Price Shocks, Vulnerability and Food and Nutrition Security among Rural and Urban Households in Tanzania

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Summary

Global food price fluctuations have increased substantially over the last decade leading to significantly high prices within the developing countries. Tanzania is not an exception, since the recent food price surges made it one of the most affected countries in SSA. This paper investigates the impact of the recent food price crisis on the quantity and quality of the dietary composition of rural and urban households in Tanzania, since excessive food price movements are likely to harm most vulnerable households. Results using household data from the 2008/09, 2010/11 and 2012/13 waves of the Tanzania National Panel Survey show that urban households are more vulnerable than rural households to food price shocks. Moreover, we find evidence that price movements negatively affected also the quality of the diet, in particular, looking at the regional distribution, fats, calcium and vitamin A were the most cutback macro and micronutrients. Short-term policy measures, such as food fortification or micro-nutrient supplementation programmes are needed to strengthen diet diversity and micronutrient intake of Tanzanian vulnerable households and to improve the ability of poor to cope better with food price instability.

Keywords: VER, food-price shocks, Tanzania, food security, nutrient intake

JEL Classification codes: D12, I12, I32, Q12

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1. INTRODUCTION

Poor households in developing countries face a wide array of risks arising from many sources, both natural and economic. In particular, food price fluctuations have increased substantially over the last decade and there are concerns that excessive food price movements represent a problem that will persist for a while with severe consequences for the poor (Fan, 2011). Tanzania is not an exception: after the 2007/2008 food price spike, food prices increased between 2010 and 2011 and again at the beginning of 2013, making Tanzania one of the most affected countries in SSA, in particular for cereals like maize, wheat and rice (Minot, 2014). These products account for a large part of the total dietary consumption of Tanzanian households: as a result, the sharp increase and high volatility of their prices raised serious concerns about the ability of Tanzanian poor to meet basic needs and achieve adequate level of food security. Existing contributions tell us that the effects of higher food prices on poverty are likely to be very differentiated. They depend on which commodity prices change, on the structure of the economy (Ravallion and Lokshin, 2004; Hertel and Winters, 2006) and on the households status as food buyers or sellers (Aksoy and Izik-Dikmelik, 2008).[1]

Many authors tried to analyse the effect of price shocks on poverty. Ivanic and Martin (2008) analyzed nine low-income countries finding that the impact of soaring food prices on poverty is commodity and country specific and that poverty growth is much more frequent, and larger, than poverty reduction. Polaski (2008) explored the links between labour and agricultural prices in India highlighting that food price upswings benefited mostly poor households, whilst Wodon et al.(2008) found a negative effect of price rise for West and Central Africa poor. More recent contributions on this literature come from Sarris and Rapsomanikis (2009), Wodon and Zaman (2010), Ivanic et al.(2012).

A smaller body of the literature attempted to measure how food price movements affected households food consumption. Using data from two provinces in China, Jensen and Miller (2008) found a small impact of price increase on consumption and nutrition of poor households. Brinkman et al.(2010) examined the impact of the crises on food consumption, nutrition and health outcomes for several specific developing countries, emphasizing that, as a result of the crises, a large number of vulnerable households has reduced the quantity and quality of their food consumption. Similarly, Harttgen and Klasen (2012) showed a very large impact of changes in prices of maize and staple food on individual caloric consumption in Malawi and Uganda. Drawing from the very recent micro-economic development literature, Alem and Sodebrom (2012) measured the effect of the recent price spikes on household vulnerability by including in their analysis a direct measure of self-reported food price shocks. By employing an AIDS model, Zaki et al. (2014) evaluated the impact of rising food prices on micronutrients intake among households in Lebanon, showing that soaring prices negatively

[1] These analyses employ a number of methodologies which are applied to household survey data from different developing countries.

affected the intake of some macro and micronutrients. In contrast with the recent literature, D'Souza and Jolliffe (2014) found that Afghan most vulnerable households experienced no decline in caloric intake as a response of wheat price surge, arguing that food caloric intake is indeed an ineffectual indicator to measure the onset of food insecurity.

Concerning Tanzania, only few authors have systematically analysed the effect of food price movements on households vulnerability and food consumption. Christiansen et al. (2006) examined the effects of coffee and cashew price decline in 2000s on household welfare, pointing out that they resulted in an important average welfare loss. A study by Sarris and Karfakis (2007) focusing on Kilimanjaro (north) and Ruvuma (south-west) regions, showed that vulnerability in the rural regions of Tanzania is quite high and considerably higher in poorer (Ruvuma) as compared to more well off regions (Kilimanjaro). However, vulnerability systematically differ among different areas within both region, in particular in Kilimanjaro. Both studies were conducted before the food price spikes, thus leaving the question about the effect of the recent food price crisis on vulnerability among Tanzanian urban and rural households still unanswered.

The overall objective of this paper is to contribute to the existing literature on shocks and household vulnerability by documenting the effects of the very recent food price shocks on food consumption across households in urban and rural Tanzania. We will examine the impact both quantitatively (e.g. food caloric intake) and qualitatively (e.g. dietary diversity), assuming that the greater the correlation, the less effective the risk management strategy implemented by the household to insulate consumption from idiosyncratic and covariate shocks[2] Moreover we will try to shed light on whether certain types of households are relatively more 'vulnerable' than others to food price surges. In doing this, we will control for the intensity of the event, measuring the consumption response in case the event is classified by the household as severe or not. Since Tanzania is affected by several shocks we think that it is important to take into account also the incidence of other idiosyncratic and covariate shocks. We will employ as shock variables the household's self-reported perception of the shocks they experienced over the five years before the survey. This measure is used as an indicator of whether households perceived (positive or negative) food price changes had a detrimental impact on the household welfare or not.

In order to pursue our objectives we rely on the Vulnerability as Uninsured Exposure to Risk (VER) framework of analysis[3]. Following Dercon and Khrisnan (2000) we adopt food consumption instead of income as a well-being measure (because the latter is more volatile, while households are assumed to seek stable levels of welfare over time) and we assess our measurement of vulnerability to shocks by using the coefficients of shock variables instead of the income variation[4]. The database employed for the analysis is the Tanzanian Living Standard Measurements Study - Integrated Surveys on Agriculture (LSMS - ISA). From the technical view point, the fact that in Tanzania are available three waves of the LSMS (2008/09, 2010/11 and 2012/13) offers a unique opportunity to take advantage of a panel data structure with good quality data.

The paper is set out as follows. Section 2 provides background information on Tanzanian economic growth, food prices and inflation. Section 3 reviews the empirics of shocks. Section 4 presents the methodology. Section 5 introduces the data, variables description and the econometric specification of the model. Section 6 reports the results of the analysis and, finally, section 7 concludes.

[2] We define food consumption smoothing as a form of consumption insurance in the way intended by Skoufias and Quisumbing (2004)

[3] VER is a backward looking measurement, which can be defined as an ex-post assessment of the extent to which a negative shock (e.g. price surge, drought) generates a welfare loss

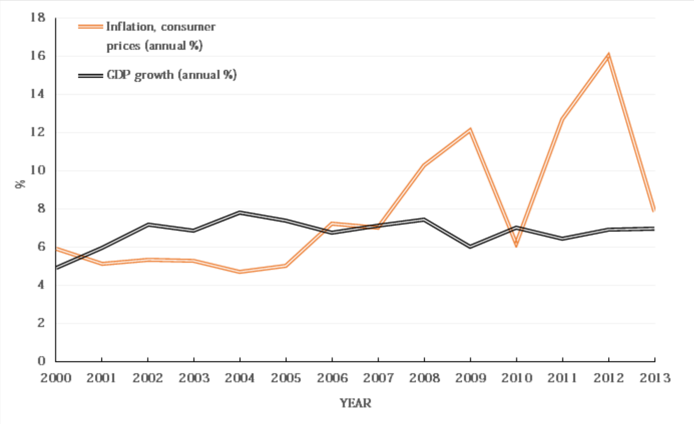
[4] See Hoddinott and Quisumbing (2003) for a comprehensive review of all the possible VER framework specifications

2. ECONOMIC GROWTH, INFLATION AND FOOD VOLATILITY IN TANZANIA

Official statistics indicate that Tanzania has grown at a constant pace over the last ten years (cf. table A.1 in the Appendix). Real GDP grew on average at an annualized rate of approximately 7%. However, Tanzania is still among the world's poorest countries. In November 2013, the Government of Tanzania announced the new official poverty figures indicating that approximately 28.2% of the population lives below the national poverty line. The decline in poverty incidence over the last years has been modest, though about 6 millions of people have been lifted out of poverty since 2007 (IMF, 2014). Although in the last decade agricultural value added (as a share of GDP) sharply declined, agriculture still remains the backbone of Tanzanian economy. In 2014 it accounted for nearly 27% percent of Tanzanian GDP, providing 85% of exports, and employing 80% of the work force (Cleaver et al., 2010). Cereals represent more than half of Tanzania's total harvested land area. Maize is the country's dominant staple food crop, while the country is a net importer of wheat and rice. Maize yields are low (about 0.75 tons per hectare) and smallholder farmers rely on traditional agronomic practices and technologies. Cassava and potatoes are also important food sources and account for 15% of harvested land (WFP, 2012). The recent successful economic growth occurred despite many local and global challenges. At local level, Tanzania was hit by a severe drought in 2009, which adversely affected crop production, livestock and power generation (WFP, 2012). At the global level the country was negatively impacted by high oil and food prices in 2007-2008 and in the subsequent years. From 2007 onwards, consumer price inflation registered the highest peaks in Tanzanian recent history (see figure 1). After the 2007/08 unprecedented food prices peak, the Government of Tanzania imposed an export ban and removed the import duties for maize and rice. The government lifted up the export ban in October 2012 and implemented again an import duty in 2013.

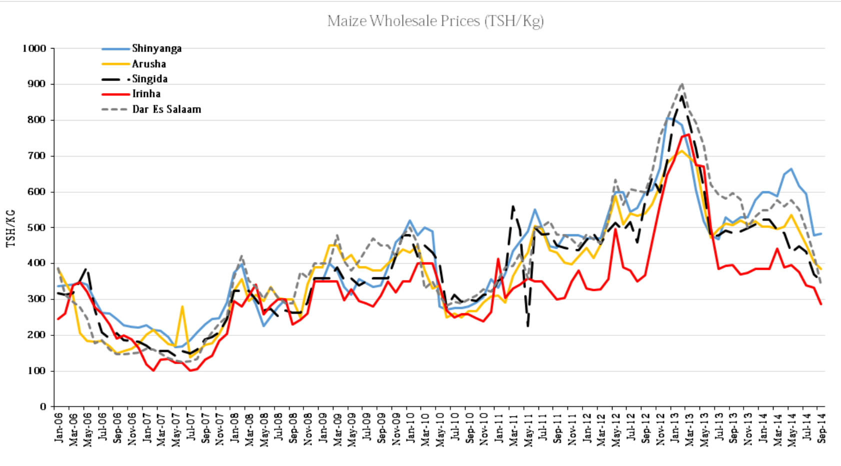
As a result, food prices continued to increase thus affecting the majority of net buyers in urban areas. In particular, prices of cereals experienced the highest fluctuations, as shown by maize prices movements in the main Tanzanian local markets. We adopt maize as a benchmark for cereals prices for two reasons. First, as pointed out by Minot (2010) maize is the main staple food in Tanzania and is consumed by the majority of the households in both rural and urban areas. Second, data on maize are the most complete available time series (see figure 2). In February 2008 maize prices almost doubled with respect to 12 months before. Then, maize prices began to fall prior to reach other two peaks in March 2009 and in January 2010, respectively. An unprecedented peak was touched in February 2013 when in Der Es Salaam the cost of 1 kg of maize was about 900 Tsh. Prices of agricultural inputs have also increased (especially fertilizers) thereby shrinking agricultural incomes: as expected this resulted in an increase in food insecurity of the more vulnerable households.

Figure 1: Inflation and GDP growth between 2000 and 2013 in Tanzania.



Source: Author's elaboration of World Development Indicators data, World Bank (2014).

Figure 2: Wholesale Prices of Maize (TSH/Kg) in Shinhanga, Arusha, Singida, Irinha, Dar Es Salaam (Tanzania).



Source: Author's elaboration of WFP-VAM (2014) data.

