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ESSP2 Discussion Paper 011

Food Demand Elasticities in Ethiopia: Estimates Using Household Income Consumption Expenditure (HICE) Survey Data

Kibrom Tafere, Alemayehu Seyoum Taffesse, and Seneshaw Tamiru
with Nigussie Tefera and Zelekawork Paulos

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THE ETHIOPIA STRATEGY SUPPORT PROGRAM 2 (ESSP2) DISCUSSION PAPERS

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1. INTRODUCTION

How households adjust their consumption in response to changes in prices and income is crucial determinant of the effects of various shocks to market prices and commodity supplies. These adjustments in demand are particularly significant in Ethiopia, where many households consume inadequate quantities of calories, protein and other nutrients. Household consumption behaviour in the country is also rather complex. Regional consumption patterns differ considerably with no single staple dominating. Instead, four different cereals (teff, wheat, maize and sorghum) are major staples in parts of the country and even within most regions, two or more food staples account for relatively large shares of total calories and food expenditures[1].

Quantifying household responses to price and income changes requires careful econometric analysis of household consumption patterns. This paper utilizes household level data on consumption, prices, expenditures, and household characteristics (including location, size, and education of household head) to estimate demand parameters for various commodity groups. The Quadratic Almost Ideal Demand Model (QU-AIDM) was used for that purpose. The QU-AIDM has solid theoretical foundations and sufficient flexibility to capture substitution effects that are especially important in the Ethiopian context of multiple staple foods.

The recent unprecedented rise in food prices in Ethiopia renewed interest in the empirical analysis of consumer demand.[2] Coupled with the paucity of current and Ethiopia-specific demand elasticities estimates, this interest makes the present study timely. Indeed, robust income and price elasticities of demand not only deepen understanding of economic behaviour in the country, but can also enhance policy analysis by serving as important ingredients to such efforts as welfare evaluations and CGE analyses.

[1] Enset ('false banana') is also a major staple in the highland areas of Southern Nations, Nationalities and Peoples region (SNNP).
[2] See for instance Ulimwengu, Workneh, and Paulos (February 2009); *Tefera (August 2009)*; and *Tefera, Nigussie, Rashid, and Taffesse (August 2009).*

2. METHODOLOGY

Model

Consumer demand theory characterizes the basic problem of a consumer as that of maximizing utility subject to a budget constraint.[3] Under a set of assumptions, this optimization results demands which:(i) add-up to total expenditure (value form) or to one (budget-share form), (ii) are homogeneous of degree zero in prices alone (compensated or Hicksian demands), or jointly in prices and total expenditure (uncompensated or Marshallian demands), (iii) have negative compensated own-price responses, and (iv) exhibit symmetric compensated cross-price responses (Deaton and Muellbauer (1980a)).[4] As can be expected, testing the validity of this characterization occupies a major place in empirical demand analysis. In this regard, it is common practice to specify functional forms (for utility or expenditure) that are flexible enough to lead to demands possessing the above properties, such that the relevant restrictions are statistically imposed and tested. As a prelude to empirical implementation this section describes the demand models adopted in this study.

One of the most commonly used specifications in applied demand analysis is the Almost Ideal Demand Model (AIDM) proposed by Deaton and Muellbauer (1980b). Its popularity is in part due to the fact that it satisfies a number of desirable properties[5] and allows linear approximation at the estimation stage. The model has budget shares as dependent variables and logarithm of prices and real expenditure/income as regressors.

The original AIDM was subsequently extended to permit non-linear Engel curves. The resulting model, proposed by Banks, Blundell, and Lewbel (1997), is the Quadratic Almost Ideal Demand Model(QU-AIDM). Under QU-AIDM, the ith budget share (wi) equation for household h is given by:[6]

$$w_{ih} = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln\left[\frac{x_h}{a(\mathbf{p})}\right] + \frac{\lambda_i}{b(\mathbf{p})}\left\{\ln\left[\frac{x_h}{a(\mathbf{p})}\right]\right\}^2 \quad (1)$$

with:

[3] As will be seen shortly, the bulk of the data used by this study are at the household level. The household is assumed to behave as if it were a single consumer. This approach is known as the 'unitary approach' to household consumption behaviour. An alternative, broadly known as the 'collective approach', attempts to accommodate the possible preferential and other heterogeneity of household members. The latter is rapidly growing in acceptance as a better perspective. See Browning, Chiappori, and Lechene (2006) for a recent elaboration of the difference between the two approaches.

[4] The classic statement of this is Chapter 2 in Deaton and Muellbauer (1980a).

[5] AIDM satisfies axioms of choice exactly; it allows exact aggregation over consumers; is simple to estimate; and it can be used to test the restriction of homogeneity and symmetry through linear restrictions on fixed parameters (see Deaton and Muellbauer (1980b); and Moschini (1995)).

[6] Note that with λ_i=0 the QU-AIDM reduces to the original AIDM.

$$\ln a(\mathbf{p}) = \alpha_0 + \sum_{k=1}^{n} \alpha_k \ln p_k + \frac{1}{2}\sum_{k=1}^{n}\sum_{j=1}^{n} \gamma_{kj} \ln p_k \ln p_j \qquad (2)$$

$$b(\mathbf{p}) = \prod_{k=1}^{n} p_k^{\beta_k} \qquad (3)$$

In equations (1)−(3), pj and x stand for the price of commodity j and total consumption expenditure, respectively, while ln() indicates logarithmic transformation. The αs, βs, γs, and λs are parameters to be estimated.

Three main properties of demands derived from utility maximization under a budget constraint can be stated and tested as restrictions on the parameters of the QU-AIDM equation system (1).[7] These are:

$$\sum_{i=1}^{n} \alpha_i = 1; \quad \sum_{i=1}^{n} \gamma_{ij} = 0; \quad \sum_{i=1}^{n} \beta_i = 0; \quad \sum_{i} \lambda_i = 0 \qquad (4)$$

$$\sum_{j} \gamma_{ij} = 0 \qquad (5)$$

$$\gamma_{ij} = \gamma_{ji} \qquad (6)$$

The equalities in (4) are the adding-up restrictions. They express the property that the sum of the budget shares equals 1 (i.e. $\sum w_{ih} = 1$). The restrictions (5) express the prediction that the demand functions are homogenous of degree zero in prices and expenditure/income. Slutsky symmetry is satisfied only if the restrictions in (6) hold.

If the restrictions in equations (4)-(6) are satisfied, it would imply (Deaton and Muellbauer [1980b, 314]):

1) With no variation in relative prices and 'real' expenditure (x/a(P)), the budget shares are constant.
2) The direct impact of relative prices appears through the coefficients γij , each representing 100 times the effect on the ith budget share of a 1 percent increase in the jth price with (x/a(P)) held fixed.
3) A change in 'real' expenditure work through the terms βi and λi.

[7] Note that negativity of own-price responses cannot be imposed in the form of restrictions on the parameters of the model. See Deaton and Muellbauer (1980b).

A number of additional features, to be introduced below to accommodate various data and estimation issues, will modify the form in which these implications, as well as the restrictions they are based on, apply.

3. DATA

The analysis in this paper is primarily based on data collected by the Central Statistical Agency (CSA) via its Household Income Consumption Expenditure Survey (HICES) during 2004/05. Additional information was extracted from the Welfare Monitoring Survey (WMS) of the same year. [8] The HICES covers all rural and urban areas of Ethiopia except all zones of the Gambella region, and three predominantly non-sedentary zones from Afar region and six such zones from Somali region.

For the purpose of HICES 2004/05, CSA divided the country into three broad categories: 'rural', 'major urban centres' and 'other urban centres' categories. The 'rural' category consists of all rural areas in all regions of Ethiopia except those noted earlier. 'Major urban centres' consists mainly of regional capitals and four other urban centres with relatively sizable populations, while 'other urban centres' includes all urban areas that do not fall under 'major urban centres' category.[9] A total of 21,595 households make up the HICES sample. This nationally representative sample contains 12,101 urban households and 9,494 rural households selected from 1554 enumeration areas (EAs) in 444 woredas.

The HICES collect information on quantity of consumption, consumption expenditure, and other expenditures of households. In contrast, the WMS survey focuses on assets, health, education, nutrition, access to and utilization and satisfaction of basic facilities/services. Hence, the expenditure data from HICES (2004/05) are combined with the information on assets and demographics drawn from WMS (2004).

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[8] Detailed description of the HICES and the WMS can be respectively found in CSA (May 2007) and CSA (June 2004).

[9] According to CSA, an urban area is generally defined as a locality with 2000 inhabitants or more. However, in the HICE (2004/05) survey urban areas are:

i) All administrative capitals (Regional capitals, Zonal capitals and Wereda capitals);
ii) Localities with Urban Dwellers' Association (UDAs) not included in (i); and
iii) All localities which are not included either in (i) or (ii) above, having a population of 1000 or more persons, and whose inhabitants are primarily engaged in non- agricultural activities.

4. ESTIMATION STRATEGY

This section describes the key elements of the estimation strategy deployed in this paper. The strategy is adopted to address a number of issues including endogeneity of total expenditure to budget shares, the use of unit values in place of market prices, and the case of zero expenditures.

Unit values

The HICES dataset does include a set of prices. Nevertheless, consultation with CSA revealed that it is not advisable to use these prices in the analysis. It was thus necessary to explore alternatives. One option was presented by the data on expenditures on and quantities of commodities collected by the HICE survey. It is as a result possible to calculate the unit value of each commodity as the ratio of expenditures and quantities for households with data on both. Data on expenditure, or quantity, or both are not reported for some households. Some of these households did not purchase the commodity during the survey period, while others did but part or all of the information on their purchase is not recorded. Consequently, missing unit values are replaced by the mean unit value of the corresponding EA, Kebele, Woreda, zone, or region, whichever occurs first. The unit values thus computed are used as 'prices'. More specifically, for each commodity the household-level unit value takes the place of the corresponding price in estimating price responses of commodity demands.[10]

The use of unit values as prices has some problems which have been thoroughly examined in Deaton (1987; 1988; 1990; 1997) and more recently in Crawford, Laisney, and Preston (2003) and Kedir (2005). The following paragraphs highlight the major concerns identified so as to put the paper's empirical results in perspective.

Two main complications arise from the use of unit values even when they are assumed to be direct indicators of corresponding prices (Deaton (1997)). The first relates to quality differentiation within a commodity subgroup. Take wheat, for instance. It comes in several varieties and quality grades. These types, varieties, or grades are unlikely to be valued equally by consumers or have a uniform price. The unit value of wheat thus reflects these quality differences. Household choice among goods differentiated by quality, in turn, is likely to be influenced by prices. The price of a commodity therefore affects unit values directly and through quality choice. Whenever operational, the latter effect prevents unit values from moving one to one with corresponding prices. Clearly, this complication is likely to be more severe when commodities are aggregated into groups with two or more constituents. In this regard, assuming group-separable preferences Deaton (1987; 1988) demonstrates that the unit value of a

[10] In this regard *Tefera (August 2009)* and *Tefera, Nigussie, Rashid, and Taffesse (August 2009)* also adopted this solution. The strategy deployed by Ulimwengu, Workneh, and Paulos (February 2009) is not explicitly discussed in the paper.

commodity group will have a less than proportionate response to the price of the group if the aforementioned quality effect is present. The solution he proposes involves correcting quantities and unit values for quality differences before estimating a quantity-unit value relation.

Measurement error is the second problem. Expenditures and quantities are measured with errors. Unit values, being ratios of the two, are thus contaminated by those errors. Deaton (1988) illustrates that these errors are likely to be spuriously negatively correlated with recorded quantities. Estimating the relationship between quantities and unit values without accounting for measurement error can hence results in biased estimates of the price responses of demand.

In short, quality differences within commodity groups and errors of measurement in expenditures and quantities can lead to biased estimates. As a solution (Deaton, 1987) proposes a complicated errors-in-variables estimator corrected for quality. Implementing this estimator is not attempted here. Apart from the view that such implementation merits a separate treatment in its own right, a number of considerations led to this decision.

First, 'quality' elasticity of unit values were estimated and did not prove to be very large. For food commodities, these elasticities range from -0.018 for sorghum through to 0.1722 for 'sugar and salt' (Table 9). Elasticities of comparable magnitude are also reported in Kedir (2005) for urban Ethiopia. As expected the quality divergence caused by income/expenditure differences are much wider in the case on non-food commodities. Second, the quantitative significance of adjustments for 'quality' effects and measurement error associated with the use of unit values does not appear to be large. Kedir (2005) obtains estimates of 'price' elasticities of quantity demanded for urban Ethiopia that correct for these problems. He concludes "(s)pices, fruits and vegetables, and tella have relatively large quality corrections. Teff, cereals, shiro, oil, meat, milk and butter have modest corrections followed by slight corrections for wheat, pulses, coffee and sugar." In other words, from among his 13 commodities only three, and none of them a staple, have sizable corrections (see Table 3 in Kedir (2005)). Third, the level difference between unit values and prices may not be considerable. Capéau and Dercon (2005) implemented a regression-based adjustment procedure to correct unit values. Out of the 15 cite-crop specific mean unit values, only 4 fell outside the 95% confidence interval of the corrected 'price' estimates (see Table 4 in Capéau and Dercon (2005)). To conclude, the present paper's estimates of price responses of demands are obtained on the basis of unit values.[11]

[11] Two further points. Even when adjustments are made for quality effects and measurement error, it is still necessary to establish the significance of the results thereby obtained via a comparison with an analogous estimation using observed prices. Furthermore, if measurement error is the main culprit, the bias may not necessarily be eliminated by using directly collected prices, since the latter may also be measured with substantial error. The findings in Deaton (1987, 1988, 1990), though not necessarily applicable in general, suggest that relative to quality differentiation, measurement error is by far the more significant source of bias. Indeed it is not possible to infer a priori that the potential bias associated with unit values is necessarily worse than that related to prices.

Zero-expenditures

Zero expenditure on individual commodities is a common feature of survey data, and HICE surveys are no exception. The statistical problems that may be thus created depend on the causes underlying the phenomena. Similarly the treatment of zero-expenditures has to reflect these causes.[12] Apart from imperfect recall, three main reasons for zero-expenditure on a good can be identified; permanent zero consumption, zero consumption during the survey period and optimal zero consumption.[13] Households reporting zero-expenditures can be correspondingly categorized into three groups; genuine non-consumers, non-consumers for the survey period, and potential consumers. The first group is comprised of those households which will never consume the good for some noneconomic reason, including religious beliefs and health considerations. Non-smokers and teetotallers are typical examples. Households of the second category are those which report no consumption because the frequency with which they consume the good is such that the survey period is not long enough to capture it. The third category is formed by those households for which no consumption of the good is an optimal decision for the given set of prices and income. They are potential consumers in that for a different price and income configuration they may move away from the corner solution at zero to some positive level of consumption.

Unfortunately, it is not possible to identify which of these reasons is responsible for each of the reported zero-expenditures from the HICES data. However, aggregation over commodities and across households helps reduce the problem. Commodities were aggregated into 21 sub-groups – 18 food sub-groups and 3 non-food sub-groups. Commodity aggregation went some way in reducing the incidence of zero expenditure. The problem did remain a major concern, however. Ten percent or more of the sample households reported no expenditure for each of 13 commodity groups, while a quarter or more of them did so for 8 commodity groups (see Table 10 in the annex). Thus, it is necessary to deploy a technique for alleviating the sample selection problem that may arise with the presence zero expenditures (or a censored dependent variable). The study adopts the two-step approach initially proposed by Heien and Wessells (1990) and further modified by Shonkwiler and Yen (1999). Following Shonkwiler and Yen (1999), the problem can be stated as estimating the system of equations:

[12] Pudney (1989, Chapter 4) deals with the problem of zero-expenditures in some length. See also Deaton (1986, 1987), and, for the more recent developments, Heien and Wessells (1990), Yen and Lin (August 2006).

