The Effect of Rising Food Prices and Policy on Children and Households Nutritional Outcomes in Ethiopia

Bizuayehu G. Bedane

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Bringing Rigour and Evidence to Economic Policy Making in Africa

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By

Bizuayehu G. Bedane

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Abstract

This study examined the effect of rising food prices and policy on children and households' nutritional outcomes. Cross and own price elasticities are calculated for the nine food groups. The result suggests that own price increase leads to a decrease in households budget share for the food groups examined. Households were able to substitute from expensive to relatively cheaper food group. A fixed effect model is estimated for the whole sample and for the sub-sample of children under five. The result suggests that a rise in the price of food negatively and significantly affect height-for-age, weight-for-age and weight-for-height measures of children nutritional outcomes. The effect of food policy on households and children nutritional outcome vary across food groups. It positively and significantly affects weight-for-height and weight-for-age measures of nutritional status indicators only for cereal and tuber food groups.

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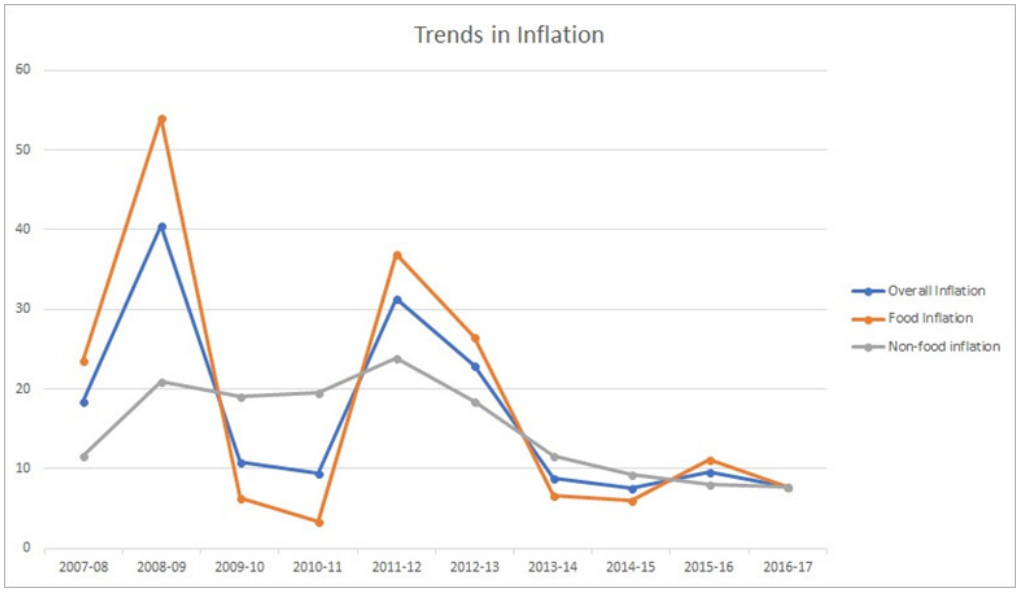
Introduction

Inflation has been one of the major challenges of the Ethiopian Economy starting from 2007-08. Following the rise in the global food prices and other domestic factors, food prices followed an upward trend. The data from National Bank of Ethiopia (NBE) shows that in

2008-09, the food price inflation and the general inflation was 54.2% and 40.6%, respectively. Food price inflation was 42.9% in 2011-12, whereas the general inflation was 34.1% and exhibit a downward trend after 2012 (NBE, 2015). In 2017-18 food inflation was 13.5%, and general inflation was 14.4% (CSA, 2019).

The main determinants of long-run inflation in Ethiopia are exchange rate and international food and goods price. The short-run determinants of inflation are agricultural supply shock, inflation inertia and money supply growth (Durevall et al., 2013).

Figure 1: Trends in Inflation

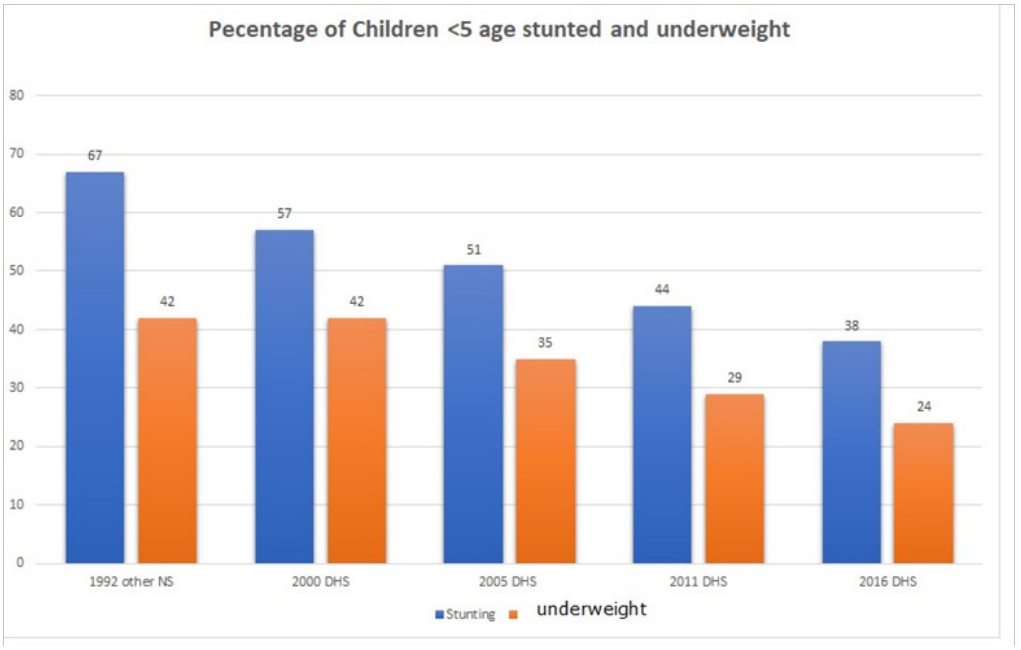


Source: National Bank of Ethiopia

The rise in food prices may adversely affect the nutritional intake of households. Given the high prevalence of under nutrition, a rise in food prices may worsen families nutritional intake and outcome. Under nutrition can cause stunting and wasting of children under five.

The data in figure two highlights the trend in stunting and underweight overtime in Ethiopia. The percentage of children under 5 stunted was 67% in 1992 and falls to 38% in 2016. The percentage of children under five underweight also reduced from 42% in 1992 to 24% in 2016. (USAID,2014) (See the figure 2 below for detail).

Figure 2: Percentage of Children under age 5 stunted and underweight



Source: DHS & USAID

The potential costs of malnutrition include death, high risk of impaired child development, fall in productivity and economic growth. Moreover, it directly increased the cost of health care and indirectly affect productivity and maybe leading to a fall in adult wage.

Given the high prevalence of malnutrition in Ethiopia, rising food prices will negatively impact families nutritional intake and outcomes. Malnutrition at the early age of child development has a long-lasting effect on children's education and health outcomes. Arndt et al. (2016) examined the effect of food price shock on child malnutrition using a household level data from Mozambique. The study finds that weight-for-height and weight-for-age measure of nutritional status deteriorate due to food price inflation. Their finding suggests that food price rises results in a substantial increase in malnutrition among under five children. A study by Hou et al. (2016) find

that rising food price has a negative effect on school enrollment and it differs by gender, economic status and the presence of siblings.

Households may respond to the rising food price by substituting across foods. Nutritional intake may not be affected if households are able to substitute from expensive to cheaper food that contain the same nutrients. The challenge for poor households is that they are already consuming low cost and low-quality foods. This implies that the effect of food price rise on poor households is severe. Jensen & Miller (2008) find that the impact of global food price rise on two Chinese provinces is small because households were able to substitute to cheaper domestic staple foods. Domestic food prices were low because of government intervention in the grain market.

Moreover, the effect of food price rise on rural households depends on whether the households are net buyers or net sellers. Net seller households benefit from the rising food prices whereas net buyer households lose. For net seller of labor, a higher wage increases the welfare of the landless while reducing the welfare of net buyer of labor.

The elasticity of food expenditure share with respect to the change in the price of food can be negative or positive depending on whether the substitution effect dominates the income effect or not. If the positive income effect dominates the negative substitution effect, an increase in food prices will increase food expenditure. The final effect of a change in the price of food depends on the marketed surplus. Marketed surplus is positive for net sellers of food and negative for net buyers. This means an increase in food price maybe leading to a fall in consumption for net buyers. The responsiveness of food consumption expenditure to an increase in food price can be positive if the positive marketed surplus is large enough Sadoulet & De Janvry (1995). Vu & Glewwe (2011) find that the overall effect of food price rise on average Vietnamese household welfare is positive because the average welfare lose of net buyers was smaller than the average welfare gains by net sellers.

This study examined the effect of rising food prices and policy on children and households' nutritional outcomes. The study also investigates household's responsiveness to the change in food prices. Specifically, is there a shift from high price food item to low price food item? If so, what is the impact on nutritional outcomes of children and households? Given the nature of the data, one can see the dynamics over time, by region, and different socioeconomic groups. This is done by estimating a seemingly unrelated regression for the quadratic almost ideal demand system (QUAIDS) and calculating the cross and own price elasticities for the nine food groups (cereals, fruits and vegetables, meat, milk, oil seeds, stimulants, salt and sugar, tuber and stem, and pulses) in Ethiopia. Furthermore, a fixed effect model is estimated to examine the effect of food price rise and policy on children and household's nutrition outcomes. The policy variables used in the analysis includes, the productive safety net program , free food, food aid and input and food for work.

The major contribution of this study is estimating a QUAIDS model and linking it to the children nutritional outcome. As explained in the methodology section of this paper, a system of the demand models is estimated and the predicted value of the

nine-food group expenditure share is generated. Moreover, the predicted children nutritional status outcome is generated by estimating nutritional status indicators on expenditure share and demographic variables. Then a fixed effect model of predicted nutritional status indicator as a function of predicted expenditure share and other controls is estimated. To the best of my knowledge, this study is the first to conduct a simulation of this kind.

The result suggests that own price increase leads to a fall in food budget share implying a reduction in nutritional intake. Meat and milk food groups have an elastic demand indicating budget share for these food groups fall at a larger proportion than the increase in price. These food items are the sources of protein and other important nutrients. This indicates that the larger fall in the already small budget share food group leads to a deterioration in families nutritional intake and outcome.

It is also found that there are strong substitute food items in the face of rising food prices implying households can substitute the relatively expensive food item with a relatively cheaper food item. This enables households to satisfy the required daily energy intake but not necessarily the required micro and macro nutrients.

The finding from the fixed effect regression suggests a positive contribution of food price policies on household's milk and oil seeds expenditure share. Specifically, families that participate in the productive safety net program have a higher oil seeds and milk budget share as compared to non-participants. The effect of food policy on children nutritional outcome vary across food groups. It positively and significantly affects weight-for-height and weight-for-age measures of nutritional status indicators only for cereal and tuber food group regressions.

Moreover, the increase in food price deteriorates the height-for-age, weight-for-age and weight-for-height children nutritional outcome indicators. This suggests a rise in food price negatively and significantly affect children nutritional outcome and increase the incidence of stunting and wasting.

2. Policy context: The productive safety net program

The Productive Safety Net Program (PSNP) was launched in 2005 with the support of donors.

It provides food and/or cash for chronically or transitory food insecure households in rural Ethiopia. The program covers rural food insecure households in Amhara, Oromiya, Afar, Harari, Dire Dawa, Southern Nations, Nationalities and Peoples and Tigray regions. The main objectives of the program are reducing poverty, social protection, improving nutritional status of women and children, reducing risk and impact of disaster MOA (2014). PSNP is one of the largest social transfer programs covering 8.3 million people in 2006Sabates-Wheeler & Devereux (2010).

