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When Does Food Stop Being a Luxury? Evidence from Quadratic Engel Curves with Measurement Error

by

Sourafel Girma and Abbi M. Kedir

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Abstract

Using quadratic Engel curves with measurement errors, we identify the proportion of urban households in Ethiopia for whom food exhibits the characteristics of a luxury commodity. The threshold welfare level beyond which food ceases to be a luxury is found to lie between the 35th and 47th percentiles of the total expenditure distribution. This suggests that policy aimed at reducing food poverty should target nearly half of urban households. In sharp contrast, estimates which erroneously neglect the problem of measurement error in expenditure data imply that no more than a quarter of the urban population suffers from food poverty. This demonstrates the potential for serious policy distortions resulting from a lack of careful statistical analysis.

Outline

I. INTRODUCTION

Engel curve analysis has been an important tool in understanding the dynamics of household welfare. Earlier studies used the Leser-Working specification in which budget shares are assumed to be linear functions of the total expenditure [e.g., Deaton and Muellbauer, 1980 and Leser, 1963). However, as suggested by a growing body of empirical evidence, the Leser-Working specification fails to account for non-linear relationships in certain budget share equations (e.g., Hausman et al. 1995, and Lewbel, 1991).

In this paper, we estimate quadratic Engel curves for food using household expenditure data for Ethiopia. As Bank et al. (1997) observe a quadratic specification allows for a variety of curvatures in Engel curves, where some commodities have the characteristics of luxuries at low levels of expenditure and necessities at high levels. Our main goal is to get an accurate estimate of the level of total consumer expenditure beyond which food stops being a luxury, by taking into account the fact that consumption expenditure data are beset by the problem of measurement error.

The presence of measurement error has been duly recognised in the literature of Engel curves estimation. Liviatan (1961) documents that neglected measurement error induces non-negligible bias in OLS estimates of linear Engel curve parameters estimated from Israeli family budget data. Aasness et al. (1993) explicitly model measurement error in the estimation of a system of consumer functions from Norwegian household budget data, and conclude that measurement error accounts for about 27% of the variability of the observed total consumption expenditure. Hausman et al (1995) employ non-linear error-in-variables models in examining the parameters of some Engel curves using US consumer expenditure survey data, and estimate that about 42% of the total variance of measured expenditure is due to measurement error. Within a GMM estimation of household demand for fuel in the United Kingdom, Lewbel (1996) finds that correction for measurement error changes parameter estimates by more than 15%. Finally, using data from the British Family Expenditure Survey, Hikaru & Kozumi (2001) consider Engel curves estimation with measurement error from Bayesian perspectives, and report that the observed mean household total expenditure over-estimates the mean of the `true' total expenditure. In the light of these findings, we argue that with error-ridden expenditure data, simpler econometric approaches do not provide the appropriate framework for answering the central question of this study: W*hen does food stop being a luxury?* In fact, under a classical measurement error with a normally distributed regressor, Kuha and Temple (1999) have shown that OLS-type `naïve' estimators tend to generate estimates where the quadratic model appears to curve less steeply than it actually does. Thus we apply quadratic errors-in-variables techniques so as to recover consistent estimates of the Engel curve relationship. To our knowledge, this is the first paper to do so using developing country data where measurement error problems are arguably more severe. We also evaluate the effects of neglecting measurement error in estimation, and identify the magnitude of measurement error in the total expenditure data from the Ethiopian Urban Household Survey, which was conducted in 1994. This will hopefully give some guidance to future researchers wishing to use this data set.

Our study also has important implications for food transfer, food subsidies and income policies in Ethiopia where policy making suffers from an acute lack of empirical foundations especially using household survey data sets. In the eyes of many people, including many development economists, poverty is closely related to whether or not people get enough to eat. Documenting the living standards of the poor is essentially a question of counting calories, and examining how levels of nutrition change with the amount of money people have to spend. If the elasticity of food consumption with respect to income is high, general economic development will eliminate hunger. But if this elasticity is low, we are faced with a choice between a strategy for economic growth with hunger remaining a problem for a long time, perhaps indefinitely, or a more interventionist strategy that targets the nutrition of the poor while letting general economic development look after itself. For these reasons it is critical to have an accurate knowledge of the household expenditure threshold above which the share of the budget allocated to food starts to decline.

The paper is organised as follows. Section 2 reviews some of the relevant literature on Engel curve analysis. Section 3 introduces the quadratic errors-in-variables inference procedure. Section 4 discusses the data used in our empirical analysis. It also provides a nonparametric description of the shape of the Engel curve for food. The main empirical results and their policy implications are presented in section 5. Finally section 6 concludes.