3. Shocks and vulnerability

The vulnerability literature has identified different sources of shocks, characterizing them according to the nature of the event and the magnitude at which they occur. Using Dercon *et al*. (p. 5, 2005) definition, in this paper shocks are defined as "adverse events that lead to a loss of household income, a reduction in consumption and/or a loss in productive assets".

3.1. Empirics of shocks

Since information on idiosyncratic and covariate shocks is often lacking in most household surveys[5] , our understanding of risk is at the moment relatively incomplete (Toye, 2007). A common conclusion of the recent studies[6] on the effect of idiosyncratic and covariate shocks on vulnerability is that people affected by

[5] By comparing sixteen different households survey, Heltberg et al. (2012) provided a general overview on what are the most frequent sources of risk and coping strategies.

[6] Some authors contributed to this literature on vulnerability by analysing only the impact of selected shocks on households' consumption (e.g., Paxson, 1992; Rosenzweig and Binswanger, 1993; Kochar, 1995; Glewwe and Hall, 1998; Gertler and Gruber, 2002; Ligon and Schechter, 2003;

shocks commonly respond to a welfare reduction[7] by smoothing consumption, increasing the working hours, looking for credit and assistance, adjusting the level of assets or relying on savings and sales. Yet, the outcomes are context specific and depend strongly on the relative incidence of covariate and idiosyncratic shocks (World Bank, 2005). Since the aim of this paper is to understand how different households change their consumption patterns as a response to price shocks (large fall of crop selling prices, large rise of food prices, large rise of agricultural input prices), but these shocks are not exhaustive of all shocks hitting a household (e.g. drought and health shocks), we will provide a broad picture of some of the contributions related to the three most important sources of risks, namely natural disasters, health and price shocks.

As reported by Wagstaff and Lindelow (2014) studies on weather-related shocks normally analyze asset losses determined by shocks, whilst health shocks studies focus more on consumption and labor-market consequences. Concerning natural shocks, Dercon (2004) highlights that rainfall shocks in Ethiopia slowed down the growth of households consumption while Hoddinott and Kinsey (2001), Alderman et al.(2006) and Yamano et al.(2005) underlined the existence of a causal relationship between rainfall shocks and human capital formation. Hoddinott and Kinsey (2001), by relying on natural experiments, identified the long and short-term impacts of shocks on children born during periods of severe natural or systemic shocks, while Kurosaki (2014) tried to assess which are the types of households most affected by drought and floods shocks. Households may respond to agricultural shocks especially through off-farm labor supply and income to mitigate crop income loss (Kijima, 2006).

In some countries, health shocks have a larger effect on consumption than natural disasters shocks (Heltberg and Lund, 2009). Other recent contributions confirming this finding include Wagstaff (2007), which looks at the effect of health shocks in Vietnam, and Islam and Maitra (2012) that examined the effect of health shocks in Bangladesh.

Regarding the effect of price shocks on consumption Alem and Sodebrom (2012) and Kumar and Quisumbing (2013) investigated how Ethiopian urban households and rural female headed households coped with the 2008 food price shocks. The former concluded that households with lower assets levels as well as households with members engaged in casual works were more affected by high food price shocks. The latter found that female headed households are more vulnerable to food price shocks than male headed households and more likely to experience a food price shock.

Furthermore, food price shocks may have a great incidence on the quality of food intake. Brinkman *et al.* (2010), for example, modelled the effect of high food prices on food consumption by employing the Food Consumption Score Index finding that, large numbers of vulnerable individuals reduced the quality and quantity of consumed food as a result of the food price crisis. Not always the most vulnerable households experience the largest consumption fall. For example, D'Souza and Jolliffe (2014), in a study conducted on Afghanistan households, found that the most vulnerable households exhibit no decline in caloric intake when food prices increase, while a stronger variation in the quantity of calories absorbed is registered by households at the top of the caloric intake distribution. A coping strategy usually adopted to buffer against a decline in energy intake is often changing the dietary mix (D'Souza and Jolliffe, 2012).

Christiaensen and Subbarao, 2004; Skoufias and Quisumbing, 2004; Woolard and Klasen, 2005; Alderman, Hoddinott, and Kinsey, 2006; Gertler et al. 2006; Grimm, 2008).

[7] Skoufias and Quisumbing (2004) discussed the impact of shocks on household welfare.

3.2. Shocks in rural and urban Tanzania

To understand the incidence of different risky events we report descriptive statistics on shocks among Tanzanian rural and urban households in 2008/09, 2010/11 and 2012/13. We seek to quantify the incidence of shocks, how severe they were and their degree of dispersion. For each shock we have several information. The enumerators inquired about the incidence of the shocks over the five years prior to the survey, the timing of the shocks, their severity, the costs in terms of income/asset losses and finally their degree of dispersion. This last is defined as whether the adverse event was experienced by other people in the community (i. e. covariate shock, such as drought, epidemic illnesses and economic shocks), or if it was faced only at household level (idiosyncratic shock). As reported by Sango *et al.* (2007) this distinction is important because households are much more able to insure consumption from the adverse effects of idiosyncratic shocks by making use of informal insurance mechanisms, such as social safety nets, while such networks are inadequate in shielding households' consumption from systemic (covariate) risks (Kochar, 1995; Morduch, 1995; Dercon, 2004, Gunther and Harttgen, 2009; Hoogeveen et al., 2011).

The figures reported in table 1 and tables A.2, A.3, A.4, provide an overview of shocks experienced by Tanzanian households in 2008/09, 2010/11 and 2012/13 expressed as the shares of rural (urban) households hit by a given shock over total rural (urban) households. We split the shocks into seven broader categories: (i) price shocks, (ii) natural disasters, (iii) asset shocks, (iv) employment shocks, (v) health shocks, (vi) crime and safety shocks, (vii) household break-up. Since the majority of households are at least partly engaged in agricultural activities, agricultural shocks account for most of the shocks reported. Price shocks include large fall of crop selling prices, large rise of food prices, large rise of agricultural input prices. Natural disasters comprise drought/flood, water shortage, fire and crop disease. Asset shocks include loss of land, livestock death, dwelling damage. Employment shocks include loss of salaried employment and household business failure. Health shocks comprise death, chronic/severe illness or accident of household members, while crime and safety comprise common theft and violence of all kinds. Separations but also incidents (e.g. jail) are included in household break-up. To facilitate the comparison between shocks, table 1 shows the percentage of urban and rural surveyed households, reporting the incidence of a single/multiple shock in 2008/09, 2010/11 and 2012/13.

Looking across our sample we notice that food price shocks, natural disasters and health shocks clearly stand out as the most frequent shocks. In particular, food price rise affects more than two-third households. This is the most common shock registered in all years. This evidence is not surprising because the surveys were conducted during or in the aftermaths of the 2008 and 2010 peaks of the food price crisis. It is also evident from table 1 that rural households are more sensitive than urban households to large fall in crop prices as well as to large rise in agricultural input prices.

Conditional to the occurrence of a shock, rural households are more likely than urban respondents to experience natural disasters and asset shocks (i.e. livestock dead 13-28 percent). Droughts/floods and crop disease rank high among shocks. They are reported as shock by approximately one-third of the rural households against 7% and 14% of urban households, respectively, in the case of crop disease shock and drought/flood shock. Some shocks are relatively common among both urban and rural households. For example the proportion of rural and urban households being affected by severe water shortage or death of other family member is similar (with higher values registered for urban households). On the other hand, some other shocks like dwelling damages (0-1%), loss of land (1-4%), employment shocks (1-9%), household break-up shocks (0-8%) are far less frequent.

Table 1: Percentage of urban and rural households surveyed reporting the incidence of a single/multiple shock in 2008/09, 2010/11 and 2012/13

	Rural			Urban		
Year	2008	2010	2012	2008	2010	2012
(i) Price Shocks						
Large fall in sale prices for crops	32%	25%	20%	7%	8%	6%
Large rise in agricultural input prices	32%	22%	20%	11%	10%	8%
Large rise in price of food	65%	48%	43%	70%	59%	51%
(ii) Natural Disasters						
Crop disease	31%	25%	18%	6%	7%	5%
Droughts or floods	30%	26%	27%	13%	12%	14%
Fire	2%	3%	1%	1%	1%	1%
Severe water shortage	32%	27%	21%	41%	35%	21%
(iii) Asset Shocks						
Dwelling damaged, destroyed	1%	0%	0%	1%	0%	1%
Livestock died or were stolen	28%	19%	13%	8%	10%	8%
Loss of Land	4%	4%	3%	1%	3%	2%
(iv) Employment Shocks						
Household business failure	3%	4%	3%	9%	8%	8%
Loss of salaried employment	1%	2%	1%	6%	4%	3%
(v) Health Shocks						
Chronic illness/accident of HH member	11%	6%	5%	7%	8%	5%
Death of a member of the HH	16%	9%	9%	11%	9%	7%
Death of other family member	37%	31%	23%	46%	45%	37%
(vi) Crime and Safety Shocks						
Hijacking/Robbery/burglary/assault	9%	6%	5%	13%	16%	7%
(vii) Household break-up						
Break-up of the HH	5%	6%	7%	6%	8%	8%
Jailed	1%	1%	1%	0%	0%	0%

Values expressed as percentage of rural (urban) households over total rural (urban) households
Note: the numbers in the columns do not add up to 100% since households indicated multiple shocks.

Respondents were also asked to rank shocks by severity (table A.2). Both rural and urban respondents reported perceived shocks mostly as high impact shocks. The finding may indicate that respondents recall shocks more often when the shocks are severe or the respondents perceive them as severely affecting household welfare. Among the events ranked by households as most serious, there are primarily health-related shocks. More than two-thirds of the households that suffered the death of a household member reported this as the ”most severe”. Also, the death of a member of another family is found to be among the most severe shocks. Fire destroying dwelling or assets, it is also a serious concern for households. Although it affects a small number of individuals, it is considered a very critical shock by half of the respondents who have experienced it. The same goes for household break-up shocks. Except for the price shock of agricultural inputs, which is described as the most severe shock by one third of rural households, it can be concluded that households tend to perceive idiosyncratic shocks as the most serious shocks (see table A.4). This is true for both rural and urban households. However, rural households tend to suffer less the employment shocks. The relationships between idiosyncratic shocks and the severity ranking emerge even more when comparing this shock with more covariant shocks. For example, the incidence of price rise is rated as the most critical shock only by the 15% of rural households and by the 11% of urban households, as well as the fall in sales prices of crops is assessed as most severe by 12-16% of households.

Many shocks have significant adverse effects. Table A.3 reports the extent to which shocks have different costs among households. We identify three different consequences: income loss, asset loss and a combination of income and asset losses. On average, shocks cause more adverse consequences in terms of income than in terms of assets. Assets are usually depleted when they are stolen (e.g. livestock stolen), in case of fire or when the dwelling is damaged or destroyed. In the other cases, the households mainly report income reduction as a consequence of a shock. A more pronounced effect is observed for those households who bear the brunt of the impact of price volatility and natural disasters even if the differences between the shocks are similar, and it is quite difficult to single out which are the most relevant in terms of income reduction. Table A.4 shows the degree of dispersion of each shock, i.e. covariate vs. idiosyncratic shocks. In doing this, the respondents were asked to estimate the impact of each household shock on others. The response categories were: this household, some other households, most households, all households. We categorize shocks as idiosyncratic if they belong to the first two groups and as covariate if they belong to the last two groups. As expected, in both rural and urban subsamples, responses reveal that price shocks and natural disasters can be defined as covariate shocks. The remaining shocks are idiosyncratic.

