NASS Journal of Agricultural Sciences
https://ojs.nassg.org/index.php/njas

ARTICLE

Asymmetric Impacts of Rising Food Prices on Household Welfare in South West Ethiopia

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ARTICLE INFO

Article history
Received: 23 February 2022
Revised: 16 May 2022
Accepted: 27 May 2022
Published Online: 6 June 2022

Keywords:
Censoring
Elaticities
Welfare
QUAIDS
CV
Simulation

ABSTRACT

Food price inflation is pervasive effects to household welfare and macroeconomy. The study estimated Quadratic Almost Ideal Demand system of six food groups to simulate money costs of food prices inflation on households' welfare and predict relative potency of income and price policies to counteract the effects in a particular context of South West Ethiopia. It drew on Household Income and Consumption Expenditure Survey data of 519 households collected by the Central Statistical Authority of Ethiopia. While response to income change of households is commodity specific, the rural dwellers respond more than urban counterparts to price changes. The welfare losses due to higher food prices fall heavily more on urban households than rural counterparts. On average, it requires resource allocation as large as percentage increases in prices which could be achieved through a mix of price and income policies to keep households' welfare at pre-price change level.

1. Introduction

Food prices will remain a topical issue of Least Developing Countries (LDCs) so long as food dominates budget of households [1-6]. Higher prices signal deficiency in supply to counterbalance demand side factors. Higher future population entails the challenge for feeding in the light of urbanization. Economic growth leads to diversification in nutritional diets and higher demand for high value food staffs [3,7]. The dynamic shifts in consumer preferences towards high value foods coupled with shocks such as drought will exacerbate deficiency in staple foods. The rise in inequality concomitant to income growth means that the rich afford both high value foods and staples while the poor cannot.

A higher food price implies a lower real income and a lesser consumption bundle limiting substitution of cheaper staples for preferable ones. Also, the poor have to compromise other life essentials [8] to be able to acquire minimum calory intake. The less diversified diet leads to deficiency

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DOI: http://dx.doi.org/10.36956/njas.v4i2.494

in nutritional intake pervasive to household welfare [3]. For instance, the financial crises and food price surge of 2008 derived 175 million people worldwide into hunger and undernourishment [3]. The monthly report by Central Statistical Authority (CSA) shows that food prices have been increasing over the recent years by close to 40% a year and the burden of the price upsurge falls heavily on vulnerable poor households who spend nearly 80% of expenditure on foodstuff ① [6].The pervasive effects spill over to the macro-economy as social and political instability [2].

Food prices have attracted the attention of academics and practitioners for their asymmetric effects across different spectrums of livelihoods. i) Higher food prices are a blessing for net producers while it hurts net buyers [1,2,4,5]. Over the long run, higher prices have the potential to benefit rural households if it is incentive enough by turning them into net sellers [9]. ii) The negative effects are disproportionately borne owing to household characteristics such as headships, education, sex, age, residence location. The poor households are the most adversely affected group [1,5,6,10] due to deprivations of resources such as land, employment, and asset, etc. iii) welfare effect of price changes varies based on the weight of commodities in the budget of the household [1,4].

The current study shares the same motives with previous studies on Ethiopia and elsewhere to quantify the welfare cost of higher food prices but, in a particular context of Southwest Ethiopia. Capitalizing on the responses of consumers to changes in the economic environment, the research adds to the current body of knowledge in three ways :

First, it applied the current state-of-the-art framework known as Quadratic Almost Ideal Demand System (QUAIDS) by using Non-Linear Seemingly Unrelated Regression (NLSUR) to estimate food demand systems. The model helps to test the nonlinear curvature in food demand systems and the estimator imposes theoretic restrictions simultaneously controlling for censoring and endogeneity. Second, theoretic consistent elasticities provide insights into the potency of income and price policies to keep households well off in the event of price changes. Third, based on the second-order approximation, the study simulated Compensating Variations (CV) to establish discriminatory effects of higher food prices across different clusters of households.

Following the introduction, section two presents a review of recent literature. The third section presents the methodology applied to estimate elasticities and compute welfare effects. Section four discusses the results. Section five concludes along with policy implications.

2. Review of Literature

Demand elasticities are powerful tools for capturing adjustment in food consumption patterns that follow shocks to the budget constraints of households and quantifying the resulting welfare impact [11]. Once estimated, the welfare measure is used to establish nutritional deficiency and food security of households. Elasticity estimates also provide information that guides interventions to mitigate pervasive effects of price increases. Higher-income elasticity than price counterpart provides evidence for the more likely scope of income policy to achieve welfare outcomes [1,2,4,6,9,11,12].

Reliable estimates are likely to come from a system of demand functions that measure the household behavioral responses while simultaneously capturing heterogeneity in household characteristics. Unbiased and consistent measurements make results transferable [2]. However, there is an acute dearth of literature providing consistent elasticity estimates even at the continental level [7]. By a systematic review of empirical studies on food demand in Africa, observed high heterogeneity in income elasticities across countries, which could be partly an estimation issue. They highlighted the need for more country-specific studies supported with state-of-the-art methodologies to better inform agricultural and food policies. There are variant functional forms of demand models with desirable qualities dictated by demand theory.

One of contemporary the state of art frameworks is the Quadratic Almost Ideal Demand System (QUAIDS) pioneered by Banks et al. [13]. It is an improvement over the Almost Ideal Demand System (AIDS) of Deaton and Muellbauer [14] after the latter failed to take account of non-linearity between food consumption and income. Moreover, QUADS has an exceptional quality of functional flexibility for obtaining luxuries (or necessities) goods for different income levels [2,3,11]. The framework is the best fit for a cross-sectional study based on low-income countries and is used for current study.

Many authors had drawn impressive results for different countries based on the QUADS. Prifti et al. [10] measure welfare impact on households in Lesotho by simulating prices of maize by 20%, 40%, and 60% and determine that it costs incomes amounting to 8.8%, 15.5%, and 20.3% respectively to keep consumption at the pre-shock level. They conclude that households need 40% more income to stay well off for every one percent increment in the price of maize during 2015/16.