II. ENGEL CURVES FOR DEVELOPING COUNTRIES: A BRIEF REVIEW OF THE LITERATURE

In this section, we briefly discuss some of the existing empirical literature focusing on studies based on developing countries data. An Engel curve study on a data set from Maharashtra (India) based on six food commodities shows that only wheat is a luxury good (Deaton, 1997). Conditional on per capita expenditure, increases in household size decrease the shares of coarse cereals, pulses, and fruits and vegetables, but they have little or no effect on the budget share of rice and increase the share of wheat. Moffit (1989) investigates the magnitude of the effect of in-kind transfers on the consumption of subsidised goods by evaluating the experience of an actual conversion from stamps to cash in Puerto Rico. A linear budget share equation gives –0.89 as the coefficient of the household welfare measure. This statistically significant term suggests that as households' welfare improves the share of the household budget devoted to food will diminish. Moffit (1989) also found that as household size increases the budget allocated to food declines probably due to the economies of scale enjoyed as family size expands.

There is a lack of empirical work that links food share with total household expenditure/income in the existing literature for LDCs. Most studies discuss income elasticities of calorie intake and calorie availability. Bouis and Haddad (1992) ask 'What effect do increases in income of the poor in developing countries have on their levels of calorie consumption?' Their analysis highlights how accurate measurement of calorie-income elasticities is fundamental to sound nutrition policy analysis and how the existing literature has produced a perplexingly wide range of elasticity estimates at the household level[1]. Depending on the variable pair and estimation technique employed, the authors found calorie-income elasticities ranging from 0.03 to 0.59 for rural households in the Philippines. The calorie intake-total expenditure variable pair gives the elasticity estimate in the 0.08-0.14 range. Ayalew (2000) argues that differentiating households in terms of their ability to smooth consumption and decomposing income into permanent and transitory income partly explain why the evidence on the estimates of the income elasticity of calorie intake are so diverse. The author hypothesises that income elasticity of calorie consumption differs between those who can smooth their consumption and those who cannot do so due to the inability to borrow against future income. Using the Rural Household Survey data of 1994/5 for Ethiopia, the results of the study reveal that the calorie elasticity with respect to income (permanent, transitory and total) is consistently higher for credit- constrained households. Specifically the elasticity with respect to permanent income ranges from 90 per cent for constrained to 42 percent for unconstrained households. For constrained households, calorie consumption responds even to transitory income. Kebede (2000) uses the same data set used by Ayalew (2000) to estimate a Quadratic Almost Ideal Demand System in an attempt to unveil the intra-household allocation of resources. His findings indicate that food is a luxury in rural Ethiopia, suggesting that many rural households live near subsistence levels. It is also observed that at very low levels of income where households are on the verge of starvation, additional income is most likely to be used to increase food purchases.

As this brief review of the literature demonstrates, ours is the first study of Engel Curves for developing countries that employs non-linear errors in variables estimators. It is also unique in its explicit focus on the identification of the threshold level of household expenditure below which food (the most basic of human needs) is effectively a luxury.

III. THE ECONOMETRIC FRAMEWORK

Due to imprecise definition of variables or inaccurate measurement, errors are endemic in economic variables. The presence of errors in variables induces non-zero correlation between the contaminated regressors and the equation disturbance, so that OLS estimates are biased and inconsistent (e.g., Aigner et al. 1984 and Fuller, 1987). One way of dealing with errors in variables is to assume that they have a non-normal distribution, and exploit the information contained in higher order moments of the data to produce identifying restrictions on the parameters of interest. This approach has not thus far gained much currency in the applied economic literature. Another approach is to assume some knowledge of the measurement error variance, in which case the model can be identified by purging the contaminating effect of the measurement error from the covariance matrix of the data. But by far the most popular method of getting round the

1 See Bouis and Haddad (1992) for a tabulated summaries of the elasticities estimated for a relatively large

identification problem caused by errors in variables appears to be instrumental variables estimation. Unfortunately, for non-linear models standard IV techniques lead to inconsistent estimates because the true variables are not additively separable from the measurement error (Amemiya, 1985). Hence the estimation problem is not trivial.

In this paper we employ the instrumental variable estimation approach for polynomial errors-in-variables due to Hausman et al. (1991,1995), in the context of the following quadratic Engel curve model:

$$y_i = \beta_o + \beta_i z_i + \beta_2 z_i^2 + \phi r_i + \varepsilon_i, \qquad i = 1,\ldots N \tag{1}$$

where i indexes households, y is the budget share of food; z represents the log of `true' total household expenditure, which is not observed; r denotes household size, which is assumed to be correctly measured, and ε is a stochastic disturbance term.