[13] Consumption rather than purchase is used as the criterion because we are dealing with the food consumption of farming households. They generally produce food such that purchase does not necessarily coincide with expenditure due to the consumption of own-output.

$$w_{ih}^{*} = f(\mathbf{x}_{ih}, \boldsymbol{\mu}_i) + u_{ih}, \qquad d_{ih}^{*} = \mathbf{z}_{ih}'\boldsymbol{\theta}_i + v_{ih} \tag{7}$$

$$d_{ih} = \begin{cases} 1 \text{ if } d_{ih}^{*} > 0 \\ 0 \text{ if } d_{ih}^{*} \leq 0 \end{cases}$$

$$w_{ih} = d_{ih} w_{ih}^{*}$$

where i and h respectively index commodity sub-groups and households, wih and dih are the observed expenditure shares and the indicator of whether household h consumed the ith commodity sub-group; w_{ih}^{*} and d_{ih}^{*}, the corresponding latent variables; xih and zih, vectors of explanatory variables; $\boldsymbol{\mu}_i$ and $\boldsymbol{\theta}_i$, vectors of parameters and uih and vih, random disturbances. Shonkwiler and Yen (1999) identify two main difficulties in estimating the system of equations in (7):

I. if a considerable fraction of wi are zero, then representing it by a continuous distribution is likely to be inappropriate; and
II. the presence of cross-equation correlation of error terms mean that the likelihood function will involve multiple integrals thereby making direct maximum likelihood estimation of equation (7) very difficult.

As an alternative, Shonkwiler and Yen (1999) develop a two-step procedure that also solves the inconsistency of the Heien and Wessells (1990) approach. Shonkwiler and Yen (1999) assume that for each i, the disturbance terms $u_i, v_i\ '$ are distributed as bivariate normal with $\text{cov}(u_i, v_i) = \delta_i^2$, and show the unconditional expectation of wih to be:

$$E(w_{ih} | \mathbf{x}_{ih}, \mathbf{z}_{ih}) = \Phi(\mathbf{z}_{ih}'\boldsymbol{\theta}_i) f(\mathbf{x}_{ih}, \boldsymbol{\mu}_i) + \delta_i \phi(\mathbf{z}_{ih}'\boldsymbol{\theta}_i) \tag{8}$$

With this it is possible to restate the equation for each i in (7) as:

$$w_{ih} = \Phi(\mathbf{z}_{ih}'\boldsymbol{\theta}_i) f(\mathbf{x}_{ih}, \boldsymbol{\mu}_i) + \delta_i \phi(\mathbf{z}_{ih}'\boldsymbol{\theta}_i) + e_{ih} \tag{9}$$

where $e_{ih} = w_{ih} - E(w_{ih} | \mathbf{x}_{ih}, \mathbf{z}_{ih})$, Φ(.) and φ(.) are the univariate standard normal cumulative distribution function and the probability density function, respectively.

Consequently, a two-step procedure using all observations becomes possible (Shonkwiler and Yen (1999)):

Step 1: obtain ML probit estimates $\hat{\boldsymbol{\theta}}_i$ of $\boldsymbol{\theta}_i$ using the binary outcome di = 1 and di = 0 for each i;[14]

Step 2: calculate $\Phi(\mathbf{z}'_{ih}\hat{\boldsymbol{\theta}}_i)$ and $\phi(\mathbf{z}'_{ih}\hat{\boldsymbol{\theta}}_i)$ and estimate $\boldsymbol{\mu}_1, \boldsymbol{\mu}_2, \ldots$ and $\delta_1, \delta_2, \ldots$ in the system

$$w_{ih} = \Phi(\mathbf{z}'_{ih}\hat{\boldsymbol{\theta}}_i) f(\mathbf{x}_{ih}, \boldsymbol{\mu}_i) + \delta_i \phi(\mathbf{z}'_{ih}\hat{\boldsymbol{\theta}}_i) + \xi_{ih} \qquad (10)$$

by ML or SUR procedure, where:

$$\xi_{ih} = e_{ih} - [\Phi(\mathbf{z}'_{ih}\boldsymbol{\theta}_i) - \Phi(\mathbf{z}'_{ih}\hat{\boldsymbol{\theta}}_i)] f(\mathbf{x}_{ih}, \boldsymbol{\mu}_i) + \delta_i [\phi(\mathbf{z}'_{ih}\boldsymbol{\theta}_i) - \phi(\mathbf{z}'_{ih}\hat{\boldsymbol{\theta}}_i)]$$

Three implications of this procedure should be noted:

- The parameter estimates of the second step are consistent (Shonkwiler and Yen (1999)).

- It is not possible to impose the adding-up condition via parametric restrictions as in the case of the uncensored demand system (Drichoutis, et. al. (2008)). From the options available to address this problem, the approach first recommended by Pudney (1989) and also recently used, among others, by Yen, Lin, and Smallwood (2003) is adopted. The procedure involves treating the nth good as a residual category and estimating the first n − 1 equations (i = 1, 2, . . . , n − 1) in the system (6), along with an identity:

  $$w_n = 1 - \sum_{i=1}^{n-1} w_i \qquad (11)$$

  defining the budget share of good n as a residual share. The adding-up identity can be used to calculate elasticities of the residual good. However, the resulting estimates will not be invariant to the good selected as the residual.

- The disturbance terms in equation (10) are heteroscedastic. Steps to systematically deal with this problem in line with ways suggested by Shonkwiler and Yen (1999) and Drichoutis, et. al. (2008) were not attempted. Robust standard errors are used, however.

Endogeneity of total expenditure

The paper estimates a demand system spanning non-durables. The implicit assumption underlying this partitioning is separability of durables and non-durables in household choice. This creates the possibility that total expenditure is jointly determined with the budget shares of the specific commodities in the demand model. In other words, total expenditure becomes

[14] Shonkwiler and Yen (1999) acknowledge that "(e)stimation of the separate probit models implies the restriction E(v_{ih} ,v_{kh}) = 0 for $i \neq k$, without which the multivariate probit model would have to be estimated. With some loss in efficiency (relative to multivariate probit) these separate probit estimates are nevertheless consistent."

endogenous in the budget share equations – an endogeneity that may induce inconsistent parameter estimates if not taken care of (Bundell and Robin (1999)). Bundell and Robin (1999) recommend and illustrate an augmented regression technique to solve the problem. Two steps are involved. First, total expenditure is regressed on a set of exogenous variables including those which may directly influence budget shares. The residual from this reduced-form regression is added, in the second step, as an explanatory variable in the budget share equations together with total expenditure. The OLS estimator of the parameter of the total expenditure variable in this augmented regression is identical to the Two-Stage Least Squares (2SLS) estimator (Blundell and Robin (1999)). Moreover, Blundell and Robin (1999) argue that testing for the significance of the coefficient, in the augmented regression, of the 'residual' obtained in the first regression serves as a test of the exogeneity of total expenditure in the share equations. The paper adopts this approach.

Spatial variation

As much as it is important to learn the national consumption responses to changes in prices and income, it is imperative to recognize that the responsiveness of households may be different across spatial locations. One important distinction of this type is between urban and rural areas. Major differences in household characteristics, asset holdings and expenditure/income levels between urban and rural households point towards potential differences in their reactions to changes in economic variables (such as price and income). Accordingly, three sets of elasticities were estimated: country-level (national) elasticities and elasticities for urban and rural households separately.

Estimation – summary

The first step involved a probit regression to estimate the probability that a household will consume the commodity under consideration. It expresses the dichotomous choice problem as:

$$d_{ih} = \theta_0 + \sum_j \theta_{ij} \ln p_j + \theta_x \ln x_h + \sum_k \theta_{1k} N_{kh} + \sum_l \theta_{2l} a_{lh} + \sum_r^{R-1} \theta_{3r} D_r + \sum_z^{Z-1} \theta_{4z} D_z + u_i \qquad (12)$$

where dih=1 if the hth household consumes the ith food item, (i.e., if wih > 0) and 0 if the household does not consume the item in question; Nks are household demographic variables (household size, age of household head, age of household age squared, gender of household head, and years of schooling completed by the household head), ajs are household assets (household ownership of its dwelling unit, number of rooms in the dwelling unit, main construction material of the dwelling's roof, number of dwellings/other buildings owned by the household, number of pack animals owned, number of gas or electric stove owned, number of radios owned, number of plough animals owned, and number of bicycles owned), Drs are regional dummies (10 regions), Dzs are zonal dummies (74 zones). The zero-expenditure problem happened to be significant in size for sorghum (28 percent), teff (22 percent), maize (16

percent), wheat (9 percent), and, marginally, animal products (2 percent). Equation (12) was estimated for all commodities. The corresponding $\Phi(\mathbf{z}'_{ih}\hat{\boldsymbol{\theta}}_i)$ and $\phi(\mathbf{z}'_{ih}\hat{\boldsymbol{\theta}}_i)$ are computed from these regressions and subsequently entered in the second-stage estimation as instruments that correct for the zeros in the dependent variable.
Prior to executing the second-stage, total expenditure was regressed on its determinants:

$$\ln x_h = \alpha_0 + \sum_j \alpha_{ij} \ln p_j + \sum_k \alpha_{1k} N_{hk} + \sum_l \alpha_{2l} a_{hl} + \sum_r^{R-1} \alpha_{3r} D_r + \sum_z^{Z-1} \alpha_{4z} D_z + e_h \qquad (13)$$

where, xh is total household consumption expenditure on non-durables, Nks are household demographic variables (household size, age of household head, gender of household head, and years of schooling completed by the household head), ajs are household assets (household ownership of its dwelling unit, number of rooms in the dwelling unit, main construction material of the dwelling's roof, type of toilet facility of the household, number of dwellings/other buildings owned by the household, number of pack animals owned, number of gas or electric stove owned, number of radios owned, number of plough animals owned, number of equine animals, number of sheep and goats owned, number of equine animals owned, and number of bicycles owned), Drs are regional dummies (10 regions), Dzs are zonal dummies (74 zones), and e is a normally distributed residual. The residuals $\hat{e}_h$ are computed and subsequently entered in the budget share equations estimated in the second-stage.

Therefore, the demand system finally estimated takes the form:[15]

$$w_{ih} = \Phi(\mathbf{z}'_{ih}\hat{\boldsymbol{\theta}}_i)\left\{\alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln\left(\frac{x_h}{a(\mathbf{p})}\right) + \frac{\lambda_i}{b(\mathbf{p})}\left[\ln\left(\frac{x_h}{a(\mathbf{p})}\right)\right]^2 + \tau_i \hat{e}_h\right\} + \delta_i \phi(\mathbf{z}'_{ih}\hat{\boldsymbol{\theta}}_i) + \xi_{ih} \qquad (14)$$

where $\hat{e}_h$ is the residual from the total expenditure regression and $\Phi(\mathbf{z}'_{ih}\hat{\boldsymbol{\theta}}_i)$ and $\phi(\mathbf{z}'_{ih}\hat{\boldsymbol{\theta}}_i)$ are obtained from the first-stage probit regressions.

The parameters of the QU-AIDM model is estimated using Poi's STATA routine (Poi, 2008) after modifying it to include additional control variables in order to capture endogeneity and selectivity problems as appropriate.[16]

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[15] See Appendix III for price and expenditure elasticity of demand formulas under QU-AIDM model.

[16] The authors would like to thank Miguel Robles of IFPRI for providing them with his modified STATA ado and do files which served as a basis for subsequent adaptation.

The specific estimation technique chosen reflects a number of requirements in part created by the specific features of the QU-AIDM. First, adding-up, homogeneity, and symmetry have to be accommodated. The adding-up condition is accommodated by dropping one of the budget share equations and imposing an adding-up identity (see above). Symmetry and homogeneity, on the other hand, have to be explicitly imposed during estimation. The way this is achieved reflects the nature of these restrictions. Symmetry is a cross-equation restriction, whereas homogeneity is essentially a within-equation restriction. The joint application of the two is a major feature of the QU-AIDM. Second, QU-AIDM is non-linear because of the quadratic total expenditure term and the two expressions in log prices (a(p) and b(p)). To handle these features the model was estimated as a non-linear system of seemingly unrelated regression equations (or NSURE).[17] Parameter estimates were thus obtained by estimating the respective system of SURE, with symmetry and homogeneity simultaneously imposed. In each case the 'Other non-food' budget-share equation is dropped to accommodate adding-up. The remaining 20 equations were estimated by iterated feasible generalised non-linear least squares (IFGNLS) which is equivalent to the maximum likelihood (ML) (Poi (2008)).[18],[19] Estimates of the elasticities of the excluded (or dropped) budget-share equation are then recovered by exploiting the adding-up and homogeneity restrictions.[20]

[17] The NSURE framework also accommodates the possibility that the disturbances contain unobserved factors common to budget shares.

[18] All estimation procedures were implemented using Stata/MP 11.0 for Windows .

[19] Following the recommendation in Deaton and Muellbauer (1980a) α_0 in $\ln a(\mathbf{p})$ is chosen to be just below the lowest value of ln$x$ in the data. This ensures positive real total expenditure throughout. Note also that a number of

[20] For uncensored versions of the model estimates, the parameters of the of the excluded (or dropped) budget-share equation are recovered by exploiting the adding-up and homogeneity restrictions, with their standard errors computed via the delta method.

5. RESULTS

Tables 8.1-8.3 report the parameter estimates of the QU-AIDM obtained at the country-level and for rural areas and urban areas, respectively.

Country-Level Results

The overall performance of the QU-AIDM at the country level can be ascertained with the information in Table 9.1. The root mean square error (RMSE) of each of the budget share equation is low. Ranging from 0.11 through to 0.82, with half of them greater than 0.5, the corresponding R2 values are credible. Consistent with these is the statistical significance of most of the unrestricted coefficients (268 out of 310, to be specific) reported in the Table 9.1. Moreover, the probability density term turned out significant in all the equations but one thereby further corroborating the importance of adjusting for zero-expenditures. The services group proved the exception – an expected result in light of the fact that this group has the highest budget share and no reported zero expenditure (0.02 percent to be exact).

Total expenditure and prices are shown to be significant determinants of demand. Looking at the results for expenditure first, the exogeneity of total expenditure is rejected for all commodities except barley, the enset group, and clothing and shoes.[21] Controlling for its endogeneity, total expenditure turns out to be highly significant, both linearly and quadratically, in the budget share equations. Maize, pulses, and sugar and salt proved to be the exception. As to prices, most come out significant. Out of the possible 230 distinct price effects only 26 are insignificant – eight of these being in the teff share equation and seven in that of oil seeds. Substantively more informative and significant are the price and expenditure elasticity estimates. Country-level elasticity estimates are reported in Tables 1, 2, and 3. The compensated own-price elasticities are, as predicted by theory, negative for all commodities.[22] That they are also close to -1 suggests that most of the commodities are own-price unitary elastic. Own-price elasticities of maize and sorghum are the furthest away from -1.

Cross-price effects are also present, although they appear rather weak for most commodity pairs (Tables 1b, 4, and 5). Among the four major cereal items (teff, wheat, maize, and sorghum) complementarity is detected between the teff-sorghum and maize-sorghum pairs, while substitution appears to be the link between teff and wheat. These results seem to reflect

[21] Recall that the relevant check is the t-test of the significance of the residual term that enters each budget share equation from the reduced–form regression using equation (13) above. The results of the reduced-form estimation can be found in Table 11 (add the table).
[22] The only exception is the residual 'other non-food' group whose elasticity is computed using the estimates of the rest of the commodity groups using adding-up and homogeneity.

limited possibilities in consumption for substitution and/or complementarity in Ethiopia. Diversity in the bio-physical and socio-economic landscape are likely to constrain these possibilities.

Table 1a: Compensated Price Elasticities (Country-level)[23]

	National
Teff	-0.888
Wheat	-0.981
Barley	-0.948
Maize	-0.746
Sorghum	-0.656
Other cereals	-1.074
Processed Cereals	-1.022
Pulses	-0.952
Oilseeds	-0.999
Animal products	-0.939
Oils and Fats	-0.983
Vegetables and Fruits	-0.979
Pepper	-0.991
Enset/Kocho/Bula	-0.993
Coffee/Tea/Chat	-0.960
Root crops	-0.985
Sugar and Salt	-0.989
Other foods	-0.976
Clothing and Shoes	-0.953
Services	-0.683
Other Non-food	0.873

Source: Authors' calculation based on CSA's HICE 2004/05 data.