Community members with chronic food insecurity and those who suddenly face food insecurity as a result of variety of risks are selected to participate by a kebele food security task force MOA (2014). Chronically food insecure households are identified using a mix of administrative guidelines and community knowledge Gilligan et al. (2009). The criteria to participate in the program is being a community member facing continuous food shortage for the last three years or households who suddenly become food insecure as a result of loss of asset or households without adequate family support (MOA, 2014).

These households can participate in the direct transfer component or public works component. Households with able bodies adult participate in public works and receive transfer for six months of the year (MOA, 2014). The public work program provides temporary employment opportunity for 84% of the program participant (Sabates-Wheeler & Devereux, 2010). Households without labor capacity receive unconditional transfer for 12 months.

Ethiopia also designed the first national nutritional program in 2008 and revised it in 2015. The main objectives of the policy are improving the nutritional status of women, infant, young children and adolescence; improving the delivery of nutrition for communicable and non-communicable related disease; strengthening nutrition intervention; improving coordination and implementation capacity of the policy.

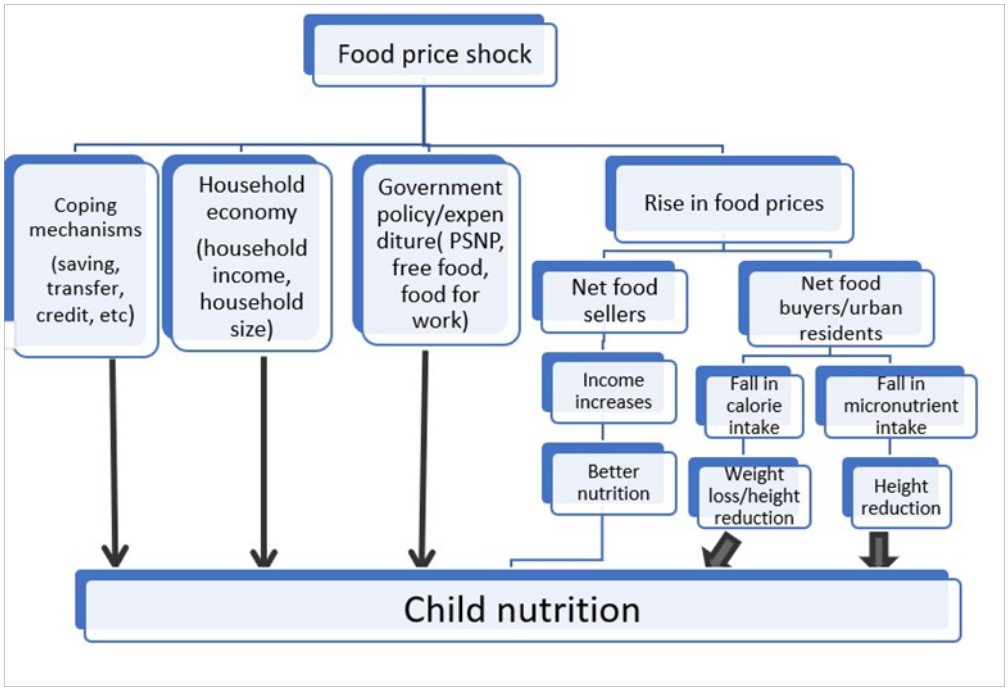
3. Conceptual framework: Food price increase, policy and nutrition

The impact of rising food price on rural households depends on whether the households are net food buyers or net food sellers. For net food buyer households, food price rise leads to a shift from variety of high micro nutrient food items to high carbohydrate staple foods. According to Meerman & Aphane (2012), most staple foods are much cheaper than fruits, vegetables and animal products.

> "When households replace meat, fruits, vegetables and other micro nutrient-rich foods with high carbohydrate staples, their energy intake may remain above the minimum requirement, but both macro and micro nutrient intake is compromised, thus increasing risk of stunting, micro nutrient deficiencies and associated poor health outcomes."(Meerman & Aphane, 2012)

If food price continues to rise not only the dietary quality but also the quantity of calorie intake maybe reduced. This reduces the energy intake of individuals and leads to various health risks. Figure 3 shows the relationship between rising food price and child nutrition. As we can see from the figure, the effect of an increase in the price of food depends on whether households are net buyers of food or net sellers of food. Other factors that minimize the negative effect of food price rise for net buyer households include government policy, community and individual level coping mechanisms and household income(see figure 3 for detail).

Figure 3: Conceptual framework of food price rise and its impact on nutrition



Source: Adapted from Holmes et al. (2008) and Kalkuhl et al. (2013).

4. Literature review

A range of studies examined the effect of food price increase on household welfare and nutritional outcomes. In this section, I reviewed studies related to the topic under investigation.

The effect of food price rise varies by region. For instance, Ferreira et al. (2013) examined the effect of food price rises on household welfare in Brazil using a spatially disaggregated monthly data. They find that a rise in food price increases extreme and moderate poverty in Brazil. The magnitude of the effect of food price rise in reducing welfare is higher in urban areas than rural areas due to the income effect of food price rise in rural areas. They examined the effect of food price rise by controlling for market income effect, the expenditure effect, and the transfer income effect. Ivanic & Martin (2008) argued that the short run impact of rising food price on poverty in nine developing countries vary by country and by commodity.

Similarly, Levin & Vimefall (2015) examined the effect of higher maize prices on different socioeconomic groups and regions in Kenya. They find that a rise in maize price reduce household's welfare. They also find that poor households lose a larger proportion of their welfare than relatively wealthy households and rural landless households lose. But households that owns five acres or more land gain from price increase.

Attanasio et al. (2013) analyze the welfare effect of food prices rise in Mexico. They evaluate the effect of conditional cash transfer program and subsidy policy as a means of mitigating food price rise. The result suggests that food price rise results in welfare loss and the loss is not uniform among different groups of households.

There are studies that examined the effect of rising food price in Ethiopia. A study by Shimeles & Woldemichael (2013) argued that rising food prices negatively affect the welfare of urban households and rural landless households, whereas it benefits land rich rural households. Hadley et al. (2012) conducted a qualitative study on rising food prices and food insecurity in Jimma town in Ethiopia. The result shows that the rising food prices negatively affect different community level support systems. The rising food prices and food insecurity leads to poor mental health, stress, and deteriorating physical health. Woldemichael et al. (2017) also found that food price inflation has a negative effect on child weight and height in Ethiopia.

According to Woldehanna & Tafere (2015) and Admassie (2014) , following the rising food price the Ethiopian government tried to take some corrective policy measures

starting from 2010. These policies include price control, enforcing fixed prices, production subsidies, social safety nets for food insecure households, fiscal measures such as adjustments in tariffs, the release of grains from the strategic reserve, media campaign, export bans on food product and promoting consumer associations in urban areas and unions in rural areas. Woldehanna & Tafere (2015) pointed out that price control measures may exacerbate the rising food prices by reducing supply while consumer associations help to stabilize food prices.

5. Theoretical and empirical framework

A quadratic almost ideal demand system (QUAIDS) is estimated. This model is an extension of the almost ideal demand system (AIDS). This method has several desirable properties. The AIDS model satisfies the aggregation restriction, it is simple to estimate, and with simple parametric restrictions, homogeneity and symmetry can be imposed. The AIDS is derived from the indirect utility (Deaton & Muellbauer, 1980). [1]

Banks et al. (1997) suggested the quadratic almost ideal demand system (QUAIDS) which allows expenditure shares to respond more flexibly with respect to total expenditure. Specifically, the quadratic term implies goods can be luxurious at low levels of total expenditure and necessities at higher levels. The QUAIDS is given as:

$$w_{it} = \alpha_i + \sum_i \gamma_{ij} ln(p_{jt}) + \beta_i ln(\frac{X_t}{a(P)}) + \frac{\lambda_i}{b(P)}[ln(\frac{X_t}{a(P)})]^2 \quad (1)$$

where w_{it} $(\text{i.e. } w_{it} = \frac{p_{it}q_{it}}{X_t})$ is the expenditure share of food group i at time t ; p_{jt} is the price of food group j at time t; Xt is the total food expenditure at time t, and P is a translog price index defined by:

$$lna(P) = \alpha_0 + \sum_i \alpha_i ln(p_{it}) + \frac{1}{2}\sum_j \sum_i \gamma_{ij} ln(p_{it}) ln(p_{jt} \quad (2)$$

p_{jt} is the price of food group i at time t and b(p) is simple Cobb-Douglas price aggregator

$$b(P) = \prod_{i=1}^{n} P_{it}^{\beta_i} \quad (3)$$

The indirect utility is defined with

$$\lambda(p) = \sum_{i=1}^{n} \lambda_i lnp_{it}, where \sum \lambda_i = 0 \quad (4)$$

In order to examine substitution possibilities due to the rising food price, the empirical strategy is estimating a system of demand equation of the form (1) including household size, age, and dummy for rural. A seemingly unrelated regression (SUR) is estimated. Since the error terms are contemporaneously correlated, we cannot estimate each equation separately. When the error terms are correlated we can gain a more efficient estimator by estimating the equations jointly. Based on the estimated coefficients we can calculate the own and cross price elasticities. The elasticities are calculated for the nine food groups.

Using equation (1), I conducted the following simulation. First, I estimated the QUADS model and generated the predicted value of expenditure share for the nine food groups. The predicted value of the expenditure shares is used as a dependent variable in the following model. This estimation is intended to see the effect of rising food prices and policies on the household's expenditure share which is used as a proxy for nutritional status of the household.

$$\hat{w}_{it} = \beta_0 + \beta_1 hhsize_{it} + \beta_2 age_{it} + \beta_3 femalehead_{it} + \beta_4 Policy_{it} + \beta_5 Price_{it} + \beta_6 Netbuyer_{it} + \beta_7 Interaction_{it} + \beta_8 response_{it} + c_i + \epsilon_{it} \quad (5)$$

Where $\hat{w}_{it}$ is predicted value of the expenditure share of food group i at time t; hhsize is the household size; age of the household head; femalehead =1 if head is female, 0=otherwise; Policy represent PSNP, food for work, free food, input for work, and other; price is the log of food group i price at time t; Net buyer= 1 if the household is a net buyer, 0=net seller; two interaction terms used: the interaction between food group i price and PSNP and Net buyer with PSNP; response is the response to food price increase which includes: dis-saving, help from friends and families, changing eating pattern, migration, additional work, reducing expenditure, and selling assets; ci is the individual time invariant fixed effect, and εit is the error term. Food price rise and a change in policy may not immediately affect children and household's nutritional outcome. To control for the effect lag, the lag of all the food prices and policy variables is used in all the regressions.

Household size is expected have a negative effect on children nutritional outcome, the policy variables are expected have a positive contribution to families nutritional outcome. The controls for risk mitigating mechanisms are also expected to improve household's nutritional intake. Food price rise can be negative or positive depending on whether the households is a net seller or a net buyer. Net seller households are expected to have a better nutritional status relative to net buyers. Female headed households are expected to have lower expenditure share and nutritional intake relative to male headed households.

To assess the effect of food price increase on children nutrition outcome the following model is estimated. In this case, the main goal is to see how rising food price

and policies affect children nutritional outcome after controlling for other important determinants of nutritional status. The children nutritional outcome equations are estimated using the predicted value of the nutritional status indicator as function of predicted expenditure share of each food group and other controls.