There are both conceptual and pragmatic reasons why expenditures available from household surveys might be preferred to an indicator such as household income in developing countries. If the income stream accruing to the consumer and his needs were steady over time, it could be argued that the conditions of the static theory of consumers' demand were satisfied and that income is an appropriate measure of welfare. However, this supposition is unrealistic because both the income of a household and its needs change over time, and the income received in a particular period may be a very poor indicator of its standard of living. This is attributed to the permanent income hypothesis (PIH). In the light of the PIH, it is often argued that expenditures reflect not only what a household is able to command based on its current income, but also whether that household can access credit markets or household savings at times when current incomes are low. In this way, expenditure is thought to provide a better picture of a household's longer run standard of living than a measure of current income. Further, calculating consumption expenditure is often easier than calculating household incomes, particularly for the poor (Hentschel and Lanjouw, 1996).

As stated in the introduction, we explicitly recognise that errors are present in our expenditure data. Instead of the `true' expenditure variable z_i, we have observed expenditure variable x_i, which is related to z_i via the following measurement model:

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number of developing countries in Africa, Asia and Latin America.

$$x_i = z_i + \eta_i \qquad \text{i = 1,..,N} \qquad (2)$$

where η_i is a mean zero measurement error with unknown variance σ_η^2.

Suppose that in equation (1) $\beta_2 < 0$ and consider the turning point of the true model for $E\{Y \mid z\}$, $\beta^* = -\frac{\beta_i}{2\beta_2}$. Kuha and Temple (1999) show that the degree and direction of bias in the estimator for the turning point depend on the variance of η and the location of the turning point relative to the population mean of *z,* say μ_z. The true turning point always lies between μ_z and the OLS estimates of the turning point. In general the effect of measurement error is to "flatten" the observed relationship between y and x, where the quadratic model curves less steeply and has a smaller maximum value for y[2]. The identifying information for our model comes in the shape of a p-dimensional vector of instrumental variables q_i which contains sufficient independent variation that helps predict the unobserved regressor z via the equation:

$$z_i = q_i'\alpha + v_i \equiv w_i + v_i, \quad \text{i = ,..,N} \qquad (3)$$

The instruments used in this study include the log and log square of income, the gender of the head of household and regional dummies. In equation (2) $w_i \equiv q_i'\ \alpha$ can be interpreted as the part of z which is linearly related to the instrumental variables (Hausman et al, 1991). The two most crucial assumptions imposed on the data are:

Assumption 1: $E(\varepsilon_i \mid q_{i,}, r_i) = E(\eta_i \mid q_i, r_i) = 0$ *and* $E(\varepsilon_i . \eta_i \mid q_i, r_i) = \sigma_{\varepsilon\eta}$

Assumption 2: υ_i is independent of q_i and r_i with $E(\upsilon_i) = 0$ and $E(\upsilon_i . \varepsilon_i \mid q_i, r_i) = \sigma_{\varepsilon\upsilon}$.

Substituting equation (3) into equation (1), gives;

$$y_i = \gamma_0 + \gamma_1 w_i + \gamma_2 w_i^2 + \gamma_\phi r_i + e_i \qquad (4)$$

where the composite error term *e* can be shown to be orthogonal to the repressors of the reduced form model (4). The parameters of the reduced form model are related to the structural parameters as follows: $\gamma_0 = \beta_0 + \beta_2 \sigma_\eta^2$; $\gamma_1 = \beta_1$; $\gamma_2 = \beta_2$ and $\gamma_\phi = \phi$.

Hence equation (4) can be used to identify β_1 and β_2, but not β_0 and σ_η^2. To identify the remaining coefficients of interest we follow Hausman et al. (1991) in multiplying equation (1) by the mismeasured regressor x_i and substituting $w_i + \upsilon_i$ for z_i, to obtain a second reduced form equation[3]

$$x_i . y_i = \delta_0 + \delta_1 w_i + \delta_2 w_i^2 + \delta_3 w_i^3 + \delta_\theta w_i r_i + error \quad (5)$$

It can easily be shown that there exists a one-to-one mapping between the coefficients of the above model and the structural parameters. That is, $\delta_o = \beta_1 \sigma_\eta^2 + \beta_2 \upsilon_3 + \sigma_{\varepsilon\eta} + \sigma_{\varepsilon\upsilon}$ where $\upsilon_3 = E(\upsilon^3)$; $\delta_1 = \beta_0 + 3\beta_2 \sigma_\eta^2$; $\delta_2 = \beta_1$; $\delta_3 = \beta_2$ and $\delta_\phi = \phi$.