Mbegalo et al. [2] quantifies that 22% food price infla-

① Visit https://tradingeconomics.com/ethiopia/inflation-cpi & the agency's web tion during the 2008-2012 years in Tanzania costs 11% of incomes of both the poor and middle classes and 8% that of rich households.

In India, 10 percent higher food prices derived nearly 5% rural and 2% urban households into poverty, amounting to 6% and 4% income loss respectively [3]. Besides, the author showed that both welfare and poverty effects get double when stimulated for a 20 percent price increment. Adekunle et al. [1] corroborate this finding that rural households are more vulnerable as there are more productive job opportunities in urban than rural areas. Moreover, Quentin et al. [4] showed that dominant food items in the budget of households determine poverty and welfare effects. By simulating the prices by 10 percent and 40 percent, rural households were worse hit by cereals and roots crops while animal products and vegetables severely affected urban counterparts.

Adekunle et al. [1] examine the welfare effects of food prices inflation on Nigerian households employing direct and indirect approaches. Second-order effects show that overall price rose by 2.38% between 2010 and 2016 and reduced Nigeria's net buyers' mean annual expenditure by 2 percentages while it increased net sellers' real income by 1.58%. According to first-order estimates, for a 1% increase in the price of cereals, an increase of 1.84% in the household income is required to allow individuals to enjoy real welfare.

Attanasio et al. [5] estimate that the average rural household in Mexico lost about 20% of food expenditure to higher food prices during 2011 alone, which reduces to 16% and 14% respectively when households are compensated with 50 Peso per week and 5% price subsidy. In rural Ethiopia, the poor are the worst adversely affected group by food inflation and the impact dies out as one jump to higher income group [6].

Akbari et al. [8] measure the welfare effects on Iranian urban households of 47 percent food price inflation between 2009/10-2011/12 as 49.9 percent food expenditure to keep households consumption at pre-price shock level.

3. Materials and Methods

Quadratic Almost Ideal Demand System

One way to express expenditure function of QUAIDS is ②:

$$\ln e(p,u) = \ln a(p) + \frac{b(p)U}{1-U\lambda(p)} \quad (1)$$

where $\ln a(p)$ is a transcendental price index given by:

$$\ln a(p) = \alpha_0 + \sum_{i=1}^{n} \alpha_i \ln P_i + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} \gamma_{ij} \ln P_i \ln P_j \quad (2)$$

b(*p*) *is* Cob- *Douglass price aggregator defined as :*

$$b(p) = \prod_{i=1}^{n} P_i^{\beta_i} = \exp\left(\sum_i \beta_i \ln P_i\right) \quad (3)$$

$\lambda(p)$ = is a differentiable, homogenous function

$\lambda(p) = \sum_i^n \lambda_i \ln P_i$

where

$$\sum_i^n \lambda_i = 0 \quad (4)$$

U is utility & p is a set of prices and the subscript $i = 1,....n$ denotes the number of food groups in the demand system.

Applying Shephard's lemma to (1) and substituting for U in the indirect utility function obtain expression for the QUAIDS:

$$w_i = a_i + \sum_{i=1}^{n} \gamma_{ij} \ln P_j + \beta_i \ln\left(\frac{m}{a(P)}\right) + \frac{\lambda_i}{b(p)} \ln\left(\frac{m}{a(p)}\right)^2 + \varepsilon_i \quad (5)$$

where w_i is the expenditure share for the i^th^ food, a_i, Y_{ij}, β_i and λ_i are the parameters to be estimated; a_i is the constant coefficient in the i th share equation, Y_{ij} is the slope coefficient associated with the j^{th} good in the i th share equation, P_j is the price of the j^{th} good, and m is the total expenditure on the system of foods; and ε_i is error term.

Demographic variables enter the system of budget share equations via a_i as intercept terms ③:

$$w_i = a_i + \sum_{j=1}^{k} \delta_{ij} D_j + \sum_{i=1}^{n} \gamma_{ij} \ln P_j + \beta_i \ln\left(\frac{m}{a(P)}\right) + \frac{\lambda_i}{b(p)} \ln\left(\frac{m}{a(p)}\right)^2 + \varepsilon_i \quad (6)$$

where δ_i and δ_{ij} are parameters to be estimated and D_j is socio-demographic variables. Theoretical restrictions are given as follows:

Adding up of budget shares requires ($\sum_{i=1}^{n} w_i = 1$):

$$\sum_{i=1}^{n} \alpha_i = 1; \sum_{j=1}^{k} \delta_{ij} = 0 \sum_{i=1}^{n} \gamma_{ij} = \sum_{i=1}^{n} \beta_i = \sum_{i=1}^{n} \lambda_i \quad (7)$$

Homogeneity of zero degree in price:

$$\sum_{i=1}^{n} \gamma_{ij} = 0 \quad (8)$$

And

Slutsky symmetry: $Y_{ij} = Y_{ji}$ (9)

Two econometric issues have to get dealt with before estimation: one is censored demand equations attributed to zero consumption, which leads to corner solution. Zero consumption arises due to factors such as non-preference, non-affordability, purchase infrequency, non-availability, and self-consumption during the recall period of the sur-

② where $\log U = \frac{\log X}{b(p) + \lambda(p)\log X}$ is indirect utility function of *quadratic logarithmic budget share systems when* $\log X = \frac{b(p)U}{1-U\lambda(p)}$

③ Where $ai = ai + \sum_{j=1}^{k} \delta_{ij} D_j$ and $\sum_{j=1}^{k} \delta_{ij} = 0$

vey [11,15,16]. If not accounted for, regressing the censored QUADS model yields biased coefficients.