To find the predicted value of the children nutritional status outcome, I estimated the following model

$$NS_{it} = \beta_0 + \beta_1 foodshare_{it} + \beta_2 hhsize_{it} + \beta_3 age_{it} + \epsilon_{it} \quad (6)$$

Where NS_{it} is nutritional status indicator of child i at time t. Three children nutritional status indicators are used; namely

HAZ(height-for-age z score) , WAZ (weight-for-age) and WHZ(weight-for-height z score).

The predicted value of the dependent variable (NS^ it) is generated.

The final stage of the simulation exercise is estimating $\hat{NS}_{it}$ as a function of predicted expenditure of food group i and other control variables.

$$\hat{NS}_{it} = \beta_0 + \beta_1 hhsize_{it} + \beta_2 age_{it} + \beta_3 femalehead_{it} + \beta_4 Policy_{it} + \beta_5 Price_{it} + \beta_6 Netbuyer_{it} + \beta_7 Interaction_{it} + \beta_8 response_{it} + \beta_9 \hat{w}_{it} + c_i + \epsilon_{it} \quad (7)$$

To the best of my knowledge, this study is the first to conduct a simulation of this kind. All the estimated models are fixed effect models which enables us to control for individual level time invariant fixed effect.

The weight-for-height ratio (measure of wasting) and height-for-age (measure of stunting) are used as a dependent variable as explained above. Wasting is when the value of the weight-for-height Z-score (WHZ) is below the international reference value by more than two standard deviations. Stunting is where the value of height-for-age Z-score (HAZ) is below the international reference value by more than two standard deviations. Underweight is when the value of weight-for-age Z-scores (WAZ) is below the international reference value by more than two standard deviations. The international reference value is the WHO Child Growth Standards median.

Food price is generated from the data as follows. Information is available about the amount of money spent on 25 purchased food items (55 food items in the third round) and their respective quantities. First, I generated the median price for the 25 food items by dividing the total amount of money spent with the total quantity consumed. The average of the median price for a given enumerating area is used as a food group price. Second, using the quantity of food consumed from own production, gift and other sources; the value of food consumed from own production and gift is

generated. Total food consumption is the sum of purchased food, own production, gift and other sources. The expenditure share for each food group is calculated based on this information. The food group includes cereals, pulses, oil seeds, meat, milk and diary, salt and sugar, and stimulants. Own and cross elasticities are calculated for each food group.

Moreover, the cross and own price elasticities are calculated for the rural and urban households. The sample is divided into net seller and net buyer. As explained in the introduction, the effect of rising food price is different for net sellers and net buyers. Net seller and net buyer households are identified by finding the difference between amount of money spent on food purchase and earning from sale of food crops.

6. Data

The data used for this study is collected from rural and urban Ethiopia. The data source is the Ethiopian socioeconomic survey-Living Standards Measurement Study Integrated Surveys of Agriculture (LSMS-ISA) collected by the CSA and The World Bank. This data is collected for three rounds in 2011/12, 2013/14 and 2015/16. The first round is designed to be representative of rural and small town with a sample size of 3969 households. The second round included large town areas with a sample size of 5469 households. The sample size reduced to 4954 in the third round due to attrition. The regression analysis is conducted using the data from small town and rural areas. It is not possible to use the lag of the food group prices and policies for the urban sample since there is only two rounds of data for the urban sample.

This data set allows us to see the effect of rising food prices on households and children nutritional outcome. Moreover, the panel nature of the data enables us to see the shift on households consumption in response to a rise in food prices overtime if there is any.

7. Summary statistics

The data used in the analysis is collected from urban and rural Ethiopia. The first round is collected from rural and small towns. The second and third round is representative for rural and urban Ethiopia. The data shows that the average household size for the whole period is 4.7. The average age of the household head is 44 in 2011/12 and increased to 46.4 in 2015/16. The proportions of households that are net buyers are 87% in the first and second round but it increased to 92% in the third round.

Table 1: Household Demographics

	Round 1	Round 2	Round 3
Household size	4.75	4.58	4.77
Number of adults in the household	3.26	4.14	4.99
Number of working age in the household	2.33	3.69	3.52
Number of elderly in the household	0.17	0.22	0.23
Number of females in the household	2.36	3.60	3.78
Number of children under 15 in the household	1.50	3.13	2.97
Number of working age female in the household	1.21	1.91	1.81
Age of household head	44.03	44.18	46.36
Net buyer	87.70	87.00	92.39
Real annual consumption expenditure (in Birr)	14417.29	15453.51	24475.22

Households food consumption is divided into nine food groups[2]. Table 2 shows the amount and share of spending for each food group. Cereal takes the largest share of consumption spending, 46.5 % in the first round, 47.1 % in the second round and 36.7% in the third round. The share of cereal falls due to the information on additional 30 food items collected in the third round. Stimulants take the second largest food budget share. Oil seeds take the smallest share of the household food budget (see table 2 for detail).

Table 2: Real consumption spending and share by food group

	Mean Value in Birr			Share		
	Round 1	Round 2	Round 3	Round 1	Round 2	Round 3
Cereals	4389.332	6428.358	8736.549	0.462	0.471	0.367
Pulses	1068.109	1399.551	2280.172	0.105	0.096	0.100
Oilseeds	64.71679	37.16481	1169.665	0.007	0.003	0.056
Vegetables and fruits	337.4381	724.688	3094.27	0.036	0.044	0.140
Tuber and stems	642.5757	800.9205	1150.48	0.057	0.059	0.055
Meat and other	1020.2	2178.91	2406.541	0.078	0.069	0.065
Milk and diary	649.1367	1038.057	1719.785	0.057	0.069	0.060
Salt and sugar	481.0458	716.9333	649.8691	0.049	0.052	0.032
Stimulants	1916.08	2128.926	3160.733	0.149	0.138	0.125

One of the objectives of this study is to examine the effect of policy on nutritional outcome. As explained in the introduction, the government of Ethiopia introduced various policy measures to curb the effect of rising food prices. As shown in table 3, about 15.9%, 10%, and 11.3% of the households receive assistance in the form of productive safety net in the first, second and third round of the survey, respectively. About 9.1% receive free food on average. From the total households in the sample, 26.5% receive assistance in different forms in 2011/12, 17% in 2013/14, and 22.4% in 2015/16.

Table 3: Assistance from different sources

Variable	Round 1	Round 2	Round 3
Productive safety net program(psnp)	0.159	0.100	0.113
Free food	0.087	0.058	0.128
Food for work	0.031	0.020	0.027
Input for work	0.003	0.002	0.003
Other	0.020	0.011	0.007
Assistance from different sources	0.265	0.170	0.224
Value of assistance (in Birr)	360.95	272.30	465.78

On average, 28.45% of the household's face food price shock in the first round, 20.3% in the second round and 30.8% in the third round. Households used different coping mechanisms in the face of food price shock. To mitigate the effect of price shock households reported using personal saving, helps from different sources (government, families and friends), change their eating pattern, work more, family member migration, reduce their spending on health and education, sell assets and obtain credit. In 2011/12, 27.9% of the households use dis-saving as a response to food price shock followed by selling assets (see table 4 for detail).

Table 4: Response to price increase

	Round 1	Round 2	Round 3
Proportion of households that face Price increase	0.2845	0.2026	0.3078
Response to price increase			
Saving	0.2790	0.2205	0.3200
Helps from different sources	0.1143	0.0947	0.1246
Change eating pattern	0.0204	0.0122	0.0170
Additional work	0.0593	0.0638	0.0505
Migration	0.0115	0.0056	0.0059
Reduced expenditure on health and education	0.0071	0.0075	0.0085
Credit	0.0549	0.0450	0.0367
Sold assets	0.2418	0.2045	0.1757
Other measures	0.2551	0.3677	0.2715

As we can see in table 5, the percentage of children under five stunted is 35.48% in 2011/12, 35.75% in 2013/14, and 34.4% in 2015/16. The percentage of children under five underweight is about 22%. About 10% of children under five are wasted.

Table 5: Percentage of children under 5

	Stunted	Wasted	Underweight
Round 1	35.48%	9.72%	22.81%
Round 2	35.75%	9.64%	21.09%
Round 3	34.43%	11.36%	22.04%

8. Results and discussion

Own and cross price elasticities

The data is collected for three rounds. Based on this data, a seemingly unrelated regression for the QUAIDS model (equation 1) is estimated. The model is estimated by including demographic variables (see table 12). The nine food group shares are used as a dependent variable. The estimated coefficients of the prices and share of the food items is used to calculate the own and cross price elasticities. Both compensated and uncompensated elasticities are calculated. Most of the estimated coefficients are significant as shown in table 12.

The compensated and uncompensated price elasticities are provided in table 7. When we look at own price elasticities for the whole period cereal, vegetables and fruits, tuber and stem, meat, milk and dairy and stimulants have the theoretically expected sign. As the price of food share increases the quantity demanded for the food item goes down. The sign of pulses, oil seeds and salt and sugar are positive. This result is counter intuitive. Meat, milk and dairy products are price elastic implying these food groups are highly responsive to their own price change. These food items are the sources of protein and other important micro-nutrients. This indicates that a larger fall in their already small expenditure share deteriorate the families nutritional intake. Cereal, which takes about 42.8% of the food budget share, is elastic (1.44) implying an increase in its own price leads to a larger fall in its share. The results from the compensated and uncompensated elasticities are more or less the same.

The cross-price elasticities are also calculated to see the substitution and complementarity of food items. It is found that when the price of meat goes up the demand for cereals increase indicating that meat and cereals are substitute. This is good news if cereal and meat have the same macro and micro nutrients.

Cereal and pulses are complementary where the sign of their cross-price elasticity is negative. The sign of cross price elasticity for oil seeds and cereal is positive and significant. indicating oil seeds and cereals are substitute. Cereal is also complement with tuber and stems and sugar and salt.

Table 6: Predicted shares, budget and (un)compensated own-price elasticities

	Shares	Budget	u price	c price
	b/se	b/se	b/se	b/se
share cereal	0.428	0.338***	-1.441***	-1.297***
	(.)	0.051	0.096	0.1
share pulses	0.102***	0.902***	0.402	0.495*
	0.002	0.106	0.207	0.208
share oilseeds	0.023	-1.925	0.619***	0.575***
	(.)	(.)	0.145	0.148
share veg	0.085	-1.504	-0.541***	-0.668***
	(.)	(.)	0.09	0.091
share tuber	0.055***	1.515***	-1.407***	-1.324***
	0.002	0.228	0.176	0.177
share meat	0.070***	8.937***	-5.335***	-4.711***
	0.01	1.119	0.667	0.673
share milk	0.058	1.785***	-4.386***	-4.283***
	(.)	0.186	0.302	0.301
share salt	0.048***	2.595***	0.592***	0.468**
	0.003	0.231	0.16	0.158
share stimulants	0.132	1.888***	-0.782***	-0.532***
	(.)	0.117	0.109	0.102

Pulses are substitute with oil seeds, vegetables, and meat and eggs. It is complement with cereals, tuber and stem, milk and diary, salt and sugar and stimulants. Pulses and cereals are strong complement as the cross-price elasticity is elastic.

Another food group, Oil seeds, are substitute with cereals, pulses, vegetables, tuber and stems, milk and stimulants. It is complement with meat and salt. Vegetables are complement with tuber and stem and meat. It is substitute with all other food groups. It is strong substitute with cereals with cross price elasticity of 2.48.

The result also shows tuber and stems are complements with cereals, pulses, vegetables and fruits and stimulants. It is a substitute with the rest of the food groups. Oil seeds and vegetables are strong complement for Meat. Milk and meat are also strong complement. This result shows that there are strong substitute food items in the face of rising food prices implying households can substitute the relatively expensive food item for the relatively cheaper food item.

