An analysis of food demand in a fragile and insecure country: Somalia as a case study

An Analysis of Food Demand in a Fragile and Insecure Country: Somalia as a case Study

Abstract

We present an analysis of household level food demand for Somalia, which is emerging from a destructive twenty-year civil war. Using novel World Bank household survey data collected in 2018, we estimate demand elasticities for Somalia taking account of differences in household type, regional conflict, and income remittances from overseas. Our results reveal the extent to which household food consumption, as represented by expenditure, own and cross price elasticities, is highly sensitive to income shocks, especially for animal products such as meat and milk which are the main sources of protein for the population. Furthermore, the impact of an exogenous income shock, affecting food prices and household budgets, will likely result in a less diversified diet because of more emphasis on cereal consumption, especially for nomadic households. The resulting negative macronutrient implications have obvious consequences for levels of malnutrition. As such, improved food security is critical for Somalia's economic recovery and resilience in the future.

Key Words: Food demand; QUAIDS, Somalia.

JEL: D12, O12, Q18.

1. Introduction

Somalia is at last beginning to emerge from a long civil war after the complete collapse of central government in January 1991, followed by inter-clan violent power struggle (Solomon et al., 2018). In the absence of a central government, the country endured a pro-longed period of violent conflict and economic decline. However, with the restoration of the central government in 2012, and the emergence of a federal governance systems with substantive powers devolved to the constituent Federal Member States (FMS) the country has made significant progress toward political stability and economic recovery. Herring et al. (2020) note that this process is complicated in Somalia given the hybrid political system based on inter-clan power sharing, alongside elected parliamentary representation. There has also been increasing government control of the main urban centres which used to be in hands of the Islamist militant group Al-Shabab. Furthermore, as the World Bank (2019) observes, there have been extensive efforts to strengthen governance by re-establishing laws, regulations and policies in areas ranging from taxation, through to public spending and telecommunications. These reforms have enabled the country to secure a debt relief package under the Highly Indebted Poor Countries (HIPC) initiative – a major milestone that is expected to support the countries recovery and development in the future (IMF, 2020).

Unsurprisingly, the capacity of the agricultural sector, which has been historically and continues to be the backbone of the economy, has been severely hampered by the decades of conflict. For example, with the significant decline in agricultural production, food imports increased dramatically from the late 1980s and now accounting for about 60% of the domestic consumption (World Bank, 2018). In addition, there have been frequent droughts and severe land degradation that has reduced agricultural productive capacity, leading to severe food shortages and significant displacement of the rural population to urban centres (Federal Government of Somalia, 2018). For example, during the last major cycle of drought in 2015/17 more than 1.7 million people were affected with almost 800,000 internally displaced as they sought food and water (OCHA, 2018) and pastoral households lost almost 60 percent of their livestock (Federal Government of Somalia, 2018).[1] Therefore, the country continues to be economically fragile as the legacy of conflict and environmental damages linked to climate change have severely weakened household resilience.

In this context, strategic economic development planning needs to embed food security as part of an overall national poverty reduction strategy. Designing and implementing appropriate policy responses, however, requires a thorough understanding of the current food security situation. Drawing on the definition of food security introduced by Barrett (2010) (i.e., the three pillars: availability, access, and utilization), given that Somalia is a fragile country subject to ongoing but decreasing levels of violence and the gradual introduction of formal government institutions and significant imports, food security can be considered now less concerned solely about availability, but more about access and utilization.[2]

In terms of food access, Somalia is affected by poor transport infrastructure and distribution networks which can limit price arbitrage across and within regions/districts. Hastings et al. (2020) report that conflict can influence food prices for certain food stuffs such as imported rice. In rural areas, where pastoral and agropastoral production takes place the impact of conflict generally affects imported food prices, whilst in urban environments conflict can affect the supply of domestic produce, especially if the conflict affects major supply routes. With improving domestic security most conflicts in Somalia tend to be inter-clan clashes that are typically resolved through traditional conflict resolution means and as such only last for a few

[1] Almost 70 percent of Somalians live in poverty (Pape and Karamba, 2019) meaning malnutrition is prevalent. UNICEF (2018) and FSNAU (2018) report acute malnutrition levels of between 12 to 19 percent.

[2] Obviously, when conflict is augmented by reoccurring drought this severely affects domestic production such that food shortages can result in famines especially when conflict prevents a timely humanitarian food assistance response as happened in Somalia in 2011 (Maxwell et al., 2016).

days. However, in the South-Central regions (e.g., Hiiraan, Jubba and Shabelle) where there is a significant presence of militant groups in rural areas, armed conflict is still a major concern and as such access to food can be a significant issue. In relation to food security and utilization as defined by Barrett (2010), the major concern is more about the effective use of available food. In this case, policy needs to be more concerned with dietary quality and nutritional composition of the food that is being consumed and the resulting health consequences.

In a fragile and insecure country like Somalia, it is essential that policy to deal with food security is informed by timely economic analysis. However, no official statistics have been collected over the last two decades and as such researchers and decision-makers are faced with major challenges in generating meaningful evidence. For example, Martin-Shields and Stojetz (2019) note that they cannot assess the relationship between food security and conflict in Somalia as there is no suitable data available. Similarly, Colen et al. (2018) include no data for Somalia in their meta-analysis of income elasticity research conducted in Africa. The paucity of up-to-date studies or suitable data has meant that anyone examining food demand and security in Somalia needed to "borrow" elasticity estimates from other countries. For example, the food security study by Thorne et al. (2018) yields an international food security assessment that includes Somalia, but as they note, in the case of Somalia no demand elasticities are available and as such, they use estimates from Ethiopia.[3] This is an important information gap that needs to be addressed. Elasticities are important parameters when it comes to undertaking economic policy analysis. If the elasticities being used to describe household responses to new or existing policy initiatives in Somalia are inaccurate then any inference being drawn about these policy interventions may be seriously biased.

Clearly, the absence of key parameters such as own price, cross price and income elasticities for Somalia is an issue that needs addressing as the country is now undertaking the major reforms intended to support its economic recovery and development. Historically, no demand analysis has been undertaken in Somalia due to the lack of effective government and security challenges preventing researchers collecting household data. However, with the emergence of a relatively more settled situation in Somalia and advances in household consumption survey methods it is now feasible to collect relevant micro data sets. In particular, the World Bank has

[3] Thorne et al. (2018) draw on the work of Muhammad et al. (2011) (revised in 2013). In this study it is noted that data quality for some countries is poor and as such gives rise to outliers in the data. Ethiopia is listed as an outlier which raises questions about using estimates for Ethiopia especially as the estimates generated for Ethiopia by Muhammad et al. (2011) are not derived from country specific data (see page 11 for details).

collected household consumption data using an innovative high frequency survey method that combines satellite data-based sampling and short face-to-face interviews in accessible areas of the country to generate a credible sampling frame of household consumption data (Pape and Wollburg, 2019). In this paper, we use the resulting second wave of the Somalia High Frequency Survey (SHFS) and estimate own price, cross price, and expenditure elasticities of food demand for Somalia using the quadratic almost ideal demand system (QUAIDS) (Banks et al., 1997).

Given the data we employ, our analysis contributes in a unique way to the wider literature on household food demand. Specifically, the data collection undertaken in Somalia gives us a unique insight into how households within a war-torn fragile economy express preferences for food. There is good reason to assume that the elasticities derived in this setting will be different in terms of magnitude than those derived in more mature and stable economies including neighbouring countries. Previous research, such as that by Skoufias et al. (2012) reports variation in income elasticity estimates before and during an economic crisis. They note that income elasticities increase during a crisis such that cash transfers may help to ameliorate the worst effects on households. Clearly, these differences may be significant and therefore merit attention when designing and framing the related policy and programme responses to obvious food security issues confronting Somalia.

Another feature of our analysis is that we explicitly include a dummy variable to capture regional conflict in our model, which has been constructed by relating survey regions in Somalia with data from ACLED (Armed Conflict Location and Event Data Project).[4] The reason for taking account of conflict in our analysis stems from the regional variations that we observe. Apart from the rural areas in the south-central regions where militant activities are concentrated in, there is no ongoing largescale violent conflict. Some administrative states like Somaliland and much of Puntland (together roughly 40-50% of territory) have been stable for significant periods of time. Nevertheless, inter-clan skirmishes do happen from time to time in many regions, but these are typically between pastoralists fighting over pasture and water during dry seasons. The need to take account of conflict in our analysis is supported by the fact that Somalia has experienced the greatest number of incidents involving civilians in the world since 1997 (Brookings Institute, 2019).

[4] https://acleddata.com/#/dashboard

Another contribution, we make is examining the differences in elasticities by household type identified within the SHFS: urban; rural; internally displaced people (IDP); and nomadic households. The difference in household types is important given how society within Somalia is organised. Nomadic households are pure pastoralists who are highly mobile throughout the year in search of water and pasture for their livestock, and as such see food, outside own animal production, opportunistically. In contrast, rural households lead a more sedentary life and typically practice some form of seasonal or permanent crop production alongside animal production and therefore interface more with food markets more regularly. IDP households are typically rural residents, displaced by previous conflict and/or the reoccurring drought and flood cycles, who, after their pastoral or agropastoral livelihoods became untenable, relocated to peri-urban camps temporarily or permanently. Some or most people in these camps often receive food or cash transfer assistance.

The final piece of our analysis examines how our elasticity estimates are impacted once we take account of the likelihood of a household receiving some form of remittance income from outside the country. The reason for examining this issue is that remittances are an important source of income in developing countries and regions such as Sub-Saharan Africa (SSA) (Randazzo and Piracha, 2019). The importance of remittances to household food security in Somalia is noted by Majid et al. (2018) who report that this source of income, estimated to be $1.4 billion in 2016, enables households to buy more food and more diverse types of food. We focus specifically on remittances sent from outside Somalia, typically by migrant workers abroad, to households that can be both money and goods.[5] Given the quality of the data available, we use a basic dummy variable that is incorporated into our demand estimation. In taking this simple approach, we are able to see if the price elasticities we derive by controlling for those who receive versus not-receiving remittances compared to our general results differ, as well as examining if the elasticities differ by household type.[6]

The structure of paper is as follows. In section 2, we begin by briefly describing the survey undertaken to generate the SHFS and associated sample descriptive statistics. Next in section 3, we describe our estimation strategy and present the model employed. In section 4, we share

[5] Details on how the remittance of funds flow into Somalia is provided by Vargas-Silva (2017).
[6] It is noted by Majid et al. (2018) that for Somalia there is significant variation in the frequency of when remittances are sent i.e., monthly, bi-monthly, or on an ad hoc basis.

our results. This is followed in section 5 by a discussion of the results and policy implications. Finally, in section 6 we conclude.

2. Data and Descriptive Statistics

2.1. The Somali High Frequency Survey

We conduct our analysis of food demand using data from the second wave of the SHFS, as it is far more comprehensive than the first. The survey is designed to monitor welfare and perceptions of citizens. The first wave covered 9 out of 18 pre-war administrative regions in the country and was collected in 2016. The second wave, collected in 2017-18, covered 17 out of 18 regions (Awdal, Bakool, Babadir, Bari, Bay, Galgaduug, Gedo, Hiran, Jubbada Hoose, Mudug, Nugal, Sanaag, Shabeellaha Dhexe, Shabeellaha Hoose, Sool, Togdheer, Woqooyi Galbeed). The 18^{th} region, Jubbada Dhexe (Middle Juba), was deemed inaccessible due to insecurities such that statistical methods were used to extrapolate data. However, we do not include the 18^{th} region given the synthetic nature of the data collected. The 18 regions covered by the survey are shown in Figure 1.

{Approximate Position of Figure 1}

Across the 17 regions involved in the face-to-face data collection exercise a multi-stage stratified random method was used to generate the sample data. The method yielded 57 strata in total, defined along two dimensions: i) administrative location (pre-war regions and emerging states); and ii) population type (urban areas, rural settlements, IDP settlements, and nomadic population). Households were then clustered into enumeration areas (EAs), with 12 interviews carried out for each selected EA. As such, EAs are the lowest geographical identifier for the surveyed households.

In terms of sample representativeness, we note that there is no current population census for Somalia. The latest UN population estimates (UNFPA 2014) indicate that Somalia had a population of 12.3 million people, with urban regions accounting for 42 percent of the population, rural 22.8 percent, nomads' 25.9 percent, and IDP 9 percent. Pape and Wollburg (2019) explicitly acknowledge that the sample employed in the second wave of SHFS is *"representative of the entire Somali population within secure areas"*, as data collection was severely inhibited in several areas southern and central Somalia (See Table 1 in Pape and Wollburg, 2019). However, they also explain that the sample data for IDP and nomadic populations typically occurred in safe areas and as the composition for these populations can be considered as representative.[7]

The sample of interviewees was randomly drawn using a multi-level clustered design to overcome multiple challenges that reduced the time available for face-to-face household interviews. Although Somalia has not collected population census data since 1975 the survey was able to use the latest available Somalia Population Estimation Survey (UNPFA, 2014). This in combination with high-resolution satellite imagery data allowed a probability-based sampling approach to be developed. However, difficulties occurred from the tracking and surveying a relatively large mobile nomadic population. As a result, an "ad hoc" strategy for sampling of nomads was used to overcome the challenges. The approach relied on lists of water points known to be used by nomadic households to water their livestock, which served as the primary sampling units.