Shonkwiler et al. [17] propose a two-step econometric technique for handling censoring problem as described below: the first step obtains consistent estimates for d_i; the probability that a household consumes the food item by using probit model. Denote ф(.) and ϕ (.) respectively for the cumulative and density functions of standard normal distribution to derive expectation for observed budget share as:

$$W_i^* = \Phi(\mathcal{Z}_i' d_i) W_i + \varphi\phi(\mathcal{Z}_i' d_i) \quad (10)$$

where **z**s are observed characteristics. The second step replaces d_i with estimates to recover the parameters of demand system.

The second is endogeneity, which warrants attention here because expenditure may be correlated with unobserved variables in budget share equations or jointly determined with the budget shares [13,18] and results in biased and inconsistent parameter estimates [19,20]. To deal with endogeneity issue, censored demand system is augmented by residuals from reduced form expenditure model as below:

$$W_i^* = \Phi(\mathcal{Z}_i'\alpha_i)\left\{\alpha_i + \sum_{j=1}^{k}\delta_{ij}D_j + \sum_{i=1}^{n}\gamma_{ij}lnP_j + \beta_i ln\left(\frac{m}{a(P)}\right) + \frac{\lambda_i}{b(p)}ln\left(\frac{m}{a(p)}\right)^2 + \sum\tau\acute{v}_i\right\} + \delta_i\varphi\phi(\mathcal{Z}_i'\alpha_i) \quad (11)$$

Demand Elasticities

By differentiating (14) with respect to lnm and ln P_j , for using afterwards to determine respectively expenditure and price elasticities, we get the following:

$$\epsilon_i = \frac{\partial w_i^*}{\partial lnm} = \Phi(\mathcal{Z}_i'\alpha_i)\left(\beta_i + \frac{2\lambda_i}{b(p)}\left\{ln\left[\frac{m}{a(P)}\right]\right\}\right) \quad (12)$$

$$\epsilon_{ij} = \frac{\partial w_i^*}{\partial lnp_j} = \Phi(\mathcal{Z}_i'\alpha_i)\left\{\gamma_{ij} - \epsilon_i\left(\alpha_j + \sum_{i=1}^{n}\gamma_{jk}lnP_k\right) - \frac{\lambda_i}{b(p)}\left\{ln\left[\frac{m}{a(P)}\right]\right\}^2\right\} \quad (13)$$

where P_k, *a price index is* calculated as the arithmetic mean of prices for all *k* food groups. Then, conditional expenditure elasticities are written as,

$$E_i = \frac{\epsilon_i}{w_i^*} + 1$$

and the conditional Marshallian price elasticities are derived as,

$$E_{ij}^{u} = \frac{\epsilon_{ij}}{w_i^*} - \vartheta_{ij},$$

where ϑ_{ij} is Kronecker delta defined as $\vartheta_{ij} = \begin{cases} 1\ for\ i = j \\ 0\ otherwise \end{cases}$.

Using the Slutsky equation allows us to derive, the conditional Hicksian (compensated) price elasticities as $E_{ij}^{c} = \frac{\epsilon_{ij}}{w_i^*} + E_i w_i^*$.

Hicksian price elasticities measure the response of a particular quantity of a commodity as price changes for a constant level of utility while the Marshallian price elasticities do the same for a constant level of income.

Welfare measures

Compensating variation was computed in a bid to quantify welfare effects of price hikes. The compensating variation is money transfer needed to compensate the consumers for the price changes so as to restore them to pre-shock positions.

Let Pc_{t-1}, M_{t-1} and U_{t-1} respectively denote vector of prices and money income and utility level before price changes: Pc_t and M_t represent respectively vector of prices and money incomes after price changes, and e_{t-1}, and e_t respectively denote expenditure functions before and after price changes. The compensation variation at time t is expressed in terms of expenditure function as,

$$CV = e(Pc_t, U_{t-1}) - e(Pc_{t-1}, U_{t-1}) \quad (14)$$

Positive value indicates reduction in consumer welfare and vice versa for negavie.. The second order Taylor expansion ④ of the minimum expenditure function is given as:

$$\Delta\, lne_{it} = \sum_i w_{it}\,\Delta\, lnp_{it} + \frac{1}{2}\sum_i\sum_i \varepsilon_{ij}^{c} w_{it}\,\Delta\, lnp_{it}\,\Delta\, lnp_{jt} \quad (15)$$

where P_{it} is vector of consumer are prices at time t; W_i is the budget share; ε_{it}^{c} is the conditional compensated price elasticity of commodity i with respect to the price change of good j; and Δsymbol stands for the variation between before and after shock period.

Data Sources and Descriptive statistics

The study used Household Income and Expenditure Survey (HIES) data collected by the Central Statistical Authority (CSA) of Ethiopia during 2016/2017. The data consist of information on various quantities of household consumables including non-food items; consumption expenditures and household demographics. The CSA's data covered a representative sample of 30,229 households nationally. After cleaning the original data of potential outlier observations, it draws on consistent data of

④ The first term of the right had expression denote the first order Taylor expansion

519 households for the South West region of which 296 of them are rural. ⑤ Back in 2016/16, the region consists of three zones Bench Maji zone consists of 265 households; Kaffa 132 (only rural) and Sheka Zones consist of 132 and 122 households respectively.

The CSA data on consumables were grouped into two distinct components: food and non-food items. The non-food groups include consumables such as housing, clothing, education, health, transport, and recreation. There are 18 food sub-groups according to CSA classifications making it difficult to analyze the demand for each commodity group. The decision to construct commodity groupings is left to the discretion of researchers and consequently is made on an ad-hoc basis as there is no theoretical basis [1]. However, for ease of practical and computational reasons, previous studies [6,9,11] were consulted and food commodities were classified into six groups: cereals, pulses and oils, root crops, fruits, and vegetables, animal products and other groups [11]. Nevertheless, aggregating food items into groups make it difficult to compute the prices of aggregated bundles. As a result, unit values calculated by dividing the purchase value by quantity were used despite the limitations that they might contain measurement errors, hide quality differences, reflect non-linear price quantity relations due to prices homogeneity [3,5,6]. For each food commodity group, the prices indices are computed as weighted means of commodities in that group, the weights being the mean budget shares of each item.

