HOUSEHOLDS' CONSUMPTION RESPONSE TO FOOD PRICE CHANGES IN TANZANIA

Vincent Leyaro[8]

Abstract

Using Household Budget Surveys and applying Deaton's Approach, this article estimates households' response to price changes of commodity products in Tanzania from 1900s to 2000s. Understanding households' behavioural response to price changes is critical to answering many questions of public policy in developing countries; in particular, to evaluating the welfare effects of changes in commodity prices. Following Deaton's approach, we relate budget shares and unit values to the logarithms of prices, outlay and other relevant household characteristics. The findings suggest that Tanzanians are sensitive and responsive to income and price changes of the commodities they consume, especially of staple foods to which they attach higher weights. All food commodity groups are income-elastic. More than half of commodity groups have own price elasticities greater than one and are statistically significant, implying that most of food commodities in Tanzania are elastic in demand. This should not come as a surprise, since, given that the majority of Tanzanians are poor, are therefore very sensitive to price changes. It was also found that there was substitution and complementarity between the commodity groups, but only fifty percent of these cross-price dependencies are statistically significant. To test for the robustness of within-cluster methodology as proposed by Deaton, the estimates were compared with estimates obtained using actual market prices from forty four districts in Tanzania.

Key words: income, own- and cross-price elasticities, Tanzania

1.0 Introduction

In most low income countries like Tanzania, food consumption makes up a huge share of households' total budget. In these countries, food accounts for two-thirds or more of average household expenditure (the share declines with income). Consequently, the importance of food consumption in household budgets is essential in evaluating the effects of changes in food prices. Despite its importance to answering many questions of public policy, little is known in most developing countries, and especially in Sub-Saharan Africa, about the behavioural response of consumers and producers to price changes. This is largely due to the problem of data availability, particularly the lack of historical records that relate average quantities to average outlays and prices over time. Traditionally, such historical data linking demand and production decisions to historical variation in prices have been used as standard data for the estimation of price responses in most developed

[8] Department of Economics, University of Dar es Salaam

countries. However, even in developed countries where such data is plentiful, many years of efforts have not succeeded in producing a set of parameters that are convincing. The difficulty lies with the aggregate nature of such annual time series. Besides the lack of precession of estimation and sufficient explanatory variables that can be modelled reasonably, such data lack detailed disaggregated goods that are much required for estimation of own- and cross-price effects.

Indeed, information about behavioural responses to price changes is more important for low income countries like Tanzania that are undertaking structural reforms to promote economic growth, ensure macroeconomics stability, ensure equitable distribution of resources, ensure food security, improve households wellbeing and reduce poverty. In such countries, many of the commodities involved are foods, some of which may be close substitutes while others are close complements. Governments, development partners and other key stakeholders in such countries are required to make proposals for structural reforms. At the end of the day one would like to calculate who benefits and who loses from such reforms (price changes) and hence assess the distributional consequences of a change in pricing policy. While that is an important part of the analysis of price change due to structural reforms, that alone is first order effects. To go further into higher dimension effects, we must also know something about the efficiency, dynamics, and interactions, which means finding out behavioural response of consumers or producers to the incentives provided by such price changes.

Though time series data that traditionally has been used to estimate elasticities is lacking in most developing countries, Tanzania being no exception, to get around this caveat, Deaton (1987, 1988, 1990, 1997) has proposed to exploit the structure of households' surveys, where the source of price variations is from price changes over space rather than over time. Applying the methodology developed by Deaton and using Tanzania Household Budget Surveys data (HBS) for 1991/92, 2000/01 and 2007, we estimate income, own- and cross-price elasticities for the major food commodities in Tanzania. By exploiting the structure of household surveys, that is, spatial variation in prices across cluster due to trade costs or market imperfections, Deaton's technique is able to annihilate measurement errors and quality effects that are very prevalent within the unit value such that we are able to arrive at the estimation of own-and cross-price elasticities, and explore substitution and complementarity patterns. In addition, Deaton's method is able to model households that do not purchase all commodities (zero consumption) and address the issue of local units of measurements.

Tanzania is a good case to study households' response to price change in low-income countries. With Gross National Income (GNI) per capita of US$1,328 and Human Development Index (HDI) of 0.466 in 2012, Tanzania is one of the

poorest countries in the world (AFHDR, 2012). Basic need headcount poverty as measured from national HBS has remained high, from 38.6% in 1991/92 to 35.6% in 2000/01 and to 33.4% in 2007, equivalent to 5.2% points reduction. The recent poverty estimates from 2012 HBS show that poverty has gone down to 28.2%. During this period, Tanzania has implemented substantial reforms, in particular trade and tax reforms. Although precise figures vary depending on how the average is measured, all data shows a decline between 1992 and 2002; the average tariff fell from 28% in the early 1990s to 16% in the early 2000s (Jones & Morrissey, 2008). Following the signing of the EAC Custom Union Common External Tariff (CET) in 2005, the highest rate is currently 25% with three tariff bands: 0%, 10% and 25%. Therefore, many reforms to tariffs and non-tariff barriers have been implemented, which have a significant impact on real domestic commodity prices. The availability of household survey data spanning a period of before and after reforms makes Tanzania an interesting case for identifying the effects of price changes due to reforms across households. There are very few studies in Africa that have used survey data and applied Deaton's methodology in doing the same.