The intercept and the measurement error variance can thus be estimated from the following recursive formulae: $\sigma_\eta^2 = \dfrac{\delta_1 - \gamma_0}{2\beta_2}$ and $\beta_0 = \delta_1 - 3\beta_2 \sigma_\eta^2$. But there is more than one solution for β_2, β_1 *and* ϕ using the reduced form parameters $\gamma_i, \gamma_2, \gamma_\phi, \delta_3, \delta_2$ *and* δ_ϕ (i.e., we have over-identification). Given the estimated reduced form parameters, a method of obtaining efficient estimators for the structural parameters is the optimal minimum distance (or minimum chi-square) technique. Define the 5×1 vector of structural parameters as $\theta = (\beta_0\ \beta_1\ \beta_2\ \phi'\sigma_\eta^2)'$ and let $\hat{\pi} = (\hat{\gamma}_1, \hat{\gamma}_2, \hat{\gamma}_\phi : \hat{\delta}_3, \hat{\delta}_2, \hat{\delta}_\phi : \gamma_0 \hat{\delta}_1)' \equiv (\hat{\pi}_1 : \hat{\pi}_2 : \hat{\pi}_3)'$ be the vector of the reduced form parameters[4] . Using the fact that $\pi_1 = \pi_2$ and letting $\hat{\pi}_r \equiv (\hat{\pi}_2 : \hat{\pi}_3)$, the solution to the minimum chi-square problem is

$$Q = \arg\min_\theta [\hat{\pi}_r - h(\theta)]' \hat{\Omega}^{-1} [\hat{\pi}_r - h(\theta)] \quad (6)$$

where Ω is the asymptotic covariance matrix of the restricted reduced form parameters

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2 This is equivalent to the measurement-error-induced bias towards zero of the slope estimators in linear regressions.

3 In a similar vein, Lewbel (1996) proposes a GMM by multiplying the original demand equation by different power of the observed total consumption expenditure.

4 Note that he estimate of δ_o is not useful in the identification of the structural coefficients.

and $h(\theta)$ is the 5×1 vector function mapping $\pi_r = \begin{bmatrix} \delta_3 \\ \delta_2 \\ \delta_\phi \\ \gamma_0 \\ \delta_1 \end{bmatrix}$ to θ,

which takes the following form: $h(\theta) \equiv \begin{bmatrix} \beta_2 \\ \beta_1 \\ \phi \\ \beta_1 + \beta_2\sigma_\eta^2 \\ \beta_1 + 3\beta_2\sigma_\eta^2 \end{bmatrix}$.

We solved equation (6) by using the general method described in Section 3.2 of Hausman et al. (1991). The resulting minimum chi-square estimator of θ, $\hat{\theta}$, is asymptotically distributed as $\sqrt{N}(\theta - \hat{\theta}) \sim N\left[\left(0, \hat{H}'\hat{\Omega}^{-1}\hat{H}\right)^{-1}\right]$, where $\hat{H}$ is a consistent estimator of the Jacobian matrix $\dfrac{\partial h(\theta)}{\partial \theta'} = \begin{bmatrix} 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & \sigma_\eta^2 & 0 & \beta_2 \\ 1 & 0 & 3\sigma_\eta^2 & 0 & 3\beta_2 \end{bmatrix}$.

Finally, one can make an appeal to the general theory of minimum chi-square estimation to establish that, under the null hypothesis of correctly specified model,

$$\sqrt{N}\,(\hat{\pi} - \hat{\pi}_{21})'\left[Var((\hat{\pi} - \hat{\pi}_{21})\right]^{-1}(\hat{\pi} - \hat{\pi}_{21}) \xrightarrow{d} \chi^2(3). \qquad (7)$$

This result is used to test the validity of the overidentifying restrictions implied by the assumptions of the model.

IV. DATA DESCRIPTION AND PRELIMINARY ANALYSIS

Our empirical analysis is based on the first round socio-economic survey of urban households in Ethiopia (EUHS,1994) which has been collected by the Department of Economics of Addis Ababa University in collaboration with the Department of Economics of the University of Göteborg, Sweden. The survey questionnaire includes modules on household demographics including education, rural-urban migration, employment and income, consumption, ownership of durables, housing, health, welfare and welfare change indicators. A sample of 1500 households was selected from seven major urban centres of the country. These are Mekele and Dessie in the north, Bahir Dar in the north-west; Addis Ababa in the centre, Dire Dawa in the east, Awassa in the South and Jimma in the South West were selected. Mekele and Dessie were selected to represent areas often affected by drought and the socio-economic groups in the north. Bahir Dar was included as a representative town in the main cereal producing areas of the country. Addis Ababa is by far the largest city and the capital, and represents the diversity of the country's population. Dire Dawa is mainly a trading centre, while Awassa is the administrative centre of the south, and was chosen to represent the large Enset culture (one of the food cultures in Ethiopia). Finally, Jimma was selected to represent the urban characteristics of the main coffee growing regions of the country. The total sample size was distributed over the selected urban centres proportional to their populations, based on the Central Statistical Authority's population figure projections. Accordingly, the sample included 900 households in Addis Ababa, 125 in Dire Dawa, 75 in Awassa, and 100 in each of the other four towns.