As shown in Table 1 cereals followed by other foods groups dominate the consumption patterns in the region. To urban dwellers, animal products and pulses and oils are preferred to fruits & vegetables to root crops while rural residents consume more quantities of pulses and oils, root crops, and fruits & vegetables than animal products.

⑤ Bench-Maji zone was dissolved into Bench-Sheko & Maji zones recently.

4. Results and Discussions

After making corrections for zero consumption in systems of demand equations and endogeneity in expenditure and household demographics, the QUADS was estimated using [21] nlsur. The estimator imposes theoretical restrictions such as symmetry, adding up, and homogeneity of QUADS mentioned in the last section. The different structural parameters for expenditure, expenditure square, and prices, demographic and instrumental variables are reported along with their p-values in Table A1 (Appendix). The statistical significance of most of the coefficients indicates that the commodity expenditure shares are responsive to prices and income and the household demographic variables included in the model.

An increase in own prices reduce quantities consumed of all food groups while that of cross price reduces and increases the quantity of others respectively for substitute and complimentary foods.

The significant coefficients for squared expenditure provide evidence in support of QUADS specification whereas the positive and negative sign of the expenditure and its square respectively indicate the property of Engle's curve; the consumption rises first and then fall as income increases consistently with that found by Mbegalo et al. [2] for rural Tanzania. Statistical significances of linear, square, and cubic terms of the residuals show the relevance of the instruments for controlling endogeneity.

Table 1. Food budget shares and proportion of zero expenditures(in brackets) by category

Items	Rural				Urban		
	Bench-Maji*	Kaffa	Sheka	Total	Bench-Maji	Sheka	Total
Cereals	0.34 (0.01)	0.17 (0.04)	0.17 (0.12)	0.22 (0.04)	0.35 (0.06)	0.11 (0.07)	0.28 (0.03)
Pulses & oils	0.11 (0.12)	0. 19 (0.27)	0.16 (0.09)	1.16 (0.08)	0.14 (0.14)	0.13 (0.04)	0.14 (0.12)
Root crops	0.10 (0.32)	0.16 (0.12)	0.17 (0.27)	0.14 (0.21)	0.03 (0.22)	0.16 (0.25)	0.07 (0.28)
Fruits & vegetables	0.18 (0.03)	0.11 (0.02)	0.15 (0.05)	0.14 (0.03)	0.13 (0.08)	0.11 (0.03)	0.13 (0.07)
Animal products	0.11 (0.46)	0.11 (0.75)	0.15 (0.27)	0.11 (0.47)	0.14 (0.34)	0.23 (0.26)	0.16 (0.32)
Other foods	0.16 (0.10)	0.26 (0.08)	0.19 (0.02)	0.20 (0.01)	0.20 (0.006)	0.23 (0.00)	0.20 (0.50)

Source: author's computation from CSA data

Larger family size is associated with higher consumptions of animal products and other food groups whereas it negatively influences demand for cereals, pulses & oils andd root crops. The positive association between household size and consumption of animal products is consistent with that obtained by Tefera et al. [6].

Headship difference in sex significantly affects the consumption of four food groups. For a rural community, head age increment is associated with a reduction in consumption of animal food and other foods and a rise in that of cereals. Across the three groups, there is a visible difference in consumption patterns due to residence between Bench Maji, Kaffa, and Sheka zones for most of the food groups.

Demand Elasticities

The marginal elasticities only represent quantity responses to changes in prices, incomes, and other determinants and consequently do not help to establish welfare effects of price changes. Representative expenditure and price elasticities have to be estimated at means of sample data for they are more certain than marginal changes. These are discussed in this section.

From Table 2 it can be seen that all food items across the three groups are normal goods as indicated by positive and significant coefficients. Animal products and other food are luxury items consistent with many previous studies [1,2,6,9]. The fact that consumption increases with income are an indication that households had yet not achieved desired quantities of the two food groups. The demand for pulses & oils has the lowest elasticities followed by fruits & vegetables and cereals. In other words, these goods are necessities, and fruits & vegetables are unitary elastic for urban residents. That is, the proportion of income expended on these food groups decreases as income increases whereas that of fruits and vegetables increases at the same rate as an expenditure. Thus, it is expected that an increase in income will shift consumption patterns away from cereals, fruits & vegetables, root crops, pulses & and oils toward animal products and other food.

Tables 3 and 4 respectively present Marshallian and Hicksian own and cross-price elasticities. The former represents changes in the quantity demanded as a result of changes in prices while capturing both substitution and income effect, whereas, Hicksian elasticity of demand denotes only the substitution effect as a result of price change keeping the level of utility constant. Hence, it is as expected that compensated elasticities are lower than the uncompensated counterparts.

Table 2. Expenditure elasticities

Items	Overall	Rural	Urban
Cereals	0.41 (0.08)***	0.41 (0.09)***	0.51 (0.08)***
Pulses & oils	0.17 (0.09)*	0.32 (0.11)***	–0.007 (0.12)
Root crops	–0.05 (0.16)	–0.02 (0.15)	–0.05 (0.26)
Fruits & vegetables	0.40 (0.12)***	0.57 (0.13)***	1.00 (0.11)***
Animal products	4.67 (0.4)***	3.37 (0.42)***	3.03 (0.27)***
Other foods	1.41 (0.15)***	2.14 (0.16)***	1.31 (0.15)***

The on diagonals cells are own-price elasticities. It can be observed from the two tables that wherever they are significant own-price elasticities are negative. The demand for all goods in the rural, cereals, pulses & oils and fruits & vegetables in urban are inversely related with own prices. An increment in own prices of those goods reduces demands consistent with theory. At the regional level, all goods except animal and other food have negative coefficients as well. Furthermore, the rural households' demand for animal products and other foods are price elastic implicating the quantity demands of the two goods fall at higher rates than price increment. As theoretically expected, the uncompensated elasticities are more elastic than compensated ones.