What this study found is that, in Tanzania all food commodity groups are income elastic and greatly respond to extra total household per capita. More than half of commodity groups have own price elasticities greater than one and are statistically significant, implying that most of food commodities are more elastic to demand. This should not come as a surprise given that the majority of people are poor and are therefore very sensitive to price changes. We found also the presence of substitution and complementarity between commodity groups, but only 50% of these cross price dependences are statistically significant. To test for the robustness of Deaton's within-cluster methodology, we have compared our estimates with estimates obtained using actual market prices from forty four districts in Tanzania. Further, our results compare somewhat with findings for Coted'Ivoire, Indonesia, Pakistan, India, Bulgaria and Mexico that have used similar methodology.

The next section reviews Tanzania's experiment with economic policies and their impact on the economy. Section 3 summarises the empirical specification employed with a focus on how Deaton's uses the spatial price variations due to cluster locations to extract the elasticities while addressing issues of measurement error, quality effects, zero consumption and local units of measurement. In this section too we outline the econometric methodology/stages to be used in the estimation. The discussion of the data is in Section 4. Section 5 presents and discusses the results for various commodities (plus those from the actual market prices), while Section 6 presents concluding remarks from the study.

2.0 Empirical model

To identify behavioural responses of consumers in Tanzania due to price changes, we adopted the model developed by Deaton (1987, 1988, 1990 and 1997), that exploits the structure of household surveys where the source of price variations is from price changes over space (spatial variation). Given that households are surveyed at the same time within a given calendar year, we can assume that actual market prices are constant within each cluster but different between them (spatial price variation is commonly observed). In these surveys, households are asked to report not only their expenditure on each commodity but also the physical amounts consumed; these are then used to calculate unit values. These unit values and reported quantities become the building blocks in Deaton's model.

Deaton starts by specifying the simple standard logarithmic demand model where the logarithms of both demand and unit value are related to the logarithm of household total expenditure, price of the commodities and household characteristics. He then goes on to modify this specification to address the issues of non-purchasing such that the dependent variable now becomes budget share rather than the logarithm of quantity consumed. By augmenting the Working (1943) model with price terms and adding the vector of household's characteristics, Deaton (1997) specified the paired system of budget share and logarithm of unit value equations for household h in cluster c for good i (i denotes a group of aggregated commodities), hence we have:

$$w_{ic} = \alpha^0 + \beta^0 \ln x_{ic} + \gamma^0 z_{ic} + \sum_{H=1}^{G} \theta_H \ln p_{Hc} + f_c + \mu_{ic}^0 \quad (1)$$

$$\ln v_{ic} = \alpha^1 + \beta^1 \ln x_{ic} + \gamma^1 z_{ic} + \sum_{H=1}^{G} \psi_H \ln p_{Hc} + \mu_{ic}^1 \quad (2)$$

where w_{ic} is the budget share devoted to good i in household h's budget. $\ln v_{ic}$ is the logarithm of unit value of good i. x_{ic} is household total expenditure per household member, z_{ic} is the vector of household's characteristics and p_{Hc} logarithm of the prices of all of the i goods in a cluster c and f_c is a cluster fixed effect. The μ_{ic}^0 and μ_{ic}^1 are idiosyncratic error terms (for more details on how each of this is obtained see Leyaro, 2012).

Both share and logarithm of unit value equations are taken to be a linear function of logarithm of total household expenditure per capita, vector of household's characteristics and logarithm of the prices of all goods in a cluster. Due to the modification of equation (1) from the logarithmic model, its coefficient θ_H is not

the price elasticity but the response of budget share to price change, and ψ_H is the response of unit value to the change in price. The income elasticity is estimated as β^0 and β^1 is the quality elasticity.

Despite the advantages that household surveys offer in measuring household's behavioural response to price changes, there is a drawback. Unit values are not the same as prices; they are affected by the choice of quality as well as by the actual prices that the consumer faces in the market. When there is a measurement error in the data there is obvious danger in dividing expenditure by quantity and using that to explain the quantity. In addition, not every household in the survey reports expenditure on each commodity hence no unit value can be obtained from the non-purchasers. Another concern is the issue of local units of measurements that plagues unit values in most household surveys. Leyaro 2012 details how each of these problems arises and outlines Deaton's approach to purging the unit values of these problems (i.e. measurement errors and quality effects) and estimating ε_{ij} (own and cross price elasticities).

3.0 Estimation methods

There are two stages in estimating the parameters in the paired equations (1) and (2). The first one uses within-village information to estimate budget share and the logarithm of unit value on the logarithm of total household expenditure per household member, market prices and socio-demographic characteristics. Both equations can be extended to include prices simply by adding dummy variables for each village. For a large survey, like the one in our case, this is best done by calculating village means for all variables, and then running a regression using as left- and right-hand side variables the deviation from the village means. The removal of cluster removes the prices and fixed effects and allows for consistent estimation. The estimates of β_s and γ_s from the within estimators are the final estimates of these parameters.

The second stage of estimation begins by using the first stage estimates to calculate the parts of mean cluster of budget share and unit values that are not accounted for by the first stage variables. These are the corrected budget share and unit values which are computed by subtracting the product of the slope coefficients and the regressors from the household level budget share and unit values respectively. Then cluster averages of the corrected budget share and unit values are taken. The cluster average of corrected budget share is obtained by dividing them by the number of all households in a given cluster, while the cluster

average of the corrected unit value is obtained by dividing them by the number of the purchasing households in a given cluster.