Traditional Engel curve analysis assumes that all households in a given survey face the same prices. But because transportation and distribution networks tend to develop along with economic growth, there is much greater scope for spatial price variation in less developed than more developed countries. We relax the usual constant price assumption in the present paper and employ spatial price deflator on the raw expenditure data. The spatial price indices are reported in the Table 1 and details on how they are constructed can be found in Kedir (2001). Table 2 gives summary statistics of the variables used in the study for households where complete information is available[5].

On average food share for other urban areas is higher by about 3.5 percentage points compared to Addis Ababa, and this proves to be significant at 1% level using a t-test for the equality of means. By contrast no appreciable difference in the means of deflated total expenditure is found at conventional significance levels. By way of a preliminary analysis we conducted some nonparametric kernel regressions of food share on the log of deflated expenditure. The fits from these regressions, along with the corresponding pointwise confidence intervals, are presented in Figure 1. The

5 Apart from missing observations, we also dropped households with reported 0 or 100% food share values.

nonparametric regression smoothing approach reveals an approximate inverted U-shaped relation between budget shares for food and log of total expenditure. This makes it apparent that the Leser-Working linear curve formulation is not an accurate approximation in our context. It also appears from Figure 1 that the budget shares allocated to food start to decline at about 400-492 *Birr*[6], which roughly corresponds to the median expenditure value in the raw data. Taken at face value this implies that for 50% of the households in the sample, food is a luxury. Beyond this turning point, the share of food declines, more rapidly so for households in Addis Ababa.

During our initial exploratory analysis, we also investigated if there is a need for a further (i.e. third order) polynomial term, but this notion is decidedly rejected by the Ramsey RESET test. In sum, the findings at this stage of the study suggest that the incorporation of the square of the log of household expenditure in our Engel curve equation is amply justified. This is very much in accord with the approach taken by Kebede (2000) in the context of household consumption in *rural* Ethiopia. But it is in sharp contrast, perhaps not surprisingly, to Banks et al.'s (1997) finding from U.K Family Expenditure Survey data that food does not exhibit the characteristics of a luxury commodity.

Having established the appropriateness of the quadratic Engel curve formulation in the analysis of budget share allocated to food in our sample of Ethiopian urban households, we now turn to the discussion of the econometric results.

V. EMPIRICAL FINDINGS

V.I Measurement error corrected and OLS estimates

As we report in Table 3, both the OLS and the measurement error corrected IV approaches yield negative and significant estimates for the quadratic logarithmic expenditure terms in the food budget share equations. The results are strongly indicative of the fact that food is luxury in urban Ethiopia, hinting that a small reduction in income or increase in food prices may lead to severe food shortages and possibly to malnutrition in many households. However as discussed below, the qualitative similarity between the two estimators masks some important statistical and interpretation differences.

6 The *Birr* is the name of the Ethiopian currency. The interval for the turning point is calculated based on the

Hausman-type tests reveal significant (joint) differences between the quadratic Engel curves coefficient estimates obtained from the two approaches. In other words, these tests reject the null that the measurement errors present in the expenditure data are not serious enough to invalidate OLS based inferences. This conclusion is reinforced by the magnitude of the relative importance of the measurement error variances implied from the IV estimates. Looking at the expenditure data for households from Addis Ababa, our result indicate that about a third of the total variance is due to measurement error. The corresponding figure for the sample from the other urban areas is 37%. Thus a sizeable proportion of `noise' is found to exist in the expenditure variable, justifying the use of errors-in-variables technique which seeks to extract the true `signal' from the data. As Table 3 shows, the validity of the IV technique we adopted in this paper is confirmed by the test of the overidentifying restrictions derived from the model.

The IV estimates of the coefficient on household size falls short of significance for the Addis Ababa sample, while a negative size-food share relationship is established for households outside the capital, suggesting the presence of economies of scale in food consumption. By contrast OLS estimates show that household size is not a significant determinant of food share for households outside Addis Ababa, while it attracts positive coefficients in the Engel curve specification for households in the capital. It appears that measurement error in the expenditure data has imparted an upward bias in the OLS coefficient of the correctly measured household size variable. Since household size and *total expenditure* are positively correlated in the data, the direction of this bias is consistent with predictions from econometric theory (e.g., Caroll et al , 1995).