The off diagonals cells are cross-price elasticities, which measure the degree of substitutability and complementarily among commodities for negative and positive coefficients respectively. Of 90 estimated each uncompensated (Marshallian) and compensated (Hicksian) cross-price elasticities, 45 and 57 respectively are significantly different from zero at conventional significance levels. All coefficients except two are less than one in absolute value implying a weak response of one commodity group to changes in the price of the other. There is strong substitutability between animal products and other food as shown by higher cross-price elasticities; for one percentage increment in the price of other food, demand for animal products falls by 2.89 percent. On the other hand, the demand for other food falls by 3.96 percent in response to a percentage rise in the price of animal products of which the income effect is 1.05 percent. It is found that cereals are consumed along with pulses & oils, animal products, and other food while they are substitutes for root crops and fruits and vegetables. Thus, consumption of cereals falls as prices of the former groups rise and increase with prices of the later. This is consistent with patterns of consumption expected in Ethiopia.

Table 3. Marshallian (uncompensated) own and cross price elasticities.

Equation	Cereals	Pulses and oils	Root crops	Fruits & vegetables	Animal products	Other foods
Overall						
Cereals	**–0.81 (0.03)*****	–0.03 (0.02)	–0.09 (0.02)***	–0.07 (0.02)***	0.32 (0.05)***	0.26 (0.05)***
Pulses & oils	0.014 (0.03)	**–0.52 (0.04)*****	–0.02 (0.03)	0.12 (0.03)***	–0.07 (0.05)	0.12 (0.06)
Root crops	–0.14 (0.05)***	0.007 (0.05)	**–0.30 (0.06)*****	–0.09 (0.04)***	0.29 (0.08)***	0.29 (0.10)***
Fruits & vegetables	–0.13 (0.03)***	0.09 (0.03)***	–0.11 (0.03)***	**–0.82 (0.03)*****	0.37 (0.06)***	0.19 (0.06)***
Animal products	–0.27 (0.08)***	–0.59 (0.09)***	–0.19 (0.07)***	–0.11 (0.06)*	0.45 (1.61)	–3.96 (1.59)**
Other foods	0.04 (0.03)	–0.08 (0.04)**	–0.02 (0.03)	–0.02 (0.03)	–1.47 (0.73)**	–0.14 (0.84)
Rural						
	Cereals	Pulses and oils	Root crops	Fruits & vegetables	Animal products	Other foods
Cereals	**–0.72 (0.04)*****	–0.007 (0.03)	–0.08 (0.03)***	–0.02 (0.02)	0.07 (0 .04)***	0.34 (0.05)*
Pulses & oils	0.03 (0.04)	**–0.65 (0 .05)*****	–0.02 (0 .03)	0.08 (0.03)**	0.04 (0.05)	0.20 (0.06)
Root crops	–0.04 (0.05)	0.03 (0.05)	**–0.50 (0.06)*****	–0.07 (0.04)*	0.18 (0.07)***	0.40 (0.09)***
Fruits & vegetables	–0.06 (0.04)	0.04 (0.04)	–0.13 (0.04)***	**–0.88 (0.04)*****	–0.1 (0.05)***	0.32 (0.07)***
Animal products	–0.51 (0.09)***	–0.41 (0 .11)***	–0.12 (0 .09)	–0.16 (0.07)***	**–4.47 (2.32)***	2.29 (2.36)
other foods	–0.07 (0 .04)*	–0.16 (0.04)***	–0.05 (0.04)	–0.03 (0.03)	0.91 (0.82)	**–2.75 (0.83)*****
Urban						
	Cereals	Pulses and oils	Root crops	Fruits & vegetables	Animal products	Other foods
Cereals	**–0.69 (0.07)*****	0.02 (0.03)	–0.11 (0.02)***	-0.15 (0.03)***	0.25 (0.07)***	0.17 (0.07)
Pulses & oils	0.2 (0.07)	**–0.4 (0.08)*****	–0.004 (0.04)	0.15 (0.05)***	–0.08 (1.11)**	0.11 (0.11)
Root crops	–0.4 (0.13)***	–0.03 (0.10)	–0.001 (0.12)	–0.02 (0.09)	0.34 (0.27)	0.09 (0.28)
Fruits & vegetables	–0.5 (0.06)***	–0.02 (0.05)	–0.07 (0.04)*	**–0.77 (0.05)*****	0.31 (0.11)***	–0.01 (0.11)
Animal products	–0.19 (0.15)	–0.53 (0.12)***	–0.01 (0.11)	0.05 (0.10)	–2.46 (3.15)	0.11 (3.03)
Other foods	–0.01 (0.08)	–0.12 (0.07)	–0.05 (0.07)	–0.05 (0.06)	–0.31 (2.16)	–1.39 (2.14)

***, **, * denote significance at 1, 5 and 10 percent, respectively. Standard errors in brackets.

Table 4. Hicksian (compensated) own and cross price elasticities.

