August 2016, Policy Brief No. 8

SERA Policy Brief

Food Demand in Tanzania[1]

Food demand in Tanzania is very sensitive to prices, but much less sensitive to incomes. That is one of the important and surprising conclusions that comes from a comprehensive study of food demand based on more than 10,000 Tanzanian households. That suggests that most consumers, except those in the highest expenditure groups, are concerned with achieving an adequate diet rather than with achieving a diet that satisfies their taste preferences. The finding has important policy implications because it shows that reducing food prices would be an effective way to improve diets and reduce undernutrition.

The study estimated a large demand system for Tanzania for 18 food groups and four expenditure groups. The study found that the households within the lowest quartile (25%) of expenditures spent 72.6% of their expenditures on food and only those with the highest quartile (top 75%) spent less than half of their household expenditures on food. This conclusion is consistent with the low calorie consumption of all expenditure groups, but especially for the lowest two expenditures quartiles who had average daily per capita consumption of 1,299 and 1,795 calories, respectively, which is well below the FAO recommended daily calorie allowance for a healthy active life of approximately 2,100 calories (Table 1). The survey data also showed that the mean per capita expenditures on food for the lowest expenditure group was 740 TZS ($0.46) per day.

[1] This Policy Brief was prepared by Don Mitchell and Edith Lazaro, Senior Advisor and Research Associate, respectively, of the SERA Policy Project. It is based on research conducted by Chen Zhen, Associate Professor of Agricultural Economics of the University of Georgia, Edith Lazaro, and Don Mitchell in their paper entitled: Cross-Sectional Estimation of Food and Nutrition Demand in Tanzania Using a Large Demand System. The paper is available by email from the authors at **czhen@uga.edu , edithlzr@yahoo.co.uk or don.mitchell09@gmail.com**. The SERA Policy Project is a USAID-funded Feed the Future Project that seeks to improve agricultural policies in Tanzania and build capacity for policy analysis and advocacy. It is implemented by Booz Allen Hamilton.
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Table 1. Per Capita Expenditures and Calorie Consumption.

	Quartile 1	*Quartile 2*	*Quantile 3*	*Quartile 4*
Per Capita Daily Expenditures				
Mean TZS	740	1,256	1,989	5,373
Median TZS	759	1,250	1,940	4,125
Mean USD	0.46	0.78	1.24	3.36
Median USD	0.47	0.78	1.21	2.58
Calorie Consumption	1,299	1,795	2,141	1,955
Food Share of Expenditures (%)	72.6	66.7	57.4	32.5

Source: Author's estimates.

Price Elasticities of Demand

The price elasticities of demand1 for the four expenditure groups and the aggregate of all expenditure groups for 18 food groups and All Other Goods are shown in Table 2. Almost all elasticities are statistically significant2 at the one percent level and almost all are elastic which indicates that households respond to price changes with a more than proportionate change in quantity demanded. For example, the price elasticity for rice for the lowest expenditure group is -1.88 which means that a 1.0 percent increase (or decrease) in rice prices would result in a 1.88 percent decrease (or increase) in quantity demanded. Further, nearly all price elasticities are higher for lower expenditure groups than for higher expenditure groups. This shows that households in lower expenditure groups are more responsive to price than those in higher expenditure groups because their lower expenditure levels make it more difficult to maintain the same demand when the prices rise. It also shows that they have a larger percentage demand increase when the price declines. Price elasticities are also consistent among food groups with basic staple food groups, such as maize and cassava, having lower price elasticities than more preferred food groups such as poultry or dairy. The food groups with the lowest aggregate price elasticities are: red meats (-.53), maize (-.81), and fats and oils (-.99) indicating that households reduce demand for these food items less than for other food groups if prices rise or increase their demand less if prices fall. These food groups are basic staple foods for households. The food groups with the highest aggregate price elasticities are: other meats (-3.34), dairy (-2.34), soft drinks & juices (-2.16) and fruits (-2.07). Households will increase the demand for these food groups more than proportionately to a change in prices. For example, if the price of soft drinks & juices increased by 1%, per capita household consumption would fall by 2.16%, and if the price fell by 1% per capita household consumption would rise by 2.16%. However, the response would be greater for lower expenditure groups with households in the lowest expenditure group increasing expenditures by 2.46% compared to 1.79% for households in the highest expenditure group.