The residuals from the first stage regression are used to estimate the variance and covariance in the share and unit value equations that are used, in conjunction with household size, to correct for the measurement errors. The variances and covariance allow the model to capture the spurious relationship between quantity and price that do not come from genuine price responses. With this we can estimate the matrices of variances of μ_{ic}^{0} and μ_{ic}^{1}, and covariance of μ_{ic}^{0} and μ_{ic}^{1}. When these are estimated we have a very rough estimate of the matrices of price elasticities.[9]

However, as noted already, we need to correct for the measurement errors, which can be corrected using the estimated covariance of the residuals of share and the unit value equations in conjunction with measures of average cluster size. But still we have not corrected for the quality effects. To correct for the quality effects requires the application of the quality model. This completes our estimation stage, where the first stage parameters and the residuals are used to make covariance matrices, the results of which are used to calculate the matrix, an estimate that is corrected using the first stage estimates to give the parameters or elasticity matrix.

4.0 Data sources and descriptive statistics

The Tanzania Household Budget Survey for the years 1991/92, 2000/01 and 2007, is the basic data set used in this study. These are nationally representative surveys conducted by the National Bureau of Statistics, which provide raw data to describe patterns and trends for a range of welfare indicators over the 1990s and 2000s.[10]

With an average share of 64% of household income spent on food consumption in 2007, 66.5% in 2000/01 and 71.3% in 1991/92, Tanzania is a typical poor country. Table 1 provides summary statistics for our dependent variables in the demand equations: budget share and unit values. Cereals (grains, flour, bread, confectionary and others) made the largest share of household food budget around 32% in 2000/01 and to 34% in 2007. This compares well with other studies in Tanzania that have looked at household demand for food (Sarris & Tinios, 1995; Weliwita *et al.*, 2003; Awudu & Dominique, 2004) showing that cereals are the basic staple food for most households. Other important commodity groups that account for large shares of household food budgets are starch, roots and tubers (12%), meat (over 10%), vegetables (8.5%), and fish (8%). The remaining food

[9] For more details see Leyaro (2012)

[10] For more details on sampling design and the survey records see Leyaro (2012)

groups, except pulses at around 7%, account for less than 5% of the budget. These aggregated commodities make up to almost 100% of the food consumption basket for the households in Tanzania.

Table 1: Statistics for budget share and median unit price*

	Budget share, 2007	*Median unit price, 2007*	*Budget share 00/01*	*Median unit price, 00/01*	*Price Ratio 01-07*
Cereals, grain	0.16	398	0.14	238	1.67
Cereals, flour	0.18	470	0.2	271	1.73
Other cereals	0.01	300	0.01	745	0.4
Bread	0	1,024	0.01	618	1.66
Confectionery	0.02	1,250	0.01	1,918	0.65
Starch, roots and tubers	0.12	193	0.11	134	1.43
Sugar and sweets	0.02	1,200	0.05	577	2.08
Pulses, dry	0.03	650	0.07	301	2.16
Nuts and Seeds	0.02	583	0.02	506	1.15
Vegetables	0.11	594	0.08	356	1.67
Fruits	0.03	442	0.02	288	1.53
Meat and meat products	0.09	1,760	0.1	829	2.12
Eggs	0	105,333	0	65,624	1.61
Fish and shellfish	0.08	1,306	0.08	826	1.58
Milk and dairy products	0.02	2,000	0.03	1,254	1.59
Oils and Fats products	0.05	2,000	0.03	1,028	1.95
Spices and other foodstuffs	0.01	2,500	0.02	1,335	1.87
Raw materials for drink	0.01	6,307	0.01	2,761	2.28
Non-alcoholic drinks	0.02	800	0.01	612	1.31
Alcoholic drinks	0.03	2,000	0.01	1,300	1.54

Notes: The reported figures are weighted using survey weights to reflect the total population. Thus, the 22,178 households in the 2000/01 survey correspond to a total population of 560,935 households and the 10,466 households in 2007 represents a total of 252,112.

* The Median Unit Value (uv) is in Tanzanian Shillings (TZS) per gram or millilitre, except eggs which are TZS per piece.

Source: Author's own calculations from Tanzania Household Budget Surveys for 2000/01 and 2007.

Although unit prices (nominal) have risen considerably, budget shares have not changed noticeably over time. Table 1 reports the median unit price ratios for 2007 compared to 2001. This is probably because the price of cereals, the major

share of consumption, increased in line with overall price rises, whereas products for which prices rose dramatically accounted for a small share of the budget. Leyaro (2012) shows consumption expenditure shares by product category for household deciles based on their level of consumption (total expenditure) in each survey. As expected from Engel's law, the poorest two deciles of the population spent around 66% in 1991/92, 73% in 2000/01 and 70% in 2007 of their total income on food while the richest two deciles spent 55-57% in all three years. Poverty is concentrated in rural areas, and rural compared to urban households spent more on food (which they perceive as necessities) and less on non-food (which they perceive as luxuries).

In addition to the unit values from the survey, we also have regional market prices for 27 food products collected monthly for 44 regional markets by the Ministry of Agriculture. We use these actual market prices for sensitivity and robustness checks. The 16 out of 19 items prices derived from the household surveys are close to the prices from the district markets.

5.0 Results and discussion

This section presents results obtained from estimating the system of demand equations that provide income, quality, own and cross price elasticities. This is done in stages, first, we start by discussing the first stage estimates where within-cluster estimates for equations (1) and (2) are performed to establish the magnitude of quality and income effects. After generating the corrected values for the within-cluster estimates, averaging them over their clusters, and annihilating them off their measurement errors and quality effects, the second stage estimates own- and cross-price responses. Although the main focus of the discussion is on the 2000/01 and 2007surveys, corresponding estimates for the 1991/92 survey could be obtained from Leyaro (2012).