Overall						
Equation	Cereals	Pulses and oils	Root crops	Fruits & vegetables	Animal products	Other foods
Cereals	**–0.70** (0.04)***	0.04 (0.02)***	–0.05 (0.02)***	–0.008 (0.02)***	0.37 (0.04)***	0.35 (0.04)***
Pulses & oils	0.06 (0.03)***	**–0.50** (0.04)***	–0.002 (0.03)	0.14 (0.02)***	0.09 (0.05)	0.21 (0.05)***
Root crops	–0.16 (0.05)***	0.001 (0.04)	**–0.30** (0.06)***	–0.10 (0.04)	0.29 (0.08)***	0.28 (0.08)***
Fruits & vegetables	–0.02 (0.03)***	0.15 (0.03)***	–0.07 (0.03)**	**–0.75** (0.03)***	0.41 (0.05)***	0.28 (0.05)***
Animal products	0.99 (0.11)***	0.12 (0.07)***	0.27 (0.07)**	0.57 (0.07)***	0.93 (1.61)	–2.89 (1.59)*
Other foods	0.41 (0.05)***	0.13 (0.03)***	0.12 (0.04)***	0.18 (0.03)***	–0.13 (0.72)	0.46 (0.72)
Rural						
	Cereals	Pulses and oils	Root crops	Fruits & vegetables	Animal products	Other foods
Cereals	**–0.62** (0.04)***	0.07 (0.03)***	–0.03 (0.02)	0.04 (0.02)***	0.10 (0.04)	0.43 (0.04)***
Pulses & oils	0.10 (0.04)***	**–0.60** (0.05)***	0.02 (0.03)	0.12 (0.02)***	0.07 (0.05)	0.27 (0.05)***
Root crops	–0.05 (0.04)	0.03 (0.04)	**–0.49** (0.06)***	–0.07 (0.04)	0.18 (0.06)	0.40 (0.07)***
Fruits & vegetables	0.08 (0.03)***	0.13 (0.03)***	–0.06 (0.03)	**–0.79** (0.04)***	0.18 (0.05)	0.45 (0.05)*
Animal products	0.31 (0.12)	0.13 (0.10)	0.31 (0.10)***	0.36 (0.09)***	**–4.20** (2.32)*	3.07 (2.34)
Other foods	0.45 (0.04)***	0.19 (0.04)**	0.23 (0.04)***	0.31 (0.03)*	1.08 (0.82)	**–2.26** (0.84)***
Urban						
	Cereals	Pulses and oils	Root crops	Fruits & vegetables	Animal products	Other foods
Cereals	**–0.53** (0.07)***	0.09 (0.03)***	–0.08 (0.02)**	–0.08 (0.02)**	0.31 (0.07)***	0.28 (0.06)***
Pulses & oils	0.18 (0.07)***	**–0.35** (0.07)***	–0.004 (0.04)	0.15 (0.04)***	–0.08 (0.10)*	0.11 (0.11)**
Root crops	–0.44 (0.13)**	0.03 (0.10)	–0.002 (0.12)	–0.02 (0.09)	0.34 (0.26)	0.09 (0.26)
Fruits & vegetables	–0.18 (0.06)**	0 .16 (0 .05)***	–0.008 (0.04)	–0.63 (0.06)	0.45 (0.10)***	0.21 (0.10)
Animal products	0.74 (0 .15)***	–0.10 (0 .10)	0.16 (0.10)	0.45 (0.10)***	–2.05 (3.13)	0.80 (3.06)
Other foods	0.39 (0.08)***	0.06 (0.07)	0.02 (0.07)	0.13 (0.06)	0.49 (1.84)	–1.09 (1.81)

***, **, * denote significance at 1, 5 and 10 percent, respectively & Standard errors in brackets.

Comparison of expenditure and price elasticities reveals interesting policy prescriptions about the relative effectiveness of income and price policies vis-avis rural and urban areas. It is observed that the large expenditure elasticities for urban areas implicate relative effectiveness of income policies to offset pervasive impacts of higher food prices over those of prices and whereas the larger price elasticities of the rural households emphasize the opposite.

Effects of price changes on Consumer welfare

The compensated elasticities are used to compute the welfare effects of simulated 20 and 40 percent increments in food prices. The CV measures the total transfer required to compensate all households for the price changes they experienced as a percentage of their initial total expenditure. The first order (static) approximation measures consumption responses to price changes while ignoring household behavioral responses. In contrast, the second-order (dynamic) approximation removes the substitution effects as if households are able to change their consumption patterns when prices change. Therefore, given the substantial observed price changes, substitution effects can be non-trivial, and first-order approximations may lead to significant biases and are inappropriate [13]. Table 6 shows how much first-order Taylor expresses is inflating over second-order approximation.

On average, a 20 percent increment in food prices reduces the purchasing power of southwest households by about 25 percent. When food prices were raised by 40 percentages, the loss reaches as large as 45 percent. According to the first-order approximation estimates, the welfare losses are 75 and 95 percentages for respective price simulations. Based on the second-order approximation, however, it suffices to compensate the households with a little higher income than the percentage rise in prices.

Consistent with [2,5,6] it was observed that food price hikes hart urban households than the rural counterparts. The welfare losses for worst-hit urban households, upper quintile are 78 and 1.22 percent receptively for 20 and 40 percent price increment. The least hit rural households losses from the same are 21 and 42 percentages respectively.

5. Conclusions

The following insights were drawn from the results of the study: (i) Household demand for foods are affected not by price and income alone but reflect differences in tests and preferences across households due to size, sex, age, education, and location. The non-linear curvature in-demand system provides information about the characteristics of food demand in southwest Ethiopia. (ii) The elasticities at the mean of the sample are also consistent with consumer theory: all food staffs are normal goods; animal products and other food being luxury items in the expenditure composition of households. All significant the own-price elasticities were all negative and the demand for most of foods is sensitive to cross prices. Higher-income elasticities of urban households imply relative potency of income policies over price policies to mitigate negative

Table 5. simulated welfare effects of price increases

First order effects of proportion of expenditure						
	20% increase			40% increase		
	Overall	Rural	Urban	Overall	Rural	Urban
25th percentile	0.43 (0.03)***	0.38 (0.03)***	0.48 (0.04)***	0.60 (0.03)***	0.56 (0.04)***	0.64 (0.04)***
50 th percentile	0.66 (0.03)***	0.64 (0.04)***	0.67 (0.04)***	0.83 (0.03)***	0.84 (0.04)***	0.83 (0.04)***
75th percentile	0.86 (0.04)***	0.83 (0.06)***	0.88 (0.04)***	1.04 (0.04)***	1.01 (0.06)***	1.05 (0.06)***
Mean	0.74	0.69	0.78	0.92	0.89	0.95
Second order effects of proportion of expenditure						
	20% increase			40% increase		
	Overall	Rural	Urban	Overall	Rural	Urban
25th percentile	0.27 (0.03)***	0.21 (0.04)***	0.32 (0.04)***	0.42 (0.04)***	0.50 (0.04)***	0.75 (0.05)***
50 th percentile	0.46 (0.04)***	0.49 (0.03)***	0.53 (0.05)***	0.65 (0.04)***	0.70 (0.04)***	0.98 (0.04)***
75th percentile	0.76 (0.05)***	0.73 (0.08)***	0.78 (0.07)***	1.00 (0.06)***	0.98 (0.04)***	1.22 (0.06)***
Mean	0.25	0.22	0.28	0.45	0.42	0.52