The expenditure elasticity estimates indicate that most commodities are normal, though some are marginally so (Table 2). The negative expenditure elasticities of 'other cereals' and barley indicate that the two are inferior. For the former, which is dominated by millet, the result is clearly driven by the outcome in urban demand. Teff, other cereals, processed cereals, pulses, animal products, and services have income elastic demands. These results are consistent with the perception that teff and animal products are generally considered superior food types in the country. On the other hand, wheat, maize, and sorghum, appear as expenditure-inelastic. That maize and sorghum are relatively less desired cereals in most parts of the country, while a significant fraction of wheat originates as food aid may be the explanations.

[23] For the full elasticity estimates (both national and urban/rural) see Tables 4-7.

Table 1b: Compensated Price Elasticities of Cereals (National)

	QU-AIDM				
	Teff	**Wheat**	**Barley**	**Maize**	**Sorghum**
Teff	**-0.89**	0.10	0.06	0.05	-0.10
Wheat	0.06	**-0.98**	0.05	0.04	0.05
Barley	-0.02	0.00	**-0.95**	-0.02	-0.04
Maize	0.04	0.05	0.04	**-0.75**	-0.05
Sorghum	-0.03	0.04	0.02	-0.07	**-0.66**

Source: Authors' calculation based on CSA's HICE 2004/05 data.

A number of studies report price and expenditure elasticities of demand estimated form Ethiopian datasets. These include Kedir (2005), Taffesse (2003), and Shimeles (1993). Table 7 reports the estimates of these studies alongside with those of the current paper. Kedir (2005) uses data from the Ethiopian Urban Household Survey, while Taffesse (2003) the Ethiopian Rural Household Survey (ERHS)-1994. In contrast, Shimeles (1993) is based on aggregated CSA data. In addition to some matched ones, a number of their elasticity estimates have imperfect analogues in the present paper. The values in Table 7 reveal that the estimates in Taffesse (2003) and Shimeles (1993) are broadly similar to the current paper's, while those of Kedir (2005) are rather divergent.

Rural and Urban Area Results

As noted earlier, the QU-AIDM was fitted to the rural and urban segments of the HICES sample separately. The objective is to ascertain the extent to which demand responses vary between the two household groupings. A number of significant differences are uncovered (Tables 2 and 5). Expenditure elasticities of sorghum, pulses, and the enset group are higher in rural areas. 'Other cereals', 'oil seeds', and 'sugar and salt.' Have higher expenditure elasticites in urban areas. More varied, and sometimes stronger, cross-price effects were detected within each sub-sample as well as between the samples. In contrast, own-price elasticities came out more or less the same.

Table 2: Expenditure Shares and Expenditure Elasticities

	Expenditure Share (%)			Expenditure Elasticity of Demand (QU-AIDM)		
	National	**Rural**	**Urban**	**National**	**Rural**	**Urban**
Teff	4.96	4.37	8.17	1.69	1.08	1.14
Wheat	5.06	5.53	2.57	0.78	0.42	0.41
Barley	2.55	2.91	0.57	-0.44	0.06	0.33
Maize	4.97	5.67	1.15	0.92	0.62	0.58
Sorghum	4.71	5.39	1.05	0.77	1.00	-0.81
Other cereals	0.89	0.97	0.47	-6.70	2.30	-6.70
Processed Cereals	1.91	0.96	7.00	2.33	-1.29	1.04
Pulses	4.47	4.73	3.06	1.03	1.13	0.87
Oilseeds	0.13	0.14	0.04	0.63	0.96	2.10
Animal products	4.43	4.28	5.22	1.31	1.22	1.23
Oils and Fats	1.95	1.56	4.03	0.72	0.83	0.90
Vegetables and Fruits	2.57	2.49	2.98	0.87	0.95	0.87
Pepper	1.53	1.49	1.74	0.41	0.30	0.67
Enset/Kocho/Bula	2.25	2.61	0.28	0.87	2.12	-0.39
Coffee/Tea/Chat	5.54	5.87	3.75	0.88	1.39	0.85
Root crops	1.85	2.03	0.91	0.94	0.18	0.59
Sugar and Salt	1.05	0.89	1.93	0.79	0.16	0.96
Other foods	5.92	5.85	6.30	0.16	0.52	0.12
Clothing and Shoes	6.50	6.28	7.70	0.74	1.19	0.67
Services	22.40	21.56	26.95	1.45	0.86	1.35
Other Non-food	14.37	14.41	14.14	1.38	1.72	1.50

Source: Authors' calculation based on CSA's HICE 2004/05 data.

Expenditure elasticity estimates point out that most consumption items are normal goods (see Table 2). The QU-AIDM model indicates that teff, other cereals, processed cereals, and animal products have elastic demand in both urban and rural areas. This finding further supports the claims made above about the public perception of the items. It is also interesting to find processed cereals (in rural areas) and other cereals (in rural areas) appear to be inferior goods.

Table 3: Price Elasticities of Cereals (Urban/Rural)

		Teff	Wheat	Barley	Maize	Sorghum
Rural	Teff	**-0.905**	0.051	0.04	0.03	-0.077
	Wheat	0.027	**-0.978**	0.028	0.034	0.022
	Barley	-0.003	0.009	**-0.976**	0.003	-0.009
	Maize	0.031	0.043	0.037	**-0.873**	0.001
	Sorghum	0.007	0.053	0.048	0.012	**-0.84**
Urban	Teff	**-0.862**	0.094	0.083	0.07	-0.042
	Wheat	0.013	**-0.992**	0.015	0.022	0.008
	Barley	-0.005	0.007	**-0.978**	0	-0.014
	Maize	0.001	0.011	0.006	**-0.904**	-0.031
	Sorghum	-0.053	-0.009	-0.014	-0.05	**-0.902**

Source: Authors' calculation based on CSA's HICE 2004/05 data.

6. CONCLUSIONS

This paper is aims at empirically investigating the responsiveness of demand for various food and non-food items to changes in price and expenditure using the Quadratic Linear Almost Ideal Demand Model (AIDM). The demand system was estimated using non-linear Seemingly Unrelated Regression (NSURE) technique using Household Income Consumption Expenditure Survey 2004/05 data collected by Central Statistical Agency of Ethiopia. Zero expenditures were accommodated via censored regression.

The findings of the study suggest that Ethiopian households display significant response to changes in prices and expenditure/income. It is interesting to note that price elasticities of demand for cereals are roughly the same in urban and rural areas of the country.

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Table 1 Consumption and sociodemographic variables definitions

Table 4: Compensated Price Elasticity of Demand (QU-AIDM) – Country-level

Demand for: \ Price of:	Teff	Wheat	Barley	Maize	Sorghum	Other cereals	Processed Cereals	Pulses	Oilseeds	Animal products	Oils and Fats	Vegetables and Fruits	Pepper	Enset/ Kocho/ Bula	Coffee/ Tea/ Chat	Root crops	Sugar and Salt	Other foods	Clothing and Shoes	Services	Other Non-food
Teff	**-0.888**	0.104	0.062	0.048	-0.102	0.104	0.063	0.093	0.081	0.094	0.077	.	.	.	.	.	.	.	.	0.083	0.104
Wheat	0.058	**-0.981**	0.048	0.039	0.050	0.019	0.049	0.041	0.040	0.035	0.039	0.035	0.037	0.131	0.032	0.011	0.032	0.035	0.040	0.039	0.039
Barley	-0.023	0.002	**-0.948**	-0.022	-0.044	-0.014	-0.004	-0.015	-0.010	-0.015	-0.011	-0.013	-0.013	-0.075	-0.010	-0.015	-0.014	-0.015	-0.012	-0.011	-0.011
Maize	0.037	0.045	0.040	**-0.746**	-0.051	0.045	0.044	0.043	0.044	0.042	0.045	0.035	0.045	-0.013	0.046	0.045	0.035	0.045	0.045	0.046	0.044
Sorghum	-0.028	0.043	0.021	-0.071	**-0.656**	0.021	0.035	0.045	0.037	0.033	0.036	0.037	0.036	-0.068	0.039	0.004	0.031	0.036	0.036	0.036	0.036
Other cereals	-0.027	-0.095	-0.065	-0.060	-0.109	**-1.074**	-0.053	-0.061	-0.058	-0.054	-0.057	-0.057	-0.062	-0.117	-0.059	-0.065	-0.061	-0.061	-0.060	-0.060	-0.061
Processed Cereals	-0.021	0.092	0.069	0.028	0.029	0.062	**-1.022**	0.036	0.045	0.051	0.042	0.039	0.041	0.285	0.044	0.034	0.045	0.038	0.044	0.045	0.037
Pulses	0.074	0.050	0.034	0.032	0.091	0.043	0.042	**-0.952**	0.046	0.047	0.045	0.043	0.045	0.009	0.049	-0.046	0.016	0.041	0.046	0.046	0.043
Oilseeds	0.003	0.001	0.000	-0.008	0.005	0.002	0.002	0.001	**-0.999**	0.001	0.001	0.000	0.000	0.006	0.002	-0.004	0.000	0.001	0.001	0.001	0.004
Animal products	0.164	-0.008	0.009	-0.057	-0.041	0.095	0.074	0.060	0.056	**-0.939**	0.061	0.065	0.069	-0.083	0.055	0.001	0.073	0.054	0.058	0.058	0.036
Oils and Fats	-0.192	-0.020	0.003	-0.003	0.000	0.081	-0.006	0.001	0.010	0.028	**-0.983**	-0.052	0.030	0.147	0.047	0.069	0.023	0.014	0.013	0.013	0.050
Vegetables and Fruits	.	0.024	0.026	0.009	0.031	0.028	0.024	0.025	0.022	0.023	0.021	**-0.979**	0.022	0.012	0.020	0.040	0.024	0.022	0.022	0.022	0.023
Pepper	.	-0.014	-0.002	0.049	0.060	0.002	0.005	0.016	0.005	0.030	0.015	0.007	**-0.991**	0.121	0.022	-0.029	0.001	0.007	0.006	0.008	-0.073
Enset/Kocho/Bula	.	0.038	0.014	0.003	-0.009	0.016	0.028	0.019	0.020	0.018	0.020	0.018	0.020	**-0.993**	0.019	0.020	0.025	0.019	0.020	0.020	0.023
Coffee/Tea/Chat	.	-0.059	0.087	0.112	0.173	0.080	0.060	0.085	0.057	0.047	0.061	0.010	0.060	0.023	**-0.960**	0.085	0.020	0.045	0.048	0.049	0.003
Root crops	.	0.015	0.019	0.021	0.010	0.019	0.018	0.013	0.017	0.017	0.018	0.021	0.017	0.017	0.018	**-0.985**	0.018	0.017	0.017	0.018	0.016
Sugar and Salt	.	0.005	0.011	-0.016	0.002	0.013	0.012	-0.003	0.008	0.010	0.009	0.011	0.008	0.059	0.006	0.014	**-0.989**	0.008	0.008	0.008	0.011

Other foods	.	0.012	0.028	0.079	0.094	0.049	0.020	0.025	0.034	0.019	0.015	0.051	0.018	0.076	0.016	0.110	0.039	**-0.976**	0.009	0.012	0.046
Clothing and Shoes	.	0.367	0.052	-0.155	-0.413	0.001	0.031	0.060	0.074	0.094	0.043	0.059	0.046	0.170	0.036	0.207	0.064	-0.084	**-0.953**	0.063	0.214
Services	0.344	0.350	0.225	0.197	-0.265	0.452	0.626	0.382	0.201	0.479	0.251	0.205	0.578	0.176	0.306	4.714	0.402	0.809	0.390	**-0.683**	-0.706
Other Non-food	-0.290	-0.440	-0.340	-0.060	0.730	-0.830	-0.990	-0.470	-0.490	-0.630	-0.42	-0.270	-0.940	-0.290	-0.220	**-7.41**	-0.68	-0.92	-0.290	0.900	**0.873**

Source: Authors' calculation based on CSA's HICE 2004/05 data

Table 5a: Compensated Price Elasticity of Demand by Location (QU-AIDM) - Rural

Demand for: \ Price of:	Teff	Wheat	Barley	Maize	Sorghum	Other cereals	Processed Cereals	Pulses	Oilseeds	Animal products	Oils and Fats	Vegetables and Fruits	Pepper	Enset/Kocho/	Coffee/Tea/Chat	Root crops	Sugar and Salt	Other foods	Clothing and Shoes	Services	Other Non-food
Teff	**-0.905**	0.051	0.040	0.030	-0.077	0.060	0.040	0.050	0.051	0.052	0.043	.	.	.	.	.	.	.	.	0.047	0.071
Wheat	0.027	**-0.978**	0.028	0.034	0.022	0.017	0.029	0.024	0.023	0.020	0.023	0.025	0.023	0.036	0.022	0.028	0.020	0.023	0.023	0.023	0.025
Barley	-0.003	0.009	**-0.976**	0.003	-0.009	-0.002	0.006	0.000	0.003	0.001	0.002	0.001	0.001	0.004	0.003	0.006	0.008	0.001	0.002	0.002	0.002
Maize	0.031	0.043	0.037	**-0.873**	0.001	0.040	0.039	0.033	0.035	0.034	0.035	0.023	0.035	0.011	0.036	0.040	0.027	0.035	0.035	0.035	0.036
Sorghum	0.007	0.053	0.048	0.012	**-0.840**	0.046	0.054	0.062	0.055	0.052	0.054	0.063	0.054	0.053	0.056	0.064	0.055	0.054	0.054	0.054	0.055
Other cereals	0.037	0.012	0.016	0.032	0.001	**-0.979**	0.017	0.020	0.023	0.023	0.023	0.033	0.022	0.027	0.024	0.033	0.028	0.024	0.022	0.022	0.023
Processed Cereals	-0.041	0.017	0.001	0.022	-0.008	-0.033	**-1.056**	-0.010	-0.010	-0.013	-0.014	0.002	-0.013	0.194	-0.013	0.004	-0.020	-0.016	-0.013	-0.011	-0.014
Pulses	0.059	0.054	0.046	0.032	0.096	0.047	0.054	**-0.946**	0.054	0.055	0.052	0.060	0.056	0.064	0.058	0.021	0.034	0.052	0.053	0.053	0.054
Oilseeds	0.008	0.000	0.001	-0.006	0.005	0.002	0.003	0.002	**-0.998**	0.001	0.001	0.000	0.001	0.008	0.002	-0.001	0.000	0.001	0.001	0.002	-0.007
Animal products	0.090	0.001	0.029	-0.001	0.006	0.050	0.049	0.055	0.047	**-0.947**	0.054	0.057	0.056	-0.021	0.050	-0.033	0.059	0.051	0.052	0.054	0.036
Oils and Fats	-0.149	0.013	0.005	-0.025	-0.019	0.048	0.000	-0.012	0.002	0.023	**-0.986**	-0.075	0.022	0.207	0.024	0.053	0.025	0.013	0.013	0.012	0.087
Vegetables and Fruits	.	0.025	0.023	0.001	0.039	0.030	0.026	0.026	0.023	0.024	0.022	**-0.978**	0.023	0.025	0.022	0.043	0.025	0.023	0.024	0.024	0.024
Pepper	.	-0.007	-0.005	0.028	0.004	0.003	0.004	0.027	0.006	0.015	0.009	-0.013	**-0.992**	0.112	0.016	-0.048	0.000	0.006	0.004	0.004	-0.010
Enset/Kocho/Bula	.	0.056	0.055	0.049	0.054	0.055	0.059	0.055	0.055	0.055	0.056	0.055	0.056	**-0.953**	0.055	0.050	0.055	0.055	0.055	0.055	0.057
Coffee/Tea/Chat	.	0.065	0.092	0.129	0.146	0.099	0.078	0.107	0.083	0.080	0.085	0.048	0.089	0.022	**-0.920**	0.138	0.060	0.076	0.081	0.081	0.059
Root crops	.	0.005	0.005	0.007	0.008	0.005	0.005	0.002	0.004	0.003	0.004	0.008	0.003	-0.001	0.004	**-0.999**	0.004	0.004	0.004	0.004	-0.001
Sugar and Salt	.	-0.002	0.008	-0.019	0.003	0.006	0.000	-0.007	0.001	0.003	0.002	0.003	0.001	0.004	0.000	0.002	**-0.994**	0.001	0.001	0.002	0.007
Other foods	.	0.064	0.056	0.074	0.075	0.069	0.037	0.042	0.049	0.040	0.035	0.060	0.037	0.117	0.034	0.099	0.051	**-0.958**	0.029	0.033	0.045
Clothing and Shoes	.	0.121	0.023	-0.135	-0.163	-0.059	-0.038	0.043	0.055	0.082	0.065	0.021	0.062	-0.263	0.038	-0.072	0.030	-0.054	**-0.934**	0.093	0.215
Services	0.819	1.160	1.183	1.641	1.440	1.090	1.327	0.846	1.271	0.873	0.282	1.532	0.327	-1.020	0.352	7.445	1.691	0.964	0.327	**-0.801**	-0.976
Other Non-food	-1.005	-1.554	-1.738	-2.185	-1.895	-1.714	-2.054	-1.128	-2.076	-1.202	-0.498	-2.258	-0.561	1.649	-0.280	-11.13	-2.614	-1.154	-0.221	1.003	**1.206**

Source: Authors' calculation based on CSA's HICE 2004/05 data.