4. METHODOLOGY

4.1. Theoretical Framework

Hoddinott and Quisumbing (2003) identified three different approaches to assess vulnerability. The first one links vulnerability with high expected poverty (VEP), considering it as the probability of consumption falling below an ex-ante defined poverty line (Christiaensen and Boisvert, 2000; Chauduri, 2000; Chauduri et al. 2002, Pritchett et al., 2000, and Kamanou and Morduch, 2004). To this end, it adapts to a stochastic environment the standard FGT index (Foster et al., 1984) and derives its expected value as follows:

$$V_{\alpha,ht} = F(z)\int_0^z \max\left\{0, \frac{z - c_{h,t+1}}{z}\right\}^{\alpha} \frac{f(c_{h,t+1})}{F(z)}\, dc_{h,t+1} \qquad (1)$$

where c_h is household's consumption; z is the standard poverty line, while $F(.)$ and $f(.)$ are the cumulative distribution and the density function of consumption at time $t+1$[8], respectively eq. (4.1) measures the probability of falling below the poverty line, i.e. F (z), multiplied by a conditional probability-weighted function of the shortfall below this poverty line (Christiaensen and Boisvert, 2000). Depending on whether we rely on the headcount measurement of poverty ($\alpha = 0$) or not[9], the VEP measure reduces to the probability that the household will experience poverty, i.e. $V = F(z)$. The second approach associates vulnerability with low expected utility (VEU) (Ligon and Schechter, 2003). It assesses vulnerability as the difference between the utility derived from some level of certainty-equivalent consumption analogous to the choice of a poverty line in the literature of poverty measurement, z (above which the household would not be considered vulnerable), and the expected value of the actual utility of the household from its (risky) stream of consumption, as follows:

$$v_i = U_h(z_{ce}) - EU_i(c_i) \qquad (2)$$

where U_h is a weakly concave, strictly increasing function. This can be rewritten as:

$$V_i = [U_i(z_{ce}) - U_i(Ec_i)] + [U_i(Ec_i) - EU_i(c_i)]. \qquad (3)$$

[8] Eq. (1) is obtained by multiplying the expected value of the poverty index by F (z) / F (z) . For more information on the derivation procedure of Eq. (1), see Christiaensen and Boisvert (2000).

[9] For instance, some studies employ depth of poverty ($\alpha = 1$) (see, for example, Ravallion, 1988).

The first bracketed term $[U_i(z_{ce}) - U_i(Ec_i)]$ measures poverty, it is basically the difference between a concave function evaluated at the 'poverty line' and at household i's expected consumption expenditure. The second term is a measure of the risk that the household faces. As Ligon and Schechter (2003) show, this term can be split up into a measure of aggregate risk and a measure of idiosyncratic risk. Thus we can write:

$$Vi = [U_i(z_{ce}) - U_i(Ec_i)] + \{ U_i(Ec_i) - EU_i[E(c_i \mid x)]) \} + \{ EU_i[E(c_i \mid x)] - EU_i(c_i) \}. \quad (4)$$

with $E(c_i \mid x)$ is the expected value of consumption, conditional on a vector of covariant variables x. The second term $U_i(Ec_i) - EU_i[E(c_i \mid x)]$ represents the aggregate risk faced by the household i, and finally $EU_i[E(c_i \mid x)] - EU_i(c_i)$ is a term expressing the idiosyncratic risk the household faces. When risks are not managed in an effective way, shocks may result in a fall in consumption and hence welfare losses. For this reason we need to use an ex-post measurement of vulnerability, which corresponds to the so called Uninsured

Exposure to Risk (VER). This is the third measure of vulnerability, and it is based on an ex-post assessment of the extent to which a negative shock causes welfare loss (Hoddinott and Quisumbing, 2003; Skoufias, 2003). This approach, which is mainly based on regressions of panel datasets containing the consumption levels of specific households before and after a specific shock, analyzes how households manage to smooth their consumptions over time, and categorizes households as vulnerable (Deressa et al., 2009). To get an estimate of such vulnerability, let h denote the h-*th* household living in village v at time *t*. Let's define the dependent variable, $\Delta lnFC_{htv}$, as the difference between log food consumption between $t - 1$ and t, i.e. the rate of food consumption over the period under consideration. Then the impact of the shocks occurred between $t - 1$ and t on the food consumption of the h-*th* household can be estimated according to the following relationship:

$$\Delta lnFC_{htv} = \Sigma_i \alpha_i CS(i)_{tv} + \Sigma_i \beta_i IS(i)_{htv} + \sigma_{tv} \delta_{tv} D_{tv} + \gamma X_{hvt} + \varphi Z_{hv} + \Delta\epsilon_{hvt}$$

where, $CS(i)_{tv}$ is a vector of covariant shocks occurred between $t - 1$ and t, $IS(i)_{htv}$ is a vector of idiosyncratic shocks over the same period, D_{tv} is a set of dichotomous variables identifying each community, X_{hvt} and Z_{hv} are respectively time varying and time invariant household characteristics, and $\Delta\epsilon_{hvt}$ is a household-specific stochastic error term[10].

The estimated values for α and β identify the magnitude of the impacts of covariate and idiosyncratic shocks, respectively, net of the mitigating role played by private coping strategies and public responses: by quantifying the impact of these shocks this approach identifies which risks would be an appropriate focus of policy. Moreover, considering the well-known asymmetric impact of positive and negative shocks, it may be useful to disaggregate the shock variables into positive and negative shock components (Dercon and Krishnan, 2003).

5. DATA AND VARIABLES

5.1. Data and sample household

We use household data from the 2008/09, 2010/11 and 2012/13 Tanzania National Panel Survey (TZNPS Y1, Y2 and Y3). The surveys are part of the World Bank's Living Standards Measurement Study -

[10] The literature on vulnerability as uninsured exposure to risk uses four variants of the equation (5)

Integrated Surveys on Agriculture (LSMS - ISA) and are the subsequent rounds of a series of three household panel surveys. The TZNPS Y1 was administered between October 2008 and October 2009 and covered 3,265 households and about 16,709 individuals. The TZNPS Y2 started in October 2010 and ended in September 2011, interviewing the same households of TZNPS Y1 plus some more households totalling 3,924 households and 20,559 individuals. Household members leaving their original households in order to start new households of their own or move with other households explains the increase. Marriage and migration are the most common reasons for households splitting over time. The last wave, TZNPS Y3, consists of 5,010 households (and 25,412 individuals) including all households already surveyed in the previous two rounds. Similarly, the duration and timing of the field work for the third round ranged from October 2012 to November 2013. These survey are based on a multi-stage, stratified, random sampling of Tanzanian households which is representative at the national, urban/rural, and agro-ecological level.

Therefore the final sample consists of 12,199 households, that, after tracking the households over time reduces to 8793 units.

5.2. Estimation model

In this section, we introduce the estimation model and describe the variables employed to address the hypothesis introduced previously. In order to measure the impacts of price shocks and other idiosyncratic and covariate shocks on the food caloric intake, we specify the food consumption at the individual level as a function of the shocks, as well as household and individual characteristics. The model specification of the food per capita caloric intake of household *i*, at year *t*, denoted by y_{ijt}, is reported in levels[11] as follows:

$$y_{it} = \beta_0 + \beta_1 P_{it} + \beta_2 S_{it} + \beta_3 X_{it} + \mu_i + \eta_t + \epsilon_{it} \tag{6}$$

where *P* is a vector of price shock variables, *S* represents a vector of non-price shock variables, *X* is a vector of variables of households' characteristics, μ represents the time-invariant household's fixed effects (such as for example eating habits or food preferences), η represents the year effects, and ϵ_{it} is the error term which is IID ~ N (0, σ^2). We assume that households' fixed effects can be captured by a separate constant for each household: the use of time-invariant household fixed effects is necessary to remove unobserved time-invariant factors at the household level. The failure to control for these household-specific attributes will produce omitted variable bias if the omitted factors are correlated with observed covariates. Regarding the dependent variable we use the per capita daily caloric food intake, which is also a measure of household food security. It basically relates to the access to food and is a widely used measure of health and undernutrition. We employ the Tanzania Food Composition Tables (Lukmanji, 2008) to convert the total reported household food consumption[12] over the seven days prior to the interview into kilo-calories. We then obtain per capita daily caloric intake by dividing the total kilo-calories by the household size expressed in adult equivalents[13]. Following WFP (2012) we incorporate in the effective number of household members eating at home, also the number of "guests eating meals within home". As for variables representing price shocks, we build three dummies aimed at identifying whether over the past five years the household was severely negatively affected

[11] We represent our model in levels by taking advantage from having a three years-panel dataset. This specification differs slightly from the cross-section specification reported in (5).

[12] Total food consumption was based on a list of regularly consumed local foods from the different food groups (cereals, roots and tubers, vegetables and fruits, meat and fish, fats).

[13] We adopt the nutrition (calories) based equivalence scales used by Dercon and Krishnan (1998).

by (i) ”large fall in sale prices for crops”[14], (ii) ”large rise in prices of food”, (iii) ”large rise in agricultural input prices”. We control also for covariant shocks by setting up a dummy which is equal to 1 if a natural disaster (i.e. drought/floods) hit the household in the past five years, and idiosyncratic shocks controlling for the households experiencing chronic/severe illness of a household member. By using this model we assess whether food caloric intake increases/decreases after food price shocks and if the responses are different when considering idiosyncratic and covariate shocks.

As regressors for the household characteristics we include demographic composition (number of household members, number of children, sex ratio and dependency ratio), the characteristics of the household head (sex, education[15] and whether he/she is employed in agriculture/livestock), the average land acreage owned by the household, a set of productive assets indices[16], wealth indices[17] and the household net position in the market. Finally we include an index of source of income diversity, since households with more diversified income sources can better mitigate the effect of shocks. As controls for individual characteristics that determine food consumption variation (vector X_{it} in equation (6)) we include roster information (i.e. age of the individual), education (three different dummies (=1) if the individual has completed respectively primary school, secondary school or university) and income source from agricultural activity (a dummy (=1) if the household member works in agriculture). Summary statistics are reported in table A.6.

6. Results and Discussion

6.1. Model Specification: Rural vs Urban

Table 2 reports model (6) fixed effects estimates for the overall, rural and urban samples at individual level. The signs of the coefficients are generally in line with theory, and several coefficients are large relative to their standard errors. In all regressions, standard errors are robust to heteroskedasticity. The first column focuses on the overall sample, presenting a fixed effects estimator of the log of food caloric intake on levels of household characteristics, and a set of covariate and idiosyncratic shock variables. In the overall sample specification the findings are broadly consistent, with several variables among the controls having statistically significant coefficients. First of all, female-headed households consumption is positive and statistically significant: this result, which seems counterintuitive, confirms the findings of Christiansen and Sarris (2007). Two explanations can be offered. First, female heads may be much more concerned about children’s health and decide to allocate a larger share of their expenditure to children nutrition. A second explanation could be that since female headed households are often the chief earners as well as being responsible for the whole household, they are more likely to report accurate information about household food consumption. This emphasizes the existence of a bias in the estimation, inflating the consumption level for female headed and understating that of male headed households (Louat et al., 1993). Age is positive and significant at 10% for rural households. Head of households’ education clearly matters. Our results for the overall sample show that this has a positive impact on food caloric intake. This effect is also statistically significant among rural

[14] The household respondent was asked ”Did you experience in the past five years a ”large fall in sale prices for crops”?”

[15] The education of the household head variable ranges between 0 and 3. It equals 0 if the household head has not completed primary school, and is equal to 1, 2, 3 if the household head has completed primary, secondary, and post-secondary education respectively.

[16] Three indexes including the ownership of base agricultural assets, sophisticated agricultural assets and animals (cf. table 4B.2 for details on the composition of these assets).

[17] Which serve as proxy for household economic status. They include a set of asset indicators, household quality and access to services. For more information see table 4B.1.

individuals. Looking at the effect of the education level we notice that the only significant results are registered at rural level, households with higher educated heads have also higher remunerative employment opportunities. Regarding the effect of the household size on daily food caloric intake, we find a negative and statistically significant correlation at 1 percent level. We note that rural households with more household members, consume, on average, less, suggesting that they are (ceteris paribus) more vulnerable. The dependency ratios coefficients do not exhibit any significant association with the consumption. Two out of three wealth indices, namely the Housing Quality Index and the Consumer Durables Index have positive and statistically significant effects on per capita consumption. The Quality/Access to services index is not statistically significant in any of the specifications. Regarding labour variables (i.e.), we do not find any significant effect, neither for employment in agriculture/livestock, nor for income diversification index. Households with larger landholdings experience an increase in consumption, reinforcing the finding that economic growth experienced by Tanzania between 2008 and 2012 was mainly based on agriculture (see the figures reported in Table A.1). The signs of these partial correlations appear reasonable. Looking at the impact of the shock variables on consumption, which is the main focus of this paper, we notice that in the overall, rural and urban specifications all the statistically significant coefficients are of the expected sign (negative) with the exception of the natural shocks (drought/flood), which are surprisingly positive and statistically significant, although only at 10%. One possible explanation could be that this variable embraces both drought and flood shocks, since respondents were asked about the perception of both types of shock and their response was recorded under the same variable. Furthermore, severe/chronic illness shocks have a negative and statistically significant impact on consumption only for urban households. As expected, a food price fall results in an increase in purchasing power and higher consumption. This effect is particularly robust in urban areas where we record a higher share of food buyer households[18]. Food price rise shocks are not statistically significant, while shocks regarding price of input rise are statistically significant and play a negative role on food consumption for both the overall and urban sample.

