0.0001	0.0001	0.0001	0.0002
δ_4	**0.015**	**0.001**	**0.003**	**-0.003**	**-0.016**
	0.0005	0.0002	0.0002	0.0002	0.0004
δ_5	**-0.002**	**0.000**	**0.004**	**0.001**	**-0.004**
	0.001	0.0002	0.0002	0.0002	0.0005
δ_6	**0.049**	**-0.022**	**-0.015**	**0.009**	**-0.021**
	0.003	0.001	0.001	0.001	0.002
δ_7	**0.030**	**-0.020**	**-0.006**	**-0.018**	**0.014**
	0.002	0.001	0.001	0.001	0.002
δ_8	**-0.033**	**-0.011**	**0.003**	**-0.006**	**0.046**
	0.002	0.001	0.001	0.001	0.002
δ_9	**-0.017**	**-0.016**	**-0.004**	**-0.001***	**0.038**
	0.002	0.001	0.001	0.001	0.002
δ_{10}	**-0.010**	**-0.031**	**-0.014**	**0.017**	**0.038**
	0.002	0.001	0.001	0.001	0.002
δ_{11}	**-0.042**	**0.007**	**-0.005**	**0.005**	**0.035**
	0.002	0.001	0.001	0.001	0.002

* not significant at 5% level
** not significant at 1% level but significant at 5% level

TABLE A.11

RSQ urban estimates

log likelihood = 126509.45

Coefficient Std.err	FD	FL	CBF	PTI	MISC
α	**0.575**	**0.109**	**0.091**	**0.070**	**0.155**
	0.006	0.002	0.003	0.003	0.006
β	**-0.035**	**-0.009**	**0.003***	**-0.011**	**0.052**
	0.005	0.002	0.002	0.002	0.005
γ_1	**-0.036**	**-0.002***	**-0.017**	**0.013**	**0.042**
	0.004	0.002	0.002	0.002	0.004
γ_2		**0.002***	**0.024**	**-0.019**	**-0.005***
		0.002	0.002	0.002	0.003
γ_3			**0.043**	**-0.013**	**-0.036**
			0.004	0.003	0.003
γ_4				**0.024**	**-0.005***
				0.005	0.006
γ_5					**0.005**
θ	**0.005**	**0.003**	**-0.006**	**-0.004**	**0.002****
	0.001	0.0004	0.0003	0.001	0.001
δ_1	**0.013**	**0.002***	**-0.004**	**0.006**	**-0.017**
	0.003	0.001	0.001	0.001	0.003
δ_2	**0.021**	**0.000***	**0.001***	**-0.002***	**-0.021**
	0.002	0.001	0.001	0.001	0.002
δ_3	**0.027**	**0.001**	**0.003***	**-0.001**	**-0.029**
	0.001	0.0002	0.0002	0.0003	0.001
δ_4	**0.022**	**0.005**	**0.004**	**-0.007**	**-0.025**
	0.001	0.0003	0.0003	0.0004	0.001
δ_5	**-0.007**	**0.002**	**0.000**	**0.001**	**0.004**
	0.001	0.0003	0.0003	0.0004	0.001
δ_6	**0.057**	**-0.007**	**-0.020**	**-0.013**	**-0.017**
	0.004	0.002	0.001	0.002	0.004
δ_7	**0.038**	**0.005**	**-0.009**	**-0.013**	**-0.020**
	.003	0.002	0.002	0.003	0.004
δ_8	**-0.025**	**0.004**	**0.004**	**-0.006**	**0.024**
	0.003	0.001	0.001	0.001	0.003
δ_9	**0.007**	**0.005**	**-0.005**	**-0.007**	**0.000***
	0.003	0.001	0.001	0.001	0.003
δ_{10}	**-0.014**	**-0.006**	**-0.010**	**0.002***	**0.028**
	0.003	0.001	0.001	0.001	0.003
δ_{11}	**-0.027**	**-0.003**	**-0.002***	**0.002***	**0.031**
	0.003	0.001	0.001	0.001	0.003

* not significant at 5% level
** not significant at 1% level but significant at 5% level

TABLE A.12

Income elasticity at all India level

Rural						Urban				
item	FD	FL	CBF	PTI	MISC	FD	FL	CBF	PTI	MISC
model										
LES	0.617	0.375	1.234	0.826	2.495	0.691	0.353	0.533	0.570	2.022
AIDS	0.868	0.673	0.933	0.896	1.632	0.772	0.743	0.953	0.874	1.577
RSQ	1.092	0.505	0.828	0.897	0.995	0.976	1.028	0.711	0.327	1.223
BBLQ	1.093	0.503	0.824	0.882	0.998	0.963	1.028	0.713	0.342	1.248