5.1 First stage estimates: Income and quality elasticities

Table 2 presents a selection of parameter estimates from the within-village regressions for budget share and unit value equations for each of the 20 commodity groups with estimated expenditure elasticities for quality (β^1) and quantity (β^0). Although regressions for equations (1) and (2) contain a full range of composition and socio-economic variables, in addition to region and month dummies, only the coefficients on the logarithms of total household expenditure per adult equivalent and household size are presented and discussed here.

Table 2: Within-village estimates: Budget shares, unit values and expenditure Elasticities, 2000/01

Commodity Group	*Expenditure elasticities*	*Budget Shares*		*Unit Values*	
		Lnx ($\square^0$)	*lnn*	*Lnx ($\square^1$)*	*Lnn*
Cereals, grain	1.012	0.017	0.014	0.123	-0.022
Cereals, flour	**0.582**	**-0.047**	-0.003	0.136	0.040
Other cereals	**0.992**	**-0.001**	0.001	0.117	0.060
Bread	1.342	0.002	0.001	0.003^{NS}	-0.016
Confectionery	**0.959**	**-0.001***	0.001	0.030	0.024
Starch, roots and tubers	**0.643**	**-0.029**	-0.005	0.073	0.034
Sugar	1.244	0.012	0.009	-0.014	-0.010
Pulses, dry	**0.793**	**-0.009**	-0.003	0.056	0.004
Nuts and Seeds	**0.958**	**-0.001** ^{NS}	0.001*	0.037	0.021
Vegetables	**0.627**	**-0.026**	-0.022	0.062	0.010
Fruits	1.023	0.003	0.003	0.099	0.012
Meat and meat products	1.316	0.035	0.016	0.058	0.044
Eggs	1.773	0.003	0.001	0.038	-0.011
Fish and shellfish	**0.722**	**-0.014**	-0.012	0.083	0.054
Milk and dairy product	1.231	0.008	0.008	0.055	0.016
Oils and Fats products	1.295	0.011	-0.001	0.014	-0.039
Spices and other foodstuffs	**0.568**	**-0.004**	-0.004	0.141	0.122
Raw materials for drink	1.305	0.002	0.000	0.003 ^{NS}	-0.047
Non-alcoholic drinks	1.683	0.011	0.006	0.085	-0.007
Alcoholic drinks	1.009	0.007	0.004	0.631	0.272

Note: All coefficients are significant at the 1% level except for * significant at 10% and NS not significant. Values in **bold** denote necessities.

Source: Authors' own calculations from the Tanzania Household Budget Survey 2000/01.

Column 1 presents expenditure elasticities (of household spending on a commodity group with respect to a measure of household income) for the 2000/01 survey. Estimates for the 1991/92 and 2007 surveys are in Leyaro (2012). Most commodities are responsive to additional total household expenditure per capita: fourteen out of twenty commodity groups have expenditure elasticity greater than 0.90. Cereal flour, confectionary, other cereals, starch, pulses, nuts, seeds, vegetables, fish, and spices have negative β^0 coefficients and expenditure (income) elasticities that are less than unity and therefore can be classified as necessities (these are mostly consumed by low income groups). Goods such as cereal grains, bread, sugar, meat, eggs, milk, non-alcohol and alcoholic drinks consumed at home have positive β^0 coefficients and income elasticities greater than unity, thus appear to be luxury goods (consumed mostly by middle to high

income groups). These results largely compare well with those for 2007 and 1991/92 surveys.

What is more important is to look at the derived quality elasticities, where for the same commodity groups consumers pay different prices given differences in grades, with better off households paying more per unit. With the exception of sugar, whose coefficient is negative and significant, and bread and raw materials for drinks (insignificant), the quality elasticities are positive and significant at the one percent level. The reason sugar, bread and raw materials for drinks have no quality effects may be that they are of almost homogeneous quality and their prices are similar across different regions. Most important staple food commodities (cereals, starch, pulses, nuts and seeds, vegetables, fruits, meat, eggs, milk, oil and fats and fish) have very modest quality elasticities ranging from three to 14%. It is only alcoholic drinks that have relatively higher quality effects, at 63%, which is due to a mix of more expensive brands such as spirits consumed by the rich and cheap locally produced drinks like '*kibuku*' consumed by the poor.

5.2 Second stage: Own- and cross-price elasticities

The output obtained from the first stage estimates are used to calculate the own- and cross price elasticities. First, the corrected values of share and unit values are generated. Then inter-cluster variations of these corrected magnitudes, after purging them of their measurement errors and quality effects, are used to estimate the matrices of own- and cross-price elasticities, for unconstrained and symmetry constrained estimates. Removing quality effects is important as is evident from Table 2 that, though modest, quality elasticity is significantly different from zero for most goods. There are differences between unconstrained (uncompensated or Marshallian estimates) and symmetry constrained (compensated or Hicksian estimates) results. For these reasons, symmetry constrained estimates are our preferred results used in the estimation of consumer welfare and presented here for the 2000/01 survey.