Table 5b: Compensated Price Elasticity of Demand by Location (QU-AIDM) - Urban

Demand for: \ Price of:	Teff	Wheat	Barley	Maize	Sorghum	Other cereals	Processed Cereals	Pulses	Oilseeds	Animal products	Oils and Fats	Vegetables and Fruits	Pepper	Enset/ Kocho/ Bula	Coffee/ Tea/ Chat	Root crops	Sugar and Salt	Other foods	Clothing and Shoes	Services	Other Non-food
Teff	**-0.862**	0.094	0.083	0.070	-0.042	0.100	0.084	0.094	0.095	0.097	0.087	.	.	.	.	.	.	.	.	0.093	0.104
Wheat	0.013	**-0.992**	0.015	0.022	0.008	0.005	0.017	0.011	0.010	0.007	0.010	0.010	0.009	0.012	0.009	0.008	0.007	0.010	0.010	0.010	0.011
Barley	-0.005	0.007	**-0.978**	0.000	-0.014	-0.002	0.005	-0.001	0.002	0.000	0.002	-0.002	0.001	-0.001	0.002	-0.001	0.004	0.001	0.002	0.002	0.002
Maize	0.001	0.011	0.006	**-0.904**	-0.031	0.008	0.010	0.004	0.006	0.005	0.006	-0.004	0.007	-0.004	0.007	0.007	0.002	0.006	0.007	0.007	0.007
Sorghum	-0.053	-0.009	-0.014	-0.050	**-0.902**	-0.013	-0.008	-0.002	-0.008	-0.010	-0.008	-0.003	-0.009	-0.011	-0.007	-0.004	-0.009	-0.009	-0.009	-0.009	-0.008
Other cereals	-0.010	-0.046	-0.040	-0.017	-0.066	**-1.033**	-0.040	-0.035	-0.031	-0.031	-0.029	-0.023	-0.033	-0.035	-0.030	-0.028	-0.029	-0.031	-0.032	-0.032	-0.032
Processed Cereals	0.044	0.097	0.084	0.105	0.074	0.059	**-0.972**	0.073	0.074	0.072	0.071	0.079	0.071	0.137	0.071	0.073	0.066	0.069	0.072	0.073	0.071
Pulses	0.033	0.028	0.018	0.000	0.082	0.022	0.028	**-0.973**	0.027	0.028	0.025	0.028	0.028	0.025	0.030	-0.022	0.012	0.024	0.026	0.026	0.026
Oilseeds	0.008	0.000	0.000	-0.007	0.005	0.001	0.002	0.001	**-0.998**	0.000	0.000	0.000	0.001	0.003	0.001	-0.002	0.000	0.001	0.001	0.001	-0.003
Animal products	0.115	0.004	0.038	-0.006	0.004	0.063	0.061	0.068	0.058	**-0.934**	0.067	0.071	0.069	0.032	0.062	-0.033	0.069	0.063	0.064	0.065	0.054
Oils and Fats	-0.099	0.036	0.030	0.003	0.042	0.056	0.025	0.019	0.028	0.043	**-0.963**	-0.027	0.044	0.095	0.044	0.067	0.041	0.036	0.036	0.036	0.065
Vegetables and Fruits	.	0.028	0.025	-0.001	0.044	0.031	0.029	0.028	0.026	0.027	0.024	**-0.976**	0.025	0.026	0.024	0.046	0.026	0.026	0.026	0.026	0.026
Pepper	.	-0.001	0.000	0.031	0.008	0.010	0.010	0.028	0.012	0.019	0.017	-0.005	**-0.985**	0.046	0.020	-0.041	0.009	0.012	0.012	0.011	0.005
Enset/Kocho/Bula	.	0.002	-0.001	-0.017	-0.002	-0.001	0.011	0.000	-0.001	-0.002	0.000	-0.001	0.000	**-1.008**	-0.002	-0.012	-0.001	-0.001	-0.001	-0.001	0.001
Coffee/Tea/Chat	.	0.016	0.047	0.098	0.119	0.048	0.029	0.058	0.035	0.031	0.037	-0.001	0.041	0.009	**-0.970**	0.102	0.021	0.027	0.031	0.031	0.019
Root crops	.	0.006	0.006	0.008	0.009	0.006	0.006	0.004	0.005	0.005	0.006	0.009	0.005	0.003	0.006	**-0.999**	0.005	0.005	0.005	0.006	0.003
Sugar and Salt	.	0.011	0.031	-0.028	0.021	0.025	0.015	0.004	0.018	0.021	0.019	0.021	0.018	0.020	0.016	0.018	**-0.977**	0.017	0.019	0.019	0.024
Other foods	.	0.043	0.034	0.059	0.060	0.037	0.014	0.018	0.028	0.016	0.014	0.036	0.015	0.042	0.011	0.077	0.018	**-0.982**	0.007	0.009	0.015
Clothing and Shoes	.	0.348	0.128	-0.105	-0.189	-0.027	-0.110	0.101	0.129	0.112	0.064	0.145	0.069	0.019	0.028	0.223	0.100	-0.132	**-0.952**	0.077	0.232
Services	-1.815	-1.74	-1.33	-2.926	-2.956	-0.701	0.688	-0.606	0.031	0.432	-0.090	-1.148	-0.201	-4.757	-0.170	3.600	-0.102	0.595	0.403	**-0.666**	-1.235
Other Non-food	3.915	3.163	2.350	5.564	5.693	1.214	-0.880	1.155	-0.284	-0.674	0.269	2.232	0.360	8.927	0.474	-7.026	0.179	-0.716	-0.346	1.073	**2.065**

Source: Authors' calculation based on CSA's HICE 2004/05 data.

Table 6: Summary of Own Price Elasticities (QU-AIDM)

	National	Rural	Urban
Teff	-0.888	-0.905	-0.862
Wheat	-0.981	-0.978	-0.992
Barley	-0.948	-0.976	-0.978
Maize	-0.746	-0.873	-0.904
Sorghum	-0.656	-0.840	-0.902
Other cereals	-1.074	-0.979	-1.033
Processed Cereals	-1.022	-1.056	-0.972
Pulses	-0.952	-0.946	-0.973
Oilseeds	-0.999	-0.998	-0.998
Animal products	-0.939	-0.947	-0.934
Oils and Fats	-0.983	-0.986	-0.963
Vegetables and Fruits	-0.979	-0.978	-0.976
Pepper	-0.991	-0.992	-0.985
Enset/Kocho/Bula	-0.993	-0.953	-1.008
Coffee/Tea/Chat	-0.960	-0.920	-0.970
Root crops	-0.985	-0.999	-0.999
Sugar and Salt	-0.989	-0.994	-0.977
Other foods	-0.976	-0.958	-0.982
Clothing and Shoes	-0.953	-0.934	-0.952
Services	-0.683	-0.801	-0.666
Other Non-food	0.873	1.206	2.065

Source: Authors' calculation based on CSA's HICE 2004/05 data

Table 7: Comparison of Own Price Elasticity of Demand Estimates

	Teff	Wheat	Maize	Sorghum	Other Cereals	Pulses	Animal Products	Fruits and Vegetables	Root crops	Grain	Cereals	Food
QAIDM												
National	-	-0.981	-	-	-	-0.952	-	-0.979	-0.985			
Rural	-	-0.978	-	-	-	-0946	-	-0.978	-0.999			
Urban	-0.862	-0.992	-0.904	-0.902	-1.033	-0.973	-0.934	-0.976	-0.999			
Taffesse (2003)	-	-	-	-	-		-	-1.09		-1.30	-	-
Shimeles (1993)												
LES	-	-	-	-	-		-	-		-	-	-0.68
ELES	-	-	-	-	-		-	-		-	-	-0.88
Kedir												
(2001)	-1.77	-2.54	-	-	0.36		-1.21	-0.20		-	0.10*	-
(2005)	-0.29	-	-	-	-0.02		-0.04*	-0.01*		-	-0.03*	-

Source: Authors' calculations, Kedir (2001, 2005), Shimeles (1993), and Taffesse (2003).

Table 8: Elasticity Estimates from Alternative Demand Models or Estimation Procedures

	Expenditure Elasticity					Compensated Own-price Elasticity				
	QU-AIDM - Censored[1]	QU-AIDM - Uncensored[1]	QU-AIDM - Uncensored (EA	LA-AIDM - Uncensored[1]	QU-AIDM – Censored[2]	QU-AIDM - Censored[1]	QU-AIDM - Uncensored[1]	QU-AIDM - Uncensored (EA	LA-AIDM - Uncensored[1]	QU-AIDM – Censored[2]
Teff	1.69	1.12	0.81	1.01	0.69	-0.89	-0.92	-0.91	-0.96	-1.02
Wheat	0.78	1.08	0.83	0.99	1.19	-0.98	-0.95	-0.98	-1.03	-0.96
Maize	0.92	0.40	0.56	1.05	0.94	-0.75	-0.96	-0.94	2.06	-0.74
Sorghum	0.77	0.61	0.54	0.90	1.82	-0.66	-0.83	-0.77	3.66	-0.66
Barley	-0.44	1.08	0.81	0.92		-0.95	-0.76	-0.71	-0.02	
Other cereals	-6.70	-2.25	-1.65	0.99		-1.07	-1.04	-1.05	-3.28	
Processed	2.33	0.98	1.16	-0.54		-1.02	-1.03	-1.02	-6.02	
Pulses	1.03	1.14	0.81	0.88		-0.95	-0.96	-0.97	-1.17	
Oilseeds	0.63	0.70	0.92	0.81		-1.00	-1.00	-1.00	0.42	
Animal	1.31	1.51	1.31	1.49		-0.94	-0.93	-0.94	-1.21	
Fruits and	0.87	0.62	0.02	1.13		-0.98	-0.99	-1.00	-1.42	
Root crops	0.94	0.84	0.60	1.10		-0.99	-0.98	-0.99	-1.58	
Enset/Kocho/	0.87	0.34	0.48	1.49		-0.99	-0.99	-0.99	-1.28	
Oils and Fats	0.72	1.35	0.18	1.11		-0.98	-0.99	-1.02	-0.77	
Pepper	0.41	0.87	0.32	0.73		-0.99	-0.96	-0.99	-1.30	
Coffee/Tea/C	0.88	0.97	1.02	0.97		-0.96	-0.98	-0.98	-1.12	
Sugar and	0.79	0.58	1.07	1.00		-0.99	-0.99	-0.98	2.00	
Other foods	0.16	0.26	0.57	0.32		-0.98	-0.97	-0.96	-0.87	
Clothing and	0.74	0.69	0.20	0.92	2.00	-0.95	-0.96	-0.98	-0.56	-0.87
Services	1.45	1.40	1.83	0.93		-0.68	-0.69	-0.63	-0.76	
Other Non-	1.38	1.15	1.42	1.35		0.87	0.30	0.29	-0.94	

Source: Authors' calculations based on CSA's HICE 2004/05 data.
Notes: [1]The reported elasticities are computed from the specifications with 21 commodity groups. [2] These set of elasticities are computed from the specifications with 10 commodity groups. Teff; Wheat; Maize; Sorghum; and Clothing and shoes are the same in the two demand systems. In the system with 10 commodity groups, the rest of the commodities are aggregated in to Pulses, oilseeds, and other cereals; Animal products; Fruits, vegetables and root crops; Other food; Other non-food .

APPENDICES

Table 9.1: IFGNLS Estimates of the QU-AIDM Parameters – Country-level

C	w1	w2	w3	w4	w5	w6	w7	w8	w9	w10
lnp1	0.0338*** [0.005792]	0.0225*** [0.003132]	-0.0146*** [0.002676]	-0.0149*** [0.003635]	-0.1072*** [0.004393]	0.0288*** [0.002259]	-0.0334*** [0.00273]	0.0194*** [0.001643]	0.0018** [0.000782]	0.0361*** [0.001381]
lnp2	0.0225*** [0.003132]	-0.0202*** [0.003374]	0.0091*** [0.002069]	-0.0007 [0.002752]	0.0076** [0.003211]	-0.0275*** [0.001731]	0.0213*** [0.002042]	0.0026** [0.001183]	0.0003 [0.000522]	-0.0167*** [0.000958]
lnp3	-0.0146*** [0.002676]	0.0091*** [0.002069]	0.0608*** [0.002645]	-0.0094*** [0.002135]	-0.0239*** [0.002723]	-0.0057*** [0.00155]	0.0125*** [0.001893]	-0.0079*** [0.000951]	-0.0004 [0.000413]	-0.0137*** [0.001038]
lnp4	-0.0149*** [0.003635]	-0.0007 [0.002752]	-0.0094*** [0.002135]	0.2080*** [0.004496]	-0.1022*** [0.003549]	-0.0012 [0.001854]	-0.0043** [0.001786]	-0.0056*** [0.001366]	-0.0033*** [0.000778]	-0.0205*** [0.000826]
lnp5	-0.1072*** [0.004393]	0.0076*** [0.003211]	-0.0239*** [0.002723]	-0.1022*** [0.003549]	0.3064*** [0.005489]	-0.0283*** [0.002278]	-0.0042* [0.002436]	0.0192*** [0.001472]	0.0018** [0.000741]	-0.0186*** [0.00115]
lnp6	0.0288*** [0.002259]	-0.0275*** [0.001731]	-0.0057*** [0.00155]	-0.0012 [0.001854]	-0.0283*** [0.002278]	-0.0150*** [0.001738]	0.0107*** [0.001632]	-0.0024*** [0.000822]	0.0006* [0.000342]	0.0146*** [0.000761]
lnp7	-0.0334*** [0.00273]	0.0213*** [0.002042]	0.0125*** [0.001893]	-0.0043** [0.001786]	-0.0042* [0.002436]	0.0107*** [0.001632]	-0.0654*** [0.003092]	-0.0055*** [0.000862]	0.0010*** [0.000316]	0.0117*** [0.001143]
lnp8	0.0194*** [0.001643]	0.0026** [0.001183]	-0.0079*** [0.000951]	-0.0056*** [0.001366]	0.0192*** [0.001472]	-0.0024*** [0.000822]	-0.0055*** [0.000862]	0.0015 [0.000939]	-0.0001 [0.000358]	0.0024*** [0.000428]
lnp9	0.0018** [0.000782]	0.0003 [0.000522]	-0.0004 [0.000413]	-0.0033*** [0.000778]	0.0018** [0.000741]	0.0006* [0.000342]	0.0010*** [0.000316]	-0.0001 [0.000358]	0.0000 [0.00015]	0.0003 [0.00027]
lnp10	0.0361*** [0.001381]	-0.0167*** [0.000958]	-0.0137*** [0.001038]	-0.0205*** [0.000826]	-0.0186*** [0.00115]	0.0146*** [0.000761]	0.0117*** [0.001143]	0.0024*** [0.000428]	0.0003 [0.00027]	0.0042*** [0.000363]
lnp11	-0.0353*** [0.001336]	-0.0051*** [0.000528]	-0.0020*** [0.000653]	-0.0019** [0.000964]	-0.0017* [0.00103]	0.0123*** [0.000703]	-0.0067*** [0.000639]	-0.0035*** [0.00053]	-0.0012*** [0.000207]	0.0070*** [0.000323]
lnp12	. .	0.0013 [0.000951]	0.0041*** [0.000698]	-0.0094*** [0.001054]	0.0064*** [0.001126]	0.0080**** [0.000626]	0.0037*** [0.00064]	0.0044*** [0.000503]	-0.0005*** [0.000483]	0.0033*** [0.000236]
lnp13	. .	-0.0053*** [0.000713]	-0.0032*** [0.000517]	0.0047*** [0.001048]	0.0066*** [0.00099]	-0.0024*** [0.000474]	-0.0019*** [0.000489]	0.0021*** [0.000562]	-0.0018*** [0.000253]	0.0159*** [0.000825]
lnp14	. .	0.0436*** [0.00252]	-0.0172*** [0.001345]	-0.0286*** [0.0014]	-0.0524*** [0.002003]	-0.0116*** [0.001161]	0.0485*** [0.00146]	-0.0029*** [0.000606]	0.0013*** [0.000235]	-0.0144*** [0.000612]
lnp15	. .	-0.0256*** [0.00171	0.0093*** [0.00116	0.0096*** [0.00110	0.0206*** [0.00145	0.0090*** [0.00101	0.0055*** [0.00117	0.0141*** [0.00053	0.0030*** [0.00065	-0.0018*** [0.00062