Moreover, expenditure elasticities are estimated (see table 6 column 3) for the whole period. The result shows that tuber and stem, meat and eggs, milk and diary, and stimulants are expenditure elastic. This means as expenditure increases the spending on these food groups increase by a larger proportion. Cereals and pulses are expenditure inelastic. The expenditure elasticity of Oil seeds and vegetables are negative and insignificant.

Table 7: Cross-price elasticities

	Log of prices								
	Cereal	Pulses	Oil seeds	Vegitables	Tuber	Meat	Milk	Salt	Stimulants
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
Share	UNCOMPENSATED								
Cereal	-1.441***	-0.411***	0.025	0.336***	-0.114**	0.840***	0.187	-0.165**	0.406***
	0.096	0.1	0.083	0.048	0.041	0.079	0.102	0.056	0.057
Pulses	-1.963***	0.402	0.398*	0.692***	-0.680***	1.024***	-0.04	-0.633***	-0.103
	0.195	0.207	0.168	0.109	0.082	0.157	0.205	0.113	0.122
Oil seeds	1.421***	2.037***	0.619***	0.273*	1.474	-7.349	4.277	-1.428	0.601***
	0.312	0.248	0.145	0.129	(.)	(.)	(.)	(.)	-0.158
Vegetables	2.484***	1.080***	0.065	-0.541***	-0.615***	-2.495	0.438*	0.896***	0.190*
	0.112	0.193	0.161	0.09	0.107	(.)	0.191	0.097	0.079
Tuber	(-1.396***)	(-1.335**)	0.548	-1.210***	-1.407***	1.096***	2.541***	1.130***	-1.482***
	-0.409	-0.433	-0.353	-0.237	-0.176	-0.329	-0.447	-0.244	-0.241
Meat	1.468**	0.678	(-2.699***)	-3.910***	0.452	-5.335***	0.671	1.532***	-1.795***
	0.457	0.509	0.668	-0.827	-0.237	-0.667	-0.423	-0.297	-0.473
Milk	0.763*	-0.16	1.633***	0.363	2.384	1.310***	-4.386***	-2.782***	-0.910***
	0.343	0.37	0.279	-0.189	(.)	-0.273	-0.302	-0.115	-0.173
Salt	-0.216	(-0.993***)	(-0.677**)	1.677	1.511***	3.038***	-3.105***	0.592***	0.768***
	0.24	0.202	0.232	(.)	-0.181	-0.284	-0.351	-0.16	-0.143
Stimulants	0.649**	(-0.180)	0.017	-0.165	-0.631***	-0.455*	-0.403	0.063	-0.782***
	0.226	0.222	0.188	-0.126	-0.038	-0.183	-0.241	-0.126	-0.109
	COMPENSATED								
Cereal	-1.297***	-0.376***	0.032	0.364***	-0.095*	0.863***	0.206*	-0.148**	0.451***
	0.1	0.1	0.083	0.047	0.041	0.077	0.103	0.056	0.056
Pulses	-1.577***	0.495*	0.419*	0.769***	-0.631***	1.087***	0.012	-0.590***	0.016
	0.205	0.208	0.167	0.106	0.083	0.154	0.206	0.113	0.12
Oil seeds	0.598	1.841***	0.575***	0.11	1.369	-7.484	4.165	-1.52	0.346***
	0.392	0.292	0.148	0.164	(.)	(.)	(.)	(.)	0.059
Vegetables	1.841***	0.927***	0.03	-0.668***	-0.697***	-2.6	0.351	0.824***	-0.009
	0.184	0.197	0.161	0.091	0.11	(.)	0.194	0.101	(.)
Tuber	-0.748	-1.181**	0.583	-1.081***	-1.324***	1.202***	2.628***	1.202***	-1.282***
	0.431	0.435	0.351	0.23	0.177	0.322	0.45	0.244	0.236
Meat	5.290***	1.590*	-2.491***	-3.153***	0.939**	-4.711***	1.188**	1.960***	-0.612*
	0.832	0.63	0.642	0.722	0.309	0.673	0.441	0.34	0.284
Milk	1.527***	0.022	1.675***	0.514**	2.481	1.435***	-4.283***	-2.697***	-0.673***
	0.359	0.372	0.278	0.182	(.)	0.265	0.301	0.118	0.179
Salt	-1.326***	-1.258***	-0.738**	1.457	1.370***	2.857***	-3.255***	0.468**	0.424**
	0.255	0.187	0.235	(.)	0.171	0.273	0.36	0.158	0.129
Stimulants	1.456***	0.012	0.061	-0.005	-0.528***	-0.323	-0.294	0.153	-0.532***
	0.237	0.229	0.187	0.113	0.047	0.176	0.242	0.123	0.102

The QUAIDS model is also estimated for each year and for the rural and urban sample separately (see table 13,14 and 15). The result is more or less the same as before. Rural households allocate larger share of their expenditure for cereal, tuber and stem, milk and stimulants as compared to urban and small-town residents. The share of oil seeds, meat, vegetables, and salt and sugar is less for rural households than urban households.

The own and cross price elasticities are also calculated for net buyer and net seller households. The is no significance difference between net buyer and net seller households in terms of their responsiveness to the change in own price and cross price (see table 17 and 18 in the appendix for detail). Pulses and oil-seeds are positive for net sellers. This is evidence for the strong marketed surplus that outweighs the substitution effect of a rise in the price of these food groups.

The effect of food price and policy on nutritional outcomes

Another objective of this paper is to examining the effect of food price and policy on nutritional outcomes. In this regard, a fixed effect model is estimated for all the nine food groups by including price, demographic variables, policy variables and two interaction terms. The main policy variable used for the analysis is production safety net program (PSNP). This variable is interacted with the price of each food group and net buyer.

The first model is estimated by using predicted expenditure share of the nine food groups as a dependent variable. The result suggests that households that participate in the productive safety net program have positive and significant expenditure share for oil seeds and milk food groups. Households that participate in the program have 3.2% higher expenditure share for milk than non-participants. This program has a negative and significant effect on cereals, tuber and stimulants. Participant households have 5% less expenditure share for cereal and tuber and stem relative to non-participants. It has no effect on pulses, vegetables and meat food groups.

Cereal price, oil seeds price, tuber and stem price, sugar and salt price, and stimulants price increase negatively and significantly reduce their respective expenditure. Oil seeds share reduced by 13% for a one Birr increase in its price. Net buyers have less cereal, tuber and salt expenditure share than net sellers. They have more expenditure share for the rest of the food groups than net sellers.

The interaction between PSNP and food price is significant and positive for cereal, pulses, tuber and stem and stimulants. This indicates that households that participate in the PSNP have a higher expenditure share relative to non-participants. The difference is small. PSNP participants have a 1% higher expenditure share relative to non-participants in all the cases. Dis-saving as a coping mechanism is significant and positive for oil seeds and vegetables food groups.

Participants in free food program have a lower expenditure share for the cereals, oil seeds, and vegetables food groups. It is positively and significantly related with pulses, vegetables, and milk (see table 8).

Table 8: Effects of food price and policy on food expenditure share

	Cereal	Pulses	oilseeds	Veg	tuber	Meat	Milk	Salt	Stim
Dependent Var: Predicted expenditure share	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se
Household size	0.001	-0.003***	0.005***	0.010***	-0.005***	-0.004***	0.002***	-0.004***	-0.007***
	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
Age	-0.002***	0.000	0.002***	0.003***	-0.003***	0.001	0.001	-0.002***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Age squared	0.000***	-0.000	-0.000***	-0.000***	0.000***	-0.000**	-0.000**	0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Head female	-0.009	-0.003	-0.001	0.003	-0.004	0.006	0.003	-0.003	0.004
	(0.006)	(0.003)	(0.004)	(0.008)	(0.004)	(0.008)	(0.006)	(0.005)	(0.005)
Assistance from different sources									
Lag PSNP	-0.052***	-0.011	0.026***	0.006	-0.054***	-0.000	0.032***	0.006	-0.027***
	(0.010)	(0.007)	(0.008)	(0.010)	(0.007)	(0.009)	(0.010)	(0.007)	(0.004)
Lag Free food	-0.006***	0.002***	-0.003**	-0.012***	0.003**	0.002	0.011***	0.000	0.001
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.003)	(0.002)	(0.001)	(0.001)
Lag Food for work	0.001	-0.001	-0.005***	-0.008***	0.007***	0.001	0.000	0.007***	-0.002
	(0.002)	(0.001)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)
Lag Input for work	-0.003	-0.006*	0.008*	0.003	0.004	0.007	0.005	0.003	-0.002
	(0.006)	(0.003)	(0.004)	(0.009)	(0.005)	(0.009)	(0.007)	(0.005)	(0.005)
Interaction: Food price i and LPSNP	0.006***	0.001*	-0.001	0.001	0.008***	-0.000	-0.002***	-0.001	0.000***
	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)
Log of price of food group i(lag)	-0.095***	0.014***	-0.132***	0.094***	-0.032***	-0.022***	0.026***	-0.043***	-0.023***
	(0.003)	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Net buyer	-0.005***	0.001*	0.003**	0.007***	-0.004***	0.005***	-0.001	-0.006***	-0.001
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Interaction: Net buyer and LPSNP	0.006	0.001	0.000	0.002	0.004	-0.009	0.003	-0.001	0.008
	(0.006)	(0.003)	(0.004)	(0.009)	(0.005)	(0.009)	(0.007)	(0.005)	(0.005)
Response to price increase									
Dis-saving	-0.002	-0.001	0.005***	0.014***	-0.006***	-0.004*	-0.000	-0.003**	-0.005***
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
Helps	0.003	0.004***	0.001	0.001	-0.001	-0.001	-0.007***	-0.011***	-0.000
	(0.002)	(0.001)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)
Change eating pattern	-0.010	0.000	-0.000	0.001	0.002	0.005	0.006	-0.002	-0.000
	(0.006)	(0.003)	(0.004)	(0.009)	(0.005)	(0.009)	(0.007)	(0.005)	(0.005)
Additional work	0.002	0.009***	-0.009***	-0.001	0.001	-0.002	-0.001	-0.009***	0.007**
	(0.003)	(0.002)	(0.002)	(0.004)	(0.002)	(0.005)	(0.004)	(0.003)	(0.003)
Migration	-0.000	0.008	-0.006	-0.027*	0.011	0.022	-0.006	-0.007	0.010
	(0.011)	(0.006)	(0.008)	(0.015)	(0.008)	(0.016)	(0.012)	(0.009)	(0.009)
Reduced expenditure	-0.013	0.003	-0.004	0.008	-0.000	0.008	-0.012	-0.016**	0.005
	(0.010)	(0.005)	(0.007)	(0.013)	(0.007)	(0.014)	(0.011)	(0.008)	(0.008)
Credit	0.003	0.002	0.000	0.007	0.004*	0.002	-0.013***	-0.008***	0.002
	(0.003)	(0.002)	(0.002)	(0.005)	(0.002)	(0.005)	(0.004)	(0.003)	(0.003)
Sold assets	-0.004**	0.000	0.002*	0.003	-0.003***	0.002	0.002	-0.004***	0.001
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
Other measures	-0.002	-0.002**	0.005***	0.005**	-0.003***	-0.001	0.000	0.001	-0.005***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
Constant	0.688***	0.069***	0.301***	-0.321***	0.237***	0.150***	-0.036***	0.247***	0.331***
	(0.011)	(0.010)	(0.011)	(0.015)	(0.008)	(0.016)	(0.012)	(0.010)	(0.010)
Number of observations	6,427	6,427	6,427	6,427	6,427	6,427	6,427	6,427	6,427
R-squared	0.355	0.069	0.781	0.489	0.314	0.130	0.084	0.255	0.298

Moreover, the panel data model is re-estimated by using the predicted height-for-age, weight-for-height, and weight-for-age z scores as a dependent variable. The result is reported in table 9, 10 and table 11.