[2]The price elasticity of demand is defined as the percentage change in quantity divided by the percentage change in price. Since price and quantity move in opposite directions (price increases cause demand decreases) it is a negative number (with rare exceptions).
Statistical significance is a test of whether the estimated parameter is significantly different from zero. Estimates are normally reported as statistically significant at the 1, 5, and 10% level with 1% being the most significant.

Table 2. Price Elasticities of Demand.

	Quartile 1	*Quartile 2*	*Quantile 3*	*Quartile 4*	*Aggregate*
Food Categories					
Rice	-1.88***	-1.70***	-1.57***	-1.50**	-1.72***
Maize	-0.90***	-0.81***	-0.88***	-0.43	-.81***
Cassava	-1.34***	-1.19***	-1.06**	-0.92	-1.19**
Wheat & Other Cereals	-1.86***	-1.73***	-1.61***	-1.56***	-1.74***
Red Meats	-0.76***	-0.52***	-0.39**	-0.14***	-.53***
Poultry	-2.02***	-1.87***	-1.77***	-1.71***	-1.88***
Fish & Seafood	-1.26***	-1.48***	-1.70***	-2.09***	-1.48***
Other Meats	-4.03***	-3.30***	-2.83***	-2.48***	-3.34***
Dairy	-2.44***	-2.32***	-2.27***	-2.22***	-2.34***
Fats & Oils	-1.03***	-0.98***	-0.94***	-0.88***	-.99***
Fruits	-2.27***	-2.05***	-1.90***	-1.85***	-2.07***
Vegetable	-1.42***	-1.21***	-1.01***	-0.69***	-1.23***
Pulses	-1.46***	-1.24***	-1.05***	-0.74***	-1.27***
Roots & Tubers	-1.90***	-1.71***	-1.61***	-1.60***	-1.74***
Sugar	-1.30***	-1.21***	-1.15***	-1.09***	-1.22***
Eggs	-1.31***	-1.22***	-1.16***	-1.11***	-1.22***
Coffee, Tea & Cocoa	-2.23***	-1.92***	-1.72***	-1.51***	-1.94***
Soft Drinks & Juices	-2.46***	-2.16***	-1.98***	-1.79***	-2.16***
All Other Goods	-1.22**	-1.23***	-1.24***	-1.25***	-1.23***

Note: Parameters are estimated for four income groups (quartiles), with the lowest group comprised on those households in the lowest quartile (25%) of all households, the second quartile comprised of those households in the second lowest 25% of per capita expenditures, etc. The statistical significance of the parameter estimates are denoted by *s, with those significantly different from zero at the 10% level denoted by *, those significantly different from zero at the 5% level denoted by **, and those significantly different from zero at the 1% level denoted by ***.

Starchy food such as pulses, roots & tubers, and cassava generally have lower price elasticities than animal products such as meats, dairy, and poultry products with the exception of red meats which has the lowest aggregate price elasticity of all food groups. Red meats include: beef, goat, sheep and offal, and it seems surprising that the price elasticity is the lowest of all food groups. The price elasticity of demand for fish & seafood is also unusual because the price elasticity increases for households in higher expenditure groups. This result may be due to the wide variation in the quality and price of fish & seafoods available. Households in higher expenditures groups may be more responsive to price changes of the most costly types of fish & seafoods while households in lower expenditure groups may consume a more affordable variety and be less responsive to price changes.

Expenditure Elasticities of Demand

Expenditure elasticities measure the responsiveness of quantity demanded to changes in the level of expenditures – which is a proxy for income levels. Demand studies typically use expenditure levels instead of income because income levels are not usually available while expenditure levels are available from household surveys. An expenditure elasticity is defined as the percent change in quantity demanded divided by the percentage change in expenditure level. The expenditure elasticities for the 18 food groups plus All Other

Goods for four expenditure groups and the aggregate for all expenditure groups are shown in Table 3. The results show that households in all income groups are less responsive to changes in their expenditure levels than to changes in prices. As with the estimates of price elasticities presented in Table 2, the statistical significance of the estimates is denoted by the number of *. The results show that the quantity demand of many food groups does not increase as the level of expenditure increases. Rice demand, for example, was estimated to be very responsive to changes in prices (Table 2) but not to changes in expenditures.