		3]	3]	7]	3]	3]	3]	7]	5]	3]
lnp16	.	-0.0065***	0.0044***	0.0053**	-0.0128***	0.0042***	0.0040***	-0.0168***	-0.0012***	-0.0054***
	.	[0.001765]	[0.001313]	[0.002247]	[0.002351]	[0.001233]	[0.001245]	[0.001173]	[0.000189]	[0.000312]
lnp17	.	-0.0030***	0.0025***	-0.0135***	-0.0037***	0.0045***	0.0063***	-0.0154***	-0.0008***	0.0064***
	.	[0.000989]	[0.000693]	[0.000945]	[0.001075]	[0.000633]	[0.000653]	[0.000439]	[0.000137]	[0.000755]
lnp18	.	-0.0113***	-0.0062***	0.0012	0.0048***	0.0023***	-0.0050***	-0.0047***	0.0000	-0.0027***
	.	[0.001719]	[0.000983]	[0.000875]	[0.00128]	[0.000818]	[0.001184]	[0.000398]	[7.67E-05]	[0.000414]
lnp19	.	0.0096***	-0.0016***	-0.0067***	-0.0137***	-0.0039***	-0.0031***	-0.0010***	-0.0001	0.0043***
	.	[0.001042]	[0.000539]	[0.000509]	[0.00074]	[0.000438]	[0.000654]	[0.000222]	[7.79E-05]	[0.000533]
lnp20	-0.0020***	-0.0020***	-0.0043***	-0.0039***	-0.0098***	0.0005	0.0095***	-0.0007***	-0.0061***	0.0073***
	[0.000617]	[0.000562]	[0.000579]	[0.000529]	[0.000778]	[0.000458]	[0.001081]	[0.000218]	[0.000873]	[0.000693]
lnp21	0.0649***	0.0060***	0.0074***	-0.0023***	0.0049***	0.0026***	-0.0051***	0.0007***	0.0055***	-0.0198***
	[0.00507]	[0.000571]	[0.000642]	[0.000525]	[0.000734]	[0.000504]	[0.000325]	[0.000235]	[0.000903]	[0.001292]
lnx	0.0339***	-0.0143***	-0.0219***	0.0025	-0.0181***	-0.0096***	0.0388***	0.0014	-0.0006*	0.0241***
	[0.002547]	[0.002293]	[0.0024]	[0.002211]	[0.003112]	[0.002051]	[0.002501]	[0.000902]	[0.000316]	[0.002396]
$(\ln x)^2$	0.0000	-0.0005	0.0023***	0.0010	-0.0011*	0.0091***	0.0020***	.	0.0000	0.0016***
	[0.000626]	[0.000631]	[0.000633]	[0.000936]	[0.000534]	[0.000759]	[0.000254]	.	[9.86E-05]	[0.000601]
$\hat{e}$	0.0302***	0.0136***	0.0009	0.0026***	-0.0094***	0.0028***	0.0195***	0.0093***	0.0002***	0.0200***
	[0.001367]	[0.001277]	[0.000885]	[0.000971]	[0.001234]	[0.000524]	[0.001465]	[0.000633]	[0.000069]	[0.001215]
ф	-0.0375***	0.0236***	0.0397***	0.0278***	0.0051**	-0.0085***	-0.0326***	0.0133***	-0.0007***	0.0236***
	[0.002296]	[0.002475]	[0.001953]	[0.001666]	[0.002376]	[0.001331]	[0.002743]	[0.001962]	[0.000246]	[0.003062]
Constant	0.1678***	0.0698***	0.0886***	0.1282***	0.1633***	-0.0255***	0.1050***	0.0342***	0.0025**	0.0226***
	[0.007471]	[0.005704]	[0.004806]	[0.004903]	[0.006097]	[0.003848]	[0.00412]	[0.002212]	[0.001039]	[0.003697]
Observations	21265	21265	21265	21265	21265	21265	21265	21265	21265	21265
RMSE	0.0634	0.0569	0.0409	0.0451	0.0587	0.0256	0.0765	0.0278	0.0035	0.0549
R-squared	0.5792	0.3792	0.1758	0.4731	0.4362	0.1539	0.365	0.6561	0.1063	0.5121

Source: Authors' computation using CSA's HICES data.
Notes: Robust standard errors in brackets. w1-w21 and lnp1-lnp20 stand for the expenditure (budget) shares and logarithm of 'prices' respectively of teff, wheat, barley, maize, sorghum, 'other cereals', 'processed cereals', 'pulses', 'oil seeds', 'animal products', 'oil and fat', 'vegetables and fruits', pepper, 'enset, kocho, and bula', 'coffee, tea, and chat', 'root crops', 'sugar and salt', 'other food', 'clothing and shoes', 'services' and 'other non-food'. ***, **, and * indicate statistical significance at 1 percent, 5 percent, and 10 percent, respectively. RMSE is root mean square error. The rest of the variables and acronyms are as defined in the text.

Table 9.1 cont'd

VARIABLES	w11	w12	w13	w14	w15	w16	w17	w18	w19	w20
lnp1	-0.0353*** [0.001336]	. .	. .	. .	. .	. .	. .	. .	. .	-0.0020*** [0.000617]
lnp2	-0.0051*** [0.000528]	0.0013 [0.000951]	-0.0053*** [0.000713]	0.0436*** [0.00252]	-0.0256*** [0.001713]	-0.0065*** [0.001765]	-0.0030*** [0.000989]	-0.0113*** [0.001719]	-0.0096*** [0.001042]	-0.0020*** [0.000562]
lnp3	-0.0020*** [0.000653]	0.0041*** [0.000698]	-0.0032*** [0.000517]	-0.0172*** [0.001345]	0.0093*** [0.001163]	0.0044*** [0.001313]	0.0025*** [0.000693]	-0.0062*** [0.000983]	-0.0016*** [0.000539]	-0.0043*** [0.000579]
lnp4	-0.0019** [0.000964]	-0.0094*** [0.001054]	0.0047*** [0.001048]	0.0286*** [0.001400]	0.0096*** [0.001107]	0.0053** [0.002247]]	-0.0135*** [0.000945]	0.0012 [0.000875]	-0.0067*** [0.000509]	-0.0039*** [0.000529]
lnp5	-0.0017* [0.00103]	0.0064*** [0.001126]	0.0066*** [0.00099]	-0.0524*** [0.002003]	0.0206*** [0.001453]	-0.0128*** [0.002351]	-0.0037*** [0.001075]	0.0048*** [0.00128]	-0.0137*** [0.00074]	-0.0098*** [0.000778]
lnp6	0.0123*** [0.000703]	0.0080*** [0.000626]	-0.0024*** [0.000474]	-0.0116*** [0.001161]	0.0090*** [0.001013]	0.0042*** [0.001233]	0.0045*** [0.000633]	0.0023*** [0.000818]	0.0039*** [0.000438]	0.0005 [0.000458]
lnp7	-0.0067*** [0.000639]	0.0037*** [0.00064]	-0.0019*** [0.000489]	0.0485*** [0.00146]	0.0055*** [0.001173]	0.0040*** [0.001245]	0.0063*** [0.000653]	-0.0050*** [0.001184]	-0.0031*** [0.000654]	0.0095*** [0.001081]
lnp8	-0.0035*** [0.00053]	0.0044*** [0.000503]	0.0021*** [0.000562]	-0.0029*** [0.000606]	0.0141*** [0.000537]	-0.0168*** [0.001173	-0.0154*** [0.000439]	-0.0047*** [0.000398]	-0.0010*** [0.000222]	-0.0007*** [0.000218]
lnp9	-0.0012*** [0.000207]	-0.0005 [0.000483]	-0.0018*** [0.000253]	0.0013*** [0.000235]	0.0030*** [0.000655]	-0.0012*** [0.000189	-0.0008*** [0.000137]	0.0000 [7.67E-05]	-0.0001 [7.79E-05]	-0.0061*** [0.000873]
lnp10	0.0070*** [0.000323]	0.0033*** [0.000236]	0.0159*** [0.000825]	-0.0144*** [0.000612]	-0.0018*** [0.000623]	-0.0054*** [0.000312]	0.0064*** [0.000755]	-0.0027*** [0.000414]	0.0043*** [0.000533]	0.0073*** [0.000693]
lnp11	0.0023*** [0.000444]	-0.0095*** [0.000438]	0.0111*** [0.000514]	0.0074*** [0.000486]	0.0197*** [0.000944]	0.0031*** [0.000397]	0.0014*** [0.000367]	-0.0005*** [0.0002]	-0.0029*** [0.000221]	-0.0112*** [0.000519]
lnp12	-0.0095*** [0.000438]	-0.0018*** [0.00035]	-0.0010** [0.000458]	-0.0041*** [0.000401]	-0.0093*** [0.000898]	-0.0076*** [0.000331]	-0.0021*** [0.000305]	-0.0008*** [0.000169]	-0.0013*** [0.000183]	-0.0044*** [0.000957]
lnp13	0.0111*** [0.000514]	-0.0010** [0.000458]	0.0012*** [0.000335]	0.0082*** [0.000326]	0.0121*** [0.000975]	-0.0043*** [0.000285]	-0.0026*** [0.000214]	-0.0004*** [0.000118]	-0.0020*** [0.000121]	0.0191*** [0.002426]
lnp14	0.0074*** [0.000486]	-0.0041*** [0.000401]	0.0082*** [0.000326]	-0.0134*** [0.00082]	-0.0030*** [0.000824]	-0.0006 [0.000488]	0.0165*** [0.001032]	-0.0045*** [0.000646]	0.0001 [0.000661]	-0.0034*** [0.00095]
lnp15	0.0197*** [0.000944]	-0.0093*** [0.000898]	0.0121*** [0.000975]	-0.0030*** [0.000824]	-0.0090*** [0.000805]	0.0031*** [0.000411]	-0.0089*** [0.000654]	-0.0040*** [0.000367]	-0.0036*** [0.000408]	-0.0038 [0.002797]
lnp16	0.0031***	0.0076***	-	-0.0006	0.0031***	-	0.0021***	-0.0002	0.0007**	0.0299***

			0.0043***			0.0029***				
	[0.000397]	[0.000331]	[0.000285]	[0.000488]	[0.000411]	[0.000752]	[0.000565]	[0.000312]	[0.000308]	[0.000435]
lnp17	0.0014***	0.0021***	-0.0026***	0.0165***	-0.0089***	0.0021***	0.0031***	-0.0020***	-0.0020***	-0.0020***
	[0.000367]	[0.000305]	[0.000214]	[0.001032]	[0.000654]	[0.000565]	[0.000322]	[0.000178]	[0.000178]	[0.000178]
lnp18	-0.0005***	-0.0008***	-0.0004***	-0.0045***	-0.0040***	-0.0002	-0.0020***	0.0028***	-0.0190***	0.0284***
	[0.0002]	[0.000169]	[0.000118]	[0.000646]	[0.000367]	[0.000312]	[0.000178]	[0.000527]	[0.00066]	[0.000428]
lnp19	-0.0029***	-0.0013***	-0.0020***	0.0001	-0.0036***	0.0007**	-0.0020***	-0.0190***	-0.0029***	0.0295***
	[0.000221]	[0.000183]	[0.000121]	[0.000661]	[0.000408]	[0.000308]	[0.000178]	[0.00066]	[0.000485]	[0.000976]
lnp20	-0.0112***	-0.0044***	0.0191***	-0.0034***	-0.0038	0.0299***	-0.0020***	0.0284***	0.0295***	-0.0090***
	[0.000519]	[0.000957]	[0.002426]	[0.00095]	[0.002797]	[0.000435]	[0.000178]	[0.000428]	[0.000976]	[0.000713]
lnp21	0.0173***	0.0014	-0.0563***	0.0306***	-0.0369***	-0.0137***	0.0067***	0.0218***	0.0186***	-0.0628***
	[0.00102]	[0.001393]	[0.002878]	[0.003197]	[0.003538]	[0.003087]	[0.002092]	[0.002069]	[0.001551]	[0.004719]
lnx	0.0001	0.0059***	-0.0052***	0.0176***	-0.0049***	0.0062***	-0.0012	0.0620***	0.0137***	-0.1256***
	[0.001007]	[0.000739]	[0.00047]	[0.003177]	[0.001574]	[0.001372]	[0.000779]	[0.002649]	[0.002329]	[0.002945]
$(\ln x)^2$	0.0008***	0.0014***	0.0006***	0.0031***	0.0002	0.0011***	0.0002	-0.0019**	0.0047***	-0.0346***
	[0.000254]	[0.000197]	[0.000128]	[0.000865]	[0.000441]	[0.000343]	[0.00021]	[0.000754]	[0.000592]	[0.000821]
$\hat{e}$	0.0070***	0.0079***	0.0009***	0.0006	-0.0026**	0.0072***	0.0094***	-0.0384***	-0.0007	-0.0787***
	[0.000524]	[0.000489]	[0.000322]	[0.000609]	[0.001153]	[0.000664]	[0.000526]	[0.001866]	[0.001185]	[0.002604]
ϕ	0.0211***	0.0222***	0.0138***	0.0392***	0.0551***	-0.0108***	0.0241***	-0.079***	-0.0317***	.
	[0.001250]	[0.001711]	[0.000697]	[0.001881]	[0.009791]	[0.00118]	[0.002634]	[0.004979]	[0.00615]	.
Constant	0.0548***	0.0116***	0.0551***	-0.0060	0.0651***	-0.0287***	0.0147***	0.1826***	0.0098***	0.2393***
	[0.002232]	[0.001772]	[0.001689]	[0.004655]	[0.002884]	[0.003812]	[0.001688	[0.003733]	[0.003184]	[0.003951]
Observations	21265	21265	21265	21265	21265	21265	21265	21265	21265	21265
RMSE	0.0229	0.0209	0.0135	0.035	0.0497	0.0284	0.0226	0.0842	0.0529	0.1182
R-squared	0.7068	0.6451	0.6455	0.3592	0.51	0.2534	0.5343	0.3483	0.6838	0.8188

Source: Authors' computation using CSA's HICES data.
Notes: Robust standard errors in brackets. w1-w21 and lnp1-lnp20 stand for the expenditure (budget) shares and logarithm of 'prices' respectively of teff, wheat, barley, maize, sorghum, 'other cereals', 'processed cereals', 'pulses', 'oil seeds', 'animal products', 'oil and fat', 'vegetables and fruits', pepper, 'enset, kocho, and bula', 'coffee, tea, and chat', 'root crops', 'sugar and salt', 'other food', 'clothing and shoes', 'services' and 'other non-food'. ***, **, and * indicate statistical significance at 1 percent, 5 percent, and 10 percent, respectively. RMSE is root mean square error. The rest of the variables and acronyms are as defined in the text.