When it came to actual data collection, time for interviews was frequently constrained by security concerns for both survey enumerators and interviewee in some areas (Pape and Mistiaen 2018). Thus, a rapid consumption methodology allowing the partitioning of consumption items into core and optional modules was adopted to shorten interview times (Pape and Mistiaen, 2018). In effect, each household was systematically assigned the core module containing more regularly consumed items and randomly assigned one of the optional modules containing less consumed items. Multiple imputation techniques were then used as part of the rapid consumption methodology to estimate total household consumption of the optional modules. Results reported by Pape and Mistiaen (2018) from an *ex-post* simulation indicated that the rapid consumption methodology reliably estimated consumption and poverty in Somalia. The resulting microdata also contains extensive information on economic conditions, education, employment, access to services, security, perceptions, and details of other relevant household characteristics.

2.2. Household Descriptive Statistics

For this study, we used the food output and household demographics files to estimate the household demand for food. The survey covered 114 food items and asked all households to recall any consumption over a 7-day period. In total, the dataset covers 5,145 households,

[7] The issue of sample composition matters if we emphasise our results as being representative at the population level. In our analysis sampling variables are included which means we indirectly take account of the sample composition in our analysis.

consisting of 3,145 urban households, 1,025 rural households, 468 households in IDP settlements and 507 nomadic households. A summary of the main summary statistics for entire sample and by household type are reported in Table 1.

{Approximate Position of Table 1}

From Table 1, we can see that weekly expenditure on food is $33.52 for nomads, $29.03 rural households $26.42 for urban households and $22.01 for IDP households. The same data recalculated per household member is $6.54 for nomads, $6.21 for rural, $5.79 for urban and $4.39 for IDPs. These estimates can partly be explained as nomads and rural households with livestock consume higher than national average amounts of dairy and meat from own animal production which in effect command highest food prices. These two groups are also likely to face higher imported food prices compared to urban households because of the high transport costs due to the dilapidated state of the road network. Specifically, we see that more than half of nomadic households take more than one hour to reach a food market, and these markets will typically be in remote parts of the country.[8] We also observe that urban households achieve relatively higher levels of total expenditure than the other three household types. It is also the case that for nomadic and rural households their household head tends to be older and more likely to be male. While household size and proportion of male and children in the households are similar across household types, there is a large difference with regard to literacy. Urban households have the highest proportion of literate members (i.e., 65%) while nomadic households have the least (i.e., 14%).

2.3. Food Descriptive Statistics

The next step in undertaking our demand analysis required us to perform several data transformations. First, we generate seven food categories accounting for all 114 food items including cereals, fruits/vegetables (veg), pulses, meat/fish, diary, oils/fats and others. Second, we then calculate the quantity consumed and expenditure for each food category. Descriptive statistics for each food category are provided in Table 2.

{Approximate Position of Table 2}

Table 2 shows us that Somali household diets are largely dominated by cereals which account for 27% of household weekly total food expenditure, followed by meat/fish (16%) and fruit

[8] The household expenditure results we report in Table 1 match those reported in World Bank (2019).

and vegetables (19%). These three food categories alone account for 62% of the weekly food expenditure. Cereal consumption is dominated by a small number of staples such as rice, pasta, maize and sorghum consumed as main meals. Whilst the maize and sorghum consumed in Somalia are largely produced domestically, rice, pasta and a range of other cereals derivatives such as flour, breakfast cereals and bakery products are imported. We also note that meat and fish, especially high-quality cuts, are beyond the reach of a sizeable proportion of urban households who instead use lower quality meat to prepare traditional stews.

In terms of nomadic households, animals provide milk, and ghee for own consumption. They also sell, meat, milk, ghee, hides and skins that in turn allow them to buy rice, sorghum, flour, pasta, oil (a substitute for ghee) and sugar. Therefore, as a group they are relatively more likely to depend on food they produce themselves, although the relative balance between self-supply and market purchase (or aid supplies) is in large part dictated by the time of year. Therefore, in the dry season they become more dependent on purchased imported food items such as cereals, oil and sugar. It is estimated by FSNU (2001) that two-thirds of food needs are purchased.

Another important feature of the information presented in Table 2 is the proportion of zero observations by food group. As is clear from the table pulses have by far the largest number of zero observations. Data on existing levels of pulse consumption are provided by the FAO (2005) who note that the supply of pulses had not changed in Somalia between the mid-1960s and 2000. They also reported that pulses and nuts represent 2 percent of dietary energy supply in 2000 which is less than the global average of 3 percent and lower than the 4 percent average for the SSA. Another reason for low level of consumption might be because of lack of domestic supply. As Joshi and Rao (2016) note the global supply of pulses has failed to keep up with cereals, and pulses are frequently grown in poorer countries and subject to low productivity. Also, in Somalia they are grown in rain fed systems that are subject to climatic conditions that can have a serious impact on yield. Joshi and Rao (2016) also note that world pulse prices are not only significantly higher than those of cereals but also subject to greater year-on-year fluctuations reflecting the fact that they are frequently grown in marginal environments. Consumption of pulses is less common some regions of Somalia where meat and cereals dominate diet and as such households may report more frequently a zero consumption. There are also a reasonably large number of zeros in several other food groups. For this reason, it has become standard practice when examining household food expenditure data, to take account of zero observations as part of the estimation strategy.

2.4. Quality adjusted unit values (prices)

As is common with household level survey data the SHFS did not collect market prices for any food items. As a result, we adopt the standard approach and construct a proxy for prices by employing unit values that are obtained by dividing expenditure by the quantity bought for all food items. Although the calculation of unit values in this way is a practical step in undertaking demand estimation the approach can exaggerate actual price differences. For example, it is likely that there will be product quality differences within markets that are not being captured. In addition, unit values can exhibit measurement error because households do not accurately recall expenditure and/or the quantity consumed.

There are also country specific issues that can bias unit value calculations in Somalia. For example, weights and volume measurement units used in Somalia vary across the country. Whilst metric systems are commonly used in urban centres, often volumetric measurement units based on traditional customs are widely used for both solid and liquid food in rural areas, with varying units and customary names in different regions. Thus, there may be incidental measurement errors unless the enumerators employ, for example, pictorial prompters to aid household reporting. As a result, it is necessary to correct unit values before undertaking model estimation.

In this research, we employ the approach introduced by Majumder et al. (2012). Specifically, unit values are adjusted by employing the following Ordinary Least Squares (OLS) regression:

$$v_i - \left(v_i^{hr}\right)_{median} = d_r D_r + d_h D_h + \theta_i m + \eta_i Z + \varepsilon_i \qquad (1)$$

where v_i is the unit value of food group i *(i=1,…,n)* in USD per kilogram faced by each household i and $\left(v_i^{hr}\right)_{median}$ is the median unit value of that food group of household type h residing in region r. D_r and D_h denote regional and household type dummies respectively. The variable m represents weekly food expenditure. A vector of household characteristics, Z, (i.e., gender of household head, household size (in log), proportion of children in household, proportion of male in household and proportion of literate person in household as well as dummy variables for time needed to walk to closest food market) are added as control variables. In particular, the time needed to walk to food markets is employed as a proxy for the degree of market access to food enjoyed by the household. Finally, we assume that households of the same type within the same region face the same vector of food prices, p_i which is obtained by summing the median unit value with the median estimated residual of each household type in each region.

2.5. Conflict Data

As noted in the Introduction, we include a measure of conflict at the region level within our analysis. The data we employ is taken from the ACLED project, which collects conflict information on the dates, actors, locations and fatalities as associated with a conflict.[9] What is defined as conflict includes battles, explosions/remote (controlled) violence, protests, riots, violence against civilians, and strategic developments such as violent takeover of a territory regardless of the scale and duration.

For Somalia, we have extracted data for five years period, starting from January 2013 through to December 2017 which coincides with the last date for the collection of the SHFS consumption data. We have chosen the five years window to allow for account for both short and medium to long-term impacts of conflict which may vary from a temporary displacement and subsequent return of place of residence following transient conflict events to permanent displacement leading to settlement elsewhere following events such as hostile takeover of a territory.

In terms of how we employ the ACLED data, we first calculate an average annual count of incidents for each of the regions in the SHFS data. Second, we established a cutoff point of 100 incidents per year to classify these regions into conflict and non-conflict regions. Figure shows that most of the northern and north-eastern regions such as Awdal, Nugaal, Sanaag and Waqooyi Galbeed experienced little conflict over the five years, compared to South-Central regions of the country where there is the presence of the militant group Al-Shabaab. Most of the events occurring in these 'non-conflict' regions are small scale violence against civilians perpetrated by local clan militia, police and unknown actors, with many appearing to be incidents of crime and/or clan conflict as opposed to largescale conflict causing permanent displacements for a large number of people. A summary of the average annual conflict events by SHFS region are presented in Figure 2.

{Approximate Position of Figure 2}

[9] ACLED (2020). Current data files: Africa. Armed Conflict Location & Event Data Project https://acleddata.com/#/dashboard and https://acleddata.com/curated-data-files/

3. Empirical analysis of food demand

3.1. QUAIDS demand specification

In this paper, we employ the QUAIDS model specification. It allows for flexible Engel curves while permitting consistency with utility theory. In addition, this model permits goods to be luxuries at some income levels and necessities at others.

Formally, the QUAIDS assumes that a household consumption decisions result from utility maximization subject to a budget constraint. Following Banks et al. (1997), the indirect utility function (V) is defined as follow:

$$\ln V = \left\{ \left[\frac{\ln m - \ln a(p)}{b(p)} \right]^{-1} + \lambda(p) \right\}^{-1} \tag{2}$$

where m denotes weekly food expenditure and $\ln a(p)$ takes the translog form[10][11]:

$$\ln a(p) = \alpha_0 + \sum_{i=1}^{n} \alpha_i \ln p_i + \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_{ij} \ln p_i \ln p_j \tag{3}$$

and $b(p)$ is the Cobb-Douglas aggregator function of the price vector (p) given by:

$$b(p) = \prod_{i=1}^{n} p_i^{\beta_i} \tag{4}$$

and $\lambda(p)$ is a price aggregator function which is homogenous of degree zero in prices defined as:

$$\lambda(p) = \sum_{i=1}^{n} \lambda_i \ln p_i \tag{5}$$

Equations (2) to (5) define the QUAIDS specification. After applying Roy's identity to equation (2), the budget share of food group i (w_i) is derived as follow:

[10] Following Banks et al. (1997), α_0 is chosen to be just below the lowest value of the logarithm of weekly food expenditure (i.e. minus by 0.01).
[11] p_j denotes the price of food group j $(j=1,\ldots,n)$.

$$w_i = \alpha_i + \sum_j \gamma_{ij}\, ln\, p_j + \beta_i\, ln\left[\frac{m}{a(\mathbf{p})}\right] + \frac{\lambda_i}{b(\mathbf{p})}\left\{\ln\left[\frac{m}{a(\mathbf{p})}\right]\right\}^2 \qquad (6)$$

where $\alpha_i, \gamma_{ij}, \beta_i, \lambda_i$ are parameters that determine the utility, a household receives from food consumption. We follow Ecker and Qaim (2011) and allow the constant term of each food group to depend on a set of household characteristics: household size (in log), age of household head (in log), gender of household head, proportion of children in household and proportion of male in household as well as the regional conflict variable.[12]

Finally, demand theory implies that following restrictions are required in the estimation of QUAIDS parameters:

Adding up:

$$\sum_{i=1}^{n} \alpha_i = 1, \sum_{i=1}^{n} \beta_i = 0, \sum_{j=1}^{n} \gamma_{ij} = 0, \sum_{i=1}^{n} \lambda_i = 0 \qquad (7)$$

Homogeneity:

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

Symmetry:

$$\gamma_{ij} = \gamma_{ji} \qquad (9)$$

In terms of potential issues arising from price endogeneity, we are to control for bias by incorporating household demographics in the demand equation (6). It is also noted by Zhen et al. (2014) that because households' decisions do not impact equilibrium prices that supply-demand simultaneity should not be an issue. Also, in the case of Somalia, with a large share of food being imported, almost 60% of domestic consumption this further reduce the likelihood of biases from price endogeneity. In addition, given that we follow Majumder et al. (2012) to derive our unit values it has been argued by Capacci and Mazzocchi (2011) that this procedure generates estimates that can be considered as exogenous variables.

[12] As expenditure appears on both sides of our demand model there is a potential for expenditure endogeneity. Unfortunately, the SHFS does not collect household level income so we cannot deal with expenditure endogeneity. However, Zhen et al. (2014) observe that that the significance of expenditure endogeneity is generally statistically irrelevant.

3.2. Dealing with zero expenditures

As shown in Table 2, a large proportion of households report zero expenditure for certain foods. However, a zero can be reported for several reasons such as consumption being infrequent because a food item can be stored. In contrast, other households may not consume some items like fish at all because it is not part of their culinary habit. Nomadic households who largely consume own animal products, such as meat and milk as a main source of protein, may never consume fish.

Distinguishing between types of zeroes is difficult in survey data and zero censored consumption issues can potentially lead to selection biases in any demand models using expenditure as the dependent variable (Ecker and Qaim 2011). A common approach to deal with such biases is to use a two- step estimation method taking account of the likelihood of a household with a certain demographic and socio-economic characteristics consuming an item that they reported as a zero. In this paper, we adopt the approach introduced by Shonkwiler and Yen (1999) which is a consistent two-step estimation method.