Maize and cassava demand were estimated to be responsive to both price and expenditure level for the lowest expenditure groups but not for the highest expenditure groups. In general, the demand for cereals (maize, rice, wheat, and other cereals) was more responsive to changes in price than expenditure levels. The demand for animal products (meats, dairy, and eggs) was more responsive to price than expenditure levels with the exception of poultry which was responsive to both price and expenditure levels for all expenditure groups. The demand for fruits and, to a lesser extent vegetables, were responsive to both price and expenditure levels and lower expenditure groups had higher price and expenditure elasticities than higher expenditure groups. The demand for vegetables was responsive to the level of expenditures for the lowest two expenditure groups but not for the two highest expenditure groups. Pulses and tubers were not found to be responsive to expenditure levels for any of the expenditure groups, but they were found to be responsive to prices for all expenditure groups. Sugar and beverages (coffee, tea, and cocoa) were responsive to both expenditure levels and price for all four expenditure groups.

Table 3. Expenditure Elasticities.

	Quartile 1	*Quartile 2*	*Quantile 3*	*Quartile 4*	*Aggregate*
Food Categories					
Rice	0.33	0.37	0.46	0.50	.39
Maize	0.50***	0.37**	0.17	-0.42	.42*
Cassava	2.51*	2.02**	1.75*	1.54	1.61*
Wheat & Other Cereals	0.56	0.66	0.83	1.05	.58
Red Meats	0.11	0.32	0.55	0.70**	.34
Poultry	2.57***	2.47***	2.38***	2.17***	2.26***
Fish & Seafood	1.12***	1.05***	1.06***	1.06***	1.05***
Other Meats	-1.31	-0.76	-0.47	-0.19	-1.66
Dairy	1.34**	1.37***	1.32**	1.24**	1.37**
Fats & Oils	0.10*	0.13	0.21	0.22	.19
Fruits	1.61***	1.35***	1.20***	1.01***	1.29***
Vegetable	0.60***	0.47**	0.31	-0.18	.57*
Pulses	-0.10	-0.17	-0.20	-0.36	-.04
Roots & Tubers	-0.01	0.13	0.26	0.41	-.04
Sugar	2.65**	2.14**	1.79**	1.38*	1.65**
Eggs	0.50	0.82	1.14	1.51**	.87
Coffee, Tea & Cocoa	3.30**	2.57***	1.93**	1.36**	1.84**
Soft Drinks & Juices	-0.59	-0.13	0.15	0.37	-.13
All Other Goods	1.59***	1.49***	1.38**	1.26***	1.4***

Note: Parameters are estimated for four income groups (quartiles), with the lowest group comprised of those households in the lowest quartile (25%) of all households, the second quartile comprised of those households in the second lowest 25% of per capita expenditures, etc. The statistical significance of the parameter estimates are denoted by *s, with those significantly different from zero at the 10% level denoted by *, those significantly different from zero at the 5% level denoted by **, and those significantly different from zero at the 1% level denoted by ***.

Cross Price Elasticities of Demand

Cross price elasticities of demand measure the responsiveness of quantity demanded to changes in the prices of other goods. The cross price elasticity of demand for maize with respect to the price of rice, for example, is 0.57 which means that a 1.0% increase in maize price would lead to a 0.57% increase in the demand for rice and the elasticity is statistically significant at the highest level. All cross price elasticities are available in the complete report but are not presented here due to space limitations.

The Model

The demand study estimated a two-way Exact Affine Stone Index demand system for 18 food groups and a numéraire good using the 2011/12 Tanzania household budget survey of close to 10,000 households. To our knowledge the study is the largest food and nutritional demand system ever estimated for Tanzania at different income levels. It extends the literature in that it is the first demand study where econometric complications of censored demand, price and expenditure endogeneity, and curse of dimensionality associated with large demand systems are addressed in unified framework in a developing country context. Also the utility-theoretic demand model estimated allows even the Hicksian price elasticities to be different between households at different total expenditure levels. This extra flexibility in functional form can be especially useful for developing countries because, with foods being necessities, demand patterns may be quite distinct between households of different income levels. The model and data are described in the Box.

Policy Implications

The main finding of this Policy Brief is that food demand in Tanzania is very sensitive to prices but much less sensitive to incomes at all expenditure levels. This finding has important policy implications. First, it shows the importance of reducing food prices in order to increase food consumption and reduce undernutrition. This is a priority because per capita calorie consumption is very low for the two lowest expenditure groups (half of the population) and raising consumption levels would contribute to reducing stunting in children and undernutrition in the general populations. Improving the efficiency of the marketing system and increasing agricultural productivity would contribute to lower food prices. Trade policy could also be used to reduce food prices by reducing tariffs and border controls on imported foods. Second, a few food groups were found to have high responsiveness to changes in expenditure levels, and those food groups (poultry, sugar, and beverages) are expected to have more than proportionate increases in per capita consumption as expenditure levels rise in the future. Greater investments in these food groups will be needed to increase productivity and production in order to meet future demand. Third, those food groups with the lowest responsiveness to expenditure levels (maize, red meats, fats & oils) are expected to have the slowest growth in per capita demand as expenditure levels rise in the future. Since these are basic staples, reducing prices through productivity enhancing investments are still important in order to increase consumption, but future per capita demand growth will not be significantly increased by increased levels of household expenditures.