Table 9.2: IFGNLS Estimates of the QU-AIDM Parameters – Rural

VARIABLES	w1	w2	w3	w4	w5	w6	w7	w8	w9	w10
lnp1	0.0026	0.018***	-0.0327***	-0.0551***	-0.1018***	0.0281***	-0.0035	0.0345***	0.0019	0.0239***
	[0.01121]	[0.00671]	[0.00555]	[0.00681]	[0.0079]	[0.00492]	[0.00304]	[0.00292]	[0.00134]	[0.00207]
lnp2	0.018***	0.0087	0.0218***	-0.016***	-0.0117*	0.0148***	-0.0013	0.0086***	0.0007	-0.0083***
	[0.00671]	[0.00744]	[0.00455]	[0.00538]	[0.00634]	[0.00379]	[0.00249]	[0.00231]	[0.00093]	[0.0016]
lnp3	-0.0327***	0.0218***	0.1067***	-0.0248***	-0.0363***	0.003	0.0026	-0.0145***	-0.0003	-0.0165***
	[0.00555]	[0.00455]	[0.00557]	[0.00419]	[0.00548]	[0.00353]	[0.00204]	[0.002]	[0.00072]	[0.00182]
lnp4	-0.0551***	-0.016***	-0.0248***	0.2998***	-0.1179***	-0.021***	0.0003	-0.0111***	-0.0056***	-0.0215***
	[0.00681]	[0.00538]	[0.00419]	[0.00817]	[0.00635]	[0.00373]	[0.00251]	[0.00238]	[0.00137]	[0.00134]
lnp5	-0.1018***	-0.0117*	-0.0363***	-0.1179***	0.4363***	-0.0329***	0.0038	0.0312***	0.0028**	-0.0192***
	[0.0079]	[0.00634]	[0.00548]	[0.00635]	[0.01002]	[0.00459]	[0.00289]	[0.00266]	[0.00124]	[0.00184]
lnp6	0.0281***	0.0148***	0.003	-0.021***	-0.0329***	-0.027***	0.0033*	0.0001	0.0018***	0.0212***
	[0.00492]	[0.00379]	[0.00353]	[0.00373]	[0.00459]	[0.00387]	[0.00181]	[0.00165]	[0.00059]	[0.00124]
lnp7	-0.0035	-0.0013	0.0026	0.0003	0.0038	0.0033*	-0.0025	-0.0042***	0.0009*	0.0035***
	[0.00304]	[0.00249]	[0.00204]	[0.00251]	[0.00289]	[0.00181]	[0.00157]	[0.00107]	[0.00047]	[0.00069]
lnp8	0.0345***	0.0086***	-0.0145***	-0.0111***	0.0312***	0.0001	-0.0042***	-0.0006	0.0000	0.002***
	[0.00292]	[0.00231]	[0.002]	[0.00238]	[0.00266]	[0.00165]	[0.00107]	[0.00147]	[0.00049]	[0.00067]
lnp9	0.0019	0.0007	-0.0003	-0.0056***	0.0028**	0.0018***	0.0009*	0.0000	0.0002	0.0011***
	[0.00134]	[0.00093]	[0.00072]	[0.00137]	[0.00124]	[0.00059]	[0.00047]	[0.00049]	[0.00021]	[0.00041]
lnp10	0.0239***	-0.0083***	-0.0165***	-0.0215***	-0.0192***	0.0212***	0.0035***	0.002***	0.0011***	-0.0003
	[0.00207]	[0.0016]	[0.00182]	[0.00134]	[0.00184]	[0.00124]	[0.00069]	[0.00067]	[0.00041]	[0.00043]
lnp11	-0.0222***	-0.0099***	-0.0024**	-0.0087***	0.0048***	0.0102***	0.0008	-0.006***	-0.0006**	0.0072***
	[0.00209]	[0.00098]	[0.00112]	[0.00177]	[0.00161]	[0.00111]	[0.00072]	[0.00075]	[0.0003]	[0.00047]
lnp12	.	0.0071***	0.0101***	0.0014	0.0097***	0.0026**	0.003***	0.0035***	-0.0024***	0.0019***
	.	[0.00177]	[0.00129]	[0.00176]	[0.00192]	[0.00113]	[0.00079]	[0.00075]	[0.00082]	[0.00036]
lnp13	.	-0.0064***	-0.0046***	0.0075***	0.0192***	-0.0053***	0.0011	0.000	-0.0031***	0.0432***
	.	[0.0015]	[0.00107]	[0.00203]	[0.0018]	[0.00093]	[0.00073]	[0.00084]	[0.00095]	[0.00135]
lnp14	.	0.0184***	-0.0157***	0.0028	-0.1454***	-0.0455***	-0.0031	-0.0091***	0.0011***	-0.0123***
	.	[0.00491]	[0.00384]	[0.00467]	[0.00547]	[0.00361]	[0.00211]	[0.00192]	[0.00034]	[0.00093]
lnp15	.	-0.0413***	0.0157***	0.0056***	0.0161***	0.0232***	-0.0057***	0.0153***	0.0021**	-0.0027**
	.	[0.0029]	[0.0021]	[0.00178]	[0.00236]	[0.00176]	[0.00096]	[0.0009]	[0.00101]	[0.00118]
lnp16	.	-0.0015	-0.002	-0.0067	-0.0393***	0.02***	-0.005**	-0.0271***	-0.0005	-0.0056***
	.	[0.00457]	[0.00354]	[0.00459]	[0.00501]	[0.00317]	[0.00206]	[0.00203]	[0.0003]	[0.00041]
lnp17	.	-0.0013	-0.0007	-0.0183***	-0.0075***	0.0048***	0.0058***	-0.0144***	-0.001***	0.0066***
	.	[0.0016]	[0.00119]	[0.00152]	[0.00173]	[0.00102]	[0.00069]	[0.00066]	[0.00023]	[0.00105]
lnp18	.	-0.005*	-0.0066***	0.0025	0.008***	-0.0013	-0.0021**	-0.0081***	0.0002	-0.0051***
	.	[0.00258]	[0.00183]	[0.00154]	[0.00212]	[0.00153]	[0.00084]	[0.00075]	[0.00013]	[0.00062]
lnp19	.	0.0044***	-0.0001	-0.0067***	-0.0146***	-0.0014*	0.0012**	-0.0007*	-0.0002	0.0016*
	.	[0.00162]	[0.00103]	[0.00091]	[0.00128]	[0.00082]	[0.00048]	[0.00044]	[0.00014]	[0.00095]
lnp20	-0.0021	-0.0039***	-0.0057***	-0.006***	-0.0088***	0.0002	0.0008	0.0009**	-0.014***	0.007***
	[0.00135]	[0.00124]	[0.00128]	[0.00109]	[0.00149]	[0.00096]	[0.00148]	[0.00045]	[0.0013]	[0.00084]
lnp21	0.1084***	0.0041***	0.0029**	-0.0005	0.0035***	0.0015	0.0003	-0.0003	0.0149***	-

										0.0275***
	[0.01018]	[0.00112]	[0.00131]	[0.00104]	[0.00127]	[0.00102]	[0.00024]	[0.00048]	[0.00138]	[0.00186]
lnx	0.0036***	0.005***	0.0038***	0.0044***	0.0005	-0.0019***	0.002***	.***	-0.0001	0.0012
	[0.00124]	[0.00138]	[0.00111]	[0.00163]	[0.00117]	[0.00056]	[0.00053]	.	[0.00015]	[0.00118]
$(\ln x)^2$	0.0296***	0.0039	-0.0001	0.0097***	0.0041	-0.0008	-0.0077***	0.0063***	-0.0006	0.018***
	[0.00457]	[0.00428]	[0.00477]	[0.00392]	[0.00547]	[0.00395]	[0.00185]	[0.00175]	[0.00052]	[0.0044]
$\hat{e}$	0.0139***	0.0163***	0.0045**	0.0131***	-0.0061**	0.0019*	0.0043***	0.0068***	0.0006***	0.0253***
	[0.00216]	[0.00273]	[0.00206]	[0.00247]	[0.00293]	[0.00106]	[0.00081]	[0.00135]	[0.00017]	[0.00233]
ϕ	0.0008	0.0149***	0.0527***	0.0156***	-0.0506***	-0.0101***	0.0022	0.0243***	-0.0006*	0.0357***
	[0.00351]	[0.00391]	[0.00369]	[0.00344]	[0.00393]	[0.00221]	[0.00161]	[0.00336]	[0.00037]	[0.00443]
Constant	0.2074***	0.052***	0.0954***	0.1856***	0.0466***	-0.0561***	0.0215***	0.0249***	0.0015	0.0857***
	[0.0162]	[0.01146]	[0.00933]	[0.00944]	[0.01083]	[0.00735]	[0.00408]	[0.00399]	[0.00179]	[0.00619]
Observations	9440	9440	9440	9440	9440	9440	9440	9440	9440	9440
RMSE	0.061	0.0731	0.0569	0.0636	0.0808	0.0303	0.0242	0.0358	0.0048	0.0622
R-squared	0.3997	0.4388	0.2489	0.4876	0.4896	0.2124	0.2015	0.6126	0.1228	0.4583

Source: Authors' computation using CSA's HICES data.

Notes: Robust standard errors in brackets. w1-w21 and lnp1-lnp20 stand for the expenditure (budget) shares and logarithm of 'prices' respectively of teff, wheat, barley, maize, sorghum, 'other cereals', 'processed cereals', 'pulses', 'oil seeds', 'animal products', 'oil and fat', 'vegetables and fruits', pepper, 'enset, kocho, and bula', 'coffee, tea, and chat', 'root crops', 'sugar and salt', 'other food', 'clothing and shoes', 'services' and 'other non-food'. ***, **, and * indicate statistical significance at 1 percent, 5 percent, and 10 percent, respectively. RMSE is root mean square error. The rest of the variables and acronyms are as defined in the text.

Table 9.2 cont'd

VARIABLES	w11	w12	w13	w14	w15	w16	w17	w18	w19	w20
lnp1	-0.0222***	.	.	.	.	.	.	.	.	-0.0021
	[0.00209]	.	.	.	.	.	.	.	.	[0.00135]
lnp2	-0.0099***	0.0071***	-0.0064***	0.0184***	-0.0413***	-0.0015	-0.0013	-0.005*	0.0044***	-0.0039***
	[0.00098]	[0.00177]	[0.0015]	[0.00491]	[0.0029]	[0.00457]	[0.0016]	[0.00258]	[0.00162]	[0.00124]
lnp3	-0.0024**	0.0101***	-0.0046***	-0.0157***	0.0157***	-0.002	-0.0007	-0.0066***	-0.0001	-0.0057***
	[0.00112]	[0.00129]	[0.00107]	[0.00384]	[0.0021]	[0.00354]	[0.00119]	[0.00183]	[0.00103]	[0.00128]
lnp4	-0.0087***	0.0014	0.0075***	0.0028	0.0056***	-0.0067	-0.0183***	0.0025	-0.0067***	-0.006***
	[0.00177]	[0.00176]	[0.00203]	[0.00467]	[0.00178]	[0.00459]	[0.00152]	[0.00154]	[0.00091]	[0.00109]
lnp5	0.0048***	0.0097***	0.0192***	-0.1454***	0.0161***	-0.0393***	-0.0075***	0.008***	-0.0146***	-0.0088***
	[0.00161]	[0.00192]	[0.0018]	[0.00547]	[0.00236]	[0.00501]	[0.00173]	[0.00212]	[0.00128]	[0.00149]
lnp6	0.0102***	0.0026**	-0.0053***	-0.0455***	0.0232***	0.02***	0.0048***	-0.0013	-0.0014*	0.0002
	[0.00111]	[0.00113]	[0.00093]	[0.00361]	[0.00176]	[0.00317]	[0.00102]	[0.00153]	[0.00082]	[0.00096]
lnp7	0.0008	0.003***	0.0011	-0.0031	-0.0057***	-0.005**	0.0058***	-0.0021**	0.0012**	0.0008
	[0.00072]	[0.00079]	[0.00073]	[0.00211]	[0.00096]	[0.00206]	[0.00069]	[0.00084]	[0.00048]	[0.00148]
lnp8	-0.006***	0.0035***	0.0000	-0.0091***	0.0153***	-0.0271***	-0.0144***	-0.0081***	-0.0007	0.0009*
	[0.00075]	[0.00075]	[0.00084]	[0.00192]	[0.0009]	[0.00203]	[0.00066]	[0.00075]	[0.00044]	[0.00045]
lnp9	-0.0006**	-0.0024***	-0.0031***	0.0011***	0.0021**	-0.0005	-0.001***	0.0002	-0.0002	-0.014***
	[0.0003]	[0.00082]	[0.00095]	[0.00034]	[0.00101]	[0.0003]	[0.00023]	[0.00013]	[0.00014]	[0.0013]
lnp10	0.0072***	0.0019***	0.0432***	-0.0123***	-0.0027**	-0.0056***	0.0066***	-0.0051***	0.0016	0.007***
	[0.00047]	[0.00036]	[0.00135]	[0.00093]	[0.00118]	[0.00041]	[0.00105]	[0.00062]	[0.00095]	[0.00084]
lnp11	0.0044***	-0.0088***	0.006***	0.0029***	0.0226***	0.0013***	0.0006	-0.0011***	-0.0038***	-0.0124***
	[0.00057]	[0.00064]	[0.00143]	[0.00063]	[0.00152]	[0.0005]	[0.00052]	[0.00029]	[0.00036]	[0.00071]
lnp12	-0.0088***	-0.0005	-0.0193***	-0.0073***	0.0004	0.004***	0.0013**	-0.0001	-0.0031***	-0.0132***
	[0.00064]	[0.0005]	[0.0015]	[0.0006]	[0.0015]	[0.00046]	[0.00051]	[0.0003]	[0.00036]	[0.00165]
lnp13	0.006***	-0.0193***	0.0042***	0.0079***	0.0097***	-0.0037***	-0.0039***	-0.0006***	-0.0025***	0.1656***
	[0.00143]	[0.0015]	[0.00134]	[0.00056]	[0.00158]	[0.00045]	[0.00039]	[0.00022]	[0.00025]	[0.00645]
lnp14	0.0029***	-0.0073***	0.0079***	-0.0057***	0.0228***	0.0015	0.0178***	-0.0003	-0.0067***	0.012***
	[0.00063]	[0.0006]	[0.00056]	[0.00173]	[0.00374]	[0.00137]	[0.00171]	[0.00103]	[0.00108]	[0.00148]
lnp15	0.0226***	0.0004	0.0097***	0.0228***	-0.0167***	0.004***	-0.0088***	-0.0015**	-0.0027***	0.0021
	[0.00152]	[0.0015]	[0.00158]	[0.00374]	[0.00161]	[0.00055]	[0.00102]	[0.00062]	[0.00084]	[0.00519]
lnp16	0.0013***	0.004***	-0.0037***	0.0015	0.004***	0.006***	0.0052***	0.0015*	0.0003	0.0266***
	[0.0005]	[0.00046]	[0.00045]	[0.00137]	[0.00055]	[0.00132]	[0.00136]	[0.00082]	[0.0009]	[0.00059]
lnp17	0.0006	0.0013**	-0.0039***	0.0178***	-0.0088***	0.0052***	0.0009**	-0.0012***	-0.0031***	-0.0017
	[0.00052]	[0.00051]	[0.00039]	[0.00171]	[0.00102]	[0.00136]	[0.00047]	[0.00027]	[0.00033]	[0.00147]
lnp18	-0.0011***	-0.0001	-0.0006***	-0.0003	-0.0015**	0.0015*	-0.0012***	0.0018***	-0.0179***	0.0244***
	[0.00029]	[0.0003]	[0.00022]	[0.00103]	[0.00062]	[0.00082]	[0.00027]	[0.00067]	[0.00091]	[0.0006]
lnp19	-0.0038***	-0.0031***	-0.0025***	-0.0067***	-0.0027***	0.0003	-0.0031***	-0.0179***	-0.0042***	0.0396***
	[0.00036]	[0.00036]	[0.00025]	[0.00108]	[0.00084]	[0.0009]	[0.00033]	[0.00091]	[0.0007]	[0.00131]
lnp20	-0.0124***	-0.0132***	0.1656***	0.012***	0.0021	0.0266***	-0.0017	0.0244***	0.0396***	-0.005***
	[0.00071]	[0.00165]	[0.00645]	[0.00148]	[0.00519]	[0.00059]	[0.00147]	[0.0006]	[0.00131]	[0.00136]
lnp21	0.0151***	0.0098***	-0.215***	0.1641***	-	0.0212***	0.0188***	0.0126***	0.0207***	-