V.II When does food stop being a luxury?

We now turn our attention to the discussion of the turning points of our quadratic Engel curves. In spite of the apparent closeness of the OLS and IV coefficients of the expenditure terms for Addis Ababa households, a marked difference is observed in both the point estimate and the confidence interval[7] of the Engel curves' turning point. According to the OLS estimates for Addis Ababa, food appears to be a luxury for households with less than 182 *Birr,* and this corresponds to the 15th percentile of the

exponential of 6 and 6.2, after `eyeballing' the graphs from the kernel regressions.

data. By contrast, the measurement error corrected turning point estimate points to the conclusion that food does not display the characteristics of a necessity until total expenditure reaches 351 *Birr*. The raw data shows that 35% of the households in the capital city spend less than this amount for food. Thus OLS overstates the welfare of about 20% of the households. The story is similar when one considers the sample from the other urban areas. The OLS and IV based turning points are 310 *Birr* and 501 *Birr* respectively, expenditure levels which approximately correspond to the 26th and 47th percentiles. This demonstrates that inferences that neglect the measurement error in the expenditure data would erroneously classify 21% of the households as having enough to eat. One can easily imagine the misleading picture portrayed by less careful statistical approaches.

Notice that the confidence intervals of the turning points associated with the measurement error corrected estimators are wider. This is a manifestation of the well known "bias versus variance trade off" problem, where the very process of correcting for bias makes the corrected estimator more variable than the biased estimator (cf. Carroll et al , 1995, Section 2.4). But this does not alter the fact that inferences using OLS-based confidence intervals would severely underestimate the "satiety" level of food. Incidentally, compared to OLS, the measurement error corrected IV estimator yields turning points closer to the non-parametric regressions . This is consistent with the notion that measurement error flattens the curvature of OLS-estimated quadratic functions (Kuha and Temple, 1999).

An alternative way of reiterating the above argument is to examine the rate at which a rise in total household expenditure leads to a decline in the budget share of food. To this end, we report in Table 4 elasticity estimates at selected points of the total expenditure distribution. According to the OLS estimator for Addis Ababa, food appears to be a normal commodity at about the 25th percentile while this does not occur (i.e. a negative elasticity is not observed) until we reach the 50th percentile for the measurement error corrected IV estimator. In other words, a food poverty reduction policy based on OLS or other naïve estimates would overestimate the welfare of up to 25% percent of the population.

7 We used the `delta' method to compute the standard error of the turning point.

Overall our findings suggest that a significant number of households may have just enough to eat but at the same time can be malnourished, even if they may be deemed non-food poor according to some poverty lines (e.g., Dercon and Taddesse, 1997). Thus the approach of assessing food poverty by studying the curvature of Engel curves can be a useful complement to the various poverty lines generated in the development economics literature (e.g., Islam, 1989).

V.III The policy significance of our econometric findings

In general the findings of our paper send out a strong message for a careful approach to the measurement of poverty and to the analysis of household behaviour. With the aid of our quadratic Engel curve specifications we uncover the real extent of urban food insecurity and malnutrition, providing Ethiopian policy makers with vital information they need to make sound policy decisions to reduce food insecurity and malnutrition in urban areas. With the ever-growing rates of urbanisation in the country, this problem should be of primary concern.

Ethiopia has suffered from the extreme form of food deprivation typified by famines. This has been mainly because the poor do not have adequate purchasing power to secure access to food. The failure of "entitlement" or effective demand in the short and long run can occur in a variety of ways which are linked to the system of production and distribution of income in an economy (Sen, 1981), including a decline in employment or wages; or a rise in price of food. It arises not only within the agricultural sector but also outside it as evidenced by an increasingly large number of households residing in urban areas failing to get enough food on their tables (Kedir, 2001). Policy needs to focus on enhancing households' entitlement to prevent aggravated hunger and malnutrition. The geographical and income profiles of the poor can be a basis to target them so that they benefit from policy interventions. Direct food transfers, food subsidies, employment generation and/or income transfer are the possible policy options open to the Ethiopian government to improve the food situation of urban households and survey evidence such as the one provided here can be used to guide policy makers. For instance let us take the case of food subsidies. Since low-income groups are found to spend 60-70 percent of their income on food, a reduction in the prices of food staples through subsidies by 20 percent raises the average income of the poor by 12-14 percent. How to design and implement a food subsidy programme targeted to the poor and vulnerable, without a very high administrative cost, is a daunting challenge as leakage is rampant in the corrupt environments of LDCs.