As discussed in the methodology section, I estimated the panel data model using the predicted value of height-for-age, weight-for-height, weight-for-age z scores as a function of predicted expenditure share and other controls.

As we can see in table 9 below, the result shows that the price of cereals, oil seeds, and tuber are negatively and significantly related with height-for-age z-score. This suggests that the increase in the price of those food groups deteriorates the height-for-age measure of children nutritional status. The price of meat is positive and significant indicating height-for age index is improving.

The interaction term between food price and PSNP is positive and significant for cereal and tuber and stem food groups. This suggests that PSNP participation in the face of rising food price improves the height-for-age z score of children. This reduces the incidence of stunting. Households that participate in the free food program have less height-for-age index than the rest of the households for the meat food group regression. This is expected since households that participate in this program are initially the poorest and with a lower nutritional intake.

The dummy for net buyer is significant and negative only for meat food group. This suggests that children from a net buyer household have lower height-for-age index than children from a net seller household. Net buyer households in the context of Ethiopia are urban dwellers and landless rural poor households.

Households use different shock response mechanisms in the face of rising food prices. As reported in the data, the main response mechanisms to food price increase are saving, help from family and friends, changing eating habit, additional work, migration, reducing expenditure, credit, selling assets, and other measures. From these response mechanisms, dis-saving is positive and significant for tuber and stem food groups. This means household dis-saving helps to improve the height-for-age index of children nutritional outcome. It is negative and significant for the cereal food group regression.

Predicted expenditure share significantly affect height-for-age z score. The sign varies from food group to food group. It is negative for tuber, milk, sugar and salt and meat but positive and significant for cereals, vegetables and oil-seeds. This suggests that the higher the expenditure share of these food groups improve children nutritional outcome (the height-for-age z score).

Another nutritional status indicator used as children nutritional outcome is weight-for-height (WHZ). This is an indicator for wasting. The price of oil seeds and meat food groups negatively and significantly affect the weight-for-height z score children nutritional outcome indicator. This suggests that the rise in the price of those food groups deteriorate the weight-for-height z score and increases the incidence of wasting. Cereal and tuber prices are positively and significantly related with WHZ. The increase in the price of these food groups improve the weight-for-height z score.

Table 9: Effects of food price and policy on Height-for-age (HAZ)

	Cereal	Pulses	oilseeds	Veg	tuber	Meat	Milk	Salt	Stim
Dependent var: Predicted HAZ	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se
Predicted expenditure share: good i	4.309***	0.240	4.465***	2.846***	-0.929	-0.572***	-2.107**	-6.087***	-0.142
	(0.974)	(0.175)	(0.675)	(0.180)	(1.043)	(0.064)	(0.929)	(0.805)	(0.231)
Houseold size	0.148***	0.123***	0.068***	0.071***	0.101***	0.116***	0.131***	0.115***	0.117***
	(0.034)	(0.003)	(0.016)	(0.008)	(0.024)	(0.003)	(0.037)	(0.021)	(0.006)
Age	-0.070**	-0.099***	-0.114***	-0.105***	-0.099***	-0.094***	-0.135***	-0.109***	-0.099***
	(0.031)	(0.003)	(0.014)	(0.007)	(0.022)	(0.003)	(0.033)	(0.020)	(0.005)
Age squared	-0.000	0.000	-0.000	0.000	0.000	-0.000	0.001	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Head female	-0.116	-0.038	0.022	-0.110	-0.459*	0.026	-0.135	-0.079	-0.063
	(0.350)	(0.035)	(0.162)	(0.076)	(0.255)	(0.031)	(0.371)	(0.229)	(0.063)
Assistance from different sources									
Lag PSNP	-1.029	-0.026	-0.142	0.120	-0.937**	-0.081*	-0.200	0.043	0.020
	(0.722)	(0.078)	(0.414)	(0.087)	(0.383)	(0.045)	(0.790)	(0.292)	(0.056)
Lag Free food	-0.125	-0.014	-0.018	0.003	0.035	-0.018**	0.016	-0.086	-0.026
	(0.104)	(0.010)	(0.048)	(0.023)	(0.076)	(0.009)	(0.110)	(0.068)	(0.019)
Lag Food for work	-0.090	0.020	0.040	0.026	-0.077	0.006	0.201	-0.086	-0.002
	(0.135)	(0.013)	(0.062)	(0.030)	(0.098)	(0.012)	(0.143)	(0.089)	(0.024)
Lag Input for work	0.160	-0.012	-0.131	-0.025	-0.065	0.013	-0.184	-0.206	0.029
	(0.275)	(0.027)	(0.128)	(0.060)	(0.201)	(0.024)	(0.292)	(0.180)	(0.050)
Interaction: Food price i and LPSNP	0.135*	0.001	0.008	-0.010	0.154**	0.001	0.018	0.002	0.000
	(0.081)	(0.005)	(0.027)	(0.007)	(0.062)	(0.001)	(0.043)	(0.021)	(0.001)
Log of price of food group i(lag)	-0.726***	0.002	-0.330***	0.015	-0.210*	0.013**	-0.004	-0.142	-0.010
	(0.189)	(0.027)	(0.111)	(0.033)	(0.116)	(0.006)	(0.136)	(0.112)	(0.018)
Net buyer	-0.087	0.013**	0.003	-0.001	-0.031	-0.015***	0.072	0.020	0.018
	(0.066)	(0.006)	(0.030)	(0.014)	(0.047)	(0.006)	(0.069)	(0.043)	(0.012)
Interaction: Net buyer and LP-SNP	-0.643	0.066	-0.171	0.094	0.180	-0.000	-0.034	-0.495	-0.039
	(0.861)	(0.085)	(0.398)	(0.189)	(0.629)	(0.076)	(0.912)	(0.566)	(0.156)
Response to price increase									
Dis-saving	-0.248***	0.006	0.065	0.007	0.169**	-0.008	-0.153	-0.048	-0.026
	(0.090)	(0.009)	(0.042)	(0.020)	(0.066)	(0.008)	(0.095)	(0.059)	(0.016)
Helps	-0.184	0.035**	0.018	-0.015	0.073	0.007	-0.063	-0.067	-0.012
	(0.142)	(0.014)	(0.066)	(0.031)	(0.103)	(0.012)	(0.151)	(0.093)	(0.025)
Change eating pattern	-0.105	-0.046	-0.114	-0.011	-1.012***	0.020	-0.314	-0.013	0.085
	(0.428)	(0.042)	(0.198)	(0.093)	(0.312)	(0.038)	(0.454)	(0.281)	(0.077)
Additional work	-0.084	0.005	0.188**	0.040	0.227*	0.008	0.064	0.076	-0.055*
	(0.174)	(0.017)	(0.080)	(0.038)	(0.127)	(0.015)	(0.184)	(0.114)	(0.031)
Migration	0.041	0.019	-0.191	0.027	0.314	0.028	1.754***	-0.962**	-0.252**
	(0.616)	(0.061)	(0.284)	(0.134)	(0.449)	(0.054)	(0.653)	(0.404)	(0.111)
Reduced expenditure	-0.169	-0.088*	-0.254	0.077	-0.248	-0.023	-0.048	0.024	-0.079
	(0.501)	(0.049)	(0.231)	(0.110)	(0.364)	(0.044)	(0.530)	(0.328)	(0.090)
Credit	-0.106	0.007	0.039	-0.026	-0.108	0.004	-0.001	0.080	-0.005
	(0.166)	(0.016)	(0.077)	(0.036)	(0.122)	(0.015)	(0.177)	(0.109)	(0.030)
Sold assets	0.011	-0.000	0.015	0.014	0.023	-0.001	0.139	-0.050	0.005
	(0.085)	(0.008)	(0.039)	(0.019)	(0.062)	(0.007)	(0.090)	(0.056)	(0.015)
Other measures	-0.099	0.004	0.031	0.020	0.084	0.001	-0.106	-0.068	0.006
	(0.091)	(0.009)	(0.042)	(0.020)	(0.066)	(0.008)	(0.096)	(0.059)	(0.016)
Constant	0.549	1.712***	3.623***	2.143***	2.399***	1.748***	2.265***	2.569***	1.912***
	(0.926)	(0.104)	(0.471)	(0.154)	(0.553)	(0.058)	(0.676)	(0.501)	(0.157)
Number of observations	2,602	2,602	2,602	2,602	2,602	2,602	2,602	2,602	2,602
R-squared	0.256	0.946	0.510	0.791	0.285	0.958	0.132	0.279	0.848

note: .01 - ***; .05 - **; .1 - *;

PSNP is positive and significant for cereal and tuber and stem food groups. This suggests PSNP participation improves weight-for-height nutritional status indicator. Food for work found positive and significant for pulses and vegetables food group. Net buyer is positive and significant for cereal, pulses, and meat regression. This suggests that children in the net buyer households have a higher weight-for-age z score relative to net sellers.

Dis-saving as risk coping mechanism significantly and positively contribute to weight-for-height index to cereal and meat food groups.

Households size is negatively and significantly related to the weight-for-height score for all the food group regressions. The older the age of the household head the lower the WHZ score in all the cases. Older households' heads may have a lesser income generating potential and lower household food budget which in turn negatively affect children nutritional intake.

Finally, the predicted value of weight-for-age z score is used to estimate the model. This is an indicator of under-weight. The result suggests that the price of oil seeds is negative and significant. It is positive and significant for cereal, tuber and stem, and meat food groups.

Table 10: Effects of food price and policy on Weight over (WHZ)