In the first step, we obtain household-specific probit estimates that take the binary outcome of one, if a household consumes a specific food group, and zero otherwise. The demand system of equations is thus modelled as follow:

$$\omega_i^* = z'_i \kappa_i + \upsilon_i$$

$$\omega_i = \begin{cases} 1 & \text{if } \omega_i^* > 0 \\ 0 & \text{if } \omega_i^* \leq 0 \end{cases} \tag{10}$$

$$w_i = \omega_i w_i^*$$

where w_i indicates the observed budget share of food group i and ω_i is the binary outcome which equals one if that item is consumed by the household, and zero otherwise. Their corresponding unobservable latent variables are indicated by w_i^* and ω_i^*. z'_i denotes the set of independent variables determining the consumption decision. The corresponding vector of parameters is indicated as κ_i.

In the context of Somalia, we regress ω_i on a set of independent variables including household size, age of household head, gender of household head, proportion of child in the household, logarithm of total expenditure for food and non-food consumption, dummies for

Urban/Rural/IDP or nomadic household status, the regional conflict dummy and dummy variables for time needed to walk to closest food market. Our approach is consistent with previous research in Africa which also include demographics and distance to market as possible determinants of a decision to consume a food category or not (Ecker and Qaim, 2011). More importantly, it is reasonable to believe that market access is an important factor in such decision-making in the context of Somalia where the considerable insecurity in some regions and poor road infrastructure across the country would together limit price arbitrage in food markets.

In the second step, the household-specific standard normal probability density function $\phi\,(z'_i\kappa_i)$ and the cumulative distribution function $\Phi\,(z'_i\kappa_i)$ for each food group that are computed from the Probit model are incorporated into the budget share equation (6), such that:

$$w_i^* = \Phi(z'_i\kappa_i)w_i \quad + \varphi_i\phi\,(z'_i\kappa_i) + \varepsilon_i \tag{11}$$

With this correction for zero observation, the right-hand side of equation (11) does not add up to one in the demand system. Hence, the adding-up restriction defined above no longer holds, which removes the need for dropping one arbitrary equation in the QUAIDS estimation (Ecker and Qaim, 2011).

3.3. Estimating demand elasticities

Next, using the procedure given in Banks et al. (1997), demand elasticities for aggregated food groups are derived by differentiating the budget share equation with respect to $\ln m$ or $\ln p_j$, such that:

Expenditure elasticities of demand for food group i (E_i^x)

$$\mu_i \equiv \frac{\partial w_i}{\partial \ln m} = \left[\beta_i + \frac{2\lambda_i}{b(\mathbf{p})}\left\{\ln\left[\frac{m}{a(\mathbf{p})}\right]\right\}\right]\Phi\,(z'_i\kappa_i) \tag{12}$$

$$E_i^x = \frac{\mu_i}{w_i} + 1 \tag{13}$$

Uncompensated price elasticities of demand for food group i in response to price changes in food group j (E_{ij}^u)

$$\mu_{ij} \equiv \frac{\partial w_i}{\partial \ln p_j} = \left[\gamma_{ij} - \mu_i\left(\alpha_j + \sum_j \gamma_{ji} \ln p_j\right) - \frac{\lambda_i \beta_j}{b(\mathbf{p})}\left\{\ln\left[\frac{m}{a(\mathbf{p})}\right]\right\}^2\right] \Phi\ (\mathrm{z}'_i \kappa_i) \quad (14)$$

$$E_{ij}^{u} = \left(\frac{\mu_{ij}}{w_i} - \delta_{ij}\right) \quad (15)$$

where P_k is a price index calculated as the arithmetic mean of prices for all j food groups *(j=1,…,n)* and δ_{ij} equals one if $i = j$ and zero if $i \neq j$.

4. Results

4.1. Demand Elasticities

Tables 3a, 3b and 3c reports expenditure, own price and cross elasticities from the censored QUAIDS models respectively evaluated at sample means for the full sample, for the sample of households in a conflict zone (as defined) and for the sample households in the non-conflict zones.[13] Specially, the results show the percentage change in quantity consumed in response to a 1% change in aggregate expenditure for all food categories, 1% change in (own) price of a food group and 1% change in price of another food group.

{Approximate Position of Table 3a, 3b and 3c}

In general, there are only marginal differences in the results shown in Tables 3a, 3b and 3c. Therefore, we concentrate on the results in Table 3a. Column 1 shows that whilst cereals and oils are income inelastic, the more expensive food categories such as meat/fish (1.448) and dairy (1.330) are highly elastic. There is also a relatively high expenditure elasticity estimate for fruits and vegetables (1.322) which tend to be high seasonal in Somalia. The expenditure estimates we report in Table 3a are credible given both high levels of monetary poverty in Somalia and the findings reported by Colen et al. (2018) who conducted a meta-analysis of expenditure elasticities for Africa. Overall, they report an average expenditure elasticity of 0.61 with basic staple food items having values less than this whereas for meat, fish and eggs and dairy the estimates range from 0.8 to 1.24. However, as we might expect the expenditure

[13] We report the estimation results of equations 1, 10 and 11 in supplementary materials.

elasticities are more inelastic than the average reported for Africa with cereals in Somalia less than the average of 0.55.

Next the own price elasticities (shown as shaded cells in Table 3a) tell a similar story. Most households can afford only a limited number of basic food items which they are willing to maintain in their meagre diets even if prices increase significantly. Other than fruit/vegetables (-1.063) and pulses (-1.053), all food categories can be classified as own-price inelastic, as their quantities response to change in respective prices is less than one. However, the consumption of more expensive products, such as meat/fish (-0.882) and dairy (-0.749), shows a sizeable response to own-price changes.

Turning to the cross-price elasticities, our results reveal some degree of complementarity among the broader food commodity categories. Our cross-price elasticities are based on a one percentage price change in the food group identified at the top of each column (2 to 8) and the response to this for all other food groups. Thus, for example, for a one percentage change in dairy prices the associated cereals cross-price elasticity is -0.208, such that an increase in the price of dairy will see an associated decline in quantity of cereal consumed. This complementarity is due to the fact in Somali cuisine, households' who cannot afford or are unwilling to consume cereals with the traditional meat-based stews usually use fermented dairy products as a condiment instead. Oils/fats and vegetables (the main component of the fruit and vegetable category) are also found to be complementary (-0.553). This result likely occurs as they are jointly used as ingredients in stews consumed as main meals. Indeed, an increase in meat (and fish) and dairy prices is associated with a fall in fruit/vegetable consumption, suggesting that households fall back to a cereal diet when animal products become unaffordable.

In contrast, there are substitution effects between fruit/vegetables and dairy (0.384), and cereals and oils/fat (0.873). Thus, for example, 1% increase in price of oils/fats is associated with an almost 0.87% increase in the quantity of cereals consumed, suggest a reallocation of expenditure away from oils/fats to cereals. This trade-off is likely due to a shift of consumption within the cereal category, in that when price of oils/fats increases households may switch their consumption towards cheaper and perceivably lower quality cereals derived from maize or sorghum, such as *Canjero/Laxoox* and *muufo* (types of bread) whose preparations typically do not require use of cooking oils.

4.2. Food demand across household types

Considering the differences in demographics across household types observed in Table 1, we now evaluate the demand elasticities across four household types: urban, rural, IDP and nomads. We first begin by examining weekly per capita food expenditures by household group, presented in Table 4.

{Approximate Position of Table 4}

As we would expect cereals accounts for the highest share of total food expenditure across all household types. However, there are some apparent differences for other food groups across household types. For example, urban households on average spent proportionally more on meat/fish than others. They also spent relatively more on fruit and vegetables than rural and nomadic households. For IDP households, cereals and fruit/vegetables occupied over 50% of their total food expenditure.

Given the data presented in Table 4 and combined with the heterogeneities in demographics shown in Table 1, food demand in Somalia may differ across household types and as such it is a potentially important to examine household type elasticities. Thus, we next estimate price and expenditure elasticities for the four household types. These results are shown graphically in Figures 3 and 4.[14]

{Approximate Position of Figures 3 and 4}

From Figure 3, we can see that the most extreme expenditure elasticity responses are found among nomadic households for most product categories. There are also substantial differences in the magnitude of the responses. For example, nomadic households, for both meat/fish and dairy yield expenditure elasticities that are less than one (i.e., 0.879 and 0.802) because own production dominates consumption, whilst also generating the highest (and lowest) expenditure elasticities for all other food categories (e.g., 0.170 for cereals and 2.345 for fruit and vegetables). This extreme variation in expenditure elasticities is partly explained by culturally determined food choices that differ between nomadic households and other household types in Somalia.

Clearly, what is apparent from our expenditure elasticities is that there are different responses to income shocks in terms of the composition of food purchases by the different household groups. These estimates also indicate that a significant income shock may result in a less

[14] The results presented in Figures 3 and 4 are reproduced in Table A1 in the Appendix.

diversified diet with a greater emphasis on cereals, especially for nomadic households. Given the macro nutritional implications of such a response it is therefore more likely that a negative income shock will give rise to issues of malnutrition.

Next turning to the own price elasticities shown in Figure 4, we see that the magnitudes are relatively more similar across the household types compared to the expenditure elasticities. In general, fruit and vegetables emerge as the most price elastic category, particularly for nomadic households. Furthermore, cereals are the most price-inelastic, with the lowest estimate reported for nomadic households, which indicates their dependence on purchased cereals in the diet of this household type, especially during the dry season when own animal productivity is at its lowest.[15]

4.3. Food Elasticities and Remittances

The final piece of analysis we undertook was to examine if any differences in elasticities existed if we introduced into our model specification (equation (6)) a dummy variable indicating whether a household received remittances (including money and goods) from outside of Somalia or not. The results we derived are all based on the sample means of our data. Expenditure and own price elasticities are reported in table A2. Overall, for households in receipt of external remittance, the demand is more expenditure inelastic, especially for oils/fats and others. But for pulse, dairy/eggs, their demand is more expenditure elastic than those who do not receive external remittances. For the price elasticities of demand, most results are similar to those already reported, except for small difference for oils/fats and others.[16]

5. Discussion and Implications

Our analysis has revealed several important implications in terms of food security policy design, official data collection in a fragile state such as Somalia and various other aspects of sectoral policy implementation.

First, unsurprisingly our results reveal that, as we might expect *a priori*, Somali households are faced by considerable food choice constraints. Thus, we find that for most food groups our expenditure elasticity estimates are elastic except for cereals and for oils and fats. Given the importance of these most basic calorific food groups in the diet of many Somalis these findings

[15] Cross price elasticities for all household types are provided in the supplementary materials.

[16] In supplementary materials, we provide summary statistics for the different subsamples used to evaluate the elasticities.

are not surprising. However, these results are at the extreme end of those generated by Colen et al. (2018) who undertook a meta-analysis of existing African studies. There is also variation across the household types we have examined that imply any increases in income will likely manifest in varied changes in expenditure by food group across our household types. With income growth, IDP and nomadic households will likely increase their consumption of fruits/vegetables and pulses relatively more, whereas urban households will increase their consumption of pulses, and rural households will increase consumption of meat/fish. This variation in response by household type to increases in income is important to understand when developing and implementing food security policy in economies such as Somalia.

Second, our results shed light on potential changes to dietary composition due to unfavourable exogenous shocks. Somalia is heavily dependent on food imports given the precarious state of domestic food supply and as discussed extensively in the literature, prices of many imported food commodities can and do fluctuate frequently (e.g., Bellemare, 2015; Mitchell, 2015). Dillion and Barrett (2015) note that domestic price shocks for maize in east Africa are more likely a function of global oil price changes than commodity price shocks, via transport costs. Given the isolation of many nomadic households in Somalia it is plausible that this could be a channel through which price shocks are being delivered. Clearly, our estimate for the own price elasticity of demand for cereals for nomadic households illustrates how vulnerable they are to price shocks to cereals such as maize, sorghum, wheat derivatives and rice. By recognizing such threats, policy makers need to be concerned about identifying sound strategies to improve food security and reduce adverse nutritional impacts of future shocks. Potentially, a dual strategy that on the one hand, increases productivity of the agriculture and livestock subsectors, and, on the other hand, guides humanitarian programmes, such as direct and indirect cash transfers, to smooth out consumption during price shocks is required to help tackle widespread poverty and undernutrition.

Third, a striking feature of the data, we have employed in this study is the high incidence of zero observations in the data, especially, with respect to pulses. As is common in the literature, we have dealt with the zero observations using standard econometric methods. However, the extent of zero observations for pulses may well be revealing income constraints being faced by Somali households that has a limiting effect on dietary diversity that could be due to limited supply or lack of purchasing power. As noted, pulses are typically grown in rain fed farming systems on marginal land and this is unlikely to result in security of supply in a country that is subject to climatic variation. There are also issues around the pollination and pest management of pulse production in Africa that further exacerbates security of production (Otieno et al., 2020).