*** denote significance at 1 & figures in brackets are Standard errors.

consequences on welfare while the larger elasticities indicate the reverse. (iii) The results for simulated effects of higher prices showed that higher food prices erode the purchasing power of the household and are pervasive to welfare the burden falling largely on urban households. In order to mitigate the negative consequences on the dietary of households, average households need percentage income compensation as large as the percentage increment in food prices. But, the lower-income households in both groups need at least three-fold percentages as large as the average.

Nevertheless, these findings should have been drawn from a framework that incorporates the production side for rural households and from data sets that capture rencent developments.

Conflict of Interest

The author declares that there is no conflict of interest related to the research.

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Appendix

Table A1. Quadratic Almost Ideal Demand Systems estimates

		Overall	Rural	Urban
Linear term	β_1	–0.03 (0.03)	–0.08 (0.03)**	–0.05 (0.02)***
	β_2	–0.03 (0.03)	–0.09 (0.03)***	0.07 (0.01)***
	β_3	0.15 (0.03)***	0.003 (0.03)	0.06 (0.02)***
	β_4	–0.09 (0.03)***	0.04 (0.02)**	0.06 (0.01)***
	β_5	0.007 (0.05)	0.15 (0.04)***	–0.006 (0.04)
	β_6	–0.007 (0.05)	–0.06 (0.04)	0.02 (0.03)
Quadratic term	λ_1	0.03 (0.006)***	0.02 (0.004)***	0.02 (0.004)***
	λ_2	0.01 (0.004)***	0.002 (0.004)***	0.03 (0.003)***
	λ_3	0.04 (0.004)***	0.02 (0.003)***	0.02 (0.004)***
	λ_4	0.0009 (0.005)	0.006 (0.004)	–0.006 (0.003)**
	λ_5	–0.05 (0.01)***	–0.009 (0.005)*	0.02 (0.006)***
	λ_6	–0.02 (0.01)**	–0.03 (0.0005)***	–0.04 (0.007)***
Prices	γ_{11}	**–0.04 (0.009) *** **	**–0.07 (0.01) *** **	**–0.08 (0.02)*** **
	γ_{21}	–0.003 (0.007)	0.007 (0.01)	0.009 (0.01)
	γ_{31}	–0.017 (0.007) **	–0.006 (0.009)	–0.034 (0.007)***
	γ_{41}	–0.02 (0.007) ***	–0.009 (0.007)	–0.06 (0.008)***
	γ_{51}	–0.01 (0.01)	–0.04 (0.01) ***	–0.001 (0.01)
	γ_{61}	0.012 (0.008)	–0.01 (0.02)	0.004 (0.01)
	γ_{22}	**–0.08 (0.009) *** **	**–0.07 (0.01) *** **	**–0.09 (0.01) *** **
	γ_{32}	–0.005 (0.008)	0.01 (0.01)	0.008 (0.004)
	γ_{42}	0.02 (0.007)***	0.011 (0.008)	–0.0004 (0.004)
	γ_{52}	–0.07 (0.02)***	–0.06 (0.01) ***	–0.08 (0.02) ***
	γ_{62}	–0.02 (0.009)*	–0.04 (0.02) **	–0.032 (0.016) **
	γ_{33}	**–0.09 (0.009)*** **	**–0.08 (0.01) *** **	**–0.07 (0.007)*** **
	γ_{43}	–0.03 (0.007)***	–0.014 (0.01) **	–0.01 (0.006)**

	γ_{53}	–0.03 (0.013) **	–0.03 (0.016)*	–0.01 (0.01)
	γ_{63}	–0.01 (0.011)	–0.04 (0.01)***	–0.016 (0.014)
	γ_{44}	–0.04 (0.009)***	–0.02 (0.005)***	–0.03 (0.007)**
	γ_{54}	–0.01 (0.014)	–0.009 (0.11)	0.042 (0.014)****
	γ_{64}	–0.003 (0.009)	0.005 (0.11)	0.0003 (0.014)
	γ_{55}	**–0.4 (0.17)** **	–0.18 (0.19)	–0.05 (0.41)
	γ_{65}	–0.27 (0.16)*	0.32 (0.19)*	0.107 (0.41)
	γ_{66}	**–0.29 (0.16)** **	–0.23 (0.19)	–0.06 (0.41)
Family size	δ_{11}	–0.001 (0.001)	–0.0006 (0.0013)	–0.004 (0.002)**
	δ_{21}	–0.001 (0.0008)	–0.0021 (0.001)**	–0.003 (0.001)***
	δ_{31}	–0.003 (0.0008)***	–0.004 (0.001)***	–0.0006 (0.0008)
	δ_{41}	–0.0008 (0.0008)	0.0003 (0.0008)	–0.0009 (0.0008)
	δ_{51}	0.0030 (0.0016)*	0.002 (0.0013)*	0.004 (0.002)**
	δ_{61}	0.0026 (0.0011)**	0.004 (0.002)**	0.005 (0.002)***
Sex	δ_{12}	–0.007 (0.006)	–0.017 (0.006)***	–0.011 (0.007)
	δ_{22}	0.009 (0.004)**	–0.002 (0.005)	0.003 (0.004)
	δ_{32}	0.012 (0.004)***	0.003 (0.005)	0.001 (0.003)
	δ_{42}	0.007 (0.004)**	–0.008 (0.004)**	0.0126 (0.004)***
	δ_{52}	–0.013 (0.008)	0.005 (0.006)	–0.005 (0.008)
	δ_{62}	–0.009 (0.006)*	0.02 (0.008)**	–0.001 (0.008)
Age	δ_{13}	0.0002 (0.0002)	0.0004 (0.0002)**	0.0001 (0.0002)
	δ_{23}	–0.0001 (0.000)	0.00013 (0.00014)	–0.00012 (0.0002)
	δ_{33}	0.000018 (0.00014)	0.00018 (0.00015)	0.00018 (0.0011)
	δ_{43}	–0.00004 (0.0001)	0.00014 (0.00012)	0.00003 (0.0011)
	δ_{53}	0.0003 (0.0003)	–0.0004 (0.0002)**	–0.00004 (0.0003)
	δ_{63}	–0.00031 (0.00018)	–0.0004 (0.0002)	–0.00012 (0.0003)
Literacy	δ_{14}	0.0032 (0.008)	–0.008 (0.009)	–0.006 (0.011)
	δ_{24}	0.008 (0.006)	0.005 (0.007)	0.0014 (0.007)
	δ_{34}	0.004 (0.006)	0.001 (0.008)	0.006 (0.005)
	δ_{44}	0.0008 (0.005)	0.010 (0.006)	–0.005 (0.006)
	δ_{54}	–0.0125 (0.01)	–0.001 (0.008)	0.004 (0.012)
	δ_{64}	–0.0034 (0.006)	–0.007 (0.010)	–0.0014 (0.011)
Years of schooling	δ_{15}	0.0011 (0.0008)	0.002 (0.0016)	0.0017 (0.001)*