Table 3 presents symmetry-constrained own- and cross-price estimates from the 2000/01 survey, obtained by completing the system and by imposing the symmetry restriction (unconstrained estimates for 2000/01 are in Table A.1 and both unconstrained and constrained estimates for 2007 survey in Tables A.2 and A.3). The numbers are arranged so that the elasticity in row i and column j is the response of consumption of good i to the price of good j. The bootstrapped 'standard errors' are calculated to establish the significance of the elasticities. It is worth noting that 188 out of 400 coefficients (47%) are statistically significant (the coefficient is at least twice its bootstrapped 'standard error'). This compares well with estimates done using 2007 and 1991/92 surveys, as well as the actual

market prices (Leyaro, 2012). We have highlighted (in bold) those estimates that are more than twice their bootstrapped standard errors.

The demand for most goods is more responsive to own price than to cross price elasticities. As expected, all of the own price elasticities (diagonal terms) have negative signs and are statistically significant. Except for eggs, the other commodities are not very different in magnitude from their unconstrained estimates (Appendix Table A.3). While the unconstrained own price elasticities range from -1.41 to -0.72, the symmetry constrained elasticities range from -1.36 to -0.23. Hence, as expected, the symmetry constrained estimates are slightly lower than the unconstrained ones. With 13 out of 20 commodity groups having elasticities greater than unity, food commodities in Tanzania are generally highly elastic.

Most staple food commodities such as cereals, pulses, sugar, milk and dairy products, and a few luxuries like raw materials for drinks and non-alcoholic drinks consumed at home, are highly elastic with greater than unity own price elasticities. The remaining products such as maize flour, vegetables, fruits, meat and meat products, and alcoholic drinks consumed at home have less than unity own price elasticities. They largely compare well to those for 2007 and 1991/92 surveys.

Given the nature of food commodities in Tanzania, it is reasonable to expect cross price effects. As expected, there is substitutability between commodity groups which are similar and complementarity for those which are not similar. For instance, food commodities that are sources of energy such as cereals, starch and sugar are substitute products. An increase in price of cereal grains increases the demand for cereal flour, other cereals, bread, starches and sugar. Cereal grains are a complement to nuts and seeds, meats, oil and fats and spices such that a fall in demand for cereals grains leads to a fall in demand for these goods. Pulses, meat, eggs, fish and milk can be grouped as goods demanded for similar reasons as sources of protein and so are likely to be substitutes.

Of these, meat might be relatively the most expensive in the group such that an increase in its price will trigger an increase in the demand for the rest, instead of substitution. Raw materials for drinks, non-alcoholic and alcoholic drinks consumed at home, and meals and drinks consumed outside home, are goods in the same category. Therefore, depending on the circumstances, they can either be substitutes or complements to each other. Similar results are obtained using 2007 and 1991/92 surveys as well as district market prices (see Leyaro, 2012).

Table 3: Symmetry-constrained matrix of own- and cross-price elasticities in Tanzania, 2000/01