Fourth, although the worst effects of large-scale conflict are now in the past, there is still conflict of varying degrees in rural areas and the potential reasons for this in Somalia and more generally have been examined extensively in the literature. For example, Maystadt and Ecker (2014) observe that droughts induced higher livestock prices, lead to increased localized frequency of rural conflict. In contrast, Koren (2018) reports results that contradict this hypothesis in that conflict occurs not because of too little produce but in fact because of ample produce. McGuirk and Nunn (2020) argue that it is changing precipitation, especially unanticipated shocks, that lead to increased conflict between nomads and pastoralists. Interestingly, Adams et al. (2018) observe that much of the existing research on the link between climate change and conflict has been subject to sampling bias because of a “street-light” effect. Our results did not show any qualitative difference between regions in terms of elasticities and conflict. However, the relationship between food security and conflict should be re-examined using more waves of the SHFS to enhance our understanding of the impact of conflict intensity on household food preferences. Collecting more household data will also allow for an examination of weather-related impacts on conflict given the high likelihood of future extreme weather events in Somalia. This would allow researchers to contribute to the literature on the relationship between droughts and conflict such Adelaja et al. (2019) who note there is minimal empirical evidence indicating a link between droughts and terrorism activities. In the case of Somalia Maxwell and Fitzpatrick (2011) report that Al-Shabaab-led terrorist activities did not noticeably increase in frequency or intensity during periods of drought.

Fifth, as we have already indicated there is clearly an important need for additional data collection capacity and associated statistical analysis within Somalia given that the country is, as noted by Pape and Wollburg (2019), highly data deprived. Therefore, efforts need to be made to build on the collection of data by the SHFS. However, although the rapid consumption method used for the collection of the SFHS means that data is available for the challenging environment that is Somalia today, there are limitations that need addressing. First, the rapid consumption questionnaire varies in both number of items listed and the order of listing in the consumption module between households. This variation in survey design might give rise to a response bias that future waves of the SHFS should attempt to avoid during data collection. Second, the data we have employed requires the use of imputation for the reason explained by Pape and Wollburg (2019). Although, Pape and Mistiaen (2018) argue that the methods yield robust and reliable data there is clearly a need reduce the extent of imputation in future waves of the SHFS. For the research presented in this paper, running the demand model without the imputed consumption data is feasible but any results produced will be based on a significantly smaller data set. We also contend, that employing elasticity estimates in policy analysis, generated by the type of data we have used in this paper, is preferable to borrowing parameter estimates from neighbouring countries as has occurred in the past for Somalia. Third, although the methodology used to collect the data is sound, there might be gaps between the capacity of local enumerators to collect information and the complexity of the survey instrument. The capacity of enumerators in Somalia is relatively low due to a lack of both a quality education and a loss of statistical human capacity during the civil war. The rapid consumption survey methodology by its very design increases the complexity of the questionnaire, which can in turn increase the gap between existing and required capacity at the level of enumerators. Capacity building is therefore essential, involving both formal statistical training and expert secondments within the emerging statistical authority in Somalia, to fill this skills gap. Fourth, in terms of current study, a specific limitation is our inability to undertake a household level analysis on the relative adequacy or inadequacy of food intake levels such as that presented by Ecker and Qaim (2011) or Law et al. (2020). Ideally, future research needs to estimate macro and micronutrients to provide more detailed evidence to support food security policy developments. As observed by Skoufias et al. (2012) in times of crisis that income elasticities for some micronutrients increase significantly and this has clear implications for household diets and societal wellbeing. This means that we are somewhat limited in terms of conclusions we can draw regarding diet quality and nutrition.

Finally, our analysis has revealed that taking account of remittances had a minimal impact on the results presented. However, remittances can and have helped Somali households deal with economic shocks such as severe shortages of food following a prolonged drought and spike in global food prices (Maxwell et al., 2016). Clearly, the household level data that is currently available is somewhat limited but as more waves of the SFHS are collected a more detailed examination of the importance of remittances is warranted. There is also good reason, to revisit the issue of remittances which may well play an increasing role not only in Somalia, but other countries as they experience the economic fall-out from COVID-19. According to the latest estimates published the World Bank (2020), the average amount of money migrant workers send home is projected to decline 14 percent by 2021 compared to the pre COVID-19 levels in 2019. In Sub-Saharan Africa it is expected to decline by around 9 percent in 2020 alone.

6. Conclusions

In this paper, we present the first set of household level food demand elasticities for Somalia since the onset of the civil war in 1991. To undertake this analysis, we have used a new and unique household survey, the SHFS. The previous paucity of appropriate data as well as the resulting policy relevant parameter estimates for Somalia makes this research timely in terms of supporting new and developing policy initiatives as the country slowly emerges from this difficult period. As is widely understood within the economic literature the elasticities that we present are of fundamental importance in terms of evaluating and examining current and future policy initiatives.

Our results also need to be understood in the context in which Somalia currently finds itself in that it would appear, that Somalia is no longer subject to largescale conflict despite persisting Al-Shabaab insurgency. Indeed, in certain regions such as Somaliland and Puntland there may well emerge a peace dividend that can be expected to materialise through better incomes and lower food prices. But even in these regions, Somalia has a long way to go in term of economic recovery and resilience building, so in the foreseeable future both access and utilization will remain key features of policy developments in relation to food security. In relation to domestic agriculture and the impact it can make in terms of food security, Somalia's economic recovery and its ongoing effort to alleviate poverty will depend on the country's ability to strengthen the climate resilience and productivity of its agricultural sector (World Bank/FAO, 2018; IMF, 2019). This means that an aspect of food security policy needs to focus on increasing agricultural productivity and appropriate trade policy to minimise exposure to volatility of global commodity price. In addition, more research is required regarding the development and adoption of drought resistant crop varieties, environmental governance to protect degrading/overgrazed pasturelands and enhanced veterinary services. The importance of livestock in Somalia is clear. It has the highest concentration of camels in the world (about 18 million) as well as 56 million head of sheep and goats. Yet despite the very high per capita ownership of livestock productivity remains very low in large part due to the extensive, nomadic livestock practices, as well as increasingly frequent droughts which have a negative impact on animal productivity. In addition, animal exports are an important source of foreign earnings in Somalia such that bans on the export of livestock to the Middle East (the main market) due to reoccurring outbreaks of transboundary animal diseases has a knock-on effect on the purchasing power of nomadic and rural households which in turn may increase their reliance on imported cereals. For this reason, building resilience into agriculture production in

Somalia is an important food security policy objective. This resilience needs to reduce vulnerability to climate shocks through long-term adaption strategies, plus strengthening veterinary services that can support livestock production (Marshall et al., 2016, 2019).

Finally, in terms of future research, the collection of subsequent waves of the SFHS will allow researchers to examine how the various elasticity estimates evolve over time. The way in which elasticities can evolve over time and how this relates to dietary changes has recently been examined by Law et al. (2020). There is good reason to assume that, as the security situation continues to improve and government institutions evolve, the economy grows and a greater number of Somali diaspora and refugees in neighbouring countries return that the elasticity estimates change reflecting these changes in the economy.

References

Adams, C., Ide, T., Barnett, J. and Detges, A. (2018). Sampling bias in climate–conflict research. Nature Climate Change, 8: 200–203.

Adelaja, A., George, J., Miyahara, T. and Penar, E. (2019), Food Insecurity and Terrorism. Applied Economic Perspectives and Policy, 41: 475-497.

Banks, J., Blundell, R. and Lewbel, A. (1997). Quadratic Engel Curves and Consumer Demand. The Review of Economics and Statistics, 79(4): 527-539.

Barrett, C. B. (2010). Measuring Food Insecurity. Science, 327 (5967): 825-828.

Beghin, J., Meade, B. and Rosen, S. (2017). A Food Demand Framework for International Food Security Assessment. Journal of Policy Modeling, 39: 827-842.

Bellemare, M.F. (2015). Rising Food Prices, Food Prices Volatility, and Social Unrest. American Journal of Agricultural Economics, 97(1): 1-21.

Brookings Institute (2019). 'Somalia's path to stability', 2 October 2019. https://www.brookings.edu/blog/future-development/2019/10/02/somalias-path-to-stability/

Capacci, S., and Mazzocchi, M. (2011). Five-a-day, A Price to Pay: An Evaluation of the UK Program Impact Accounting for Market Forces. Journal of Health Economics 30(1):87–98.

Colen, L. Melo, P.C., Abdul-Salam, Y., Roberts, D., Mary, S., Gomez, S. and Paloma, Y. (2018). Income elasticities for food, calories and nutrients across Africa: A meta-analysis. Food Policy, 77: 116-132.

Dillon, B.M. and Barrett, C.B. (2015) Global Oil Prices and Local Food Prices: Evidence from East Africa. American Journal of Agricultural Economics, 98(1): 154–171.

Ecker, O. and Qaim, M. (2011). Analyzing Nutritional Impacts of Policies: An Empirical Study for Malawi. World Development 39(3): 412-428.

FAO (2005). Nutrition Country Profile: Somalia. Food and Nutrition Division, FAO, Rome.

Federal Government of Somalia (2018). Somalia Drought Impact and Needs Assessment (DINA), Volume 1, Published 1st Janaury 2018.

FSAU (Food Security Analysis Unit). (2001). Pastoralists Under Pressure. Focus: October 2001. https://reliefweb.int/sites/reliefweb.int/files/resources/5AA74CEABA9C044285256AFE00694543-fsau_som_31oct.pdf

FSANU (Food Security and Nutrition Analysis). (2018). Somalia. Nutrition Update. http://www.fsnau.org/downloads/fsnau-nutrition-update-july-2018

Hastings, J.V., Phillips, S., Ubilava, D. and Vasnev, A. (2020). Price Transmission in Conflict-Affected States: Evidence from Cereal Markets of Somalia. Economics Working Paper Series 2020 – 16, University of Sydney.

Herring, E., Ismail, L., McCullough, A. and Saed, M. (2020). Somalia, fragmented hybrid governance and inclusive development. Chapter 10, pp 186-204, in Santini, R.H., Polese, A.

and Kevlihan, R. (eds) Limited Statehood and Informal Governance in the Middle East and Africa. Routledge.

IMF (International Monetary Fund). (2019). Country Report No. 19/256, August 2019. https://www.imf.org/en/Publications/CR/Issues/2019/07/30/Somalia-2019-Article-IV-Consultation-Second-Review-Under-the-Staff-Monitored-Program-and-48543

IMF (2020). Somalia to Receive Debt Relief under the Enhanced HIPC Initiative. imf.org/en/News/Articles/2020/02/13/pr2048-imf-and-wb-consider-somalia-eligible-for-assistance-under-the-enhanced-hipc-initiative

Joshi, P. K. and Rao, P. P. (2016). Global and regional pulse economies: Current trends and outlook. IFPRI Discussion Paper 1544. Washington, D.C.: International Food Policy Research Institute (IFPRI). http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/130480

Koren, O. (2018). Food Adundance and Violent Conflict in Africa. American Journal of Agricultural Economics, 100(4): 981-1006.

Law, C., Fraser, I. M. and Piracha, M. (2020), Nutrition Transition and Changing Food Preferences in India. Journal of Agricultural Economics, 71: 118-143.

Majid, N., Abdirahman, K. and Hassan, S. (2018). Remittances and Vulnerability in Somalia. Rift Valley Institute, Briefing Paper, http://riftvalley.net/sites/default/files/publication-documents/Remittances%20and%20Vulnerability%20in%20Somalia%20by%20Nisar%20Majid%20-%20RVI%20Briefing%20%282018%29.pdf

Majumder, A., Ray, R. and Sinha, K. (2012). Calculating rural-urban food price differentials from unit values in household expenditure surveys: A comparison with existing methods and a new procedure. American Journal of Agricultural Economics, 94: 1218–1235.

Marshall, K., Mtimet, N., Wanyoike, F., Ndiwa, N., Ghebremariam, H., Mugunieri, L. and Costagli, R. (2016). Traditional livestock breeding practices of men and women Somali pastoralists: trait preferences and selection of breeding animals. Journal of Animal Breeding and Genetics, 133: 534–547.

Marshall, K.D., Mtimet, N., Wanyoike, F., Ndiwa, N., Ghebremariam, H., Mugunieri, L. and Costagli, R. (2019). The traditional livestock breeding practices of women and men Somali pastoralists: breeding management and beliefs on breeding issues. Animal Production Science, 59: 1568–1583.

Martin-Shields, C.P. and Stojetz, W. (2019). Food security and conflict: Empirical challenges and future opportunities for research and policy making on food security and conflict. World Development, 119: 150-164.

Maxwell, D. and M. Fitzpatrick. (2011). Somalia Famine: Context, Causes, and Complications. Global Food Security 1 (1): 5–12.

Maxwell, D., Majid, N., Adan, G., Abdirahman, K. and Kim, J.J. (2016). Facing famine: Somali experiences in the famine of 2011. Food Policy, 65: 63-73.

Maystadt, J-F. and Ecker, O. (2014). Extreme Weather and Civil War: Does Drought Fuel Conflict in Somalia through Livestock Price Shocks? American Journal of Agricultural Economics, 96(4): 1157-1182.

McGuirk, E.F. and Nunn, N. (2020). Nomadic Pastoralism, Climate Change, and Conflict in Africa NBER Working Paper No. 28243.

Ministry of Livestock, Forestry and Range (MoLFR) (2019). Somalia Livestock Sector Development Strategy.

Mitchell, I. (2015). Grey Swans – Agricultural Price Spikes are Not a Thing of the Past, EuroChoices, 14(3): 40-45.