					0.0601***					0.2064***
	[0.00135]	[0.00233]	[0.00733]	[0.00748]	[0.00692]	[0.00639]	[0.00334]	[0.0032]	[0.00258]	[0.00945]
					-			-		-
lnx	-0.0002	0.0009**	0.0006**	-0.0014	0.0022***	0.0036***	0.0004	0.0046***	0.0000	0.0131***
	[0.00038]	[0.00036]	[0.00024]	[0.00136]	[0.00085]	[0.00098]	[0.00033]	[0.00098]	[0.00081]	[0.00113]
	-		-				-	-		-
$(\ln x)^2$	0.0043***	0.005***	0.0062***	0.0191***	0.0071**	0.0094***	0.0044***	0.0616***	0.0119***	0.1244***
	[0.00151]	[0.00126]	[0.00085]	[0.00444]	[0.0029]	[0.00363]	[0.00112]	[0.00332]	[0.00323]	[0.00385]
								-		-
$\hat{e}$	0.0004	0.0035***	-0.0007	-0.0006	0.0053**	0.0099***	0.0032***	0.0235***	0.0016	0.0641***
	[0.00075]	[0.00095]	[0.0006]	[0.00146]	[0.00236]	[0.0015]	[0.00089]	[0.00254]	[0.00179]	[0.00348]
						-				
ф	0.0209***	0.0079***	0.0185***	0.0089***	0.0367***	0.0137***	0.0303***	0.0025	-0.0091	.***
	[0.00144]	[0.00254]	[0.00099]	[0.00315]	[0.01228]	[0.00232]	[0.00788]	[0.00567]	[0.00814]	.
Constant	0.0603***	0.0117***	0.0779***	0.1024***	0.0376***	-0.0039	0.0314***	0.1954***	0.0173***	0.2188***
	[0.00344]	[0.00296]	[0.00308]	[0.00875]	[0.00523]	[0.00834]	[0.0026]	[0.00524]	[0.00466]	[0.00541]
Observations	9440	9440	9440	9440	9440	9440	9440	9440	9440	9440
RMSE	0.0194	0.0243	0.0153	0.0466	0.0599	0.0403	0.0224	0.0664	0.0472	0.0891
R-squared	0.5049	0.519	0.5756	0.48	0.5496	0.244	0.4577	0.4435	0.6983	0.8609

Source: Authors' computation using CSA's HICES data.
Notes: Robust standard errors in brackets. w1-w21 and lnp1-lnp20 stand for the expenditure (budget) shares and logarithm of 'prices' respectively of teff, wheat, barley, maize, sorghum, 'other cereals', 'processed cereals', 'pulses', 'oil seeds', 'animal products', 'oil and fat', 'vegetables and fruits', pepper, 'enset, kocho, and bula', 'coffee, tea, and chat', 'root crops', 'sugar and salt', 'other food', 'clothing and shoes', 'services' and 'other non-food'. ***, **, and * indicate statistical significance at 1 percent, 5 percent, and 10 percent, respectively. RMSE is root mean square error. The rest of the variables and acronyms are as defined in the text.

Table 9.3: IFGNLS Estimates of the QU-AIDM Parameters – Urban

VARIABLES	w1	w2	w3	w4	w5	w6	w7	w8	w9	w10
lnp1	0.0472*** [0.00634]	0.003 [0.00282]	-0.0074*** [0.00202]	-0.0102*** [0.00305]	-0.0765*** [0.00393]	0.0132*** [0.00235]	-0.0152*** [0.00359]	0.0039** [0.00169]	0.0046*** [0.00091]	0.0146*** [0.00183]
lnp2	0.003 [0.00282]	-0.0027 [0.00249]	0.0046*** [0.00123]	0.0068*** [0.00193]	-0.002 [0.00234]	-0.0092*** [0.00139]	0.0124*** [0.00193]	0.0007 [0.00100]	-0.0006 [0.00048]	-0.0129*** [0.00102]
lnp3	-0.0074*** [0.00202]	0.0046*** [0.00123]	0.0201*** [0.00128]	-0.0013 [0.00132]	-0.0094*** [0.00156]	-0.006*** [0.00094]	0.0065*** [0.00131]	-0.0049*** [0.00074]	-0.0004 [0.00039]	-0.0056*** [0.00071]
lnp4	-0.0102*** [0.00305]	0.0068*** [0.00193]	-0.0013 [0.00132]	0.0886*** [0.00316]	-0.0401*** [0.00260]	0.0046*** [0.00129]	0.0102*** [0.00162]	-0.0087*** [0.00123]	-0.0029*** [0.00077]	-0.0089*** [0.00089]
lnp5	-0.0765*** [0.00393]	-0.002 [0.00234]	-0.0094*** [0.00156]	-0.0401*** [0.00260]	0.106*** [0.00396]	-0.0135*** [0.00169]	0.0011 [0.00231]	0.0188*** [0.00135]	0.0016** [0.00076]	-0.0081*** [0.00118]
lnp6	0.0132*** [0.00235]	-0.0092*** [0.00139]	-0.006*** [0.00094]	0.0046*** [0.00129]	-0.0135*** [0.00169]	-0.0018 [0.00147]	-0.011*** [0.00187]	-0.0043*** [0.00074]	0.0002 [0.00032]	0.0007 [0.00092]
lnp7	-0.0152*** [0.00359]	0.0124*** [0.00193]	0.0065*** [0.00131]	0.0102*** [0.00162]	0.0011 [0.00231]	-0.011*** [0.00187]	-0.0439*** [0.00496]	0.0013 [0.00099]	0.0017*** [0.00042]	-0.0005 [0.00179]
lnp8	0.0039** [0.00169]	0.0007 [0.00100]	-0.0049*** [0.00074]	-0.0087*** [0.00123]	0.0188*** [0.00135]	-0.0043*** [0.00074]	0.0013 [0.00099]	0.0002 [0.00112]	0.0004 [0.00056]	0.0029*** [0.00054]
lnp9	0.0046*** [0.00091]	-0.0006 [0.00048]	-0.0004 [0.00039]	-0.0029*** [0.00077]	0.0016** [0.00076]	0.0002 [0.00032]	0.0017*** [0.00042]	0.0004 [0.00056]	0.0007*** [0.00024]	-0.0011*** [0.00039]
lnp10	0.0146*** [0.00183]	-0.0129*** [0.00102]	-0.0056*** [0.00071]	-0.0089*** [0.00089]	-0.0081*** [0.00118]	0.0007 [0.00092]	-0.0005 [0.00179]	0.0029*** [0.00054]	-0.0011*** [0.00039]	0.0027*** [0.00064]
lnp11	-0.027*** [0.00179]	-0.0001 [0.00057]	-0.0014** [0.00068]	-0.0037*** [0.00099]	0.0005 [0.00119]	0.0059*** [0.00079]	-0.0043*** [0.00096]	-0.0059*** [0.00069]	-0.0027*** [0.00037]	0.0049*** [0.00046]
lnp12	. .	0.0016* [0.00096]	-0.0007 [0.00064]	-0.0162*** [0.00104]	0.0117*** [0.00117]	0.0079*** [0.00066]	0.0057*** [0.00085]	0.0033*** [0.00066]	-0.0005 [0.00056]	0.0029*** [0.00035]
lnp13	. .	-0.0031*** [0.00071]	-0.003*** [0.00050]	0.0025** [0.00105]	-0.0008 [0.00106]	-0.001** [0.00051]	-0.0011* [0.00064]	0.0067*** [0.00074]	-0.0002 [0.00023]	0.0064*** [0.00071]
lnp14	. .	0.0042** [0.00176]	0.0005 [0.00063]	-0.0115*** [0.00086]	-0.0008 [0.00115]	0.001 [0.00091]	0.0293*** [0.00141]	0.0018*** [0.00049]	0.0013*** [0.00029]	-0.0053*** [0.00082]
lnp15	. .	-0.0036** [0.00177]	0.0031*** [0.00080]	0.0082*** [0.00110]	0.0117*** [0.00139]	0.0055*** [0.00103]	-0.0016 [0.00154]	0.0103*** [0.00061]	0.0009 [0.00069]	-0.0012*** [0.00042]
lnp16	. .	0.0017** [0.00087]	0.0015** [0.00062]	0.0029** [0.00131]	0.0058*** [0.00138]	0.0034*** [0.00064]	0.0027*** [0.00076]	-0.0084*** [0.00093]	-0.0006*** [0.00023]	-0.0087*** [0.00056]
lnp17	. .	-0.0038*** [0.00120]	0.0063*** [0.00068]	-0.0136*** [0.00093]	0.0006 [0.00111]	0.0051*** [0.00082]	-0.0039*** [0.00105]	-0.013*** [0.00057]	-0.0006*** [0.00013]	0.0038*** [0.00089]
lnp18	. .	0.0001 [0.00195]	-0.0014*** [0.00051]	-0.0008 [0.00065]	-0.0002 [0.00089]	0.0041*** [0.00076]	-0.005*** [0.00168]	-0.0035*** [0.00036]	-0.0001* [0.00009]	0.0005 [0.00049]
lnp19	. .	0.0032*** [0.00113]	-0.0011*** [0.00027]	-0.0047*** [0.00037]	-0.0059*** [0.00052]	-0.0055*** [0.00042]	-0.0095*** [0.00091]	-0.0009*** [0.00020]	-0.0002** [0.00006]	0.0023*** [0.00046]
lnp20	-0.0083*** [0.00058]	-0.0045*** [0.00036]	-0.0017*** [0.00024]	-0.0035*** [0.00030]	-0.0052*** [0.00044]	-0.0015*** [0.00035]	0.0272*** [0.00138]	-0.0016*** [0.00017]	0.0131*** [0.00126]	0.0229*** [0.00115]

lnp21	0.0582***	0.004***	0.0016***	0.0024***	0.0049***	0.0023***	-0.0021***	0.0007***	-0.0144***	-0.0124***
	[0.00538]	[0.00042]	[0.00027]	[0.00036]	[0.00051]	[0.00041]	[0.00042]	[0.00019]	[0.00127]	[0.00184]
Lnx	-0.0024***	-0.0005	-0.0008	-0.0018**	-0.0008	0.0075***	0.001***	.	-0.0003***	0.0029***
	[0.00055]	[0.00035]	[0.00052]	[0.00073]	[0.00054]	[0.00126]	[0.00026]	.	[0.00011]	[0.00070]
$(lnx)^2$	0.003	-0.0171***	-0.0066***	-0.0114***	-0.0221***	-0.0081***	0.0062***	-0.0041***	-0.0008***	0.0226***
	[0.00180]	[0.00116]	[0.00080]	[0.00093]	[0.00123]	[0.00113]	[0.00208]	[0.00051]	[0.00018]	[0.00147]
$\hat{e}$	0.0336***	0.0092***	0.0016***	-0.0006	-0.0039***	0.0016***	0.0227***	0.0109***	0.0001	0.0217***
	[0.00166]	[0.00092]	[0.00039]	[0.00053]	[0.00065]	[0.00049]	[0.00233]	[0.00054]	[0.00004]	[0.00125]
ф	-0.015***	0.0379***	0.01***	0.0182***	0.0252***	0.0063***	0.0215***	-0.0028	0.0007***	0.0431***
	[0.00308]	[0.00207]	[0.00126]	[0.00116]	[0.00167]	[0.00118]	[0.00720]	[0.00179]	[0.00023]	[0.00431]
Constant	0.2166***	0.0462***	0.0298***	0.0804***	0.0917***	0.028***	0.2009***	0.0343***	0.0031***	0.0277***
	[0.00745]	[0.00415]	[0.00269]	[0.00342]	[0.00415]	[0.00289]	[0.00474]	[0.00198]	[0.00106]	[0.00298]
Observations	11825	11825	11825	11825	11825	11825	11825	11825	11825	11825
RMSE	0.0611	0.0325	0.014	0.0195	0.0239	0.0191	0.0961	0.0188	0.0018	0.0454
R-squared	0.6946	0.408	0.1101	0.4052	0.2731	0.2205	0.422	0.7458	0.0765	0.6192

Source: Authors' computation using CSA's HICES data.
Notes: Robust standard errors in brackets. w1-w21 and lnp1-lnp20 stand for the expenditure (budget) shares and logarithm of 'prices' respectively of teff, wheat, barley, maize, sorghum, 'other cereals', 'processed cereals', 'pulses', 'oil seeds', 'animal products', 'oil and fat', 'vegetables and fruits', pepper, 'enset, kocho, and bula', 'coffee, tea, and chat', 'root crops', 'sugar and salt', 'other food', 'clothing and shoes', 'services' and 'other non-food'. ***, **, and * indicate statistical significance at 1 percent, 5 percent, and 10 percent, respectively. RMSE is root mean square error. The rest of the variables and acronyms are as defined in the text.