	Cereal	Pulses	oilseeds	Veg	tuber	Meat	Milk	Salt	Stim
Dependent var: Predicted whz	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se
Predicted expenditure share: food group i	-1.682***	0.478	5.000***	8.732***	0.031	3.175***	0.502**	-0.909***	-0.209
	(0.399)	(0.362)	(0.651)	(0.523)	(0.056)	(0.344)	(0.205)	(0.114)	(0.904)
Household size	-0.040***	-0.018***	-0.086***	-0.174***	-0.021***	0.009	-0.025***	-0.024***	-0.033
	(0.014)	(0.006)	(0.016)	(0.022)	(0.001)	(0.017)	(0.008)	(0.003)	(0.023)
Age	-0.046***	-0.044***	-0.059***	-0.068***	-0.044***	-0.054***	-0.023***	-0.045***	-0.035*
	(0.011)	(0.006)	(0.012)	(0.018)	(0.001)	(0.013)	(0.006)	(0.003)	(0.019)
Age squared	0.000	0.000	-0.000	0.000	0.000	0.000	-0.000***	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Head female	0.092	-0.043	0.060	-0.237	0.022*	-0.109	0.035	0.007	-0.196
	(0.133)	(0.067)	(0.146)	(0.208)	(0.013)	(0.157)	(0.075)	(0.030)	(0.233)
Assistance from different sources									
Lag PSNP	0.572*	-0.001	-0.238	0.307	0.046**	0.349	0.159	0.004	0.060
	(0.297)	(0.162)	(0.384)	(0.254)	(0.021)	(0.243)	(0.169)	(0.042)	(0.220)
Lag Free food	0.052	-0.020	-0.012	0.005	-0.000	0.098*	-0.004	-0.012	-0.073
	(0.043)	(0.021)	(0.047)	(0.067)	(0.004)	(0.050)	(0.024)	(0.010)	(0.074)
Lag Food for work	0.050	0.062**	0.043	0.159*	0.003	-0.058	-0.025	-0.005	0.039
	(0.053)	(0.027)	(0.058)	(0.083)	(0.005)	(0.063)	(0.030)	(0.012)	(0.093)
Lag Input for work	-0.075	-0.026	-0.150	-0.095	0.004	-0.073	0.030	-0.034	0.098
	(0.120)	(0.061)	(0.133)	(0.189)	(0.012)	(0.142)	(0.068)	(0.027)	(0.212)
Interaction: Food price i and LPSNP	-0.070**	0.000	0.014	-0.024	-0.008**	-0.004	-0.010	0.000	0.001
	(0.034)	(0.011)	(0.025)	(0.020)	(0.003)	(0.003)	(0.009)	(0.003)	(0.003)
Log of price of food group i(lag)	0.338***	0.029	-0.321***	0.048	0.014**	-0.066*	-0.013	-0.008	0.053
	(0.078)	(0.056)	(0.107)	(0.095)	(0.006)	(0.034)	(0.030)	(0.015)	(0.070)
Net buyer	0.045*	0.026**	0.010	0.022	0.001	0.083***	-0.013	0.004	0.059
	(0.026)	(0.013)	(0.029)	(0.041)	(0.003)	(0.031)	(0.015)	(0.006)	(0.046)
Interaction: Net buyer and LPSNP	-0.104	0.069	0.016	0.131	0.043**	-0.342	-0.086	0.010	0.461
	(0.221)	(0.111)	(0.242)	(0.344)	(0.021)	(0.262)	(0.125)	(0.050)	(0.385)
Response to price increase									
Dis-saving	0.095**	0.010	0.056	0.050	-0.009**	0.057	0.037*	-0.003	-0.050
	(0.037)	(0.019)	(0.041)	(0.059)	(0.004)	(0.044)	(0.021)	(0.009)	(0.066)
Helps	0.090	0.074**	0.013	-0.072	-0.006	-0.007	-0.002	-0.025*	-0.071
	(0.058)	(0.029)	(0.064)	(0.091)	(0.006)	(0.068)	(0.033)	(0.013)	(0.101)
Change eating pattern	0.043	-0.101	-0.125	-0.034	0.057***	-0.121	0.064	-0.004	0.378
	(0.187)	(0.095)	(0.206)	(0.293)	(0.018)	(0.222)	(0.106)	(0.042)	(0.329)
Additional work	0.014	-0.012	0.162**	0.027	-0.009	0.004	-0.024	0.009	-0.189
	(0.067)	(0.034)	(0.074)	(0.105)	(0.006)	(0.079)	(0.038)	(0.015)	(0.118)
Migration	-0.007	0.058	-0.223	0.108	-0.019	-0.155	-0.403***	-0.149**	-1.092**
	(0.269)	(0.136)	(0.295)	(0.420)	(0.026)	(0.318)	(0.153)	(0.061)	(0.471)
Reduced expenditure	0.083	-0.204*	-0.280	0.181	0.015	0.155	-0.001	0.000	-0.354
	(0.219)	(0.111)	(0.240)	(0.343)	(0.021)	(0.259)	(0.124)	(0.049)	(0.384)
Credit	0.051	0.024	0.047	-0.086	0.005	-0.000	0.002	0.005	0.030
	(0.070)	(0.035)	(0.076)	(0.109)	(0.007)	(0.082)	(0.040)	(0.016)	(0.122)
Sold assets	0.013	0.001	0.021	0.067	-0.001	0.010	-0.016	-0.008	0.047
	(0.035)	(0.017)	(0.038)	(0.054)	(0.003)	(0.041)	(0.020)	(0.008)	(0.061)
Other measures	0.043	0.008	0.019	0.031	-0.005	0.013	0.006	-0.018**	0.009
	(0.036)	(0.018)	(0.039)	(0.056)	(0.003)	(0.042)	(0.020)	(0.008)	(0.062)
Constant	6.762***	6.377***	8.454***	7.700***	6.529***	6.440***	6.199***	6.645***	6.489***
	(0.358)	(0.208)	(0.438)	(0.419)	(0.027)	(0.285)	(0.134)	(0.066)	(0.575)
Number of observations	2,816	2,816	2,816	2,816	2,816	2,816	2,816	2,816	2,816
R-squared	0.213	0.494	0.294	0.318	0.966	0.248	0.470	0.824	0.121

note: .01 - ***; .05 - **; .1 - *;

PSNP is positive and significant for cereal and tuber food groups. This implies PSNP participants have a higher WAZ score relative to non-participants. PSNP participation helps to reduce the incidence of under-weight. Net buyers have lower weight-for-age score relative to net sellers for the pulses and meat food group (see table 11).

Table 11: Effects of food price and policy on weight-for-age (waz)

	Cereal	Pulses	oilseeds	Veg	tuber	Meat	Milk	Salt	Stim
Dependent var: predicted waz	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se
Predicted expenditure share: food group i	-0.175***	-0.076	0.097***	0.183***	0.171	-0.053***	0.217**	0.358***	-0.062
	(0.041)	(0.075)	(0.013)	(0.011)	(0.266)	(0.006)	(0.087)	(0.046)	(0.173)
Household size	-0.075***	-0.074***	-0.074***	-0.076***	-0.069***	-0.074***	-0.074***	-0.072***	-0.075***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.006)	(0.000)	(0.003)	(0.001)	(0.005)
Age	-0.011***	-0.011***	-0.011***	-0.011***	-0.012**	-0.011***	-0.002	-0.010***	-0.011***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.005)	(0.000)	(0.003)	(0.001)	(0.004)
Age squared	-0.000	-0.000	-0.000	0.000	0.000	-0.000	-0.000***	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Head female	0.009	0.009	0.001	-0.005	0.102*	0.002	0.014	-0.003	-0.036
	(0.013)	(0.014)	(0.003)	(0.004)	(0.060)	(0.003)	(0.031)	(0.012)	(0.044)
Assistance from different sources									
Lag PSNP	0.063**	0.004	-0.003	0.008	0.199**	-0.007*	0.068	-0.000	0.018
	(0.030)	(0.033)	(0.008)	(0.005)	(0.101)	(0.004)	(0.073)	(0.017)	(0.042)
Lag Free food	0.005	0.004	-0.000	0.000	-0.010	-0.002**	-0.001	0.005	-0.016
	(0.004)	(0.004)	(0.001)	(0.001)	(0.019)	(0.001)	(0.010)	(0.004)	(0.014)
Lag Food for work	0.008	-0.011**	0.001	0.003*	0.016	0.001	-0.005	0.003	0.008
	(0.005)	(0.006)	(0.001)	(0.002)	(0.025)	(0.001)	(0.013)	(0.005)	(0.018)
Lag Input for work	-0.007	0.006	-0.003	-0.002	0.022	0.001	0.013	0.013	0.020
	(0.012)	(0.012)	(0.003)	(0.004)	(0.054)	(0.002)	(0.028)	(0.011)	(0.040)
Interaction: Food price i and LPSNP	-0.008**	-0.000	0.000	-0.001	-0.035**	0.000	-0.004	-0.000	0.000
	(0.003)	(0.002)	(0.001)	(0.000)	(0.017)	(0.000)	(0.004)	(0.001)	(0.001)
Log of price of food group i(lag)	0.035***	-0.006	-0.007***	0.001	0.056*	0.001*	-0.006	0.004	0.009
	(0.008)	(0.012)	(0.002)	(0.002)	(0.030)	(0.001)	(0.013)	(0.006)	(0.013)
Net buyer	0.004	-0.007**	0.000	0.000	-0.001	-0.001**	-0.006	-0.001	0.012
	(0.003)	(0.003)	(0.001)	(0.001)	(0.012)	(0.001)	(0.006)	(0.002)	(0.009)
Interaction: Net buyer and LPSNP	-0.013	-0.015	0.001	0.002	0.197**	0.006	-0.038	-0.004	0.088
	(0.022)	(0.022)	(0.005)	(0.007)	(0.098)	(0.004)	(0.052)	(0.020)	(0.072)
Response to price increase									
dis-saving	0.009**	-0.003	0.001	0.001	-0.049***	-0.001	0.014	0.002	-0.013
	(0.004)	(0.004)	(0.001)	(0.001)	(0.017)	(0.001)	(0.009)	(0.003)	(0.012)
Helps	0.009	-0.015**	0.000	-0.002	-0.025	0.000	0.000	0.010*	-0.013
	(0.006)	(0.006)	(0.001)	(0.002)	(0.026)	(0.001)	(0.014)	(0.005)	(0.019)
Change eating pattern	0.004	0.020	-0.002	-0.001	0.271***	0.002	0.026	0.001	0.072
	(0.019)	(0.019)	(0.004)	(0.006)	(0.084)	(0.004)	(0.044)	(0.017)	(0.061)
Additional work	0.001	0.002	0.003**	0.001	-0.040	-0.000	-0.010	-0.004	-0.035
	(0.007)	(0.007)	(0.001)	(0.002)	(0.030)	(0.001)	(0.016)	(0.006)	(0.022)
Migration	0.000	-0.011	-0.004	0.003	-0.078	0.003	-0.164**	0.058**	-0.202**
	(0.027)	(0.028)	(0.006)	(0.009)	(0.121)	(0.005)	(0.064)	(0.024)	(0.088)
Reduced expenditure	0.006	0.041*	-0.006	0.004	0.067	-0.002	-0.002	-0.001	-0.064
	(0.022)	(0.022)	(0.005)	(0.007)	(0.098)	(0.004)	(0.052)	(0.020)	(0.072)
Credit	0.006	-0.005	0.001	-0.002	0.028	0.000	0.005	-0.001	0.006
	(0.007)	(0.007)	(0.002)	(0.002)	(0.032)	(0.001)	(0.017)	(0.006)	(0.023)
Sold assets	0.001	-0.000	0.000	0.001	-0.006	-0.000	-0.007	0.003	0.009
	(0.004)	(0.004)	(0.001)	(0.001)	(0.016)	(0.001)	(0.008)	(0.003)	(0.011)
Other measures	0.003	-0.001	0.000	0.001	-0.011	0.000	0.003	0.005	0.005
	(0.004)	(0.004)	(0.001)	(0.001)	(0.016)	(0.001)	(0.009)	(0.003)	(0.012)
Constant	-0.148***	-0.123***	-0.124***	-0.137***	-0.288**	-0.160***	-0.317***	-0.205***	-0.137
	(0.037)	(0.043)	(0.009)	(0.009)	(0.129)	(0.005)	(0.057)	(0.027)	(0.109)
Number of observations	2,762	2,762	2,762	2,762	2,762	2,762	2,762	2,762	2,762
R-squared	0.878	0.888	0.994	0.986	0.287	0.995	0.604	0.913	0.450

note: .01 - ***; .05 - **; .1 - *;

Conclusion

This study is conducted based on a data collected from rural and urban Ethiopia in 2011/12, 2103/14 and 2015/16. A seemingly unrelated regression model of the quadratic almost ideal demand system is estimated for the whole sample, year by year and for rural and urban sample. The coefficients of the QUADS model are used to calculate the own and cross price elasticities. A fixed effects regression is also estimated for the whole sample and for children under five. The predicted expenditure share of the nine food groups, height-for-age, weight-for-age and weight-for-height z scores are used as a dependent variable. The nine food groups are classified based on FAO guideline and data availability. The prices used for this analysis is the median price generated for each food group at the enumerating area level.