Muhammad, A., Seale, J.L., Meade, B., Regmi, A. (2011). International Evidence on Food Consumption Patterns: AnUpdate Using 2005 International Comparison Program Data (March 1. USDA-ERS Technical Bulletin No. 1929.Available at SSRN: http://ssrn.com/abstract=2114337 or http://dx.doi.org/10.2139/ssrn.2114337)

Muhammad, A., Seale, J.L., Meade, B. and Regmi, A. (2013). International Evidence on Food Consumption Patterns: An Update Using 2005 International Comparison Program Data. TB-1929, U.S. Dept. of Agriculture, Economic Research Service.

OCHA (United Nations Office for the Coordination of Humanitarian Affairs). (2018). State-by-State Drought Analysis February 2018. https://www.humanitarianresponse.info/sites/www.humanitarianresponse.info/files/documents/files/20180228_state-by-_state_drought_analysis

Otieno, M., Steffan-Dewenter, I., Potts, S.G., Kinuthia, W., Kasina, M.J., and Garratt, M.P.D. (2020). Enhancing legume crop pollination and natural pest regulation for improved food security in changing African landscapes, Global Food Security, 26: 100394.

Pape, U. and Mistiaen, J. (2018). Household Expenditure and Poverty Measures in 60 Minutes: A New Approach with Results from Mogadishu. Policy Research Working Paper, No. 8430. World Bank, Washington, DC. http://www.worldbank.org/research

Pape, U. and Karamba, R.W. (2019). Somali Poverty and Vulnerability Assessment : Findings from Wave 2 of the Somali High Frequency Survey (English). Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/464241565765065128/Findings-from-Wave-2-of-the-Somali-High-Frequency-Survey

Pape, U. and Wollburg, P. (2019). Estimation of Poverty in Somalia Using Innovative Methodologies, Policy Research Working Paper, No. 8735. World Bank, Washington, DC. http://www.worldbank.org/research

Pape U. and Mistiaen J. (2020) Rapid Consumption Surveys, Chapter 9, pp. 153-171, In: Hoogeveen J., Pape U. (eds) Data Collection in Fragile States. Innovations from Africa and Beyond. Palgrave Macmillan.

Randazzo, T. and Piracha, M. (2019). Remittances and household expenditure behaviour: Evidence from Senegal. Economic Modelling, 79:141-153.

Research and Evidence Facility (2018). Return and (Re)Integration After Displacement: Belonging, Labelling and Livelihoods in Three Urban Cities. London and Nairobi: EU Trust Fund for Africa (Horn of Africa Window) Research and Evidence Facility.

Shonkwiler, J.S., and S.T. Yen. (1999). Two-Step Estimation of a Censored System of Equations. American Journal of Agricultural Economics, 81(4):972–982.

Skoufias, E., Tiwari, S. and Zaman, H. (2012). Crises, Food Prices, and the Income Elasticity of Micronutrients: Estimates from Indonesia, The World Bank Economic Review, 26(3): 415–442.

Solomon, N., Birhane,E., Gordon, C., Haile, M., Taheri, F., Azadi, H. and Scheffran, J. (2018). Environmental impacts and causes of conflict in the Horn of Africa: A review. Earth-Science Reviews,177: 284-290.

Thorne, K., Meade, B., Daugherty, K. and Christensen, C. (2018). International Food Security Assessment, 2018-2028, GFA-29, U.S. Department of Agriculture, Economic Research Service, Washington, DC..

UNICEF (United Nations International Children's Emergency Fund). (2018). Somalia Nutrition Strategy Note 2018-2020. http://files.unicef.org/transparency/documents/Somalia 2. Nutrition.

UNPFA (United Nations Population Fund). (2014). Somalia Population Estimation Survey. United Nations Population Fund. https://somalia.unfpa.org/sites/default/files/pub-pdf/Population-Estimation-Survey-of-Somalia-PESS-2013-2014.pdf

Vargas-Silva, C. (2017). Remittances Sent To and From the Forcibly Displaced. The Journal of Development Studies, 53(11): 1835-1848

World Bank (2018). Somali High Frequency Survey - December 2017, Wave 2. https://microdata.worldbank.org/index.php/catalog/3181

World Bank (2019). Somali Poverty and Vulnerability Assessment Findings for Wave 2 of the Somali High Frequency Survey. http://documents.worldbank.org/curated/en/464241565765065128/pdf/Findings-from-Wave-2-of-the-Somali-High-Frequency-Survey.pdf

World Bank (2020) Press Release COVID-19: Remittance Flows to Shrink 14% by 2021, October 29, 2020. https://www.worldbank.org/en/news/press-release/2020/10/29/covid-19-remittance-flows-to-shrink-14-by-2021

World Bank and FAO (2018). Rebuilding Resilient and Sustainable Agriculture in Somalia. http://documents.worldbank.org/curated/en/781281522164647812/pdf/124651-REVISED-Somalia-CEM-Agriculture-Report-Main-Report-Revised-July-2018.pdf

Zhen, C., Finkelstein, E.A., Nonnemaker, J., Karns, S. and Todd, J.E. (2014). Predicting the effects of sugar-sweetened beverage taxes on food and beverage demand in a large demand system. American Journal of Agricultural Economics, 96(1): 1-25.

Table 1: Summary statistics for household demographics

		By household types			
	All	Urban	Rural	IDP	Nomad
Total weekly expenditure on food ($)	27.24	26.42	29.03	22.01	33.52
Total weekly expenditure on food and non-food ($)	48.31	47.31	52.81	37.75	54.57
Household size (count)	5.32	5.23	5.36	5.38	5.78
Gender of household head (1=male)	0.52	0.47	0.61	0.43	0.76
Age of household head (years)	37.91	37.05	39.14	37.33	41.29
Proportion of male in household (%)	0.49	0.48	0.50	0.49	0.54
Proportion of children in household (%)	0.45	0.43	0.47	0.48	0.49
Proportion of literate person in household (%)	0.51	0.65	0.29	0.43	0.14
Households living in a conflict region	0.89	0.96	0.97	0.81	0.90
Time needed to walk to closest food market					
0-10 mins	0.45	0.57	0.24	0.47	0.11
10-30 mins	0.27	0.30	0.28	0.28	0.09
30 mins-1 hour	0.12	0.10	0.17	0.14	0.12
1-5 hours	0.15	0.03	0.29	0.10	0.62
Over 5 hours	0.01	0.00	0.03	0.01	0.06
Number of observations	5144	3145	1024	468	507

Table 2: Weekly Quantity Purchased and Food Expenditure at Household Level

Food groups	Proportion of zero observation	Quantity (kg)	Weekly expenditure ($)*
Cereals	0.01	3.29	7.07 (27%)
Fruit/Veg	0.08	1.82	5.05 (19%)
Pulse	0.57	0.88	1.24 (4%)
Meat/Fish	0.17	1.73	4.56 (16%)
Dairy	0.17	1.91	3.09 (11%)
Oils/Fats	0.16	1.53	4.38 (7%)
Others	0.03	1.86	4.38 (17%)

*Figures in the parentheses give the share of total food expenditure.

Table 3a: Demand elasticities (censored QUAIDS) (Full Data Set)

Food groups	**Expenditure Elasticities**	**Uncompensated price elasticities to price changes in food group**						
		Cereals	Fruit/Veg	Pulse	Meat/fish	Dairy	Oils/Fats	Others
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cereals	**0.550**	**-0.516**	-0.003	0.007	-0.006	**-0.208**	**0.873**	-0.031
	(0.029)	(0.112)	(0.061)	(0.035)	(0.045)	(0.026)	(0.087)	(0.050)
Fruit/Veg	**1.322**	-0.168	**-1.063**	-0.085	0.040	**0.384**	**-0.809**	**-0.100**
	(0.026)	(0.091)	(0.070)	(0.035)	(0.030)	(0.024)	(0.074)	(0.045)
Pulse	**1.426**	**0.531**	**-0.576**	**-1.053**	**-0.183**	-0.066	**-0.238**	-0.057
	(0.038)	(0.141)	(0.104)	(0.056)	(0.054)	(0.039)	(0.067)	(0.083)
Meat/Fish	**1.448**	-0.102	-0.059	-0.020	**-0.882**	**0.094**	**-0.706**	**-0.262**
	(0.024)	(0.060)	(0.037)	(0.025)	(0.042)	(0.021)	(0.032)	(0.038)
Dairy	**1.330**	**-0.365**	**0.447**	-0.033	0.045	**-0.749**	**-0.578**	**-0.444**
	(0.034)	(0.059)	(0.038)	(0.024)	(0.030)	(0.036)	(0.053)	(0.030)
Oils/Fats	**0.528**	**0.385**	**-0.553**	**0.103**	-0.063	**-0.183**	-0.121	**0.372**
	(0.042)	(0.114)	(0.081)	(0.039)	(0.049)	(0.035)	(0.096)	(0.070)
Others	**0.826**	**-0.168**	0.030	**0.097**	**-0.082**	**-0.258**	**0.388**	**-0.651**
	(0.038)	(0.075)	(0.051)	(0.028)	(0.035)	(0.021)	(0.077)	(0.068)

Note: All elasticity estimates in bold are statistically significant at 5% significance level. Robust standard errors are given in parentheses. Calculated at means for the entire sample (n=5145).

Table 3b: Demand elasticities (censored QUAIDS) for households living in conflict regions

Food groups	**Expenditure Elasticities**	**Uncompensated price elasticities to price changes in food group**						
		Cereals	Fruit/Veg	Pulse	Meat/fish	Dairy	Oils/Fats	Others
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cereals	**0.551**	**-0.508**	-0.010	0.008	-0.007	**-0.207**	**0.867**	-0.037
	(0.029)	(0.108)	(0.059)	(0.035)	(0.045)	(0.026)	(0.086)	(0.049)
Fruit/Veg	**1.328**	**-0.177**	**-1.059**	**-0.087**	0.041	**0.391**	**-0.821**	**-0.097**
	(0.026)	(0.090)	(0.071)	(0.035)	(0.031)	(0.025)	(0.075)	(0.045)
Pulse	**1.422**	**0.505**	**-0.561**	**-1.050**	**-0.180**	-0.064	**-0.252**	-0.052
	(0.038)	(0.136)	(0.101)	(0.055)	(0.053)	(0.038)	(0.066)	(0.080)
Meat/Fish	**1.455**	-0.117	-0.053	-0.019	**-0.878**	**0.096**	**-0.727**	**-0.264**
	(0.024)	(0.060)	(0.037)	(0.026)	(0.043)	(0.021)	(0.033)	(0.038)
Dairy	**1.330**	**-0.372**	**0.450**	-0.032	0.046	**-0.749**	**-0.585**	**-0.444**
	(0.034)	(0.058)	(0.038)	(0.024)	(0.030)	(0.036)	(0.054)	(0.030)
Oils/Fats	**0.520**	**0.380**	**-0.554**	**0.105**	-0.066	**-0.187**	-0.106	**0.386**
	(0.042)	(0.113)	(0.081)	(0.039)	(0.050)	(0.035)	(0.097)	(0.069)
Others	**0.826**	**-0.177**	0.037	**0.096**	**-0.083**	**-0.258**	**0.391**	**-0.644**
	(0.038)	(0.072)	(0.050)	(0.028)	(0.035)	(0.021)	(0.075)	(0.065)

Note: All elasticity estimates in bold are statistically significant at 5% significance level. Robust standard errors are given in parentheses. Calculated at means for households living in conflict regions (n=4636).

Table 3c: Demand elasticities (censored QUAIDS) for households living in non-conflict regions

Food groups	**Expenditure Elasticities**	**Uncompensated price elasticities to price changes in food group**						
		Cereals	Fruit/Veg	Pulse	Meat/fish	Dairy	Oils/Fats	Others
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cereals	**0.540**	**-0.585**	0.061	-0.002	0.000	**-0.220**	**0.922**	0.020
	(0.029)	(0.151)	(0.085)	(0.041)	(0.046)	(0.029)	(0.099)	(0.073)
Fruit/Veg	**1.278**	-0.099	**-1.095**	**-0.064**	0.033	**0.334**	**-0.728**	**-0.123**
	(0.022)	(0.102)	(0.072)	(0.032)	(0.026)	(0.022)	(0.072)	(0.049)
Pulse	**1.530**	**0.889**	**-0.821**	**-1.091**	**-0.242**	-0.096	-0.105	-0.117
	(0.048)	(0.213)	(0.151)	(0.079)	(0.077)	(0.053)	(0.082)	(0.127)
Meat/Fish	**1.380**	0.009	**-0.097**	-0.026	**-0.910**	**0.074**	**-0.524**	**-0.239**
	(0.020)	(0.059)	(0.039)	(0.024)	(0.036)	(0.019)	(0.025)	(0.036)
Dairy	**1.325**	**-0.309**	**0.424**	-0.040	0.034	**-0.756**	**-0.512**	**-0.441**
	(0.033)	(0.063)	(0.041)	(0.025)	(0.029)	(0.036)	(0.047)	(0.033)
Oils/Fats	**0.589**	**0.422**	**-0.545**	**0.095**	-0.039	**-0.151**	**-0.242**	**0.260**
	(0.038)	(0.131)	(0.085)	(0.036)	(0.045)	(0.033)	(0.095)	(0.083)
Others	**0.830**	-0.086	-0.037	**0.109**	-0.070	**-0.253**	**0.354**	**-0.721**
	(0.039)	(0.114)	(0.071)	(0.034)	(0.039)	(0.024)	(0.092)	(0.098)

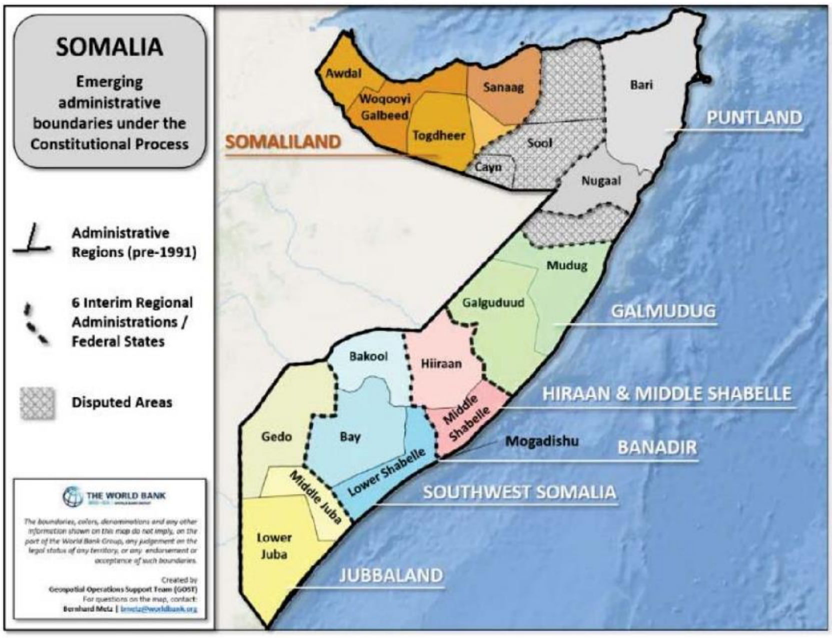
Note: All elasticity estimates in bold are statistically significant at 5% significance level. Robust standard errors are given in parentheses. Calculated at means for households living in non-conflict regions (n=511).