Table 2. Econometric results: basis specification.

	Overall		Rural		Urban	
	Ln (Caloric Intake)		Ln (Caloric Intake)		Ln (Caloric Intake)	
	Coeff.	SE	Coeff.	SE	Coeff.	SE
Head is Female	0.242***	(0.043)	0.177***	(0.044)	0.365**	(0.112)
Ln Age Head	0.215*	(0.088)	0.170*	(0.077)	0.438	(0.320)
Head Education	0.0985***	(0.024)	0.105***	(0.028)	0.0731	(0.046)
Ln HH Size (AE)	-0.239***	(0.042)	-0.318***	(0.039)	-0.175	(0.091)
Sex Ratio	0.0194	(0.013)	0.0255	(0.015)	-0.00299	(0.026)
Dependency Ratio	-0.00524	(0.013)	0.00119	(0.014)	-0.00173	(0.035)
Head Employed in Agriculture	-0.0150	(0.029)	-0.0149	(0.034)	-0.0426	(0.070)
Income Diversity Index	0.0471	(0.026)	0.0361	(0.030)	0.0600	(0.055)
Ln Acres of Land	0.0305*	(0.015)	0.0255	(0.018)		
Sofisticated Assets Index	0.0629	(0.033)	0.0775*	(0.036)		
Animal Index	0.0825***	(0.013)	0.0765***	(0.015)		
Basic Assets Index	-0.00322	(0.024)	-0.00480	(0.031)		
Housing quality index	0.226***	(0.048)	0.254***	(0.057)	0.1000	(0.101)

[18] The share of food buyers in urban vis-a-vis rural areas is 95% vs 77%.

Quality/access to services index	-0.0321	(0.043)	0.00204	(0.061)	0.0371	(0.074)
Consumer Durable index	0.430***	(0.092)	0.531***	(0.101)	0.502**	(0.172)
Cash Crop Seller	0.0156	(0.025)	0.0413	(0.025)		
Staple Food Buyer	0.179***	(0.027)	0.129***	(0.025)	0.640***	(0.139)
Shock: Illness	0.00567	(0.028)	0.0407	(0.031)	-0.104*	(0.0472)
Shock: Drought	0.0409*	(0.019)	0.0410*	(0.020)	0.0443	(0.055)
Shock P rise	0.0233	(0.019)	0.0304	(0.022)	0.0381	(0.038)
Shock P input rise	-0.0284*	(0.013)	-0.0162	(0.043)	-0.0575*	(0.026)
Shock P fall	-0.0427	(0.033)	-0.0593	(0.035)	0.283*	(0.111)
Constant	6.612***	(0.349)	6.953***	(0.296)	5.231***	(1.245)
Observations	8793		6000		2793	
R-squared	0.115		0.129		0.142	
F	23.56		19.06		6.502	

Note: The dependent variable is food consumption, as measured by logarithm of per capita daily calories intake. We control for individual fixed effects and we include year dummies (not reported) in all the regressions. Standard errors (corrected for heteroskedasticity) are reported in parenthesis. The symbols ***, **, * indicate that coefficients are statistically significant respectively at the 1, 5, and 10 percent level.

6.2. Market participation and shock severity

The estimates reported in the previous section provide a broad understanding of the effects of shocks on food caloric intake. However the causal effect of price rise shocks on food caloric intake, which are surprisingly not significant, may be due to the fact that we did not take explicitly in consideration the households market position. For instance, crop price fall may generate significant benefits for food buyers, but at the same time can worsen the conditions for cash crop sellers. The opposite happens for food price surges, which worsen the welfare of net consuming households and favour the income of producers. Therefore, to better investigate the extent by which the effect of price shocks may differ among staple food buyers (rice, maize, sorghum, wheat and cassava) and cash crops sellers, we run additional fixed effects regressions including an interaction term between the price shock variable and the dummies for staple food buyers and cash crop sellers. At the same time we control also for the effect of natural shocks on staple food buyers and cash crop sellers. Finally, a second specification including the severity of the shocks has been taken into consideration. Results for rural and urban households are provided in Table 3.

Looking at the impact on calories absorption we notice that the incidence of shocks is statistically significant only among urban households. Food and input prices upsurges are negatively and significantly correlated with the outcome. Moreover, the interaction of prices upsurges and the household's market position is associated with a negative and statistically significant coefficient, concluding that urban staple food buyers are very sensitive to price shocks.

It is worth noting that concerning the price of input rise, we control for the interaction with crop sellers, since we are aware that the effect of the relative impact of the recent dramatic increases in input costs (i.e. pesticides, fertilizers, fuel) may have had a much more prominent effect on producers. However, we do not find this interaction being statistically significant among rural households. The occurrence of natural shocks is negative and statistically significant for urban staple food buyers, whereas we register no impact in the rural sub-sample.

In columns (2) and (4) of Table 3, we report the estimates of the model including the interaction of the severity of price shocks with staple food buyers and cash crop sellers. We rely on respondents' self-reported classification of the severity of shocks they had experienced. We lack to find any relevant impact.

Table 3. Econometric results: impact of price, idiosyncratic and covariate shocks on food caloric intake in rural and urban areas.

	Rural				Urban			
	(1)		(2)		(3)		(4)	
	Ln (Caloric Intake)		Ln (Caloric Intake)		Ln (Caloric Intake)		Ln (Caloric Intake)	
Head is Female	0.162***	(0.043)	0.160***	(0.045)	0.348**	(0.107)	0.372**	(0.114)
Ln Age Head	0.0323	(0.078)	0.103	(0.083)	0.289	(0.288)	0.345	(0.300)
Head Education	0.0977***	(0.028)	0.106***	(0.030)	0.0846	(0.045)	0.106*	(0.049)
Ln HH Size (AE)	-0.327***	(0.040)	-0.326***	(0.044)	-0.163	(0.086)	-0.160	(0.088)
Sex Ratio	0.0226	(0.015)	0.0248	(0.016)	-0.00201	(0.026)	-0.00228	(0.027)
Dependency Ratio	-0.000998	(0.015)	0.00579	(0.016)	-0.00216	(0.035)	-0.00707	(0.039)
Head Employed in Agriculture	-0.00400	(0.035)	0.0175	(0.037)	-0.0238	(0.064)	-0.0400	(0.068)
Income Diversity Index	0.0639**	(0.019)	0.0492*	(0.020)	0.0593	(0.040)	0.0512	(0.040)
Ln Acres of Land	0.0243	(0.018)	0.0266	(0.019)				
Sofisticated Assets Index	0.0817*	(0.037)	0.0699	(0.040)				
Animal Index	0.0831***	(0.015)	0.0875***	(0.016)				
Basic Assets Index	0.00229	(0.030)	0.00802	(0.034)				
Housing quality index	0.260***	(0.054)	0.251***	(0.058)	0.255**	(0.080)	0.272**	(0.083)
Quality/access to services index	-0.0170	(0.058)	-0.00490	(0.060)	0.0329	(0.069)	0.0947	(0.071)
Consumer Durable index	0.452***	(0.101)	0.399***	(0.110)	0.415*	(0.167)	0.398*	(0.167)
Cash Crop Seller	0.0426	(0.028)	0.0548	(0.030)				
Staple Food Buyer	0.172***	(0.029)	0.160***	(0.031)	0.666***	(0.137)	0.631***	(0.144)
Shock: Illness	0.0561	(0.032)	0.0542	(0.035)	-0.106	(0.068)	-0.147	(0.076)
Shock: Drought	0.0404	(0.044)	0.0402	(0.046)	0.764**	(0.256)	0.801**	(0.290)
Shock P rise	0.0236	(0.048)	0.0297	(0.055)	-0.695*	(0.269)	-0.723*	(0.316)
Shock P input rise	-0.0592	(0.041)	-0.136	(0.095)	-0.302*	(0.124)	-0.393*	(0.168)
Shock P Fall	-0.0164	(0.074)	-0.0303	(0.078)	0.0279	(0.282)	0.0199	(0.296)
Shock Price Rise * SF Buyer	-0.0304	(0.054)	-0.0688	(0.082)	-0.784**	(0.273)	-0.838*	(0.332)
Shock Price of Input Rise * CC Seller	0.0530	(0.096)	0.111	(0.102)	-0.461*	(0.180)	-0.347	(0.192)
Shock Price Fall * SF Buyer	-0.0413	(0.082)	0.0996	(0.135)	0.247	(0.329)	0.668	(0.417)
Shock Drought * CC Seller	-0.0542	(0.041)	-0.0330	(0.045)				
Shock Drought * SF Buyer	0.0221	(0.044)	-0.0156	(0.047)	-0.771**	(0.259)	-0.812**	(0.294)
Severity P rise			-0.0136	(0.012)			0.0367	(0.033)
Severity P input rise			0.0411**	(0.016)			-0.0214	(0.038)
Severity P Fall			0.00980	(0.014)			-0.00925	(0.037)
Severity Price Rise * SF Buyer			0.00247	(0.029)			-0.0475	(0.045)
Severity Price of Input Rise * CC Seller			-0.0201	(0.035)			0.0418	(0.108)
Severity Price Fall * SF Buyer			-0.0479	(0.056)			-0.190	(0.170)
Constant	7.431***	(0.307)	7.153***	(0.332)	6.371***	(1.266)	6.167***	(1.326)
Observations	6000		5466		2793		2677	
R-squared	0.121		0.124		0.176		0.181	
F	15.33		11.54		7.226		5.253	

Note: The dependent variable is food consumption, as measured by logarithm of per capita daily calories intake. We control for individual fixed effects and we include year dummies (not reported) in all the regressions. Standard errors (corrected for heteroskedasticity) are reported in parenthesis. The symbols ***, **, * indicate that coefficients are statistically significant respectively at the 1, 5, and 10 percent level.

6.3. Differentiated Impacts of shocks among households

In the previous section we basically addressed whether different types of shocks had an impact on food caloric intake among rural and urban households, estimating their magnitude and disentangling their impact among staple food buyers and cash crop sellers. In this section we will examine the heterogeneity of the impact of price shocks, natural shocks (drought/flood), and idiosyncratic shocks on food caloric intake by interacting them with the households characteristics. We perform separate regressions for rural (Tab. 4) and urban (Tab. 5) residents. We selected some relevant households' characteristics reported in table 3 and we interacted them with the shock terms. The right hand variables are the following: dependency ratio, household head education, sex of the household head, acres of land owned, number of children, household size and age of the household head.

We find the following:

Dependency ratio. First of all, households with more dependent members (elderly and children) are less able to insulate their consumption from a natural shock. This is particularly evident for rural households. The same applies for the idiosyncratic shocks, whose interaction with the dependency ratio variable results in a negative and statistically significant coefficient for both rural and urban households, with a greater incidence for the latter group. As the number of households members in working age declines, the ability of the household to bear the exogenous risk decreases. The relative importance of price of input shocks is confirmed to be much relevant for rural than for urban households. More precisely, whereas among urban households the interaction between price of input rise and dependency ratio coefficient is not significant, among rural households the latter is positive and significant at 1% level.

Female headed. All the interaction terms using female headed households do not show significant coefficients, except for the interaction with the price of inputs' shock, showing a gender differentiated impact.

Land holding. Owning land mitigates the effects of climate shocks in rural contexts, since landholdings may have the effect of reducing households' vulnerability by improving their ability in resource allocation. Same effect is registered for food price rise in rural and urban areas, and illness among urban residents. Similar results were found by Kurosaki (2014).

Household Size. The interaction term of household size with non-price shocks is significant and negative only among urban households: larger households are less able to mitigate the effect of idiosyncratic shocks on food intake than the smaller ones. Regarding the ability to mitigate the effects of price movements, we find statistically significant coefficients in both subsamples: individuals belonging to larger households experience an (i) increase of their total caloric intake as a consequence of a price fall (rural households) and (ii) a decrease when price of inputs rise (both urban and rural households).

Age. In three out of ten specifications, age of head has a statistically significant effect on the daily calories intake. Households headed by older individuals experience a larger consumption decline when hit idiosyncratic shocks, this is evident only in urban areas. The age of household head is always statistically significant when the household characteristics are interacted with price of input shocks, however the coefficients show a negative sign for rural households and a positive sign for urban households.