Using the coefficients from the QUAIDS, the cross and own price elasticities are estimated. The result shows that cereal share, which is the most common food category in rural and urban Ethiopia is negative and significant. Milk and Meat food group are price elastic. The result also revealed that there are strong substitute food items in the face of rising food prices implying households can substitute the relatively expensive food item for the relatively cheaper food item. The price elasticity of pulses and oil seeds food groups are positive for net seller households indicating that the marketed surplus of an increase in food price outweighs the negative substitution effect.

The productive safety net program, which is a proxy for food policy, is positively and significantly related to oil seeds and milk food group expenditure share. This means PSNP participants have higher expenditure share as compared to non-participants indicating a better nutritional intake. It also positively and significantly affects weight-for-height and weight-for-age measures of children nutritional status indicators only for cereal and tuber food regressions.

A simulation exercise is conducted by generating the predicted expenditure share of all the food groups and the height- for- age, weight-for-age and weight-for-height children nutritional outcome indicators. The result suggests that an increase in the price food negatively and significantly affect children nutritional outcome. This indicates that food price rise contributes to an increase the incidence of stunting and wasting of children under five. Dis-saving as a risk mitigating mechanism positively and significantly contributes to weight-for-height z scores for the cereal food group.

Notes

1. See appendix 1 for the detailed derivation of the cross and own price elasticities

2. see table 19 for the detailed list of food items

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Appendix 1

The almost ideal demand system(AIDS) is derived as follows: (Deaton & Muellbauer, 1980)

$$lnV = \{[\frac{lnX - lna(p)}{b(p)}]^{-1} + \lambda(p)\}^{-1} \tag{8}$$

Where X is total food expenditure, V is an indirect utility function, p is a vector of prices, a(p) is a function that is homogenous of degree one in prices, and b(p) and λ(p) are functions that are homogenous of degree zero in prices; *lna*(p) and b(p) are specified as translog and Cobb-Douglas equations, respectively.

The AIDS model is specified as follows

$$w_i = \alpha_i + \sum_i \gamma_{ij} ln(p_j) + \beta_i ln(\frac{X}{P} \tag{9}$$

where w_i (i.e. $w_i = \frac{p_i q_i}{X}$ is the expenditure share of the ith food group ; p_j is the price of food group j; X is the total food expenditure, and P is a translog price index defined by:

$$log(P) = \alpha_0 + \sum_i \alpha_i ln(p_i) + \frac{1}{2} \sum_j \sum_i \gamma_{ij} ln(p_i) ln(p_j \tag{10}$$

The restrictions on the demand function are given as follows.

Adding up restrictions:

$$\sum_i \alpha_i = 1, \ \sum_i \gamma_{ij} = 0, \ \sum_i \beta_i = 0 \tag{11}$$

Homogeneity restrictions:

$$\sum_j \gamma_{ij} = 0 \tag{12}$$

Symmetry

$$\gamma_{ij} = \gamma_{ji} \tag{13}$$

Given the above specifications, the elasticities can be computed from estimated parameters of the AIDS model using the formula suggested by (Green & Alston, 1990). Expenditure elasticity is given as follows:

$$e_j = 1 + \frac{\beta_j}{w_j} \tag{14}$$

The Hicksian (compensated own(i=j) and cross ($j \neq i$)) price elasticities is given as

$$\eta_{ij} = -\delta_{ij} + w_j - \frac{\gamma_{ij}}{w_i} \tag{15}$$

where δ_{ij} is the Kronecker delta, $\delta_{ij} = 1$ for j=i; $\delta_{ij} = 0$ for $j \neq i$. Marshallian (uncompensated) price elasticities

$$\eta_{ij} = \frac{\gamma_{ij}}{w_i} - \beta_i \frac{w_i}{w_j} \tag{16}$$

Marshallian own elasticities is given by:

$$\eta_{ii} = -1 + \frac{\gamma_{ii}}{wi} - \beta_i \tag{17}$$

Appendix 2

Table 12: Regression result for demand system using QUAIDS

	Expenditure share								
	Cereals	Pulses	oil seeds	vegetables	tuber	meat	milk	salt	stimulant
	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se
Log of price of cereal	0.682***	-0.169***	0.242***	0.863***	-0.163***	-1.603***	-0.096**	0.520***	-0.276***
	(0.156)	(0.036)	(0.025)	(0.065)	(0.044)	(0.189)	(0.042)	(0.054)	(0.074)
Log of price of pulses	-0.169***	0.143***	0.049***	0.096***	-0.073***	0.035	-0.010	-0.044	-0.026
	(0.061)	(0.021)	(0.013)	(0.034)	(0.024)	(0.084)	(0.022)	(0.027)	(0.036)
Log of price of oil seeds	0.242***	0.049**	0.093***	0.179***	0.007	-0.642***	0.057***	0.109***	-0.094***
	(0.048)	(0.021)	(0.012)	(0.021)	(0.024)	(0.046)	(0.022)	(0.015)	(0.032)
Log of price of vegetables	0.863***	0.096***	0.179***	0.578***	-0.137***	-1.681***	-0.094***	0.518***	-0.321***
	(0.073)	(0.033)	(0.016)	(0.048)	(0.038)	(0.077)	(0.035)	(0.026)	(0.053)
Log of price of tuber	-0.163***	-0.073***	0.007	-0.137***	-0.011	0.255***	0.156***	0.003	-0.036
	(0.052)	(0.010)	(0.011)	(0.034)	(0.014)	(0.086)	(0.012)	(0.027)	(0.023)
Log of price of meat	-1.603***	0.035	-0.642***	-1.681***	0.255***	3.540***	0.390***	-1.048***	0.755***
	(0.177)	(0.069)	(0.032)	(0.068)	(0.077)	(0.197)	(0.071)	(0.053)	(0.106)
Log of price of milk	-0.096	-0.010	0.057***	-0.094***	0.156***	0.390***	-0.168***	-0.255***	0.020
	(0.068)	(0.023)	(0.014)	(0.036)	(0.026)	(0.087)	(0.027)	(0.027)	(0.038)
Log of price of salt & sugar	0.520***	-0.044*	0.109***	0.518***	0.003	-1.048***	-0.255***	0.435***	-0.237***
	(0.059)	(0.026)	(0.012)	(0.026)	(0.030)	(0.058)	(0.027)	(0.028)	(0.042)
Log of price of stimulants	-0.276***	-0.026	-0.094***	-0.321***	-0.036	0.755***	0.020	-0.237***	0.216***
	(0.082)	(0.020)	(0.016)	(0.047)	(0.022)	(0.117)	(0.021)	(0.038)	(0.050)
beta_lnx	-0.283***	-0.010	-0.068***	-0.212***	0.028**	0.554***	0.045***	-0.172***	0.118***
	(0.022)	(0.011)	(0.004)	(0.008)	(0.012)	(0.013)	(0.011)	(0.006)	(0.016)
Houeholds size	0.010***	-0.002***	0.001***	0.003***	-0.001*	-0.012***	0.003***	0.002***	-0.005***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
Age of household head	0.001***	0.000***	0.000***	-0.000***	-0.000	-0.001***	-0.000	0.000	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Rural	0.096***	-0.006***	-0.003***	-0.044***	0.020***	-0.094***	0.016***	-0.005***	0.019***
	(0.005)	(0.002)	(0.001)	(0.002)	(0.002)	(0.004)	(0.002)	(0.001)	(0.004)
Cons	-2.277***	-0.087	-0.465***	-1.495***	0.246**	4.875***	0.460***	-1.361***	1.104***
	(0.184)	(0.093)	(0.039)	(0.074)	(0.106)	(0.108)	(0.095)	(0.056)	(0.133)

Table 13: Uncompensated cross-price elasticities - Rural

		Log of prices								
Year	Share	Cereal	Pulses	Oil seeds	Vegitables	Tuber	Meat	Milk	Salt	Stimulants
2011/12	Cereals	4.845	-1.304	-0.140	0.538	-1.494	-4.583	0.803	1.458	-1.345
	Pulses	31.107	-7.681	-0.618	5.002	-9.367	-26.833	1.446	8.485	-14.986
	Oil seeds	0.318	1.472	2.868	4.041	-1.753	-4.581	-4.238	-1.383	-0.557
	Vegetables	18.302	-1.691	0.409	2.491	-5.647	-14.410	-2.054	6.266	-8.675
	tuber and stem	-34.697	7.445	0.642	-4.389	6.102	28.715	2.518	-7.952	8.802
	Meat	-34.880	9.697	0.442	-2.795	8.372	23.727	-3.103	-8.642	8.194
	Milk	22.924	-5.114	-1.002	0.617	-0.920	-17.828	-3.405	4.365	-6.358
	Salt and sugar	-17.251	0.269	0.078	-2.081	8.027	16.869	-2.855	-3.900	10.014
	Stimulants	-19.296	3.942	0.522	-2.867	4.060	16.530	-0.662	-5.840	8.063
2013/14	Cereals	1.004	-0.290	-0.129	1.006	-0.235	-3.513	-0.029	1.107	-0.251
	Pulses	-5.598	-0.919	0.514	-4.440	0.023	17.100	0.988	-5.463	1.203
	Oil seeds	-57.106	3.862	4.334	-58.162	8.083	193.928	4.600	-72.042	17.276
	Vegetables	-0.210	1.763	0.317	-0.046	-1.008	5.552	1.288	-0.003	-0.822
	tuber and stem	2.407	-1.505	-0.455	2.723	-3.341	-10.509	2.548	6.171	-2.917
	Meat	-13.415	0.831	0.865	-10.834	3.048	22.700	4.020	-14.034	1.938
	Milk	3.477	0.648	-0.336	4.525	1.723	-9.742	-8.091	4.100	-0.945
	Salt and sugar	1.631	1.418	-0.120	3.423	1.983	-6.839	-0.942	3.139	0.153
	Stimulants	1.118	-0.232	-0.111	0.932	-1.079	-4.819	-0.020	1.822	-0.299
2015/16	Cereals	-19.509	-3.740	2.427	-1.331	-5.503	0.766	16.187	8.903	-5.818
	Pulses	-15.179	-0.621	1.907	-1.794	-5.344	0.224	11.682	6.441	-2.969
	Oil seeds	-0.002	0.390	-0.450	-0.484	0.742	-2.786	3.165	0.500	-0.549
	Vegetables	-14.345	-3.181	1.911	-2.421	-6.070	0.541	14.120	8.118	-4.640
	tuber and stem	-22.323	-6.035	3.737	-4.266	-8.185	1.148	20.783	11.857	-7.214
	Meat	119.118	19.940	-19.961	10.166	38.580	-6.590	-103.931	-59.483	38.119
	Milk	102.545	18.195	-11.887	9.374	32.450	-0.120	-95.307	-51.301	33.540
	Salt and sugar	56.978	10.439	-6.820	7.030	18.488	-1.338	-50.667	-27.189	17.733
	Stimulants	-13.108	-1.416	1.658	-0.739	-4.025	-0.261	11.808	6.523	-6.912