Table 4: Weekly food expenditure per household member across household types

Food Groups	Urban		Rural		IDP		Nomad	
Cereals	1.38	(25%)	1.80	(29%)	1.28	(30%)	1.67	(27%)
Fruit/Veg	1.24	(21%)	0.91	(13%)	0.93	(21%)	0.62	(11%)
Pulse	0.17	(3%)	0.42	(6%)	0.18	(4%)	0.44	(6%)
Meat/fish	1.11	(17%)	0.90	(13%)	0.51	(11%)	1.03	(13%)
Dairy	0.64	(11%)	0.65	(11%)	0.41	(9%)	0.92	(13%)
Oils/Fats	0.39	(7%)	0.45	(8%)	0.32	(7%)	0.51	(8%)
Others	0.87	(15%)	1.08	(19%)	0.75	(18%)	1.34	(22%)
Total	5.79		6.21		4.39		6.54	

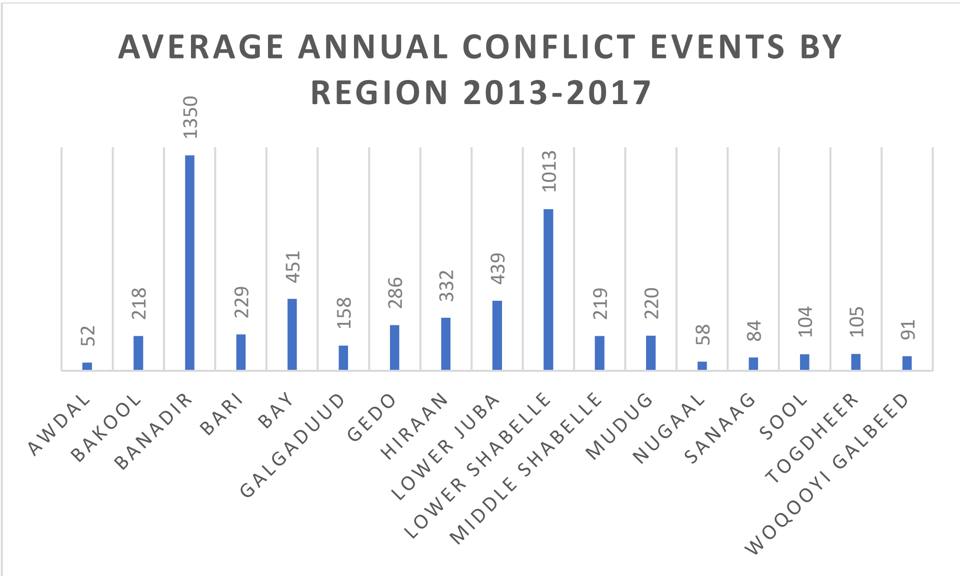
Note: Figures in the parentheses give the share of total food expenditure.

Figure 1: Map of Federal Member States and 18 Regional Administrations



Source: World Bank Geospatial Operations Support Team

Figure 2: Average Annual Conflict Events by Region in Somalia (2013-2017)



Source: ACLED https://acleddata.com/curated-data-files/

Figure 3: Expenditure elasticities by household type

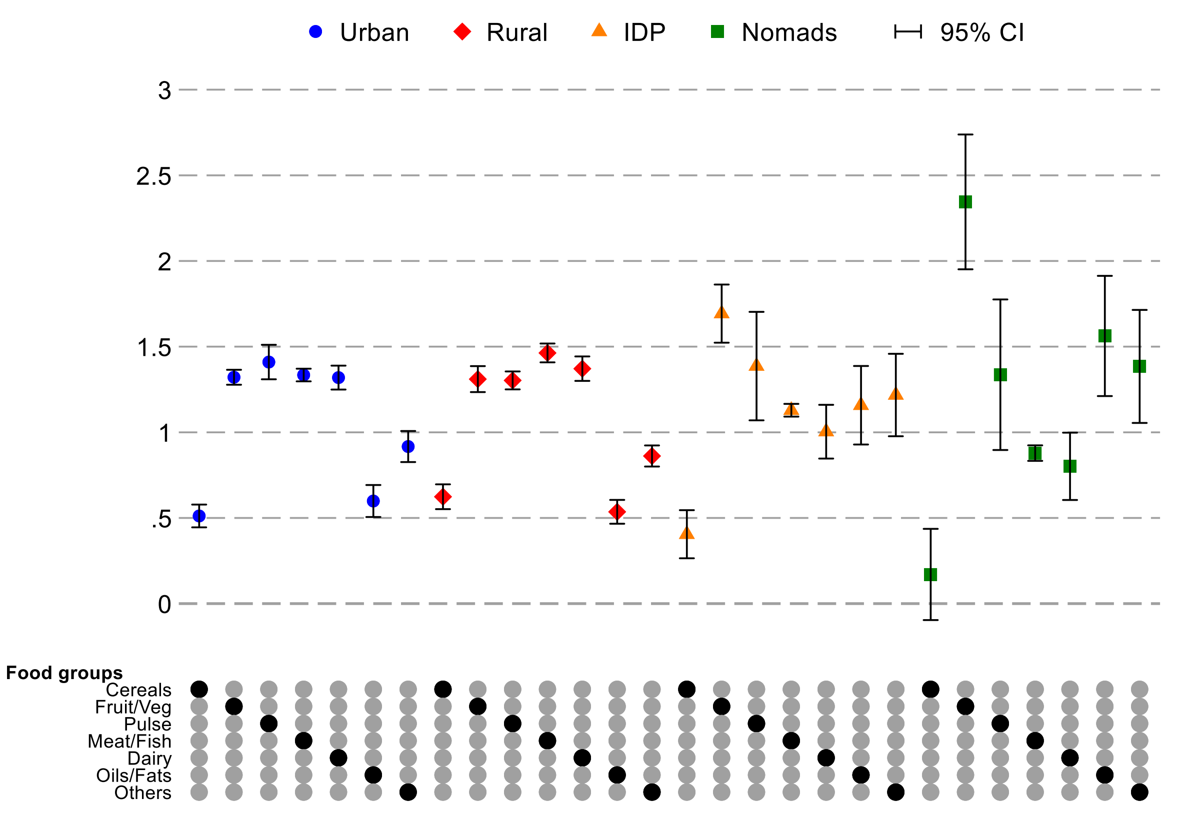
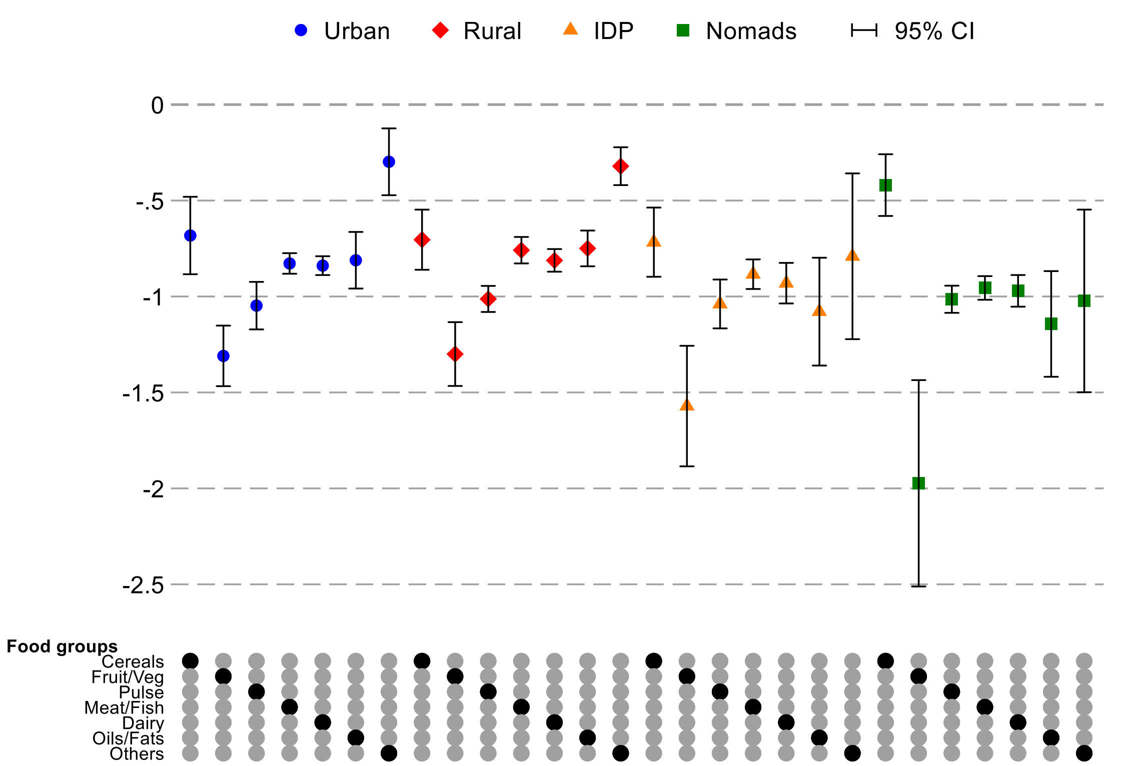


Figure 4: Uncompensated own price elasticities by household types



Appendix

Table A1: Demand elasticities by household types

	Expenditure Elasticities				Uncompensated own price elasticities			
Household types	Urban	Rural	IDP	Nomad	Urban	Rural	IDP	Nomad
Cereals	**0.512**	**0.624**	**0.405**	0.170	**-0.682**	**-0.704**	**-0.717**	**-0.419**
	(0.034)	(0.037)	(0.072)	(0.136)	(0.103)	(0.080)	(0.092)	(0.082)
Fruit/Veg	**1.321**	**1.311**	**1.693**	**2.345**	**-1.310**	**-1.300**	**-1.571**	**-1.974**
	(0.022)	(0.039)	(0.087)	(0.201)	(0.081)	(0.085)	(0.160)	(0.274)
Pulse	**1.410**	**1.303**	**1.386**	**1.336**	**-1.048**	**-1.013**	**-1.039**	**-1.014**
	(0.051)	(0.027)	(0.162)	(0.224)	(0.063)	(0.035)	(0.065)	(0.036)
Meat/fish	**1.334**	**1.463**	**1.129**	**0.879**	**-0.828**	**-0.759**	**-0.884**	**-0.956**
	(0.019)	(0.028)	(0.019)	(0.023)	(0.027)	(0.035)	(0.039)	(0.031)
Dairy	**1.319**	**1.371**	**1.004**	**0.802**	**-0.839**	**-0.812**	**-0.931**	**-0.971**
	(0.036)	(0.036)	(0.080)	(0.100)	(0.025)	(0.030)	(0.054)	(0.042)
Oils/Fats	**0.599**	**0.536**	**1.158**	**1.562**	**-0.811**	**-0.750**	**-1.079**	**-1.143**
	(0.048)	(0.035)	(0.117)	(0.179)	(0.075)	(0.048)	(0.143)	(0.141)
Others	**0.917**	**0.862**	**1.218**	**1.385**	**-0.298**	**-0.321**	**-0.791**	**-1.023**
	(0.046)	(0.031)	(0.123)	(0.168)	(0.089)	(0.050)	(0.220)	(0.243)

Note: All elasticity estimates are calculated at means of each household type (n=3145 for urban, n=1024 for rural, n=468 for IDP and n=507 for nomad). Values in bold are statistically significant at 5% significance level. Robust standard errors are given in parentheses. Uncompensated cross price elasticities are given in the supplementary materials.