Table 4. Heterogeneity in the marginal impact of shocks household characteristics in rural areas.

	(1)		(2)		(3)		(4)		(5)	
	Ln (Caloric Intake)		Ln (Caloric Intake)		Ln (Caloric Intake)		Ln (Caloric Intake)		Ln (Caloric Intake)	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Head is Female	0.187***	(0.048)	0.210***	(0.044)	0.182***	(0.051)	0.203***	(0.043)	0.195***	(0.044)
Ln Age Head	0.039	(0.086)	0.048	(0.083)	0.038	(0.087)	0.056	(0.080)	0.059	(0.082)
Head Education	0.147***	(0.027)	0.151***	(0.027)	0.142***	(0.027)	0.148***	(0.027)	0.153***	(0.028)
Ln HH Size (AE)	-0.315***	(0.043)	-0.337***	(0.041)	-0.311***	(0.046)	-0.336***	(0.041)	-0.340***	(0.041)
Sex Ratio	0.029*	(0.015)	0.030*	(0.015)	0.031*	(0.015)	0.029	(0.015)	0.029*	(0.015)
Dependency Ratio	0.003	(0.016)	0.013	(0.015)	0.003	(0.019)	0.004	(0.015)	0.007	(0.015)
Ln Acres of Land	0.017	(0.020)	0.033	(0.019)	0.025	(0.021)	0.036	(0.019)	0.033	(0.019)
Cash Crop Seller	0.043	(0.026)	0.045	(0.025)	0.045	(0.026)	0.046	(0.026)	0.045	(0.026)
Staple Food Buyer	0.205***	(0.023)	0.206***	(0.022)	0.195***	(0.023)	0.201***	(0.023)	0.203***	(0.022)
Shock: Drought	0.163	(0.262)								
Shock Drought * Head Age	-0.003	(0.066)								
Shock Drought * Dep. Ratio	-0.007*	(0.035)								
Shock Drought * Head F	0.033	(0.051)								
Shock Drought * Land	0.052*	(0.023)								
Shock Drought * HH Size	-0.088	(0.045)								
Shock: Illness			-0.083	(0.412)						
Shock Illness * Head Age			-0.052*	(0.025)						
Shock Illness * Dep. Ratio			-0.056*	(0.028)						
Shock Illness * Head F			-0.078	(0.078)						
Shock Illness * Land			0.004	(0.036)						
Shock Illness * HH Size			0.013	(0.072)						
Shock: Price Rise					-0.029	(0.223)				
Shock P Rise * Head Age					0.051	(0.056)				
Shock P Rise * Dep. Ratio					0.000	(0.020)				
Shock P Rise * Head F					0.032	(0.045)				
Shock P Rise * Land					0.012*	(0.009)				
Shock P Rise * HH Size					-0.059	(0.038)				
Shock: Price of Input Rise							-0.076	(0.054)		
Shock P Input Rise * Head Age							-0.037*	(0.018)		
Shock P Input Rise * Dep. Ratio							0.038*	(0.018)		
Shock P Input Rise * Head F							-0.154	(0.109)		
Shock P Input Rise * Land							-0.057	(0.068)		
Shock P Input Rise * HH Size							-0.080**	(0.027)		
Shock: Price Fall									0.058**	(0.022)
Shock P Fall * Head Age									-0.024	(0.037)
Shock P Fall * Dep. Ratio									-0.047	(0.035)
Shock P Fall * Head F									0.077	(0.092)
Shock P Fall * Land									0.038	(0.043)
Shock P Fall * HH Size									0.013*	(0.005)
Constant	7.559***	(0.332)	7.542***	(0.321)	7.535***	(0.332)	7.510***	(0.308)	7.510***	(0.314)
Observations	6009		6009		6009		6009		6009	
R-squared	0.088		0.085		0.092		0.088		0.086	
F	18.47		18.21		19.46		18.47		18.00	

Note: The dependent variable is food consumption, as measured by logarithm of per capita daily calories intake. We control for individual fixed effects and we include year dummies (not reported) in all the regressions. Standard errors (corrected for heteroskedasticity) are reported in parenthesis. The symbols ***, **, * indicate that coefficients are statistically significant respectively at the 1, 5, and 10 percent level.

Table 5. Heterogeneity in the marginal impact of shocks on household characteristics in urban areas.

	(1)		(2)		(3)		(4)		(5)	
	Ln (Caloric Intake)		Ln (Caloric Intake)		Ln (Caloric Intake)		Ln (Caloric Intake)		Ln (Caloric Intake)	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Head is Female	0.394**	(0.122)	0.374**	(0.114)	0.379**	(0.145)	0.397***	(0.119)	0.390**	(0.119)
Ln Age Head	0.481	(0.346)	0.462	(0.312)	0.549	(0.360)	0.479	(0.349)	0.469	(0.348)
Head Education	0.096*	(0.046)	0.107*	(0.047)	0.098*	(0.048)	0.099*	(0.047)	0.100*	(0.047)
Ln HH Size (AE)	-0.186	(0.095)	-0.189*	(0.094)	-0.169	(0.102)	-0.157	(0.094)	-0.164	(0.093)
Sex Ratio	0.002	(0.027)	0.002	(0.027)	0.005	(0.027)	0.006	(0.027)	0.004	(0.027)
Dependency Ratio	0.008	(0.035)	0.006	(0.034)	0.016	(0.042)	-0.005	(0.035)	-0.002	(0.034)
Ln Acres of Land	0.018	(0.033)	0.0418	(0.029)	0.013	(0.042)	0.0378	(0.028)	0.025	(0.028)
Cash Crop Seller	-0.239*	(0.116)	-0.214*	(0.109)	-0.244*	(0.117)	-0.244*	(0.117)	-0.265*	(0.120)
Staple Food Buyer	0.652***	(0.137)	0.642***	(0.132)	0.659***	(0.138)	0.644***	(0.138)	0.662***	(0.138)
Shock: Drought	0.452	(0.708)								
Shock Drought * Head Age	-0.143	(0.191)								
Shock Drought * Dep. Ratio	-0.054	(0.058)								
Shock Drought * Head F	-0.032	(0.129)								
Shock Drought * Land	0.049	(0.062)								
Shock Drought * HH Size	0.122	(0.122)								
Shock: Illness			-0.560	(0.988)						
Shock Illness * Head Age			-0.029*	(0.010)						
Shock Illness * Dep. Ratio			-0.127*	(0.057)						
Shock Illness * Head F			0.268	(0.122)						
Shock Illness * Land			0.089*	(0.044)						
Shock Illness * HH Size			-0.299*	(0.149)						
Shock: Price Rise					0.714	(0.419)				
Shock P Rise * Head Age					-0.177	(0.114)				
Shock P Rise * Dep. Ratio					-0.027	(0.045)				
Shock P Rise * Head F					0.027	(0.095)				
Shock P Rise * Land					0.035*	(0.018)				
Shock P Rise * HH Size					0.010	(0.081)				
Shock: Price of Input Rise							0.046	(0.047)		
Shock P Input Rise * Head Age							0.315**	(0.106)		
Shock P Input Rise * Dep. Ratio							-0.027	(0.091)		
Shock P Input Rise * Head F							-0.999*	(0.413)		
Shock P Input Rise * Land							-0.137*	(0.064)		
Shock P Input Rise * HH Size							-0.701**	(0.240)		
Shock: Price Fall									0.097	(0.054)
Shock P Fall * Head Age									0.131	(0.119)
Shock P Fall * Dep. Ratio									0.061	(0.112)
Shock P Fall * Head F									-0.081	(0.280)
Shock P Fall * Land									0.143	(0.132)
Shock P Fall * HH Size									-0.280	(0.272)
Constant	5.287***	(1.332)	5.374***	(1.170)	4.965***	(1.400)	5.267***	(1.335)	5.291***	(1.333)
Observations	2794		2794		2794		2794		2794	
R-squared	0.134		0.141		0.135		0.136		0.135	
F	6.084		6.157		6.395		7.276		7.123	

Note: The dependent variable is food consumption, as measured by logarithm of per capita daily calories intake. We control for individual fixed effects and we include year dummies (not reported) in all the regressions. Standard errors (corrected for heteroskedasticity) are reported in parenthesis. The symbols ***, **, * indicate that coefficients are statistically significant respectively at the 1, 5, and 10 percent level.

6.4. Impact on Dietary Diversity

In the previous section we provided evidence on the negative effect that soaring food prices have on daily food caloric intake among rural and urban households in Tanzania. However, price spikes not only can compromise the energy absorption, they may also have relevant effects on households and individuals' diet quality which we define as the number of different foods or food groups consumed over a given reference period (Hoddinott, 2002). Authors agree about the fact that dietary diversity is a useful indicator for the quality of the diet, because a more varied diet is associated with an improved birth-weight (Rao et al. 2001), with reduction of cancer incidence (Kant et al. 1995) and reduced risk of mortality. A series of proxy indicators aimed at providing qualitative measures of dietary diversity (e.g. Food Consumption Scores (FCS), Household Dietary Diversity Score (HDDS)) have been proposed over the last years by many organizations involved in food security valuations. Over the last decade a lot of studies have been carried out with the aim of both supporting the use of dietary diversity measures (Savy et al., 2005) as well as linking household dietary diversity indicators to improved nutrient intake in developed and developing countries (Arimond, 2004; Stein, 2005; Kennedy et al., 2007). Ferguson et al. (1993) and Hatloy et al. (2000) showed the existence of a strong correlation between the improvement of socio-economic conditions and dietary diversity scores. Savy et al. (2005) compared dietary diversity scores measured over a 1-day or 3-day period and assessed their relationship to the nutritional status of women in a rural area of Burkina Faso, while Ogle (2001) found that dietary diversity has a positive relationship with the vegetable intake in the Asian diet. The World Food Programme (WFP) conducted several assessments of household level food security to assess the impacts of high food prices on dietary changes (see Brinkman et al. (2010) for a comprehensive review).

To assess the impact of high food prices, WFP relied on a set of proxies. Among all, WFP (2007, 2009) adopted the so-called Food Consumption Score (FCS), which is a frequency-weighted diet diversity score that uses information on both dietary diversity and food frequency (defined as the number of days per week in which the food is consumed). It basically applies a different system of weights (from 0.5 to 4) for each food group based on its "nutrient density". Thus, the weights are supposed to make the FCS more capable of capturing two dimensions of food security: diet quality and diet quantity. The index is constructed by grouping all the food items into specific food groups (which include grains, pulses, vegetables, fruit, meat/fish, milk/dairy, sugar, and oil/fat). By summing up the consumption frequencies of food items within the same household it is possible to generate a food group score for each food group. Note that any score greater than seven is recorded as seven. Each value is then multiplied by its weight creating different weighted food group scores, that, once summed up again, finally lead the FCS. Higher scores denote a more varied diet and are suggestive of a higher quality diet with a potential for higher micronutrient intake.

In this section we examine the correlation between our set of shocks (price, covariate and idiosyncratic) and the logarithm of Food Consumption Score. Since information about the frequency of consumption was not available for the 2008/09 survey, with just two waves of data we perform two cross-section regressions for the 2010/11 and 2012/13 survey separately.

The results from our estimates are reported in table 6. As a result of the soaring food prices, staple food buyer households had to make large concessions in terms of dietary quality: we find in fact a statistically significant effect of food price rise shocks for the overall sample (first column) in both years. Households self-reporting a food price rise shock experienced a huge reduction in their diet's quality with respect to households not hit by the shock: price upsurges not only lead to a dramatic reduction in the food caloric intake, but also severely threaten the quality of diet. This effect was significant also for urban households in 2010. Input price shocks exhibit a negative effect on caloric intake but only among rural households in 2012. As regarding food price fall, when interacting it with staple food buyers we again find for urban households a positive and statistically significant coefficient. Our overall findings are consistent with the literature. By employing OLS estimates both Brinkman et al. (2010) for Haiti and D'Souza and Jolliffe (2014) for Afghanistan, find similar drops in the dietary diversity as a response to a price shock. The same conclusions can be drawn when considering the idiosyncratic shock variable: in households hit by severe/chronic illnesses dietary diversity is extremely low: this effect is consistent across years. Table 6 indicates also that amongst the households interviewed in 2010, urban staple food buyers had a statistically significant gain from price falls also in terms of dietary diversity, while this was not statistically significant in 2012.