Access to food can also be enhanced for urban households through an appropriate mix of market and transfer mechanisms. A major policy goal in Ethiopia should be how to design food and income transfer programmes in ways that do not adversely affect the development of a food marketing system that stimulates production incentives, income growth and more affordable food over the long run (Jayne and Molla, 1995). To guide future food policy, especially with respect to potential commodity price stabilisation and food aid monetisation[8], it is also vital to understand the factors affecting food market prices in Ethiopia and the behaviour of food markets more generally. The "three meals a day" promise often made by the Prime Minister in his speeches can only be realised if the policies are based on accurate food poverty studies and robust statistical studies such as the one provided by this paper.

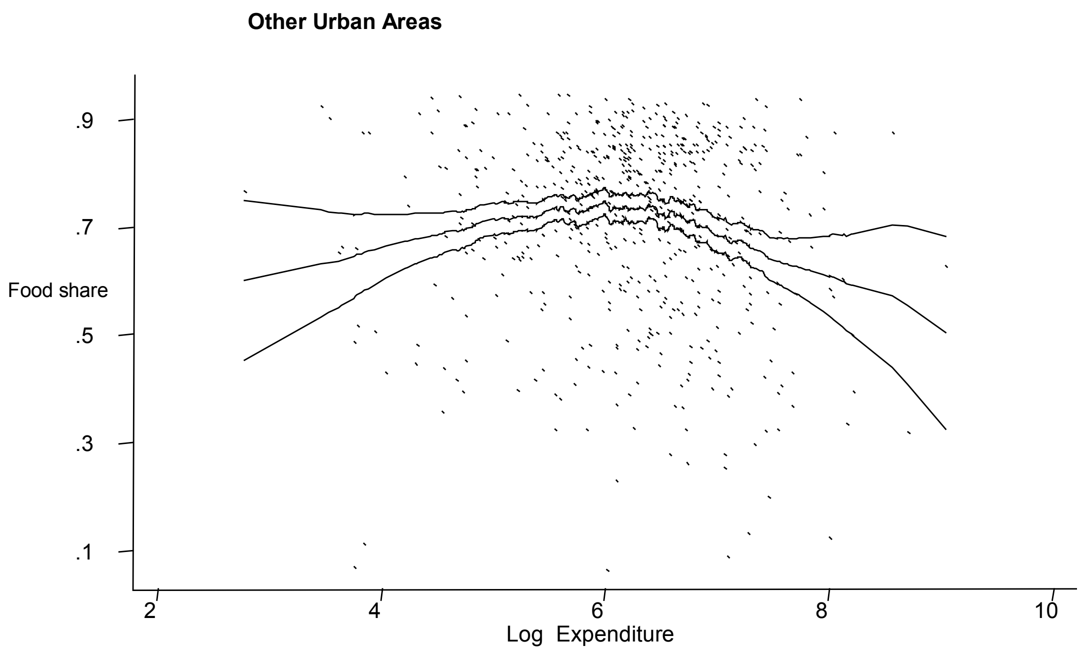
VI. CONCLUSION

The contribution of this paper to the work on household welfare analysis for developing countries is twofold. First, it recognises and deals with the fact that observed household expenditure is an imperfect measure of actual outlays. The finding that about a third of the total variance in expenditure is due to measurement error vindicates this approach. Second, it explicitly focuses on identifying the proportion of urban households in Ethiopia for whom food is, to all intents and purposes, a luxury. We have also highlighted the possible food and income policy implications that emerge from our results.

According to the estimator which has taken due account of measurement error in expenditure data, the threshold welfare level beyond which food ceases to be a luxury lies between the 35th and 47th percentiles of the total expenditure distribution. Economic policy that aims at reducing food poverty will thus have to target nearly half of the urban households. This is markedly different from the policy recommendation that emanates from the naïve ordinary squares estimator. The latter implies that no more than a quarter

8 Food monetisation refers to the sales of food aid by the state onto the market to influence market prices.

of the urban population suffer from food poverty. In this respect, the present study has demonstrated the potential for serious policy distortions resulting from a lack of careful statistical analysis.