Commodity Groups	Cereal grain	Cereal flour	Other cereals	Bread	Confectionery	Starch tubers	Sugar	Pulses, dry	Nut, Seeds	Vegetables	Fruit	Meat	Eggs	Fish	Milk	Oils, Fats	Spics, others	Material drink	Non-alcohol	Alcoholic
Cereals, grain	**-1.36**	0.15	**0.05**	0.04	-0.01	**0.10**	0.02	0.03	**-0.10**	0.01	0.06	-0.04	**0.05**	0.02	**0.07**	**-0.08**	0.00	0.04	**0.08**	**0.06**
Cereals, flour	**0.17**	**-1.05**	-0.03	-0.03	0.05	0.02	**0.15**	**-0.11**	0.05	0.07	**-0.09**	**-0.08**	**-0.08**	-0.07	**-0.10**	**0.19**	0.01	0.01	**-0.01**	**-0.11**
Other cereals	**0.71**	-0.60	**-1.16**	0.16	0.11	-0.06	0.13	-0.15	-0.13	-0.05	0.07	-0.15	**0.16**	-0.01	0.13	-0.07	0.11	0.00	0.16	**0.10**
Bread	0.81	-0.79	0.22	**-1.40**	**-0.34**	-0.31	-0.07	**1.14**	-0.14	0.06	**0.51**	0.68	**0.37**	**-0.53**	**0.46**	**0.48**	0.07	0.16	0.08	**0.02**
Confectionery	-0.04	0.43	0.07	**-0.14**	**-1.25**	0.28	-0.26	0.05	-0.02	**-0.24**	**0.21**	-0.10	**0.19**	-0.05	0.07	-0.17	**0.13**	0.02	**0.13**	**0.13**
Starch, roots tubers	0.18	0.04	0.00	-0.02	0.05	**-1.12**	0.02	-0.03	-0.01	0.00	-0.08	0.02	**-0.06**	**-0.07**	**0.08**	**-0.02**	-0.05	-0.04	**-0.08**	**-0.07**
Sugar	-0.01	**0.39**	0.02	-0.01	-0.08	-0.02	**-1.17**	-0.09	**0.06**	0.00	**0.23**	-0.15	**0.06**	-0.01	0.03	**-0.18**	0.06	0.02	**0.18**	**0.04**
Pulses, dry	0.10	**-0.31**	-0.02	**0.13**	0.02	-0.07	-0.06	**-1.18**	**0.04**	0.04	0.00	-0.08	**-0.05**	**0.16**	-0.05	-0.05	-0.03	0.00	-0.10	**0.00**
Nuts and Seeds	**-0.51**	0.33	-0.05	-0.04	-0.02	-0.08	**0.15**	**0.09**	**-1.47**	**0.19**	-0.01	-0.01	**0.04**	**-0.17**	0.04	**0.19**	0.01	-0.08	0.05	0.00
Vegetables	0.07	0.14	0.00	**0.01**	**-0.04**	0.00	0.03	0.04	**0.06**	**-0.95**	**0.04**	**0.09**	**0.03**	0.12	-0.02	**0.04**	-0.03	0.01	0.03	0.01
Fruits	0.40	**-0.80**	0.03	**0.16**	**0.16**	-0.44	**0.58**	-0.03	-0.01	**0.12**	**-0.89**	0.18	**0.08**	-0.15	**-0.06**	**0.29**	0.08	0.03	**-0.05**	0.04
Meat, meat products	-0.08	**-0.24**	-0.02	0.05	-0.02	-0.04	-0.09	-0.08	-0.01	0.03	0.04	**-0.70**	-0.04	**0.11**	**-0.12**	**0.02**	-0.06	-0.01	**0.08**	0.03
Eggs	1.89	**-4.25**	0.43	**0.72**	**0.89**	**-1.92**	0.84	-0.98	**0.26**	0.78	**0.51**	-1.26	**-0.23**	0.99	0.26	**0.92**	**-0.25**	0.25	0.71	**0.21**
Fish and shellfish	0.08	-0.17	0.00	**-0.04**	-0.01	**-0.11**	0.02	**0.13**	**-0.05**	**0.13**	-0.04	**0.20**	0.05	**-1.19**	**0.12**	**-0.06**	-0.01	0.02	0.03	**0.04**
Milk, dairy product	**0.31**	**-0.70**	0.04	**0.11**	0.04	**0.23**	0.05	-0.14	0.03	-0.11	**-0.05**	**-0.40**	0.03	**0.29**	**-1.16**	0.09	**0.05**	0.02	0.08	-0.01
Oils and Fats products	**-0.28**	**0.74**	-0.02	**0.08**	-0.08	**-0.12**	-0.26	-0.11	**0.11**	0.04	**0.16**	0.06	**0.08**	**-0.14**	0.07	**-0.93**	0.00	0.00	**0.10**	**0.08**
Spices, other foods	0.08	0.08	**0.07**	0.04	**0.14**	-0.33	0.23	-0.09	0.03	-0.16	0.12	-0.33	**-0.05**	-0.05	**0.10**	0.03	**-0.80**	-0.03	0.05	-0.06
Materials for drink	0.74	0.10	0.00	0.16	0.03	-0.69	**0.14**	-0.03	**-0.31**	0.03	0.11	-0.08	0.13	0.14	0.07	**0.02**	-0.08	**-1.05**	**0.32**	0.00
Non-alcoholic drinks	**0.61**	-0.28	0.09	0.03	0.12	**-0.63**	**0.59**	**-0.45**	0.06	0.08	**-0.08**	**0.45**	**0.16**	0.08	0.13	**0.22**	0.03	0.14	**-1.15**	**0.18**
Alcoholic drinks	**0.62**	**-1.70**	**0.07**	**0.01**	**0.17**	**-0.68**	**0.14**	-0.06	-0.02	**-0.04**	**0.07**	0.25	**0.06**	0.18	-0.05	**0.26**	-0.10	0.00	**0.23**	**-0.93**

Notes: The rows show the commodity being affected by a price change for the column commodity. The standard errors figures to determine the significance of the estimates were obtained from 1,000 replications of the bootstrap using cluster level data and are defined as half the length of the interval around the bootstrap mean that contains 0.638 (the fraction of the normal random variable within two standard deviations of the mean) of the bootstrap replications. The data is weighted using survey weights.

Source: Author's calculations using Tanzania Household Budget Survey, 2000/01.

6.0 Summary and conclusion

Availability of household budget survey data in most of developing countries recently on one hand, and Deaton's methodology that is capable of using such data set to calculate elasticities on the other hand, have made it possible to estimate income, own- and cross-price elasticities for food commodities in Tanzania in the 1990s and 2000s. As shown, unit values are not the same as actual market prices, as they are inherently contaminated with quality effects and suffer from measurement errors, amongst other things. The tractability of Deaton's approach therefore is its ability to allow for all these in addition to addressing the issues of zero consumption and local unit of measurement, such that we have confidence on the results. In the first step, budget shares and unit values (i.e. the ratio of total household expenditure to quantity purchased) are related to the logarithms of prices, outlay and other relevant household characteristics. Then the inter-cluster variation of corrected values of budget share and unit values, after annihilating them of quality effects and measurement errors, are used to estimate own and cross price elasticities.

Twenty commodity groups have been aggregated from 130 food and drinks items that make most of the food consumption basket in Tanzania and with that we estimate income, own- and cross-price elasticities. All food commodity groups are income elastic and greatly respond to extra total household expenditure per capita. More than two thirds of commodity groups have own price elasticities greater than 0.90 and are statistically significant, implying that most of food commodities in Tanzania are more elastic in demand. This should not come as a surprise given that the majority of Tanzanians are poor people and are therefore very sensitive to price changes. It was also found that there was substitution and complementarity between commodity groups, but only half percent of these cross price dependences are statistically significant. The robustness test for within-cluster methodology is done by comparing Deaton's estimates with estimates obtained using actual market prices from 44 districts in Tanzania.

As most Tanzanians are very sensitive to the prices of what they consume, any factors that influence food inflation would have serious effects on the welfare of most people; which in turn might have serious policy implications for the government to deal with. Another main contribution of this study is the elasticities tables that can be used by other researchers to asses welfare implications of many policy reforms in Tanzania or in construction of Tanzania input-output table.