To sum up, these findings suggest that as a response of price movements households modified their consumption patterns. This happened perhaps by either substituting more expensive and nutrient-rich food with cheaper ones, or reducing the size and frequency of meals. A shift towards a lower quality diet, which typically equates to a lack of fundamental sources of both micro and macro nutrients, can have potentially severe implications for a well-functioning of the immune system for the most vulnerable individuals like infants, pregnant mothers or elderly people, whose nutrients requirements are higher.

Table 6. Econometric Results: Impact of shocks on Dietary Diversity in 2010 and 2012

	2010					
	Overall		Rural		Urban	
	ln(FCS)		ln(FCS)		ln(FCS)	
Household Controls	(Yes)		(Yes)		(Yes)	
Shock: Illness	-0.0788**	(0.028)	-0.0680*	(0.026)	-0.0930*	(0.040)
Shock: Drought	-0.00364	(0.020)	-0.0177	(0.021)	0.0498	(0.039)
Shock: Price Fall	0.0563*	(0.021)	0.0320	(0.020)	0.177***	(0.035)
Shock: Price of Input Rise	-0.0282	(0.022)	-0.0405	(0.020)	0.0577	(0.066)
Shock: Price Rise	-0.0179	(0.021)	0.0121	(0.017)	-0.148*	(0.058)
-Shock Price Fall * SF Buyer	-0.0576	(0.037)	0.0138	(0.039)	0.337***	(0.082)
-Shock Price Rise * SF Buyer	-0.0406*	(0.020)	0.0158	(0.027)	-0.172**	(0.050)
-Shock Price of Input Rise * CC Seller	0.0265	(0.076)	0.109	(0.074)	-0.292	(0.150)
Constant	3.485***	(0.094)	3.623***	(0.089)	3.433***	(0.110)
Observations	3818		2587		1231	
R-squared	0.236		0.256		0.216	
F	224.6		173.2		334.2	
	2012					
	Overall		Rural		Urban	
	ln(FCS)		ln(FCS)		ln(FCS)	
Household Controls	(Yes)		(Yes)		(Yes)	
Shock: Illness	-0.0724*	(0.028)	-0.0277	(0.025)	-0.157***	(0.037)
Shock: Drought	-0.0341	(0.019)	-0.0352	(0.021)	-0.0294	(0.032)
Shock: Price Fall	-0.0207	(0.026)	-0.0135	(0.029)	-0.0650	(0.076)
Shock: Price of Input Rise	-0.0952***	(0.024)	-0.0926***	(0.022)	-0.0577	(0.056)
Shock: Price Rise	0.0138	(0.024)	0.0101	(0.029)	0.0242	(0.041)
-Shock Price Fall * SF Buyer	-0.0535	(0.045)	-0.0673	(0.049)	0.102	(0.123)
-Shock Price Rise * SF Buyer	0.0361	(0.027)	0.00990	(0.034)	0.0510	(0.054)
-Shock Price of Input Rise * CC Seller	-0.0375	(0.054)	-0.0506	(0.054)	0.0392	(0.097)
Constant	4.061***	(0.129)	4.100***	(0.124)	4.164***	(0.223)
Observations	3682		2479		1203	
R-squared	0.193		0.209		0.125	
F	93.7		121.3		331.1	

Note: The dependent variable is the logarithm of Food Consumption Score (FCS). Standard errors are corrected for heteroskedasticity. The symbols ***, **, * indicate that coefficients are statistically significant respectively at the 1, 5, and 10 percent level.

6.5. Regional nutrition mapping

It is well known that as households diversify from staple carbohydrates-based diets to a diet rich in eggs, milk, meat, fish, fruits and vegetables, they increase their intake of essential macronutrients such as proteins and fibres, and micronutrients such as calcium, iron, zinc, folate, vitamin A, B and C. However, when faced with a sharp increase in food prices households usually adopt a number of food-based coping strategies such as changing their dietary pattern towards cheaper food, skipping meals, decreasing intake of non staple foods, increasing consumption of street foods or modifying intra-household allocation of resources (i.e. mothers acting as a buffer for their children) (Rouel et al., 2010). These coping strategies, although fundamental for the households to mitigate the shocks, are all likely to result in significant deterioration of macro and micronutrient intakes. Micronutrient deficiencies exacerbate the risk of wasting (i.e. underweight-for-attained-height), stunting (i.e. insufficient attained height-for-age) and dramatically impoverish health conditions. In addition to that, they also slow down cognitive development and growth, contributing to poorer school performance and reduced work productivity (Meerman and Aphane, 2012). Given the estimated dramatic effects of price shocks on food caloric intake and dietary diversity, it is thus necessary to provide much more detailed assessments about Tanzanian nutritional deficiencies. For this reason, we conclude our analysis by including among our indicators of households' nutritional status also the changes in consumption of essential macro and micro-nutrients. In particular, in this section we will provide a picture of the evolution of macro and micronutrients distribution across geographic groupings (regions) over the three periods of analysis, so that we can provide important information to policy makers and program planners to be used in designing effective intervention to decrease the population prevalence of undernourished. To give an idea of the temporal geographical variation of the dietary structure (from 2008/09 to 2012/13), three macronutrients (carbohydrates, proteins and fats), two minerals (calcium and zinc) and two vitamins (vitamin A and vitamin C) were chosen among the macro and micronutrients available and plotted in thematic maps[19]. We made use of the Tanzania Food Consumption tables to convert the quantities consumed of each food item to its macro and micro-nutrients content. All the values obtained were expressed in g/person/day, with the exception of vitamin A, reported in mg/person/day. Then we provide for each region an updated estimate of the average intake of each of the nutrients over the three periods[20].

The assessment of the nutritional status is then reported geographically through choropleth maps[21] in which areas are patterned in proportion to the measurement of the nutrient intake variable being displayed on the map. For each nutrient we report a panel with three different maps representing the three different waves (TZNPS Y1, Y2, Y3). We superimposed a code on the region's centroid, to easily identify the regions. Region names and codes are reported in table 7.

[19] The choice of these seven elements is justified by the fact that they are recognized by WHO and FAO (2006) for their indispensability for physical and cognitive activity and growth and for maintaining a healthy and well-functioning immune system and metabolic process.

[20] Unfortunately, since data on consumption was provided at household level, we were unable to further disaggregate the estimates for children, adults and elderlies

[21] Maps were plotted using the shape file for Tanzania, which was downloaded from http://data.biogeo.ucdavis.edu/data/gadm2/shp/TZA adm.zip. Then two new files with (i) the country names and other information, and (ii) with the coordinates of the country boundaries were extracted with shp2dta command in STATA 13 to draw the map.

Table 7. Region codes.

Region Name	Code	Region Name	Code
Arusha	1	Mbeya	14
Dar Es Salaam	2	Morogoro	15
Dodoma	3	Mtwara	16
Iringa	4	Mwanza	17
Kagera	5	Pwani	18
Kaskazini Pemba	6	Rukwa	19
Kaskazini Unguja	7	Ruvuma	20
Kigoma	8	Shinyanga	21
Kilimanjaro	9	Singida	22
Kusini Pemba	10	Tabora	23
Lindi	11	Tanga	24
Manyara	12	Kusini Unguja	25
Mara	13	Mjini/Magharibi Unguja	26

Figures 3 to 5 report the macronutrient intake in acquired food. Carbohydrates dominate the nutrient composition of the food eaten by Tanzanian households, with maize being indeed the most important source of carbohydrates (it contributes to the 33% of the total daily caloric intake) followed by cassava and rice (Minot, 2010). The estimated carbohydrates intake are on average in line with the recommended values of 300 g/day (FAO and WHO, 1998) but with a considerable variance across regions and time. Peaks of consumption are registered for the eastern regions (particularly the Eastern Arc Mountains area) of the mainland - with Kilimanjaro region having the highest daily intake rate over the whole period - while the lowest consumption rates are distributed among the central and western areas. Carbohydrates consumption decreases across time, in particular between the first two waves. With respect to 2008/09, Arusha, Kagera, Lindi, Mara and Tanga regions experienced a drop in carbohydrates consumption (in 2010/11) most probably as a result of the food price changes registered between the two waves. According to FAO (2010) the recommended fat intake for most individuals should range between 15-20% and 30-35% of total energy intake. In our analysis it is close to the minimum recommended threshold in most southern and western regions. Regarding proteins, our findings are in line with the ones reported by Mazengo et al. (1998). The values are on average slightly above the 45-55 g/person/day recommended values (WHO and FAO, 2007). They experience a decline between 2008 and 2010 followed by an upswing in 2012. The most striking declines were registered between 2008 and 2010 for the regions of Mara, Pwani, Shinyanga and Tanga.

Figure 3: Macronutrient intake: carbohydrates (g/person/day)

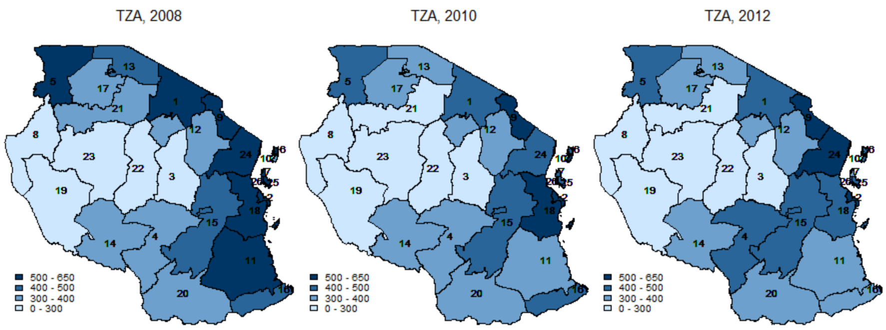


Figure 4: Macronutrient intake: fats (g/person/day)

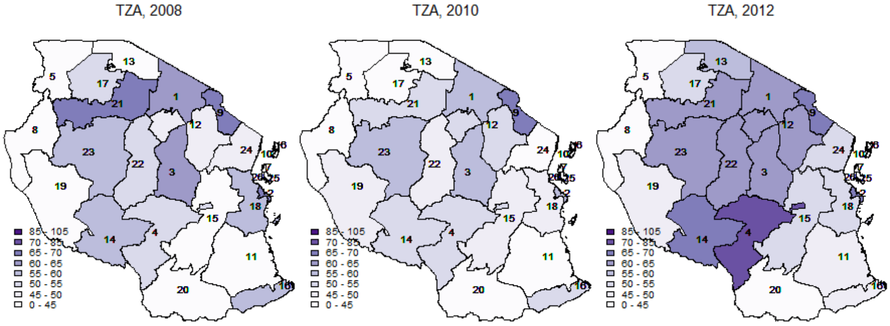
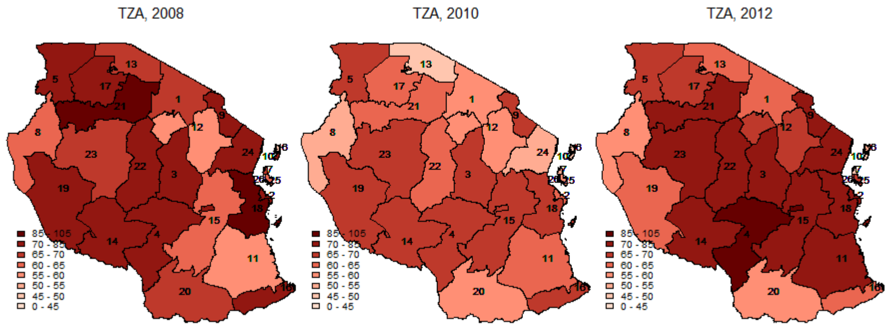


Figure 5: Macronutrient intake: proteins (g/person/day)



Figures 6 and 7 show the maps related to calcium and zinc intake. The low absorption of calcium evidenced by our analysis further exacerbates an already dramatic situation. The average daily intake per region is lower than the recommended nutritional intake (750 mg/person/day, WHO and FAO, 2004) with very deep deficiencies concentrated specifically in the western side of the country. In particular, in Kigoma and Rukwa calcium deficiency worsen over the years. The low intake of calcium depends on poor consumption of milk, dairy products, but also fish, which is one of the most relevant sources in these regions. The levels of zinc intake stay within the range established by WHO and FAO (2004) (ranging from 4 to 14 mg/person/day depending on diets, sex and age). However, we notice that the amount absorbed decreased over time, in particular in central Tanzania. Similarly to calcium, this is an effect of changing dietary patterns, which in turn is a consequence of the economic and other covariate shocks. Finally, the regions situated along the borders of the country have on average lower rates of zinc absorption.