Box: Econometric Model

The two-way approximate EASI demand system is specified as

(1) $$w_{hi}^{*} = \sum_{j=1}^{J} a_{ij} \ln p_{hj} + \sum_{j=1}^{J} a_{ijy} y_h \ln p_{hj} + \sum_{r=1}^{L} b_{ir} y_h^r + \sum_{k=1}^{K} v_{ik} z_{hk} + u_{hi}, \quad h = 1,...,H; \; i = 1,...J-1;$$

where w_{hi}^{*} is the latent budget share on the i th category for household h, p_{hj} is the price index for household h and category j, J is the number of demand categories and equals 19 (18 FAH categories plus a *numéraire*), y_h is the real total household expenditure, L is the highest degree of total expenditure polynomial to be determined by statistical tests, the z_{hk} 's are K exogenous demand shifters including a constant, the a_{ij}, a_{ijy}, b_{ir}, and v_{ik} terms are parameters, and u_{hi} is the regression residual. Following Lewbel and Pendakur (2009), we construct y_h as the Stone price-deflated total household expenditure: $\ln x_h - \sum_{j=1}^{J} w_{hj} \ln p_{hj}$, where x_h is nominal total household expenditures on food and other goods and services.Because of censoring, the latent share w_{hi}^{*} is related to observed budget share w_{hi} according to $w_{hi} \equiv \max\{0, w_{hi}^{*}\}$ $w_{hit} \equiv \max\{0, w_{hit}^{*}\}$, where w_{hit} is calculated as category-level expenditure divided by total expenditures.

The EASI demand system is estimated as a system of $J-1$ Tobit equations (1) using the extended AGLS by Zhen et al 2013 while controlling for price and expenditure endogeneity. The extended AGLS estimator builds on the standard AGLS estimator for single-equation limited dependent variable models and extends it to the context of a system of limited dependent variable equations. The estimator works in three steps. In the first step, reduced-form Tobit regressions are estimated equation-by-equation, where censored budget shares are the dependent variables. The explanatory variables are the exogenous demand shifters, instrumental variables, and residuals from least squares auxiliary regressions of endogenous total expenditures and prices on all exogenous variables and instruments. The second step recovers the structural parameters of the budget share equations (1) using minimum distance (Wooldridge 2002, p. 444) and constructs the correct asymptotic covariance matrix for the structural parameters, which accounts for the correlation between the Tobit equations and between the Tobit equations and the linear auxiliary regressions. In the third step, the

and $a_{ijy} = a_{jiy}$) on the latent demand. The three-stepextended AGLS estimator is efficient among a class of limited information estimators (Newey 1987). In comparison with full information maximum likelihood estimators that estimate all Tobit equations simultaneously (e.g., Dong, Gould, and Kaiser 2004), the extended AGLS is more feasible for estimating large demand systems, especially when some explanatory variables may be endogenous.

Data for the 18 food groups in the study were aggregated from total of 184 food items. The top three staple foods categories: rice, maize, and cassava mainly include reported consumption of grains or processed grains mostly in flour. Wheat and other cereals category include: consumption of wheat , and other grains like millet, sorghum, and barley, The red meat category is composed of fresh and processed beef, goat, and sheep meat, The poultry category is comprised of fresh and processed chicken products; the fish and seafood category includes consumption of all types of fresh fish, processed fish products, and other seafood; the other meat category consist of fresh pork, processed pork, and other wild animals; dairy includes dairy and dairy products; fats and oils includes all edible vegetable oils, seed oils, and butter; fruits includes all fresh and processed fruits; pulses includes beans, lentils, and all other pulses and their products; roots and tuber includes sweet and Irish potatoes, yams, and coco yams; sugar includes raw sugar, jam, chocolate and all other confectionery products; and all other goods includes is comprised of all other goods and services.

Note: Complete references and econometric techniques used to handle potential model and data complications are included in the complete report available from the authors.

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