TABLE A.13

LES income elasticity by type of household

Rural					Urban			
type of hhd	AFF	NA	HILL	LIT	AFF	NA	HILL	LIT
item								
FD	0.629	0.615	0.608	0.678	0.715	0.684	0.634	0.943
FL	0.387	0.371	0.364	0.456	0.364	0.351	0.327	0.438
CBF	1.227	1.239	1.239	1.142	0.530	0.534	0.542	0.518
PTI	0.916	0.819	0.758	1.000	0.608	0.570	0.486	0.559
MISC	2.277	2.543	2.733	1.797	1.866	2.071	2.622	1.269

TABLE A.14

AIDS income elasticity by type of household

Rural					Urban			
type of hhd	AFF	NA	HILL	LIT	AFF	NA	HILL	LIT
item								
FD	0.855	0.869	0.870	0.866	0.688	0.774	0.790	0.764
FL	0.602	0.676	0.683	0.662	0.681	0.745	0.762	0.735
CBF	0.938	0.932	0.932	0.933	0.955	0.953	0.953	0.954
PTI	0.874	0.897	0.905	0.885	0.876	0.874	0.892	0.865
MISC	1.456	1.645	1.693	1.577	1.362	1.591	1.748	1.532

TABLE A.15

BBLQ income elasticity by type of household

Rural					Urban			
type of hhd	AFF	NA	HILL	LIT	AFF	NA	HILL	LIT
item								
FD	1.108	1.092	1.094	1.096	0.967	0.963	0.957	0.963
FL	0.352	0.509	0.491	0.480	1.100	1.026	1.012	1.036
CBF	0.745	0.828	0.835	0.806	0.595	0.717	0.756	0.699
PTI	0.968	0.879	0.859	0.889	0.204	0.348	0.352	0.279
MISC	1.014	0.997	0.996	1.002	1.166	1.253	1.224	1.231

Table A.16

Compensated price elasticities by model for a reference household

Rural						**Urban**					
item	FD	FL	CBF	PTI	MISC		FD	FL	CBF	PTI	MISC
LES						**LES**					
FD	**-0.406**	0.038	0.009	-0.012	0.156	FD	**-0.454**	0.114	0.095	0.122	0.354
FL	0.111	**-0.451**	-0.004	-0.014	0.073	FL	0.080	**-0.433**	0.017	0.009	0.122
CBF	0.551	0.147	**-1.014**	0.088	0.372	CBF	0.138	0.011	**-0.516**	0.000	0.190
PTI	0.320	0.078	0.045	**-0.862**	0.235	PTI	0.097	0.018	0.026	**-0.692**	0.198
MISC	1.368	0.539	0.516	0.513	**-1.251**	MISC	0.741	0.458	0.376	0.543	**-1.152**
AIDS						**AIDS**					
FD	**-0.447**	0.047	0.172	0.028	0.263	FD	**-0.435**	0.121	0.079	0.097	0.277
FL	0.216	**-0.691**	-0.025	0.147	0.353	FL	0.578	**-0.881**	0.340	-0.153	0.129
CBF	1.094	-0.019	**-1.076**	0.159	-0.153	CBF	0.383	0.382	**-0.400**	-0.112	-0.251
PTI	0.211	0.332	0.383	**-1.794**	0.862	PTI	0.886	-0.353	-0.227	**-0.400**	0.083
MISC	0.891	0.206	-0.009	0.217	**-1.009**	MISC	0.851	0.161	0.014	0.107	**-0.595**
BBLQ						**BBLQ**					
FD	**-0.479**	0.030	0.158	0.014	0.277	FD	**-0.459**	0.092	0.054	0.066	0.248
FL	0.274	**-0.691**	-0.014	0.145	0.286	FL	0.576	**-0.883**	0.342	-0.163	0.128
CBF	1.098	-0.016	**-1.076**	0.167	-0.174	CBF	0.399	0.386	**-0.403**	-0.114	-0.268
PTI	0.258	0.327	0.408	**-1.800**	0.807	PTI	0.957	-0.346	-0.230	**-0.390**	0.010
MISC	0.859	0.158	-0.073	0.161	**-1.105**	MISC	0.710	0.053	-0.100	0.013	**-0.677**

TABLE A.17

R-squared by model

Rural						**Urban**				
item	FD	FL	CBF	PTI	MISC	FD	FL	CBF	PTI	MISC
model										
LES	0.808	0.551	0.277	0.399	0.743	0.617	0.298	0.539	0.240	0.719
AIDS	0.312	0.305	0.179	0.217	0.377	0.425	0.175	0.166	0.128	0.485
BBLQ	-1.579	0.064	0.069	0.105	-1.313	-0.188	-0.433	-0.238	-0.024	0.056
RSQ	-1.620	-0.004	0.073	0.109	-1.326	-0.264	-0.412	-0.244	-0.041	0.018