Figure 6: Mineral intake: calcium (g/person/day)

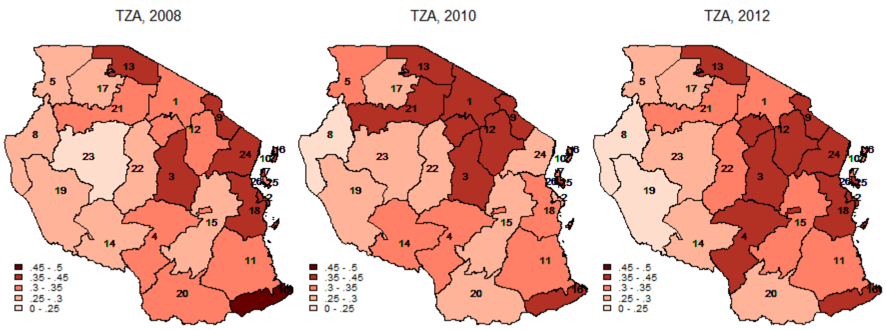
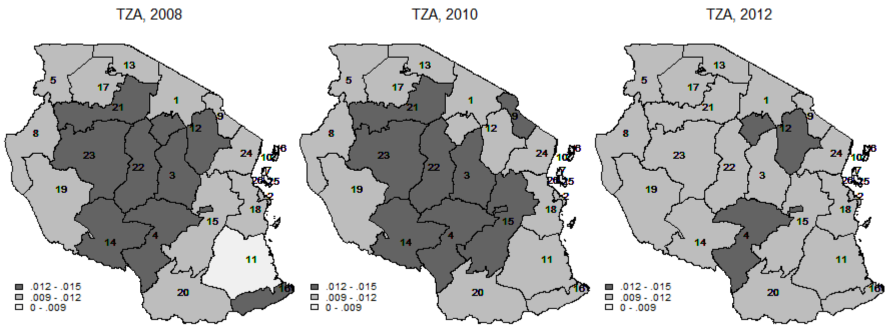


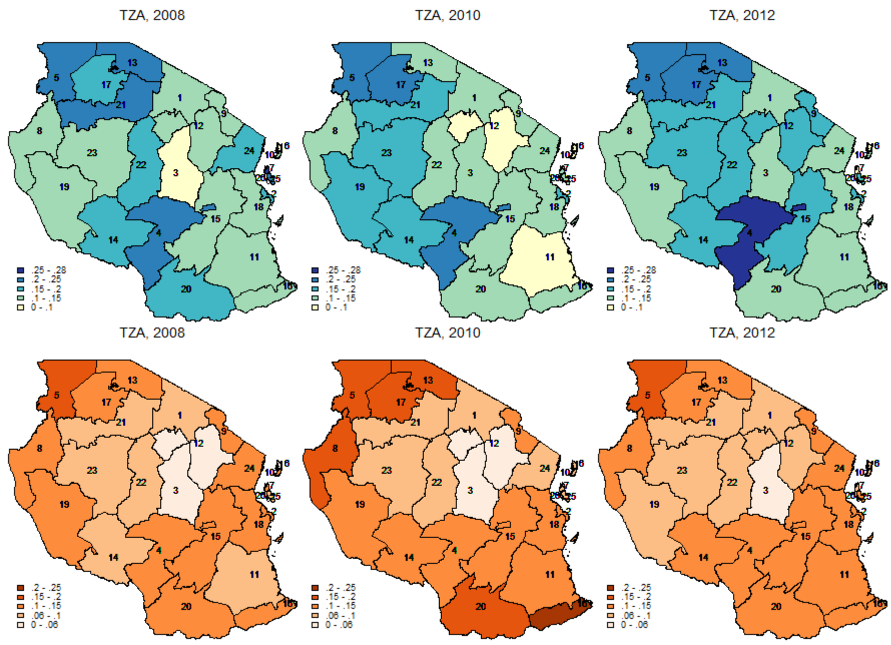
Figure 7: Mineral intake: zinc (g/person/day)



In terms of vitamin A intake (fig. 8), the regions located in the north-west (Kigoma, Ruvwa, Tabora) and south east (Lindi, Morogoro, Mtwara, Pwani) display the lowest levels of consumption for 2008, while in north Tanzania (Kagera, Shingyanga, Mara and Mwanza) the average absorption is higher. This is probably because there is a large production and consumption of sweet potatoes, which are particularly rich of this micronutrient. In this area the values registered do not change much over time. By contrast, in southern Tanzania (Lindi and Ruvuma) we register a decline in 2010 followed by a tight increase in 2012. Despite this positive variation, the vitamin A level keeps being dramatically low vis-à-vis the recommended level of 0.5-0.6 mg RE27/day with important implications for the children and adolescents' associated nutritional status.

As regards to vitamin C, the national average daily availability of ascorbic acid per person was 108 mg in 2008/09, 123 mg in 2010/11 and 109 mg in 2011/12. All the levels registered were well above the recommended nutrition intakes (RNI) estimates of 40 mg/person/day. Central-eastern regions - Dodoma and Manyara - registered the lowest rates of absorption (around 42 mg/person/day) for all the three years.

Figure 8: Vitamins intake: vitamin A (in blue) (mg/person/day) and vitamin C (in orange) (g/person/day)



7. CONCLUSIONS

Since the first price spike, the prices of basic staple foods swung again up and down, fueling new concerns about the food security of poor people, in particular in developing countries (Fan et al., 2011). Tanzania was not spared from the food price inflation, with Tanzanian people reporting the incidence of price movements as one of the most harmful shocks they experienced in the last years. Thus, assessing the effect of price and other idiosyncratic and covariate shocks on rural and urban households vulnerability was the main objective of this paper. The value added of our study is threefold. First of all, we included in our panel the newly released 2012/13 Tanzania National Panel Survey dataset which provided new information on households demographic and economic characteristics. This allowed us to offer a new contribution to the existing literature on vulnerability to shocks by giving new insights on the impact of price, idiosyncratic and covariate shocks on the quantity and quality of food consumed. Secondly, in a context of global food crisis we updated the existing studies on Tanzania by assessing also the impact of each shock on a set of households characteristics, highlighting the typologies of households to be defined as most vulnerable. Third, we reveal important patterns of malnutrition in the country by making an assessment of the evolution of macro and micro-nutrients consumption across regions over the three years.

The most important findings of our analysis can be summarized as follows. The sensitivity of food intake variation to price shocks is different among rural and urban subgroups. In the basic specification we find statistically significant results only among urban households. In particular, price of input rise and price fall had respectively a negative and positive correlation with food caloric intake. However, with the proposed method it is hard to state if the impact of a given shock is a result of an effect on households' income or rather is related to households' bad coping mechanisms against shocks. Regarding rural households the impact of price shocks is not significant also when including for the household market position. Concerning the sensitivity of households' characteristics to shocks, our findings revealed that in rural areas, more landed households are better protected against both natural shocks and price surges, while households with higher dependency ratios are particularly susceptible to idiosyncratic, natural and input price shocks.

Households also changed their consumption patterns as a response to price movements. Price surges led to a negative variation of the food consumption score only among urban households in 2010, while prices of inputs affected the dietary diversity of rural households in 2012. Finally, according to our analysis, fats, calcium and vitamin A were the most cut-back macro and micro-nutrients, which may led to negative outcomes in particular for children as well as lactating and pregnant women.

The debate on the relative importance of the different sources of risk on poor and vulnerable households in developing countries has important implications for social protection and other policies. Understanding which are the more frequent and severe sources of risk can help designing the most appropriate policy responses. In the case of Tanzania, policies should address first of all idiosyncratic risks via health insurance or other ad-hoc policies for the poorest and secondly insure households against price volatility and natural disasters introducing for example social safety nets that are more responsive to systemic crises. Potential policy interventions such as appropriate social cash transfer programs, food fortification or micro-nutrient supplementation programmes, can be used to protect the diet diversity and micro-nutrient intake of poor households during food price crises.

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APPENDIX

Table A.1. Selected Macroeconomic Indicators for Tanzania (2000-2013)

Indicator Name	Scale	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Agriculture, value added (% of GDP)		33.48	32.87	32.46	32.53	33.33	31.76	30.41	29.97	29.71	28.79	28.13	27.68	27.58	27.00
Agriculture, value added (annual % growth)		4.46	4.93	5.04	3.22	5.91	4.42	3.88	4.05	4.58	3.21	4.06	3.43	4.22	4.22
Agricultural land (% of land area)		38.38	38.50	38.61	38.69	39.69	39.92	39.92	40.25	41.74	42.00	42.11	42.11	na	na
Current account balance (% of GDP)		na	na	na	na	na	-7.73	-7.69	-10.19	-12.44	-8.47	-8.55	-16.72	-12.88	na
Current account balance (BoP, current US$)	Billions	na	na	na	na	na	-1.09	-1.10	-1.71	-2.58	-1.81	-1.96	-3.99	-3.64	na
GDP (constant LCU)	Billions	8585.34	9100.27	9752.18	10423.73	11239.74	12068.09	12881.16	13801.92	14828.34	15721.30	16828.56	17913.80	19155.77	20489.15
GDP (current LCU)	Billions	8152.79	9100.27	10444.51	12107.06	13971.59	15965.29	17941.27	20948.40	24781.68	28212.65	32293.48	37532.96	44717.66	53174.68
GDP (current US$)	Billions	10.19	10.38	10.81	11.66	12.83	14.14	14.33	16.83	20.72	21.37	22.92	23.87	28.25	33.23
GDP deflator (base year varies by country)		94.96	100.00	107.10	116.15	124.31	132.29	139.28	151.78	167.12	179.45	191.90	209.52	233.44	259.53
GDP growth (annual %)		4.93	6.00	7.16	6.89	7.83	7.37	6.74	7.15	7.44	6.02	7.04	6.45	6.93	6.96
GDP per capita (constant LCU)	Units	259727	268420	280349	291890	306386	320008	332025	345591	360492	370958	385330	397978	412869	428450
GDP per capita (current LCU)	Units	246641	268420	300251	339027	380854	423349	462455	524534	602468	665702	739436	833842	963811	1111940
GDP per capita (current US$)	Units	308.14	306.27	310.63	326.48	349.62	375.00	369.40	421.30	503.60	504.20	524.69	530.39	608.85	694.77
GDP per capita growth (annual %)		2.36	3.35	4.44	4.12	4.97	4.45	3.76	4.09	4.31	2.90	3.87	3.28	3.74	3.77
GDP, PPP (current international $)		27.32	29.62	32.23	35.14	38.93	43.14	47.46	52.20	57.18	61.09	66.18	71.84	78.16	84.87
Inflation, consumer prices (annual %)		5.92	5.15	5.32	5.30	4.74	5.03	7.25	7.03	10.28	12.14	6.20	12.69	16.00	7.87
Inflation, GDP deflator (annual %)		7.57	5.31	7.10	8.45	7.02	6.43	5.28	8.97	10.11	7.38	6.93	9.18	11.42	11.17
Population (Total)	Millions	34.02	34.90	35.81	36.76	37.77	38.82	39.94	41.12	42.35	43.64	44.97	46.35	47.78	49.25

Source: World Development Indicators

Table A.2. Percentage of households ranking a shock "Most Severe" "2nd Most Severe" "3rd Most Severe", Rural and Urban Tanzania, 2008, 2010 and 2012.