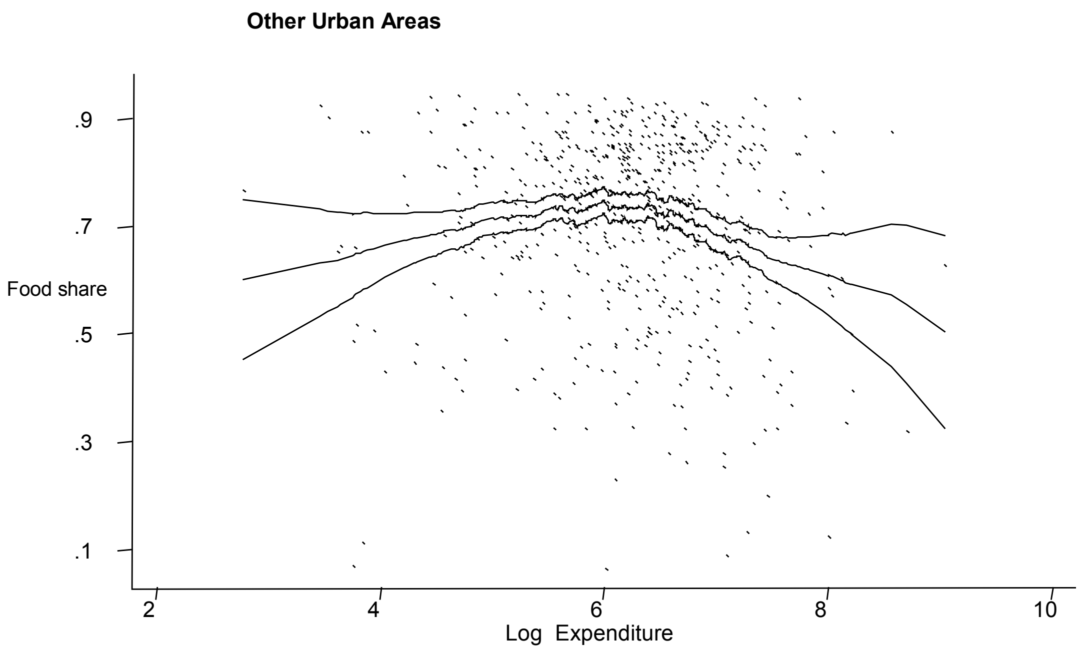


Figure 1:

Nonparametric kernel fits with 95% pointwise confidence interval

Table 1:
Regional Cost of Living Indices based on econometrically generated prices and quantities

Urban area	**Fishers' Ideal index**
Addis	100.00
Awassa	81.0
Bahardar	99.0
Dessie	105.0
Dire Dawa	113.0
Jimma	101.0
Melee	99.0

Table 2
Descriptive statistics for the food share data

Variable	Addis Ababa		Other Urban Areas	
	Mean	Std. Dev	Mean	Std. dev
Food share	0.674	.178	0.710	.174
Log total expenditure	6.213	0.919	6.216	.903
Log income	6.307	1.283	6.270	1.158
Log household size	1.746	0.506	1.643	0.565
Sample size	879		558	

Table 3
OLS and measurement error corrected
IV estimates of the quadratic Engel Curve parameters

	Addis Ababa		Other Urban Areas	
	OLS	IV	OLS	IV
Log of total expenditure	0.294	0.281	0.283	0.435
	(4.48)**	(2.36)*	(3.09)**	(4.59)**
Square of log of total expenditure	-0.028	-0.024	-0.025	-0.035
	(5.39)**	(2.56)*	(3.34)**	(4.35)**
Log of household size	0.038	0.019	-0.004	-0.040
	(2.97)**	(1.64)	(0.22)	(2.70)**
Constant	-0.111	-0.179	-0.071	-0.600
	(0.55)	(0.48)	(0.25)	(2.11)*
Turning point [95% confidence interval)	182 [126,277]	351 [207,592]	310 [210,456]	501 [352,713]
p-value for overidentifying restrictions [$\chi^2(3)$]		.107		.132
Implied share of measurement error variance		31%		37%
Number of observations	879	879	558	558

Note:
(i) Absolute value of t-statistics in parentheses
(ii) * significant at 5%; ** significant at 1%
(iii) Turning points are estimated using the values of the coefficients to seven decimal points. Their standard errors are computed using the delta method.

Table 4
Some percentile elasticities (and standard errors)

	Addis Ababa		Other Urban Areas	
Percentile	OLS	IV	OLS	IV
5th	.033 (.016)	.058 (.033)	.057 (.019)	.115 (.023)
10th	.065 (.012	.036 (.025)	035 (.015)	.084 (.013
25th	-.021 (.089)	.012 (.016)	.001 (.009)	.035 (.011)
50th	-.052 (.007)	-.014 (.010)	-.026 (.009)	-.003 (.013)
75th	-.089 (.074)	-.045 (.013)	-.052 (.012)	-.040 (.019)
95th	-.138 (.013)	-.087 (.027)	-.091 (.019)	-.095 (.030)

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