Table A.18

Correlation matrix of estimated and deflated expenditure/budget share

Rural						**Urban**					
LES	**tc1**	**tc2**	**tc3**	**tc4**	**tc5**		**tc1**	**tc2**	**tc3**	**tc4**	**tc5**
tchat_LES1	0.890					**tchat_LES1**	0.771				
tchat_LES2		0.675				**tchat_LES2**		0.513			
tchat_LES3			0.509			**tchat_LES3**			0.686		
tchat_LES4				0.380		**tchat_LES4**				0.380	
tchat_LES5					0.838	**tchat_LES5**					0.841
AIDS	**w1**	**w2**	**w3**	**w4**	**w5**		**w1**	**w2**	**w3**	**w4**	**w5**
what_aS1	0.509					**whataS1**	0.628				
what_aS2		0.419				**whataS2**		0.361			
what_aS3			0.284			**whataS3**			0.263		
what_aS4				0.308		**whataS4**				0.272	
what_aS5					0.575	**whataS5**					0.677
BBLQ	**w1**	**w2**	**w3**	**w4**	**w5**		**w1**	**w2**	**w3**	**w4**	**w5**
what_BBLQ1	0.073					**what_BBLQ1**	0.298				
what_BBLQ2		0.290				**what_BBLQ2**		0.017			
what_BBLQ3			0.083			**what_BBLQ3**			0.020		
what_BBLQ4				0.058		**what_BBLQ4**				0.184	
what_BBLQ5					0.028	**what_BBLQ5**					0.544
RSQ	**w1**	**w2**	**w3**	**w4**	**w5**		**w1**	**w2**	**w3**	**w4**	**w5**
what_ RSQ1	-0.075					**what_ RSQ1**	0.253				
what_ RSQ2		0.273				**what_ RSQ2**		0.025			
what_ RSQ3			0.095			**what_ RSQ3**			0.020		
what_RSQ4				0.074		**what_RSQ4**				0.185	
what_RSQ5					0.023	**what_RSQ5**					0.527

1:FOOD/ 2: FUEL/ 3:CBF/ 4:PTI/ 5:MISC

tc ≡ deflated per capita total expenditure and tchat ≡ estimated per capita total expenditure

w ≡ deflated per capita budget share and what ≡ estimated per capita budget share

TABLE A.19

Difference in welfare measures between different rank model estimates and estimates obtained from observed values

Rural					**Urban**			
	LES	AIDS	BBLQ	RSQ	LES	AIDS	BBLQ	RSQ
POVERTY								
HCR								
hill	4.933%	5.125%	4.635%	1.686%	8.868%	8.307%	10.894%	25.490%
hlit	7.013%	7.597%	6.860%	1.820%	18.933%	17.819%	40.486%	40.414%
PGR								
hill	5.271%	6.032%	5.533%	1.749%	17.108%	14.163%	17.793%	32.182%
hlit	7.202%	8.192%	7.478%	2.347%	24.459%	19.105%	41.789%	41.716%
FGT								
hill	5.292%	6.540%	6.184%	1.940%	23.118%	-14.648%	-20.913%	-26.770%
hlit	7.541%	9.046%	8.475%	2.993%	32.408%	-18.642%	-45.792%	-31.374%
WATTS								
hill	5.239%	6.122%	5.660%	1.798%	18.602%	14.883%	18.541%	33.309%
hlit	7.236%	8.337%	7.655%	2.466%	-23.546%	19.974%	42.699%	42.768%
CHU								
hill	4.935%	5.132%	-11.282%	-14.495%	8.964%	8.348%	10.942%	-0.960%
hlit	7.014%	7.601%	6.864%	1.824%	18.967%	17.828%	19.954%	40.424%
SEN								
hill	5.194%	5.917%	5.483%	1.813%	16.025%	12.904%	16.133%	31.070%
hlit	7.344%	8.373%	7.705%	2.427%	25.272%	20.092%	22.575%	42.635%
INEQUALITY								
GINI								
hill	-1.021%	-0.696%	-0.350%	0.151%	-2.562%	-4.233%	-6.998%	-7.468%
hlit	-0.574%	-0.395%	-0.264%	0.112%	-1.463%	-1.365%	-4.637%	-5.082%
ATKINSON								
hill	-1.827%	-1.175%	-0.603%	-0.125%	-4.898%	-7.448%	-12.954%	-13.879%
hlit	-1.036%	-0.699%	-0.472%	0.126%	-2.599%	-2.011%	-8.613%	-9.509%
THEIL								
hill	-1.688%	-0.971%	-0.507%	-0.648%	-5.348%	-7.275%	-13.365%	-14.532%
hlit	-0.951%	-0.633%	-0.432%	0.002%	-2.506%	-1.281%	-9.571%	-9.534%

This table gives the percentage variation between the poverty and inequality measures based on deflated per capita expenditure and per capita equivalent expenditure based on LES, AIDS, BBLQ and QRS respectively.


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