Table 9.3 cont'd

VARIABLES	w11	w12	w13	w14	w15	w16	w17	w18	w19	w20
lnp1	-0.027***	.	.	.	.	.	.	.	.	-0.0083***
	[0.00179]	.	.	.	.	.	.	.	.	[0.00058]
lnp2	-0.0001	0.0016*	-0.0031***	0.0042**	-0.0036**	0.0017**	-0.0038***	0.0001	0.0032***	-0.0045***
	[0.00057]	[0.00096]	[0.00071]	[0.00176]	[0.00177]	[0.00087]	[0.00120]	[0.00195]	[0.00113]	[0.00036]
lnp3	-0.0014**	-0.0007	-0.003***	0.0005	0.0031***	0.0015***	0.0063***	-0.0014***	-0.0011***	-0.0017***
	[0.00068]	[0.00064]	[0.00050]	[0.00063]	[0.00080]	[0.00062]	[0.00068]	[0.00051]	[0.00027]	[0.00024]
lnp4	-0.0037***	-0.0162***	0.0025**	-0.0115***	0.0082***	0.0029**	-0.0136***	-0.0008	-0.0047***	-0.0035***
	[0.00099]	[0.00104]	[0.00105]	[0.00086]	[0.00110]	[0.00131]	[0.00093]	[0.00065]	[0.00037]	[0.00030]
lnp5	0.0005	0.0117***	-0.0008	-0.0008	0.0117***	0.0058***	0.0006	-0.0002	-0.0059***	-0.0052***
	[0.00119]	[0.00117]	[0.00106]	[0.00115]	[0.00139]	[0.00138]	[0.00111]	[0.00089]	[0.00052]	[0.00044]
lnp6	0.0059***	0.0079***	-0.001**	0.001	0.0055***	0.0034***	0.0051***	0.0041***	-0.0055***	-0.0015***
	[0.00079]	[0.00066]	[0.00051]	[0.00091]	[0.00103]	[0.00064]	[0.00082]	[0.00076]	[0.00042]	[0.00035]
lnp7	-0.0043***	0.0057***	-0.0011*	0.0293***	-0.0016	0.0027***	-0.0039***	-0.005***	-0.0095***	0.0272***
	[0.00096]	[0.00085]	[0.00064]	[0.00141]	[0.00154]	[0.00076]	[0.00105]	[0.00168]	[0.00091]	[0.00138]
lnp8	-0.0059***	0.0033***	0.0067***	0.0018***	0.0103***	-0.0084***	-0.013***	-0.0035***	-0.0009***	-0.0016***
	[0.00069]	[0.00066]	[0.00074]	[0.00049]	[0.00061]	[0.00093]	[0.00057]	[0.00036]	[0.00020]	[0.00017]
lnp9	-0.0027***	-0.0005	-0.0002	0.0013***	0.0009	-0.0006***	-0.0006***	-0.0001*	-0.0002**	0.0131***
	[0.00037]	[0.00056]	[0.00023]	[0.00029]	[0.00069]	[0.00023]	[0.00013]	[0.00009]	[0.00006]	[0.00126]
lnp10	0.0049***	0.0029***	0.0064***	-0.0053***	-0.0012***	-0.0087***	0.0038***	0.0005	0.0023***	0.0229***
	[0.00046]	[0.00035]	[0.00071]	[0.00082]	[0.00042]	[0.00056]	[0.00089]	[0.00049]	[0.00046]	[0.00115]
lnp11	0.001	-0.0117***	0.0062***	0.0088***	0.0062***	0.0022***	0.0016***	0.0000	-0.0014***	-0.0094***
	[0.00066]	[0.00064]	[0.00058]	[0.00074]	[0.00076]	[0.00064]	[0.00046]	[0.00025]	[0.00023]	[0.00075]
lnp12	-0.0117***	-0.002***	-0.004***	0.0003	-0.0074***	0.0084***	0.001***	-0.0014***	-0.0008***	0.0017***
	[0.00064]	[0.00051]	[0.00044]	[0.00054]	[0.00067]	[0.00049]	[0.00033]	[0.00018]	[0.00016]	[0.00114]
lnp13	0.0062***	-0.004***	0.0028***	0.0064***	0.0086***	-0.0052***	-0.0017***	0.0001	-0.0012***	-0.0093***
	[0.00058]	[0.00044]	[0.00033]	[0.00041]	[0.00101]	[0.00040]	[0.00023]	[0.00013]	[0.00011]	[0.00105]
lnp14	0.0088***	0.0003	0.0064***	-0.0066***	-0.0043***	-0.0053***	0.0005	-0.0013***	-0.0033***	-0.0301***
	[0.00074]	[0.00054]	[0.00041]	[0.00073]	[0.00039]	[0.00051]	[0.00067]	[0.00042]	[0.00026]	[0.00111]
lnp15	0.0062***	-0.0074***	0.0086***	-0.0043***	-0.002***	0.0061***	-0.0053***	-0.0045***	-0.0051***	-0.0094***
	[0.00076]	[0.00067]	[0.00101]	[0.00039]	[0.00050]	[0.00063]	[0.00069]	[0.00038]	[0.00034]	[0.00181]
lnp16	0.0022***	0.0084***	-0.0052***	-0.0053***	0.0061***	-0.005***	-0.0002	-0.0012***	-0.0013***	0.0355***
	[0.00064]	[0.00049]	[0.00040]	[0.00051]	[0.00063]	[0.0005]	[0.0003]	[0.0002]	[0.0001]	[0.0007]
lnp17	0.0016***	0.001***	-0.0017***	0.0005	-0.0053***	-0.0002	0.0044***	-0.0029***	-0.0007***	0.0083***
	[0.00046]	[0.00033]	[0.00023]	[0.00067]	[0.00069]	[0.0003]	[0.00042]	[0.00023]	[0.00020]	[0.00185]
lnp18	0.0000	-0.0014***	0.0001	-0.0013***	-0.0045***	-0.0012***	-0.0029***	0.0021***	-0.0178***	0.0304***
	[0.00025]	[0.00018]	[0.00013]	[0.00042]	[0.00038]	[0.0002]	[0.00023]	[0.00075]	[0.00082]	[0.00060]
lnp19	-0.0014***	-0.0008***	-0.0012***	-0.0033***	-0.0051***	-0.0013***	-0.0007***	-0.0178***	-0.0067***	0.0422***
	[0.00023]	[0.00016]	[0.00011]	[0.00026]	[0.00034]	[0.0001]	[0.00020]	[0.00082]	[0.00050]	[0.00108]
lnp20	-0.0094***	0.0017	-0.0093***	-0.0301***	-0.0094***	0.0355***	0.0083***	0.0304***	0.0422***	-0.0089***
	[0.00075]	[0.00114]	[0.00105]	[0.00111]	[0.00181]	[0.0007]	[0.00185]	[0.00060]	[0.00108]	[0.00095]

lnp21	0.0305***	0.0002	-0.0093***	0.0144***	-0.0161***	-0.0344***	0.0142***	0.0029	0.0185***	-0.088***
	[0.00158]	[0.00174]	[0.00200]	[0.00245]	[0.00283]	[0.0023]	[0.00259]	[0.00250]	[0.00162]	[0.00441]
lnx	0.0024***	0.0023***	0.0005***	0.0006	-0.0014***	0.0002	0.0011***	-0.0005	0.0043***	-0.0329***
	[0.00036]	[0.00024]	[0.00017]	[0.00048]	[0.00049]	[0.00021]	[0.00030]	[0.00125]	[0.00084]	[0.00159]
$(\ln x)^2$	0.0047***	0.0047***	-0.0038***	-0.0015*	-0.0109***	-0.0031***	0.0035***	-0.0574***	-0.0092***	-0.0287***
	[0.00073]	[0.00047]	[0.00035]	[0.00089]	[0.00091]	[0.00049]	[0.00057]	[0.00219]	[0.00157]	[0.00274]
ê	0.0131***	0.0099***	0.0035***	0.0000	-0.0039***	0.002***	0.0107***	-0.0419***	-0.0041***	-0.0874***
	[0.00068]	[0.00049]	[0.00034]	[0.00018]	[0.00106]	[0.00036]	[0.00063]	[0.00260]	[0.00163]	[0.00345]
ф	-0.005**	0.0022	0.0003	0.0226***	-0.0021	0.0097***	-0.0066***	-0.0688***	0.0069	.
	[0.00237]	[0.00197]	[0.00115]	[0.00093]	[0.01207]	[0.00100]	[0.00249]	[0.01052]	[0.00948]	.
Constant	0.0222***	0.0133***	0.0344***	0.0115***	0.0875***	0.0053**	0.0121***	0.1157***	0.0328***	0.1642***
	[0.00236]	[0.00170]	[0.00178]	[0.00235]	[0.00246]	[0.00238]	[0.00180]	[0.00352]	[0.00237]	[0.00333]
Observations	11825	11825	11825	11825	11825	11825	11825	11825	11825	11825
RMSE	0.0239	0.017	0.0118	0.0081	0.037	0.012	0.0222	0.0953	0.0563	0.128
R-squared	0.7806	0.7668	0.7155	0.361	0.4941	0.3875	0.6006	0.3146	0.6844	0.824

Source: Authors' computation using CSA's HICES data.
Notes: Robust standard errors in brackets. w1-w21 and lnp1-lnp20 stand for the expenditure (budget) shares and logarithm of 'prices' respectively of teff, wheat, barley, maize, sorghum, 'other cereals', 'processed cereals', 'pulses', 'oil seeds', 'animal products', 'oil and fat', 'vegetables and fruits', pepper, 'enset, kocho, and bula', 'coffee, tea, and chat', 'root crops', 'sugar and salt', 'other food', 'clothing and shoes', 'services' and 'other non-food'. ***, **, and * indicate statistical significance at 1 percent, 5 percent, and 10 percent, respectively. RMSE is root mean square error. The rest of the variables and acronyms are as defined in the text.

Table 10 – Households with zero expenditure, by commodity group

Commodity Group	Households with zero expenditure (%)
Teff	33.7
Wheat	22.5
Barley	50.3
Maize	37.3
Sorghum	47.6
Other Cereals	64.3
Processed Cereals	21.1
Pulses	4.7
Oil-Seeds	75.1
Animal-Products	11.1
Oils and Fats	11.6
Fruits and Vegetables	3.6
Pepper	10.4
Enset/Kocho/Bulla	82.6
Coffee/Tea/Chat	0.6
Root Crops	27.1
Sugar and Salt	1.6
Other Food	4.9
Clothing and Shoes	3.2
Services	0.0
Other Non-food	0.1
Total	24.4

Source: Authors' computation using HICES data.
Notes: The figures in the second column are the fraction of the sample households who reported no expenditure on the respective commodity group during the survey period.

Table 11: Commodity Groups

Other Cereals	Processed	Pulses	Oilseeds	Animal	Oils and Fats
Finger millet	Spaghetti	Horse beans	Niger seed	Beef	Butter
Rice	Past	Chick peas	Linseed	Mutton	Edible oil
Oats/'Aja'	Maccaroni	Peas	Sesame	Chicken	Ground nuts
Others	Injera	Lentils	Sunflower	Pork	
	Bread	Haricot beans	Castor beans	Canned meat	
	Cakes	Vetch	Ground nuts	Goat meat	
	Porridge	Fenugreek	Others	Birds	
	Others	Soya-bean		Wild animals	
		Others		Offal	
				Fish	
				Milk	
				Yoghurt	
				Eggs	
				Honey	
				Others	

Fruits and Vegetables	Pepper	Enset/ kocho/bulla	Coffee/	Root crops	Sugar and
Ethiopian kale	Pepper whole	Kocho	Coffee	Potato	Sugar
Cabbage	Pepper flour	Bulla	Tea	Sweet potato	Salt
Lettuce	Pepper sauce	Kocho pancake	Chat	Anchote	
Spinach			Others	Cassava	
Carrot				Others	
Tomato					
Onions					
Garlic					
Banana					
Orange					
Avocado					
Others					

Other foods	Clothing and shoes	Services	Other non-foods
Spices like:	Clothing	Milling charges	Cigarettes
Corriander	Shoes	Rent	Construction
Cinnamon		Transportation costs	Bricks
Cloves etc.		Salary for servants	Water pipe
Processed foods like:		Medical expenses	Corrugated
Lazanga		Schooling related	Door set
Burger/sandwich		Registration fee	Paints etc
Halawa		Tution fee etc.	Furniture like:
'Key wot'		Others	Tables
'Tibs'			Chairs
'Minchitabish' etc.			Sofas
Beverages like:			
Coca cola family			
Pepsi family			
Mineral water etc.			
Juices			
Alcholic drinks like:			
Cognac			
Brandy			
Gin			
Katikala etc.			
Others			

APPENDIX II: DERIVATION OF ELASTICITY OF DEMAND FOR QU-AIDM

Recall that the i[th] budget share equation for the QU-AIDM is given by:

$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln\left[\frac{x}{a(\mathbf{p})}\right] + \frac{\lambda_i}{b(\mathbf{p})}\left\{\ln\left[\frac{x}{a(\mathbf{p})}\right]\right\}^2$$

where:

$$\ln a(\mathbf{p}) = \alpha_0 + \sum_{k=1}^{n} \alpha_k \ln p_k + \frac{1}{2}\sum_{k=1}^{n}\sum_{j=1}^{n} \gamma_{kj} \ln p_k \ln p_j$$

$$b(\mathbf{p}) = \prod_{k=1}^{n} p_k^{\beta_k}$$

and *p* and *x* stand for prices and total expenditure, respectively.

Price elasticities

Since $w_i = \frac{p_i q_i}{m}$, the uncompensated own-price and the cross-price elasticities respectively are:

$$\varepsilon_{i,p_i} = \frac{1}{w_i}\left\{\gamma_{ii} - \left\langle\left(\alpha_i + \sum_{k=1}^{n} \gamma_{kj} \ln p_k\right)\left[\beta_i + \frac{2\lambda_i}{b(\mathbf{p})}(\ln x - \ln a(\mathbf{p}))\right] + \frac{\beta_i}{b(\mathbf{p})}\lambda_i\left[\ln x - \ln a(\mathbf{p})\right]^2\right\rangle\right\} - 1$$

$$\varepsilon_{i,p_j} = \frac{1}{w_i}\frac{p_i}{p_j}\left\{\gamma_{ij} - \left\langle\left(\alpha_j + \sum_{k=1}^{n} \gamma_{kj} \ln p_k\right)\left[\beta_i + \frac{2\lambda_i}{b(\mathbf{p})}(\ln x - \ln a(\mathbf{p}))\right] + \frac{\beta_j}{b(\mathbf{p})}\lambda_i\left[\ln x - \ln a(\mathbf{p})\right]^2\right\rangle\right\}$$

Corresponding compensated price elasticities are:

$$\tilde{\varepsilon}_{i,p_i} = \varepsilon_{i,p_i} + \varepsilon_{i,x} w_i$$
$$\tilde{\varepsilon}_{i,p_j} = \varepsilon_{i,p_j} + \varepsilon_{i,x} w_j$$

Expenditure elasticities

Similarly, the expenditure elasticity of demand for commodity *i* (q_i) is given by:

$$\varepsilon_{i,x} = \frac{x}{q_i}\frac{\partial q_i}{\partial x} = \frac{1}{w_i}\left\{\beta_i + \frac{2\lambda_i}{b(\mathbf{p})}\ \ln x - \ln a(\mathbf{p})\right\} + 1$$

A note on unit values

Since $w_i = \frac{u_i q_i}{x}$, where u_i is the unit value of commodity *i*, we have:

$$q_i = \frac{w_i x}{u_i}$$

such that:

$$\frac{\partial q_i}{\partial x} = \frac{\partial (w_i x / u_i)}{\partial x} = \frac{\partial w_i}{\partial \ln x} \frac{1}{u_i} + \frac{w_i}{u_i} - \frac{\partial u_i}{\partial \ln x} \frac{w_i}{u_i^2}$$

Then:

$$\varepsilon_{i,x} = \frac{x}{q_i} \frac{\partial q_i}{\partial x} = \frac{1}{w_i} \frac{\partial w_i}{\partial \ln x} + 1 - \frac{1}{u_i} \frac{\partial u_i}{\partial \ln x}$$

Since $\frac{\partial \ln z}{\partial \ln y} = \frac{\partial \ln z}{\partial z} \frac{\partial z}{\partial \ln y} = \frac{1}{z} \frac{\partial z}{\partial \ln y}$:

$$\begin{aligned} \varepsilon_{q_i,x} &= \frac{\partial \ln w_i}{\partial \ln x} + 1 - \frac{\partial \ln u_i}{\partial \ln x} \\ &= \varepsilon_{s_i,x} + 1 - \varepsilon_{u_i,x} \end{aligned}$$

Thus, according to the approach developed by Deaton, the use of unit values necessitates the adjustment of expenditure elasticity of quantity demanded to account for the ‘quality’ elasticity of the commodity’s unit value.

Table 12: Estimated Quality (or expenditure) Elasticity of Unit Values

Commodity	Coefficient	Standard Error	t	P-value	95% Confidence Interval	
Teff	0.035	0.004	9.850	0.000	0.028	0.042
Wheat	0.035	0.004	8.580	0.000	0.027	0.043
Barley	-0.002	0.007	-0.330	**0.742**	-0.017	0.012
Maize	-0.006	0.004	-1.590	**0.112**	-0.013	0.001
Sorghum	-0.018	0.004	-4.370	0.000	-0.026	-0.010
Other Cereals	0.036	0.010	3.630	0.000	0.016	0.055
Processed Cereals	0.088	0.007	13.460	0.000	0.075	0.101
Pulses	0.053	0.004	12.370	0.000	0.045	0.062
Oil-Seeds	-0.009	0.007	-1.260	**0.210**	-0.024	0.005
Animal-Products	0.095	0.010	9.190	0.000	0.075	0.115
Oils and Fats	0.067	0.005	13.080	0.000	0.057	0.076
Fruits and Vegetables	0.148	0.007	19.930	0.000	0.133	0.162
Pepper	0.006	0.003	1.900	**0.058**	0.000	0.011
Enset/Kocho/Bulla	0.106	0.017	6.150	0.000	0.072	0.140
Coffee/Tea/Chat	0.026	0.006	4.170	0.000	0.014	0.038
Root Crops	0.040	0.005	8.780	0.000	0.031	0.049
Sugar and Salt	0.172	0.008	22.560	0.000	0.157	0.187
Other Food	0.093	0.010	9.530	0.000	0.074	0.113
Clothing and Shoes	0.518	0.017	30.000	0.000	0.484	0.552
Services	1.181	0.022	53.580	0.000	1.138	1.225
Other Non-food	1.939	0.040	48.990	0.000	1.861	2.017

Source: Authors' computation using HICES data and the estimation procedure in Deaton (1997).