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Appendices

Table A1a: Unconstrained matrix of own- and cross-price elasticities, Tanzania, 2007

Commodity Groups	Cereals, grain	Cereals, flour	Other cereals	Bread	Confectionery	Starch tubers	Sugar	Pulses, dry	Nut, Seeds	Vegetables	Fruits	Meat	Eggs	Fish	Milk	Oils, Fats	Spices, others	Materials drink	Non-alcoholic	Alcoholic
Cereals, grain	**-1.39**	0.07	0.00	0.10	-0.15	-0.01	-0.06	0.09	-0.06	0.07	0.11	0.11	0.07	-0.02	0.01	0.03	0.03	-0.04	0.02	0.09
Cereals, flour	-0.08	**-0.83**	0.00	-0.09	0.03	-0.06	0.25	-0.43	-0.01	0.03	0.02	-0.21	0.02	0.08	-0.05	-0.04	-0.01	-0.10	-0.04	-0.02
Other cereals	0.58	-0.09	**-1.18**	-0.02	-0.21	-0.49	0.66	0.38	-0.13	0.58	-0.15	-0.11	-0.30	-0.28	0.25	0.49	0.25	-0.14	-0.21	0.15
Bread	1.51	-1.00	0.17	**-1.10**	0.90	0.96	-0.74	-1.15	0.64	-1.31	0.75	1.82	0.43	0.18	-0.41	-0.31	-0.30	-0.64	0.19	0.07
Confectionery	0.50	-0.03	0.08	0.06	**-1.20**	0.20	0.02	0.21	-0.18	-0.20	0.25	-0.06	0.05	0.15	-0.01	0.17	-0.01	0.07	-0.23	0.04
Starch, roots tubers	0.62	-0.01	-0.14	0.01	-0.01	**-1.23**	-0.01	0.18	0.02	0.08	-0.15	0.20	-0.19	-0.14	0.04	0.16	-0.10	0.06	0.09	-0.08
Sugar	0.23	0.00	0.10	-0.06	0.10	0.34	**-1.01**	-0.34	-0.04	0.33	0.18	0.22	0.00	-0.21	-0.05	-0.13	-0.19	-0.01	-0.03	-0.12
Pulses, dry	-0.57	-0.21	-0.02	0.05	0.10	0.02	-0.20	**-1.07**	0.01	-0.16	0.01	-0.10	0.01	0.26	-0.09	-0.06	0.04	0.02	-0.16	-0.08
Nuts and Seeds	0.09	-0.18	0.06	-0.14	-0.19	-0.39	-0.23	0.33	**-1.36**	-0.04	0.50	0.13	0.00	-0.04	0.00	0.36	0.12	0.08	-0.20	-0.10
Vegetables	-0.16	0.11	0.03	0.05	-0.05	0.12	-0.01	0.08	-0.06	**-0.91**	-0.04	0.08	0.02	0.04	0.08	-0.14	-0.03	0.07	-0.04	0.02
Fruits	-0.25	0.17	0.09	0.03	0.12	0.13	-0.20	0.26	-0.05	-0.25	**-1.26**	-0.05	-0.01	0.02	-0.07	-0.16	0.17	0.01	-0.02	0.05
Meat, meat products	0.05	-0.14	0.04	0.00	0.02	0.13	0.03	-0.07	0.13	-0.08	-0.08	**-1.15**	0.00	0.05	-0.04	-0.05	0.08	0.03	0.09	0.03
Eggs	0.07	-0.28	0.14	0.36	0.15	0.27	-0.52	-0.59	-0.07	-0.11	-0.03	0.18	**-0.89**	0.01	0.01	0.17	0.17	-0.31	0.23	-0.02
Fish and shellfish	0.52	0.00	-0.04	-0.02	-0.06	-0.01	0.02	0.14	-0.13	0.07	0.04	0.19	-0.03	**-1.26**	0.07	-0.10	-0.05	0.00	0.13	-0.05
Milk, dairy product	0.11	-0.18	0.10	-0.24	0.44	-0.01	-0.15	-0.27	0.25	-0.36	0.01	0.36	0.02	0.27	**-1.20**	-0.07	0.28	0.01	0.09	0.01
Oils and Fats products	0.04	0.08	0.06	0.07	0.03	0.20	-0.07	0.01	0.10	0.08	-0.14	-0.12	0.00	-0.02	-0.01	**-1.01**	0.07	0.01	0.06	0.09
Spices, otherfoodstuffs	-0.11	-0.10	-0.08	-0.03	0.15	-0.09	0.08	-0.27	0.01	0.19	-0.12	-0.36	-0.01	-0.11	0.02	-0.02	**-0.87**	-0.01	0.01	0.02
Materials for drink	0.04	0.25	0.12	0.13	-0.31	-0.01	-0.06	-0.07	0.11	0.03	0.31	0.25	-0.14	-0.20	0.01	0.12	0.01	**-0.98**	-0.18	0.01
Non-alcoholic drinks	0.38	-0.28	0.09	-0.08	0.05	0.09	-0.23	0.39	0.05	-0.14	-0.08	-0.20	0.12	0.01	0.03	0.02	-0.04	0.07	**-0.95**	0.07
Alcoholic drinks	-0.43	-0.40	-0.08	-0.11	0.37	-0.19	-0.04	0.26	0.39	-0.28	-0.02	-0.23	0.08	0.17	-0.01	0.23	-0.23	0.03	-0.19	**-1.12**