	Rural									Urban								
Year	2008	2010	2012	2008	2010	2012	2008	2010	2012	2008	2010	2012	2008	2010	2012	2008	2010	2012
Severity	Most	Most	Most	2nd most	2nd most	2nd most	3rd most	3rd most	3rd most	Most	Most	Most	2nd most	2nd most	2nd most	3rd most	3rd most	3rd most
(i) Price Shocks																		
Large fall in sale prices for crops	12%	16%	17%	24%	22%	23%	23%	18%	24%	13%	13%	24%	16%	16%	19%	24%	16%	19%
Large rise in price of food	29%	26%	30%	28%	31%	32%	22%	21%	19%	40%	29%	39%	36%	38%	35%	17%	21%	19%
large rise in agricultural input price	15%	14%	14%	21%	20%	23%	17%	17%	17%	11%	12%	14%	18%	21%	23%	28%	14%	23%
(ii) Natural Disasters																		
Crop disease	19%	22%	23%	20%	22%	25%	25%	18%	19%	13%	6%	21%	20%	32%	24%	19%	24%	16%
Droughts or floods	29%	38%	39%	24%	25%	30%	19%	17%	17%	30%	32%	13%	19%	22%	26%	17%	10%	20%
Fire	50%	51%	55%	15%	12%	17%	10%	12%	14%	27%	50%	73%	64%	33%	13%	0%	8%	0%
Severe water shortage	17%	21%	23%	23%	25%	25%	22%	19%	16%	13%	13%	13%	32%	23%	28%	33%	35%	26%
(iii) Asset Shocks																		
Dwelling damaged, destroyed	9%	38%	54%	23%	13%	31%	27%	25%	8%	14%	0%	69%	29%	40%	15%	36%	20%	8%
Livestock died or were stolen	23%	21%	18%	23%	22%	27%	19%	19%	15%	15%	21%	14%	19%	22%	19%	23%	18%	18%
Loss of Land	29%	36%	27%	19%	24%	30%	21%	12%	15%	24%	36%	42%	47%	33%	33%	24%	11%	9%
(iv) Employment Shocks																		
Household business failure	10%	15%	24%	15%	10%	14%	19%	17%	12%	19%	18%	15%	19%	21%	26%	28%	31%	32%
Loss of salaried employment	22%	19%	24%	19%	23%	20%	7%	19%	17%	30%	38%	33%	36%	21%	21%	9%	17%	19%
(v) Health Shocks																		
Chronic illness/accident of HH member	40%	48%	57%	24%	27%	22%	12%	10%	8%	43%	47%	59%	26%	31%	25%	15%	10%	3%
Death of a member of the HH	73%	81%	88%	12%	8%	6%	5%	4%	2%	74%	84%	78%	7%	6%	13%	9%	4%	2%
Death of other family member	42%	58%	67%	19%	15%	17%	10%	9%	6%	53%	57%	46%	15%	19%	22%	14%	8%	10%
(vi) Crime and Safety Shocks																		
Hijacking/Robbery/burglary/assault	19%	29%	33%	27%	33%	25%	23%	14%	13%	25%	22%	27%	29%	35%	24%	22%	26%	20%
(vii) Household break-up																		
Break-up of the HH	34%	37%	45%	19%	27%	31%	22%	15%	12%	21%	37%	55%	37%	30%	21%	29%	16%	11%
Jailed	33%	35%	52%	13%	29%	38%	20%	6%	0%	20%	50%	86%	0%	25%	0%	40%	25%	0%

Values expressed as percentage of rural (urban) households over total rural (urban) households.

Note: the numbers in the columns do not add up to 100% since household could indicate multiple shocks.

Table A.3.: Percentage of households reporting income reduction, asset reduction or reduction of both by rural/urban residence in Tanzania, 2008, 2010 and 2012.

	Rural									Urban								
Year	2008 Income	2010 Income	2012 Income	2008 Asset	2010 Asset	2012 Asset	2008 Both	2010 Both	2012 Both	2008 Income	2010 Income	2012 Income	2008 Asset	2010 Asset	2012 Asset	2008 Both	2010 Both	2012 Both
(i) Price Shocks																		
Large fall in sale prices for crops	39%	46%	45%	6%	2%	5%	13%	7%	15%	41%	32%	44%	3%	5%	2%	8%	8%	15%
Large rise in agricultural input prices	46%	61%	61%	7%	5%	5%	22%	11%	13%	56%	63%	64%	3%	5%	3%	32%	18%	23%
Large rise in price of food	24%	40%	40%	3%	2%	1%	23%	8%	13%	31%	42%	50%	4%	1%	1%	20%	4%	9%
(ii) Natural Disasters																		
Crop disease	39%	49%	50%	2%	5%	4%	21%	7%	12%	29%	52%	46%	3%	3%	5%	20%	7%	10%
Droughts or floods	36%	53%	53%	4%	5%	10%	30%	21%	23%	21%	31%	42%	9%	7%	12%	27%	22%	22%
Fire	21%	25%	36%	13%	18%	21%	33%	27%	26%	0%	25%	33%	9%	25%	7%	55%	33%	40%
Severe water shortage	25%	37%	34%	2%	3%	1%	20%	10%	11%	37%	41%	38%	1%	3%	1%	26%	13%	15%
(iii) Asset Shocks																		
Dwelling damaged, destroyed	18%	25%	23%	23%	0%	31%	14%	38%	31%	21%	40%	31%	14%	20%	31%	36%	0%	23%
Livestock died or were stolen	22%	33%	29%	18%	15%	16%	23%	12%	13%	25%	37%	24%	7%	14%	17%	22%	8%	8%
Loss of Land	31%	38%	26%	8%	11%	20%	28%	21%	24%	53%	14%	18%	6%	33%	21%	35%	31%	33%
(iv) Employment Shocks																		
Household business failure	29%	25%	34%	2%	3%	2%	11%	14%	14%	39%	24%	19%	0%	1%	1%	26%	45%	52%
Loss of salaried employment	37%	51%	52%	0%	6%	0%	11%	4%	9%	47%	63%	56%	0%	0%	0%	26%	12%	18%
(v) Health Shocks																		
Chronic/severe illness or accident of HH member	28%	46%	52%	3%	8%	2%	34%	23%	29%	44%	48%	43%	2%	0%	3%	29%	31%	35%
Death of a member of the HH	25%	34%	35%	6%	4%	5%	21%	27%	27%	38%	37%	38%	4%	4%	0%	29%	24%	31%
Death of other family member	22%	27%	29%	3%	3%	5%	13%	7%	13%	27%	35%	34%	3%	1%	2%	19%	10%	11%
(vi) Crime and Safety Shocks																		
Hijacking/Robbery/burglary/assault	27%	38%	33%	16%	17%	18%	24%	18%	17%	42%	44%	29%	8%	19%	22%	24%	18%	14%
(vii) Household break-up																		
(vii) Household break-up																		
Break-up of the HH	18%	25%	28%	3%	11%	8%	28%	17%	26%	32%	21%	27%	6%	9%	11%	21%	21%	22%
Jailed	27%	24%	62%	7%	6%	5%	20%	35%	24%	60%	75%	43%	0%	0%	0%	0%	25%	29%

Values expressed as percentage of rural (urban) households over total rural (urban) households.

Note: the numbers in the columns do not add up to 100% since household could indicate multiple shocks.

Table A.4. Percentage of hh perceiving a certain degree of dispersion of both by rural/urban residence in Tanzania, 2008, 2010 and 2012.

	Rural												Urban											
Year	2008	2010	2012	2008	2010	2012	2008	2010	2012	2008	2010	2012	2008	2010	2012	2008	2010	2012	2008	2010	2012	2008	2010	2012
	This HH	This HH	This HH	Some other	Some other	Some other	Most HHs	Most HHs	Most HHs	All HHs	All HHs	All HHs	This HH	This HH	This HH	Some other	Some other	Some other	Most HHs	Most HHs	Most HHs	All HHs	All HHs	All HHs
(i) Price Shocks																								
Large fall in sale prices for crops	3%	1%	2%	6%	9%	7%	42%	34%	42%	8%	11%	14%	1%	3%	3%	4%	13%	10%	40%	26%	41%	8%	4%	9%
Large rise in agricultural input prices	2%	3%	2%	8%	7%	6%	32%	34%	38%	11%	7%	9%	5%	4%	5%	9%	9%	5%	34%	29%	39%	9%	5%	11%
Large rise in price of food	3%	2%	3%	15%	15%	11%	52%	44%	49%	9%	17%	18%	3%	4%	4%	9%	13%	8%	59%	50%	58%	21%	21%	2%
(ii) Natural Disasters																								
Crop disease	4%	4%	2%	8%	11%	8%	47%	39%	46%	5%	9%	12%	5%	4%	6%	11%	16%	10%	33%	39%	37%	3%	3%	8%
Droughts or floods	2%	2%	2%	8%	19%	15%	56%	47%	55%	6%	13%	15%	5%	4%	5%	7%	16%	17%	40%	38%	46%	16%	7%	15%
Fire	1%	0%	1%	8%	10%	8%	41%	34%	36%	12%	22%	19%	0%	1%	1%	4%	9%	4%	51%	47%	48%	23%	14%	14%
Severe water shortage	1%	0%	1%	8%	10%	8%	41%	34%	36%	12%	22%	19%	0%	1%	1%	4%	9%	4%	51%	47%	48%	23%	14%	14%
(iii) Asset Shocks																								
Dwelling damaged, destroyed	36%	63%	85%	0%	0%	0%	23%	13%	8%	0%	0%	0%	36%	20%	62%	0%	20%	8%	43%	20%	23%	0%	0%	0%
Livestock died or were stolen	50%	42%	38%	4%	6%	6%	11%	11%	14%	0%	2%	3%	51%	47%	28%	2%	2%	7%	5%	9%	14%	0%	2%	1%
Loss of Land	60%	59%	61%	3%	3%	3%	5%	9%	5%	1%	0%	2%	76%	67%	67%	6%	0%	6%	6%	14%	12%	6%	0%	0%
(iv) Employment Shocks																								
Household business failure	34%	33%	36%	2%	3%	10%	8%	5%	5%	0%	0%	0%	50%	33%	25%	2%	3%	3%	13%	33%	44%	0%	0%	1%
Loss of salaried employment	30%	55%	57%	0%	0%	2%	19%	6%	2%	0%	0%	0%	70%	77%	58%	4%	0%	2%	0%	0%	12%	0%	0%	2%
(v) Health Shocks																								
Chr./sev. illness/accident of HH member	73%	80%	85%	2%	3%	1%	0%	2%	0%	0%	0%	0%	79%	84%	83%	1%	2%	0%	3%	2%	4%	0%	0%	0%
Death of a member of the HH	85%	85%	88%	4%	4%	5%	1%	4%	3%	0%	0%	0%	86%	76%	88%	2%	12%	2%	1%	6%	2%	1%	0%	0%
Death of other family member	60%	55%	48%	7%	16%	32%	4%	10%	9%	0%	1%	0%	65%	58%	51%	10%	21%	22%	5%	5%	6%	1%	0%	0%
(vi) Crime and Safety Shocks																								
Hijacking/Robbery/burglary/assault	67%	74%	69%	1%	1%	1%	2%	1%	1%	0%	1%	1%	75%	79%	65%	0%	1%	1%	0%	3%	4%	1%	0%	1%
(vii) Household break-up																								
Break-up of the HH	76%	76%	86%	0%	2%	1%	0%	1%	1%	0%	0%	0%	84%	81%	83%	1%	1%	1%	1%	1%	4%	0%	0%	0%
Jailed	67%	65%	90%	0%	6%	0%	0%	0%	0%	0%	0%	0%	60%	100%	86%	20%	0%	0%	0%	0%	0%	0%	0%	0%

Values expressed as percentage of rural (urban) households over total rural (urban) households.

Note: the numbers in the columns do not add up to 100% since household could indicate multiple shocks.

Table A.5. Poverty measures

	Survey Year			
	1992	**2000**	**2007**	**2012**
Mean ($)	33.42	25.68	36.79	55.91
Pov. Line ($/month)	38	38	38	38
Headcount (%)	71.98	84.23	67.87	43.48
Pov. Gap (%)	29.24	41.23	28.10	12.98
Squared Pov. gap	15.20	24.06	14.78	5.12
Watts Index	0.44	0.66	0.42	0.17
Gini Index	33.83	34.62	37.58	37.82
MLD Index	0.19	0.20	0.24	0.24

Source: PovcalNet. Authors' elaboration.

Table A.6: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.
Caloric Intake	2275.259	1253.426	16.072	4653
Head is female	0.26	dummy	0	1
Age of head	47.431	14.74	0	108
Educ of Head	0.958	0.669	0	3
HH size	6.767	3.699	1	55
Sex Ratio	1.172	0.96	0	8
Dependency Ratio	1.106	0.879	0	8
Head works in Agri/Livestock	0.588	dummy	0	1
Asset Sofisticated Index	0.117	0.354	0	5
Animal index	0.862	0.875	0	3
Asset base index	0.131	0.416	0	5
Housing quality index	0.489	0.307	0	3.25
Quality/access to services index	0.268	0.284	0	1
Consumer durable index	0.194	0.194	0	1
Income Diversity	0.471	0.447	0	1
Cash crop seller	0.243	dummy	0	1
Staple Food Buyer	0.783	dummy	0	1

Source: Authors' elaboration.