Table 14: Uncompensated cross-price elasticities - Urban

		Log of prices								
Year	Share	Cereal	Pulses	Oil seeds	Vegitables	Tuber	Meat	Milk	Salt	Stimulants
2011/12	Cereals	6.125	-1.712	-0.173	0.647	-1.782	-5.587	0.947	1.827	-1.579
	Pulses	29.778	-7.800	-0.607	4.745	-8.810	-25.657	1.324	8.280	-14.117
	Oil seeds	1.998	2.717	12.652	14.239	-5.692	-16.930	-15.514	-3.737	-1.026
	Vegetables	8.199	-0.444	0.193	0.597	-2.626	-6.449	-0.864	2.695	-4.064
	tuber and stem	-40.597	8.929	0.762	-5.112	7.223	33.578	2.964	-9.390	10.189
	Meat	-17.139	5.065	0.225	-1.352	4.017	11.160	-1.450	-4.373	3.873
	Milk	41.047	-9.938	-1.811	1.060	-1.436	-31.911	-5.421	8.148	-10.984
	Salt and sugar	-12.900	0.707	0.075	-1.513	5.805	12.574	-2.026	-3.372	7.198
	Stimulants	-20.455	4.315	0.559	-3.025	4.250	17.510	-0.687	-6.242	8.533
2013/14	Cereals	1.387	-0.292	-0.136	1.262	-0.310	-4.288	-0.072	1.377	-0.335
	Pulses	-4.811	-0.993	0.430	-3.906	0.012	14.884	0.901	-4.794	1.073
	Oil seeds	-173.391	11.834	15.580	-177.388	22.926	591.405	14.144	-220.166	52.418
	Vegetables	-0.058	0.589	0.082	-0.792	-0.367	2.775	0.693	-0.202	-0.244
	tuber and stem	3.675	-2.214	-0.675	4.351	-4.643	-16.479	3.875	9.710	-4.600
	Meat	-6.322	0.307	0.374	-5.200	1.514	10.291	1.954	-6.691	0.972
	Milk	6.779	1.600	-0.567	9.280	3.296	-19.727	-15.234	8.417	-2.057
	Salt and sugar	1.188	0.877	-0.125	2.285	1.461	-4.622	-0.581	1.800	0.194
	Stimulants	1.277	-0.214	-0.113	1.139	-1.264	-5.674	-0.061	2.171	-0.217
2015/16	Cereals	-26.341	-5.109	3.242	-2.018	-7.522	1.758	22.329	12.034	-7.936
	Pulses	-15.022	-0.810	1.854	-1.829	-5.238	0.585	11.727	6.347	-3.021
	Oil seeds	0.379	0.369	-0.621	-0.296	0.671	-2.217	2.018	0.215	-0.294
	Vegetables	-10.164	-2.247	1.331	-2.048	-4.244	0.611	10.004	5.669	-3.271
	tuber and stem	-51.588	-13.598	8.265	-9.803	-17.461	4.329	48.192	26.789	-16.567
	Meat	52.127	8.813	-8.453	4.758	16.766	-4.807	-45.787	-25.656	16.599
	Milk	152.186	27.217	-17.336	14.847	47.906	-4.687	-141.483	-75.067	49.474
	Salt and sugar	52.538	9.697	-6.150	6.753	16.908	-2.935	-47.082	-24.897	16.307
	Stimulants	-15.652	-1.801	1.930	-1.038	-4.786	0.248	14.184	7.664	-7.871

Table 15: Uncompensated cross-price elasticities - All

		Log of prices								
Year	Share	Cereal	Pulses	Oil seeds	Vegitables	Tuber	Meat	Milk	Salt	Stimulants
2011/12	Cereals	4.978	-1.346	-0.143	0.550	-1.523	-4.687	0.818	1.496	-1.369
	Pulses	30.937	-7.698	-0.616	4.969	-9.296	-26.683	1.431	8.459	-14.874
	Oil seeds	0.383	1.518	3.240	4.428	-1.903	-5.051	-4.667	-1.471	-0.574
	Vegetables	15.923	-1.396	0.358	2.045	-4.936	-12.535	-1.774	5.425	-7.590
	tuber and stem	-35.328	7.605	0.655	-4.466	6.222	29.235	2.566	-8.106	8.950
	Meat	-30.924	8.665	0.394	-2.473	7.400	20.924	-2.734	-7.691	7.230
	Milk	24.247	-5.467	-1.061	0.649	-0.957	-18.856	-3.552	4.641	-6.695
	Salt and sugar	-16.558	0.341	0.078	-1.991	7.672	16.185	-2.723	-3.817	9.564
	Stimulants	-19.432	3.986	0.526	-2.885	4.082	16.644	-0.665	-5.888	8.118
2013/14	Cereals	1.128	-0.290	-0.131	1.089	-0.259	-3.764	-0.043	1.194	-0.278
	Pulses	-5.286	-0.949	0.481	-4.228	0.019	16.221	0.953	-5.198	1.151
	Oil seeds	-75.372	5.118	6.103	-76.885	10.406	256.358	6.096	-95.307	22.792
	Vegetables	-0.124	1.098	0.184	-0.470	-0.645	3.987	0.953	-0.117	-0.495
	tuber and stem	2.748	-1.695	-0.514	3.161	-3.691	-12.114	2.904	7.122	-3.369
	Meat	-9.535	0.543	0.596	-7.753	2.209	15.913	2.890	-10.017	1.410
	Milk	4.217	0.863	-0.387	5.592	2.075	-11.982	-9.692	5.069	-1.195
	Salt and sugar	1.434	1.177	-0.123	2.917	1.752	-5.852	-0.781	2.543	0.172
	Stimulants	1.170	-0.226	-0.112	1.001	-1.140	-5.101	-0.033	1.937	-0.272
2015/16	Cereals	-21.412	-4.123	2.656	-1.521	-6.066	1.032	17.897	9.779	-6.409
	Pulses	-15.100	-0.683	1.887	-1.803	-5.300	0.340	11.675	6.399	-2.980
	Oil seeds	0.150	0.381	-0.518	-0.409	0.714	-2.558	2.706	0.386	-0.447
	Vegetables	-12.536	-2.778	1.662	-2.258	-5.284	0.560	12.341	7.064	-4.048
	tuber and stem	-27.928	-7.489	4.609	-5.329	-9.964	1.739	26.032	14.724	-9.006
	Meat	81.950	13.767	-13.590	7.156	26.485	-5.538	-71.662	-40.736	26.184
	Milk	115.566	20.565	-13.323	10.803	36.511	-1.245	-107.421	-57.559	37.726
	Salt and sugar	55.215	10.145	-6.562	6.911	17.869	-1.889	-49.231	-26.295	17.170
	Stimulants	-13.879	-1.532	1.741	-0.829	-4.256	-0.113	12.528	6.872	-7.205

Table 16: List of food items by food group

Cereals	Pulses & nuts	Oil seeds	Vegetables & fruits	Tuber & stems	Meat	Milk & diary	Sugar & salt	Stimulants
Teff	Horse beans	Niger seed	Onion	Potato	Meat	Milk	Sugar	Coffee
wheat	Chick pea	Linseed	Banana	Kocho/ Bula	Eggs	Cheese	Salt	Khat
Barley	Field pea	other seeds *	Green chili pepper *	Kocho*	Goat & mutton meat *	Butter/ghee *		Tea*
Maize	Lentils		Red pepper *	Bula*	Beef*	Oils (processed)*		Soft drinks/Soda*
Sorghum	Haricot beans		Greens (kale, cabbage, etc.)*	Sweet potato*	Poultry*			Beer*
Millet	Ground nuts *		Tomato*	Boye/Yam *	Fish*			Tella*
			Orange *	Cassava *				
				Godere *				
				Other tuber *				

Note: * Information is available only for the 2015/16 sample

Table 17: Elasticities for net buyer households

	Cereal	Pulses	Oil seeds	Vegitables	Tuber	Meat	Milk	Salt	Stimulants
UNCOMPENSATED CROSS-PRICE ELASTICITIES									
Log of prices									
Cereals	-1.705***	-0.386**	0.093	0.584***	-0.125**	0.854***	0.093	-0.065	0.342***
	0.103	0.109	0.089	0.054	0.044	0.087	0.111	0.06	0.065
Pulses	-1.768***	0.438*	0.353*	0.682***	-0.692***	1.004***	-0.068	-0.736***	-0.136
	0.196	0.209	0.169	0.111	0.085	0.159	0.209	0.115	0.125
Oil seeds	3.167	2.274***	0.640***	-0.386	1.817	-9.782	5.742	-1.88	1.000***
	.	0.262	0.193	-0.251	(.)	(.)	(.)	(.)	-0.233
Vegetables	4.201	1.265***	-0.113	-0.895***	-0.871***	-3.221	0.659**	0.724***	0.22
	(.)	0.242	0.197	0.13	0.131	(.)	0.233	0.14	0.13
tuber and stem	-1.374***	-1.324**	0.536	-1.367***	-1.278***	0.866**	2.586***	1.168***	-1.300***
	0.405	0.436	0.35	0.232	0.178	0.328	0.451	0.247	0.245
Meat	0.812**	0.403	-1.790***	-2.612***	0.183	-3.049***	0.511	0.716***	-1.068*
	0.299	0.302	0.406	0.496	0.137	0.373	0.279	0.18	0.431
Milk	0.041	-0.199	1.691***	0.510**	2.355	1.412***	-4.329***	-2.364***	-0.865***
	0.331	0.357	0.27	0.179	(.)	0.261	0.305	0.144	0.169
Salt and sugar	0.894*	-1.514***	-0.911**	1.486	2.000***	3.196***	-3.461***	0.809**	1.138***
	0.362	0.256	0.318	(.)	-0.323	-0.442	-0.542	-0.256	-0.201
Stimulants	0.377	-0.192	0.052	-0.159	-0.539	-0.406*	-0.383	0.103	-0.685***
	0.221	0.217	0.18	0.115	(.)	0.192	0.237	0.121	0.148
COMPENSATED CROSS-PRICE ELASTICITIES									
Cereals	-1.579***	-0.354	0.099	0.607***	-0.107*	0.890***	0.112	-0.054	0.385***
	0.107)	0.11	-0.088	-0.053	-0.044	-0.085	-0.112	-0.06	-0.065
Pulses	-1.397***	0.532*	0.370*	0.748***	-0.641***	1.108***	-0.012	-0.701***	-0.007
	0.205	0.21	-0.168	-0.109	-0.086	-0.154	-0.21	-0.115	-0.124
Oil seeds	2.125***	2.010***	0.591**	-0.571*	1.673	-10.073	5.584	-1.978	0.639***
	0.331	0.337	-0.195	-0.265	(.)	(.)	(.)	(.)	-0.166
Vegetables	3.409***	1.064***	-0.15	-1.036***	-0.980***	-3.442	0.539*	0.649***	-0.054
	0.147	0.245	-0.197	-0.13	-0.134	(.)	-0.237	-0.141	-0.084
tuber and stem	-0.776	-1.172**	0.564	-1.261***	-1.195***	1.034**	2.677***	1.224***	-1.093***
	0.422	0.439	-0.349	-0.228	-0.179	-0.318	-0.453	-0.246	-0.244
Meat	3.182***	1.003**	-1.679***	-2.191***	0.511**	-2.386***	0.869**	0.939***	-0.248
	0.568	0.363	-0.391	-0.436	-0.189	-0.386	-0.296	-0.21	-0.251
Milk	0.743*	-0.021	1.724***	0.635***	2.452	1.608***	-4.223***	-2.298***	-0.622***
	0.342	0.359	-0.268	-0.173	(.)	-0.252	-0.305	-0.146	-0.177
Salt and sugar	-0.568	0	-0.979**	1.226	1.797***	2.787***	-3.682***	0.671**	0.632***
	0.315	0.257	-0.323	(.)	-0.297	-0.385	-0.567	-0.252	-0.178
Stimulants	1.114***	-0.005	0.086	-0.028	-0.437	-0.2	-0.271	0.172	-0.430**
	0.244	0.222	-0.18	-0.106	(.)	-0.178	-0.236	-0.119	-0.154

Mission

To strengthen local capacity for conducting independent, rigorous inquiry into the problems facing the management of economies in sub-Saharan Africa.

The mission rests on two basic premises: that development is more likely to occur where there is sustained sound management of the economy, and that such management is more likely to happen where there is an active, well-informed group of locally based professional economists to conduct policy-relevant research.

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