Source: Authors calculations using Tanzania Household Budget Survey, 2007

Note: As for 3

Table A1b: Symmetry-constrained matrix of own- and cross-price Elasticities, Tanzania, 2007

Commodity Groups	Cereals, grain	Cereals, flour	Other cereals	Bread	Confectionery	Starch tubers	Sugar	Pulses, dry	Nut, Seeds	Vegetables	Fruits	Meat	Eggs	Fish	Milk	Oils, Fats	Spices, others	Materials drink	Non-alcoholic	Alcoholic
Cereals, grain	**-1.36**	-0.03	0.00	0.09	-0.09	0.13	-0.04	0.01	-0.04	0.01	0.07	0.09	0.07	0.06	0.02	0.03	0.04	-0.03	0.04	0.07
Cereals, flour	0.03	**-0.90**	-0.01	-0.08	0.02	-0.07	0.13	-0.26	-0.01	0.03	0.02	-0.10	0.01	0.05	-0.05	0.01	-0.03	-0.08	-0.05	-0.05
Other cereals	-0.02	-0.31	**-1.05**	0.02	0.30	-2.11	0.35	0.05	0.26	0.55	0.56	0.74	0.06	-0.28	0.41	0.63	-0.10	0.09	0.22	-0.16
Bread	7.14	-6.80	0.07	**-1.09**	0.92	1.19	-0.50	0.24	-0.91	2.26	0.25	0.16	0.67	-0.45	-1.15	1.89	-0.54	0.08	-0.73	-0.89
Confectionery	-0.66	0.21	0.09	0.09	**-1.15**	0.02	0.15	0.21	-0.13	-0.22	0.23	0.10	0.07	-0.01	0.16	0.15	0.06	0.02	-0.07	0.21
Starch, roots tubers	0.27	-0.08	-0.12	0.02	0.00	**-1.23**	0.06	0.09	-0.03	0.11	-0.06	0.20	-0.15	-0.04	0.04	0.14	-0.08	0.03	0.08	-0.08
Sugar	-0.31	0.91	0.09	-0.05	0.13	0.26	**-0.95**	-0.37	-0.08	0.14	0.04	0.15	-0.01	-0.05	-0.05	-0.19	-0.13	-0.02	-0.05	-0.07
Pulses, dry	0.10	-1.33	0.01	0.01	0.13	0.28	-0.24	**-1.18**	0.11	-0.05	0.00	-0.12	0.02	0.33	-0.12	0.04	0.01	0.01	-0.04	-0.07
Nuts and Seeds	-0.26	-0.11	0.06	-0.07	-0.11	-0.18	-0.06	0.13	**-1.28**	-0.09	0.19	0.39	0.01	-0.20	0.06	0.32	0.13	0.09	-0.06	0.09
Vegetables	0.06	0.04	0.03	0.04	-0.04	0.09	0.04	-0.01	-0.01	**-0.91**	-0.03	0.02	0.03	0.05	0.05	-0.01	-0.02	0.05	-0.03	0.02
Fruits	0.34	0.05	0.10	0.01	0.13	-0.23	0.03	0.00	0.14	-0.12	**-1.20**	-0.12	0.04	0.06	-0.07	-0.10	0.12	0.01	-0.01	0.04
Meat, meat products	0.10	-0.27	0.04	0.00	0.01	0.14	0.03	-0.06	0.10	-0.05	-0.06	**-1.13**	0.00	0.07	-0.01	-0.06	0.06	0.02	0.05	0.01
Eggs	2.05	0.17	0.07	0.25	0.27	-3.13	-0.03	0.09	0.07	0.60	0.28	0.03	**-0.74**	-0.29	0.15	-0.03	-0.07	-0.13	0.49	0.21
Fish and shellfish	0.16	0.08	-0.02	-0.01	-0.01	-0.08	-0.01	0.14	-0.06	0.06	0.03	0.14	-0.02	**-1.27**	0.07	-0.05	-0.04	-0.02	0.11	-0.01
Milk, dairy product	0.08	-0.53	0.13	-0.13	0.17	0.15	-0.07	-0.24	0.07	0.22	-0.16	-0.07	0.04	0.26	**-1.16**	-0.08	0.14	0.02	0.03	0.02
Oils and Fats products	0.08	-0.02	0.06	0.06	0.04	0.21	-0.07	0.01	0.14	-0.07	-0.07	-0.06	0.00	-0.08	-0.02	**-0.99**	0.06	0.00	0.04	0.10
Spices,other foodstuffs	0.47	-0.40	-0.05	-0.08	0.08	-0.67	-0.20	0.02	0.24	-0.19	0.31	0.44	-0.02	-0.23	0.19	0.25	**-0.99**	-0.02	-0.01	-0.24
Materials for drink	-0.69	-1.67	0.07	0.02	0.04	0.39	-0.05	0.03	0.30	0.70	0.03	0.31	-0.09	-0.23	0.05	0.03	-0.04	**-0.97**	-0.02	0.23
Non-alcoholic drinks	0.32	-0.35	0.05	-0.06	-0.06	0.33	-0.04	-0.05	-0.06	-0.16	-0.01	0.24	0.11	0.34	0.03	0.12	0.00	-0.01	**-0.98**	-0.03
Alcoholic drinks	0.25	-0.30	-0.03	-0.05	0.09	-0.30	-0.05	-0.07	0.05	-0.02	0.02	0.04	0.03	-0.06	0.01	0.13	-0.09	0.04	-0.03	**-1.11**

Source: Authors calculations using Tanzania Household Budget Survey, 2007
Note: As for Table 3