Table A2: Demand elasticities by the remittance status of households

Household types	Expenditure Elasticities			Uncompensated own price elasticities		
	All Sample	Households receiving remittances	Households not receiving remittances	All Sample	Households receiving remittances	Households not receiving remittances
Cereals	**0.586**	**0.561**	**0.590**	**-0.599**	**-0.565**	**-0.604**
	(0.043)	(0.047)	(0.042)	(0.085)	(0.088)	(0.085)
Fruit/Veg	**1.233**	**1.199**	**1.239**	**-1.174**	**-1.139**	**-1.180**
	(0.029)	(0.026)	(0.029)	(0.064)	(0.059)	(0.065)
Pulse	**1.360**	**1.435**	**1.349**	**-1.046**	**-1.054**	**-1.045**
	(0.030)	(0.037)	(0.029)	(0.047)	(0.055)	(0.046)
Meat/fish	**1.434**	**1.420**	**1.437**	**-0.791**	**-0.796**	**-0.789**
	(0.025)	(0.023)	(0.025)	(0.035)	(0.033)	(0.035)
Dairy	**1.416**	**1.475**	**1.407**	**-0.776**	**-0.746**	**-0.781**
	(0.044)	(0.053)	(0.043)	(0.042)	(0.048)	(0.041)
Oils/Fats	**0.455**	**0.319**	**0.474**	**-0.689**	**-0.617**	**-0.699**
	(0.040)	(0.049)	(0.039)	(0.054)	(0.065)	(0.052)
Others	**0.833**	**0.797**	**0.838**	**0.955**	**1.105**	**0.933**
	(0.035)	(0.039)	(0.034)	(0.072)	(0.083)	(0.070)

Note: All elasticity estimates are calculated at means of all sample (n=5145), households receiving remittances (n=722) and households not receiving remittances (n=4423). Values in bold are statistically significant at 5% significance level. Robust standard errors are given in parentheses. Summery statistics and uncompensated cross price elasticities are given in supplementary materials.

Supplementary materials

Table S1: Unit value adjustments

	Cereals	Fruits/ Veg	Pulse	Meat/ Fish	Dairy/ Eggs	Oils/ Fats	Others
Household type (Reference group = urban)							
Rural	0.028**	0.046**	0.018	0.106***	0.030	0.085***	-0.010
	(0.013)	(0.018)	(0.043)	(0.041)	(0.032)	(0.026)	(0.020)
IDP	0.021	0.006	0.038	0.185***	0.089**	0.076**	0.022
	(0.015)	(0.020)	(0.058)	(0.047)	(0.038)	(0.030)	(0.023)
Nomad	0.008	-0.090***	-0.043	-0.022	0.190***	-0.027	-0.013
	(0.017)	(0.024)	(0.055)	(0.056)	(0.042)	(0.033)	(0.027)
Ln(food expenditure)	0.065***	0.095***	0.070***	0.180***	0.104***	0.087***	0.120***
	(0.006)	(0.009)	(0.025)	(0.023)	(0.018)	(0.014)	(0.010)
Ln(household size)	-0.056***	0.023	0.113***	-0.091**	-0.041	-0.066***	0.024
	(0.012)	(0.016)	(0.043)	(0.037)	(0.030)	(0.024)	(0.019)
% of literate person in HH	-0.013	0.008	-0.067	-0.110***	0.047	-0.115***	0.036*
	(0.012)	(0.016)	(0.042)	(0.037)	(0.029)	(0.023)	(0.019)
Ln(age of HH head)	-0.004	-0.039***	-0.115***	-0.169***	-0.099***	0.036**	-0.063***
	(0.009)	(0.013)	(0.034)	(0.031)	(0.024)	(0.018)	(0.015)
Gender of HH head (Male=1)	-0.018**	0.014	0.078***	0.135***	0.006	0.009	-0.018
	(0.008)	(0.011)	(0.028)	(0.025)	(0.019)	(0.016)	(0.012)
% of children in HH	0.022	-0.013	-0.195***	-0.109*	-0.053	-0.041	-0.020
	(0.019)	(0.025)	(0.068)	(0.059)	(0.047)	(0.037)	(0.029)
% of male in HH	0.008	0.007	-0.056	-0.170**	0.035	-0.030	0.002
	(0.021)	(0.029)	(0.075)	(0.066)	(0.052)	(0.042)	(0.033)
Time needed to walk to closest food market (Reference group: 0-10mins)							
10-30 mins	-0.039***	0.008	0.063*	0.109***	0.057**	0.016	0.015
	(0.009)	(0.012)	(0.033)	(0.028)	(0.023)	(0.018)	(0.015)
30 mins-1 hour	-0.022*	0.024	0.056	0.078*	0.066**	-0.028	-0.025
	(0.013)	(0.017)	(0.043)	(0.040)	(0.032)	(0.025)	(0.020)
1-5 hours	-0.076***	0.019	0.070	0.047	-0.006	0.014	-0.032
	(0.014)	(0.019)	(0.045)	(0.045)	(0.034)	(0.027)	(0.022)
Over 5 hours	0.012	0.083*	0.155	-0.023	-0.092	-0.007	0.122**
	(0.033)	(0.047)	(0.117)	(0.113)	(0.080)	(0.065)	(0.051)
Observations	5,088	4,705	2,207	4,246	4,267	4,303	4,986
R-squared	0.066	0.061	0.050	0.063	0.098	0.058	0.073

*Note: HH=household Robust standard errors are given in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table S2: Probit regressions

	Cereals	Fruits/ Veg	Pulse	Meat/ Fish	Dairy/ Eggs	Oils/ Fats	Others
Ln(total expenditure)	0.563***	0.750***	0.666***	1.418***	0.737***	0.600***	0.649***
	(0.074)	(0.047)	(0.033)	(0.050)	(0.038)	(0.036)	(0.057)
Household size	-0.042	0.024	0.023**	-0.069***	0.021	0.039***	0.041
	(0.035)	(0.019)	(0.011)	(0.015)	(0.014)	(0.014)	(0.026)
Age of HH head	0.002	0.002	0.004**	-0.003	-0.004**	0.002	-0.003
	(0.005)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Gender of HH head (Male=1)	0.137	0.013	0.126***	0.157***	0.066	-0.076*	-0.287***
	(0.121)	(0.063)	(0.039)	(0.051)	(0.046)	(0.045)	(0.081)
% of children in HH	0.714***	-0.028	0.422***	-0.038	0.285***	0.252**	0.005
	(0.277)	(0.151)	(0.094)	(0.119)	(0.107)	(0.108)	(0.192)
Living in a conflict region	-0.319	-0.634***	0.672***	0.506***	0.376***	-0.147*	0.055
	(0.263)	(0.121)	(0.072)	(0.074)	(0.068)	(0.077)	(0.129)
Household type (Reference group = urban)							
Rural	-0.271*	-0.842***	0.492***	-0.341***	-0.058	-0.234***	-0.179*
	(0.145)	(0.077)	(0.053)	(0.067)	(0.063)	(0.060)	(0.100)
IDP	0.493	0.330**	0.186***	0.037	-0.264***	0.140*	0.074
	(0.308)	(0.147)	(0.066)	(0.088)	(0.073)	(0.080)	(0.134)
Nomad		-1.495***	0.272***	-0.686***	-0.120	0.079	0.825**
		(0.101)	(0.077)	(0.091)	(0.091)	(0.097)	(0.382)
Time needed to walk to closest food market (Reference group: 0-10mins)							
10-30 mins	-0.023	-0.306***	0.122***	-0.187***	-0.150***	-0.010	0.019
	(0.140)	(0.083)	(0.046)	(0.063)	(0.054)	(0.054)	(0.091)
30 mins-1 hour	0.484*	-0.239**	0.304***	-0.334***	-0.101	0.011	0.091
	(0.280)	(0.101)	(0.063)	(0.079)	(0.073)	(0.073)	(0.126)
1-5 hours	-0.238	-0.537***	0.293***	-0.583***	-0.108	0.103	0.432**
	(0.183)	(0.092)	(0.067)	(0.080)	(0.078)	(0.079)	(0.172)
Over 5 hours		-0.432**	-0.074	-0.718***	0.220	0.131	0.395
		(0.193)	(0.165)	(0.184)	(0.214)	(0.198)	(0.435)
Constant	0.576	-0.082	-4.013***	-3.569***	-1.939***	-1.330***	-0.303
	(0.394)	(0.213)	(0.156)	(0.191)	(0.161)	(0.160)	(0.255)
Observations	4,593	5,144	5,144	5,144	5,144	5,144	5,144

*Note: HH=household Robust standard errors are given in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table S3: QUAIDS results

Food group i	**Cereals**	**Fruits/ veg**	**Pulse**	**Meat/fish**	**Dairy/eggs**	**Oils/ fats**	**Others**
β	-0.270***	0.273***	0.0335	-0.0637***	-0.0647**	0.091***	0.128*
	(-4.98)	(6.14)	(1.08)	(-9.73)	(-2.86)	(3.92)	(2.46)
λ	0.00899**	-0.0127***	-0.0000	0.00818***	0.00658***	-0.008***	-0.009**
	(2.65)	(-4.72)	(-0.00)	(15.21)	(4.70)	(-5.87)	(-2.96)
φ	0.00230	-0.0108***	0.0180**	-0.00643	0.0270*	-0.0335***	0.00909
	(0.49)	(-3.88)	(2.74)	(-0.47)	(2.05)	(-4.93)	(1.92)
γ (food group j)							
Cereals	-0.307*	0.360***	0.0748	-0.0659**	-0.0987**	0.106**	0.0842
	(-2.24)	(3.37)	(1.86)	(-2.83)	(-3.04)	(2.68)	(0.95)
Fruits/ veg		-0.363***	-0.0720	0.0958***	0.134***	-0.147***	-0.169**
		(-3.37)	(-1.84)	(5.68)	(4.02)	(-4.75)	(-2.67)
Pulse			-0.00803	-0.0254**	0.000651	0.00361	0.00270
			(-0.77)	(-3.24)	(0.07)	(0.27)	(0.15)
Meat/ fish				0.00361	-0.0143*	0.0221**	0.00694
				(0.60)	(-2.32)	(2.97)	(0.49)
Dairy/ eggs					-0.00195	0.0155	0.000168
					(-0.16)	(1.20)	(0.01)
Oils/ fats						-0.0249	-0.0197
						(-1.17)	(-0.76)
Others							0.0335
							(0.57)
Constant	2.010***	-1.254***	-0.343*	0.00270	0.126	-0.0712	-0.221
	(9.15)	(-6.76)	(-2.53)	(0.25)	(1.37)	(-0.74)	(-1.01)
ln(household size)	-0.00107	0.00735*	-0.0160**	-0.000542	0.0132**	0.00506	0.171***
	(-1.41)	(2.31)	(-3.15)	(-0.39)	(2.89)	(1.02)	(24.85)
ln(age of household head)	-0.0157***	0.0104***	0.00818**	-0.000292	-0.000378	-0.0144***	0.112***
	(-4.06)	(5.83)	(2.77)	(-0.15)	(-0.16)	(-3.65)	(34.90)
Gender of household head	-0.00899	0.0206***	-0.00639	0.0418***	-0.0203***	-0.00626	0.0900***
	(-1.28)	(4.42)	(-0.70)	(5.34)	(-3.57)	(-0.41)	(14.85)
% of children in household	-0.0262*	-0.00445	-0.00238	-0.000425	-0.00358	0.00515	0.130***
	(-2.33)	(-1.00)	(-0.37)	(-0.16)	(-0.48)	(0.28)	(24.37)
% of male in household	0.00164	0.0175**	0.0696***	0.00669	-0.0186***	-0.0321***	-0.0815***
	(0.67)	(2.59)	(11.31)	(0.71)	(-4.18)	(-5.25)	(-4.89)
Living in a conflict region	0.0128***	0.0201***	-0.00281	-0.0217***	-0.0193**	0.482***	0.302***
	(4.74)	(4.04)	(-0.75)	(-4.86)	(-2.66)	(8.75)	(18.80)

Table S4. Uncompensated price elasticities for urban households

	Cereals	Fruit/Veg	Pulse	Meat/fish	Dairy	Oils/Fats	Others
Cereals	**-0.682**	**0.250**	0.050	**-0.104**	**-0.181**	**0.155**	**0.294**
	(0.103)	(0.074)	(0.038)	(0.043)	(0.033)	(0.043)	(0.064)
Fruit/Veg	0.073	**-1.310**	**-0.099**	**0.198**	**0.338**	**-0.305**	**-0.469**
	(0.091)	(0.081)	(0.033)	(0.025)	(0.030)	(0.036)	(0.052)
Pulse	**0.637**	**-0.715**	**-1.048**	**-0.316**	-0.011	0.062	-0.041
	(0.144)	(0.122)	(0.063)	(0.036)	(0.041)	(0.054)	(0.099)
Meat/fish	**-0.194**	**0.109**	**-0.111**	**-0.828**	**0.057**	**-0.087**	**-0.438**
	(0.051)	(0.028)	(0.017)	(0.027)	(0.015)	(0.021)	(0.031)
Dairy	**-0.414**	**0.472**	-0.010	**0.087**	**-0.839**	**-0.140**	**-0.549**
	(0.067)	(0.050)	(0.017)	(0.026)	(0.025)	(0.026)	(0.044)
Oils/Fats	**0.339**	**-0.550**	**0.121**	**-0.097**	**-0.149**	**-0.811**	**0.677**
	(0.102)	(0.079)	(0.042)	(0.047)	(0.035)	(0.075)	(0.086)
Others	**-0.255**	**-0.211**	**0.107**	**-0.177**	**-0.216**	**0.183**	**-0.298**
	(0.084)	(0.070)	(0.027)	(0.032)	(0.025)	(0.042)	(0.089)

Note: All elasticity estimates in bold are statistically significant at 5% significance level. Robust standard errors are given in parentheses.