	δ_{25}	–0.0009 (0.0008)	–0.0006 (0.001)	–0.00002 (0.0006)
	δ_{35}	0.0006 (0.0006)	–0.0001 (0.0013)	0.0005 (0.0004)
	δ_{45}	0.0007 (0.0005)	–0.003 (0.001)***	0.0009 (0.0004)**
	δ_{55}	–0.0003 (0.001)	–0.0009 (0.001)	–0.003 (0.0018)*
	δ_{65}	–0.0017 (0.001)	0.0024 (0.002)	–0.00007 (0.002)
Kaffa dummy	δ_{16}	0.058 (0.007) ***	0.07 (0.007)***	---
	δ_{26}	–0.023 (0.006) ***	–0.01 (0.004)***	---
	δ_{36}	–0.047 (0.006) ***	–0.02 (0.005)***	---
	δ_{46}	0.012 (0.004) ***	0.027 (0.005)***	---
	δ_{56}	0.009 (0.015)	0.003 (0.012)	---
	δ_{66}	–0.009 (0.013)	–0.07 (0.015) ***	---
Sheka dummy	δ_{17}	0.06 (0.007) ***	0.06 (0.008)***	0.06 (0.008)***
	δ_{27}	–0.025 (0.006) ***	–0.005 (0.005)	–0.014 (0.006)***
	δ_{37}	–0.06 (0.006) ***	–0.025 (0.006)***	–0.05 (0.005)***
	δ_{47}	–0.008 (0.005)	0.012 (0.004)***	0.08 (0.004)**
	δ_{57}	0.05 (0.01)***	–0.032 (0.008)***	0.011 (0.013)
	δ_{67}	–0.011 (0.009)	–0.015 (0.01)	–0.02 (0.012)*
V	δ_{18}	–0.06 (0.015)***	0.09 (0.017)***	–0.07 (0.023)***
	δ_{28}	–0.049 (0.01)***	0.06 (0.017)***	–0.075 (0.016)***
	δ_{38}	–0.045 (0.01)***	0.068 (0.016)***	–0.008 (0.011)
	δ_{48}	–0.014 (0.01)	0.068 (0.013)***	(0.010) (0.011)
	δ_{58}	0.13 (0.02)***	–0.14 (0.023)***	0.010 (0.11)
	δ_{68}	0.034 (0.018)**	–0.15 (0.028)***	0.13 (0.03)***
v-square	δ_{19}	–0.007 (0.12)	0.02 (0.016)	0.01 (0.03)
	δ_{29}	–0.0139 (0.009)	0.02 (0.011)*	–0.0018 (0.02)
	δ_{39}	–0.008 (0.009)	0.017 (0.011)	–0.12 (0.016)***
	δ_{49}	0.06 (0.009)***	–0.013 (0.008)	0.03 (0.017)**
	δ_{59}	–0.04 (0.016)***	–0.01 (0.016)	0.042 (0.012)***
	δ_{69}	0.005 (0.012)	–0.034 (0.017)*	0.038 (0.028)
v-cub	δ_{110}	0.07 (0.016)***	–0.003 (0.014)	0.019 (0.026)
	δ_{210}	0.024 (0.011)**	–0.017 (0.01)	0.027 (0.032)
	δ_{310}	0.025 (0.011)**	–0.018 (0.011)	–0.104 (0.019)***
	δ_{410}	–0.038 (0.01)** *	–0.063 (0.009)***	–0.0018 (0.014)

	δ_{510}	–0.057 (0.019)** *	0.05 (0.01)	0.036 (0.016)**
	δ_{610}	–0.02 (0.016)	0.05 (0.016)***	–0.0005 (0.03)
Constant	α_1	0.026 (0.066)	–0.017 (0.07)	–0.036 (0.038)
	α_2	–0.117 (0.05)**	–0.19 (0.06)***	0.0006 (0.028)
	α_3	0.20 (0.054)***	–0.04 (0.08)	0.119 (0.02)***
	α_4	–0.127 (0.048)***	–0.012 (0.06)	0.075 (0.02)***
	α_5	0.78 (0.105)***	0.48 (0.12)***	0.52 (0.07)***
	α_6	0.24 (0.094)**	0.78 (0.12)***	0.311 (0.07)***