Table S5. Uncompensated price elasticities for rural households

	Cereals	Fruit/Veg	Pulse	Meat/fish	Dairy	Oils/Fats	Others
Cereals	**-0.704**	**0.150**	0.051	-0.064	**-0.141**	**0.103**	**0.191**
	(0.080)	(0.049)	(0.028)	(0.035)	(0.025)	(0.031)	(0.042)
Fruit/Veg	0.115	**-1.300**	**-0.159**	**0.203**	**0.413**	**-0.335**	**-0.423**
	(0.099)	(0.085)	(0.036)	(0.032)	(0.032)	(0.036)	(0.060)
Pulse	**0.335**	**-0.443**	**-1.013**	**-0.235**	-0.014	0.053	-0.074
	(0.075)	(0.057)	(0.035)	(0.029)	(0.023)	(0.029)	(0.061)
Meat/fish	-0.077	-0.028	**-0.149**	**-0.759**	**0.112**	**-0.160**	**-0.615**
	(0.066)	(0.045)	(0.031)	(0.035)	(0.023)	(0.032)	(0.056)
Dairy	**-0.315**	**0.326**	-0.015	**0.121**	**-0.812**	**-0.184**	**-0.636**
	(0.059)	(0.034)	(0.021)	(0.026)	(0.030)	(0.023)	(0.047)
Oils/Fats	**0.147**	**-0.264**	**0.115**	**-0.150**	**-0.191**	**-0.750**	**0.769**
	(0.073)	(0.054)	(0.028)	(0.040)	(0.025)	(0.048)	(0.056)
Others	**-0.241**	-0.078	**0.084**	**-0.179**	**-0.205**	**0.194**	**-0.321**
	(0.051)	(0.044)	(0.022)	(0.029)	(0.018)	(0.024)	(0.050)

Note: All elasticity estimates in bold are statistically significant at 5% significance level. Robust standard errors are given in parentheses.

Table S6. Uncompensated price elasticities for IDP households

	Cereals	Fruit/Veg	Pulse	Meat/fish	Dairy	Oils/Fats	Others
Cereals	**-0.717**	**0.342**	0.022	**-0.162**	**-0.205**	**0.216**	**0.503**
	(0.092)	(0.107)	(0.046)	(0.054)	(0.041)	(0.063)	(0.142)
Fruit/Veg	0.047	**-1.571**	-0.061	**0.347**	**0.451**	**-0.482**	**-0.973**
	(0.120)	(0.160)	(0.060)	(0.052)	(0.060)	(0.075)	(0.138)
Pulse	**0.567**	**-0.656**	**-1.039**	**-0.297**	-0.013	0.060	-0.053
	(0.229)	(0.253)	(0.065)	(0.062)	(0.070)	(0.105)	(0.176)
Meat/fish	**-0.299**	**0.433**	**-0.200**	**-0.884**	-0.026	0.046	**-0.188**
	(0.101)	(0.068)	(0.031)	(0.039)	(0.029)	(0.037)	(0.061)
Dairy	**-0.491**	**0.785**	-0.038	-0.038	**-0.931**	0.012	-0.170
	(0.100)	(0.130)	(0.034)	(0.039)	(0.054)	(0.066)	(0.115)
Oils/Fats	**0.389**	**-0.953**	0.157	0.116	0.024	**-1.079**	-0.029
	(0.158)	(0.153)	(0.082)	(0.062)	(0.077)	(0.143)	(0.199)
Others	**-0.243**	**-0.370**	**0.123**	-0.038	**-0.098**	0.020	**-0.791**
	(0.091)	(0.109)	(0.038)	(0.048)	(0.045)	(0.076)	(0.220)

Note: All elasticity estimates in bold are statistically significant at 5% significance level. Robust standard errors are given in parentheses.

Table S7. Uncompensated price elasticities for nomad households

	Cereals	Fruit/Veg	Pulse	Meat/fish	Dairy	Oils/Fats	Others
Cereals	**-0.419**	**0.226**	-0.017	**-0.182**	**-0.237**	**0.245**	**0.745**
	(0.082)	(0.089)	(0.047)	(0.066)	(0.040)	(0.077)	(0.201)
Fruit/Veg	0.254	**-1.974**	-0.114	**0.525**	**0.694**	**-0.749**	**-1.551**
	(0.214)	(0.274)	(0.104)	(0.084)	(0.101)	(0.125)	(0.250)
Pulse	**0.368**	**-0.480**	-1.014	**-0.266**	-0.020	0.065	-0.080
	(0.137)	(0.201)	(0.036)	(0.064)	(0.066)	(0.104)	(0.225)
Meat/fish	-0.105	**0.332**	**-0.180**	**-0.956**	**-0.047**	**0.080**	0.047
	(0.077)	(0.052)	(0.024)	(0.031)	(0.023)	(0.031)	(0.053)
Dairy	**-0.212**	**0.558**	**-0.064**	-0.063	**-0.971**	0.047	0.058
	(0.049)	(0.071)	(0.022)	(0.032)	(0.042)	(0.051)	(0.120)
Oils/Fats	-0.018	**-0.807**	**0.235**	**0.176**	0.062	**-1.143**	-0.426
	(0.133)	(0.116)	(0.078)	(0.066)	(0.071)	(0.141)	(0.239)
Others	**-0.453**	**-0.224**	**0.154**	-0.008	-0.070	-0.008	**-1.023**
	(0.076)	(0.067)	(0.033)	(0.049)	(0.041)	(0.071)	(0.243)

Note: All elasticity estimates in bold are statistically significant at 5% significance level. Robust standard errors are given in parentheses.

Table S8: Household Socio-Economic Data Receiving Remittances

	Receive Remittances	Do Not Receive
Household size (count)	5.24	5.34
Gender of household head (1=male)	0.51	0.53
Age of household head (years)	38.33	37.84
Proportion of male in household (%)	0.48	0.49
Total weekly expenditure on food and non-food ($)	60.23	44.32
Proportion of children in household (%)	0.43	0.45
Households living in a conflict region	0.93	0.90
Time needed to walk to closest food market		
0-10 mins	0.53	0.44
10-30 mins	0.28	0.27
30 mins-1 hour	0.10	0.12
1-5 hours	0.08	0.16
Over 5 hours	0.00	0.02
Weekly amount spent		
Cereals	7.97	7.00
Fruits/Veg	7.07	5.26
Pulse	3.13	2.84
Meat/Fish	6.48	5.34
Dairy/Eggs	3.84	3.69
Oils/Fat	2.17	2.25
Others	4.81	4.46
Total	32.14	26.44
Budget share in total food expenditure		
Cereals	0.25	0.27
Fruits/Veg	0.21	0.18
Pulse	0.03	0.04
Meat/Fish	0.18	0.15
Dairy/Eggs	0.11	0.11
Oils/Fats	0.06	0.07
Others	0.15	0.17
% of nonzero observation for each food group		
Cereals	1.00	0.99
Fruits/Veg	0.96	0.91
Pulse	0.46	0.42
Meat/Fish	0.92	0.81
Dairy/Eggs	0.89	0.82
Oils/Fats	0.88	0.83
Others	0.98	0.97

Table S9. Uncompensated price elasticities with inclusion of remittance dummy variable (whole sample)

	Cereals	Fruit/Veg	Pulse	Meat/fish	Dairy	Oils/Fats	Others
Cereals	**-0.599**	**0.147**	0.055	-0.050	**-0.162**	**0.117**	**0.605**
	(0.085)	(0.050)	(0.030)	(0.041)	(0.033)	(0.029)	(0.096)
Fruit/Veg	0.007	**-1.174**	**-0.115**	**0.137**	**0.313**	**-0.258**	**-0.531**
	(0.072)	(0.064)	(0.028)	(0.024)	(0.023)	(0.028)	(0.071)
Pulse	**0.496**	**-0.588**	**-1.046**	**-0.276**	-0.006	0.048	**-0.222**
	(0.092)	(0.070)	(0.047)	(0.037)	(0.034)	(0.034)	(0.082)
Meat/fish	**-0.165**	-0.012	**-0.121**	**-0.791**	**0.111**	**-0.156**	**-0.946**
	(0.062)	(0.035)	(0.026)	(0.035)	(0.022)	(0.024)	(0.049)
Dairy	**-0.377**	**0.311**	-0.014	**0.117**	**-0.776**	**-0.210**	**-1.037**
	(0.066)	(0.035)	(0.023)	(0.025)	(0.042)	(0.024)	(0.098)
Oils/Fats	**0.256**	**-0.305**	**0.108**	**-0.160**	**-0.233**	**-0.689**	**1.375**
	(0.082)	(0.062)	(0.033)	(0.049)	(0.028)	(0.054)	(0.102)
Others	**-0.270**	-0.071	**0.085**	**-0.198**	**-0.239**	**-0.763**	**0.955**
	(0.058)	(0.049)	(0.026)	(0.035)	(0.020)	(0.026)	(0.072)

Note: All elasticity estimates in bold are statistically significant at 5% significance level. Robust standard errors are given in parentheses.

Table S10. Uncompensated price elasticities for households receiving remittances

	Cereals	Fruit/Veg	Pulse	Meat/fish	Dairy	Oils/Fats	Others
Cereals	**-0.565**	**0.155**	**0.066**	-0.055	**-0.174**	**0.119**	**0.604**
	(0.088)	(0.053)	(0.031)	(0.044)	(0.036)	(0.031)	(0.101)
Fruit/Veg	-0.010	**-1.139**	**-0.106**	**0.121**	**0.281**	**-0.226**	**-0.451**
	(0.064)	(0.059)	(0.025)	(0.022)	(0.020)	(0.025)	(0.064)
Pulse	**0.577**	**-0.700**	**-1.054**	**-0.334**	-0.007	0.061	**-0.270**
	(0.108)	(0.083)	(0.055)	(0.047)	(0.041)	(0.041)	(0.100)
Meat/fish	**-0.229**	0.017	**-0.106**	**-0.796**	**0.107**	**-0.149**	**-0.946**
	(0.057)	(0.031)	(0.023)	(0.033)	(0.020)	(0.022)	(0.044)
Dairy	**-0.467**	**0.355**	-0.012	**0.138**	**-0.746**	**-0.236**	**-1.191**
	(0.076)	(0.038)	(0.025)	(0.028)	(0.048)	(0.027)	(0.114)
Oils/Fats	**0.356**	**-0.365**	**0.128**	**-0.208**	**-0.292**	**-0.617**	**1.710**
	(0.100)	(0.074)	(0.039)	(0.060)	(0.036)	(0.065)	(0.121)
Others	**-0.302**	-0.068	**0.098**	**-0.232**	**-0.277**	**-0.725**	**1.105**
	(0.064)	(0.057)	(0.029)	(0.041)	(0.024)	(0.030)	(0.083)

Note: All elasticity estimates in bold are statistically significant at 5% significance level. Robust standard errors are given in parentheses.

Table S11. Uncompensated price elasticities for households not receiving remittances

	Cereals	Fruit/Veg	Pulse	Meat/fish	Dairy	Oils/Fats	Others
Cereals	**-0.604**	**0.145**	0.054	-0.050	**-0.160**	**0.117**	**0.605**
	(0.085)	(0.050)	(0.030)	(0.041)	(0.033)	(0.029)	(0.095)
Fruit/Veg	0.011	**-1.180**	**-0.117**	**0.140**	**0.320**	**-0.264**	**-0.546**
	(0.074)	(0.065)	(0.029)	(0.024)	(0.023)	(0.028)	(0.072)
Pulse	**0.484**	**-0.572**	**-1.045**	**-0.268**	-0.005	0.046	**-0.215**
	(0.090)	(0.068)	(0.046)	(0.036)	(0.033)	(0.034)	(0.079)
Meat/fish	**-0.155**	-0.017	**-0.124**	**-0.789**	**0.111**	**-0.158**	**-0.947**
	(0.063)	(0.036)	(0.027)	(0.035)	(0.022)	(0.025)	(0.050)
Dairy	**-0.364**	**0.304**	-0.015	**0.114**	**-0.781**	**-0.206**	**-1.014**
	(0.064)	(0.034)	(0.023)	(0.025)	(0.041)	(0.024)	(0.095)
Oils/Fats	**0.243**	**-0.296**	**0.105**	**-0.154**	**-0.225**	**-0.699**	**1.329**
	(0.080)	(0.060)	(0.032)	(0.047)	(0.027)	(0.052)	(0.099)
Others	**-0.265**	-0.071	**0.083**	**-0.193**	**-0.233**	**-0.769**	**0.933**
	(0.058)	(0.048)	(0.025)	(0.034)	(0.020)	(0.026)	(0.070)

Note: All elasticity estimates in bold are statistically significant at 5% significance level. Robust standard errors are given in parentheses.